Smartphone use and knowledge gap hypothesis: the relationship between mobile news consumption, discussion network heterogeneity, and political knowledge

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Abstract

Purpose – The purpose of this study is to examine the knowledge gap hypothesis in the context of smartphone use for news to understand whether mobile news consumption could bridge or widen the knowledge gap between people of higher and lower socioeconomic status (SES).

Design/methodology/approach – The authors examine how smartphone news consumption is associated with the knowledge gap hypothesis by analyzing a survey dataset from Hong Kong. This study focuses specifically on a moderated mediation model in which the indirect effect of mobile news consumption on political knowledge via discussion network heterogeneity is contingent on level of education.

Findings – Smartphone use for news/information was positively associated with level of discussion network heterogeneity. The indirect effect of smartphone news use on political knowledge via discussion network heterogeneity was stronger for those with lower levels of education.

Originality/value – This study advances the understanding of the role of smartphone use in contributing to the functioning of deliberative democracy as this use enhances discussion network heterogeneity and general levels of political knowledge. Moreover, our study contributes to the literature on the knowledge gap by not only examining the relationship between smartphone use, discussion heterogeneity, and political knowledge but also taking into consideration individual levels of education.

Keywords Mobile communication, Smartphone use, Interactive media, Discussion network heterogeneity, Knowledge gap

Paper type Research paper

1. Introduction

The adoption of mobile phones has exploded worldwide in the past decade due to their technologies that facilitate various functions of communication (International Telecommunication Union, 2021; Pew Research Center, 2018; Shin *et al.*, 2021). Mobile news consumption has permeated individuals' news consumption repertoires. With decreased costs for Internet access, improved network connectivity, and increasingly available news content, people can access news almost anywhere, anytime, and in various forms.

Mobile devices have become one of the most common ways people get news (Pew Research Center, 2015), outpacing desktop and laptop computers (Pew Research Center, 2018).

In recognition of the importance of mobile phones in everyday activities, a stream of research has highlighted the impact of their use on civic and political life (e.g. Campbell and Kwak, 2011). For instance, scholars have highlighted that seeking out news and discussing politics via mobile phones have a significant influence on political participation (Campbell and Kwak, 2011; Kim *et al.*, 2016). It is therefore important to examine whether and how mobile news consumption plays a role in a democratic society by influencing people's learning about political affairs.

Although there are a handful of studies on the relationship between mobile phone use and participatory activities, there are very few on the relationship between smartphone use and political knowledge. Furthermore, these studies mostly focus on the direct relationship between mobile phone use and political knowledge, ignoring its underlying mechanism (e.g. Ohme, 2020; Ohme *et al.*, 2022).

To fill this gap in the current literature, we examine the mediating role of discussion network heterogeneity in the relationship between mobile news consumption and political knowledge. Mobile phones are often used as communication resources to strengthen core ties within a limited network which is typically private and homogeneous. Some scholars have raised concerns that mobile technologies could confine people's interests to their likeminded network and limit their communication with diverse people (Ling, 2008). However, others have found that the affordances of mobile technologies have helped to revitalize a healthy participatory democracy (Campbell and Kwak, 2010, 2011). Moreover, researchers have documented the potential benefits of mobile communication for deliberative democracy through enhancing open dialogue and discussion with heterogeneous others (Campbell and Kwak, 2012). Having political conversation with others, especially heterogeneous others, has been found to be a key variable in political learning (Eveland and Hively, 2009). Therefore, it is reasonable to presume that mobile news consumption may help people gain political knowledge by facilitating discussion with dissimilar others.

Although mobile news consumption could enhance political knowledge through discussion with heterogeneous others, not everyone uses their phone to expand their discussion network heterogeneity and discuss with dissimilar others. The degree of knowledge gain therefore varies depending on individual characteristics. We propose socioeconomic status (SES) as a conditional factor, posing the question: how does smartphone use for news influence the knowledge gap between people with higher versus lower SES (i.e. levels of education)?

Research on the knowledge gap hypothesis demonstrates that how much individuals gain knowledge from news consumption may differ depending on individuals' SES such as levels of education. That is, individuals' acquisition of knowledge of public affairs will proceed at a faster rate among better-educated persons than among those with less education, thus widening rather than narrowing the gaps in knowledge between low- and high-SES groups (Tichenor *et al.*, 1970). To date, however, there has yet to be a study on the influence of smartphone use on this knowledge gap.

It is thus the purpose of this study to examine the knowledge gap hypothesis in the context of smartphone use for news to understand whether mobile news consumption could bridge or widen the knowledge gap between people with a higher SES and those with a lower SES. Most of the studies on the knowledge gap hypothesis used respondents' formal education as a valid indicator of SES (e.g. Hwang and Jeong, 2009; Tichenor *et al.*, 1970; Wei and Hindman, 2011). This study focuses specifically on a moderated mediation model in which the mediating relationship between mobile news consumption, discussion network heterogeneity, and political knowledge is contingent on one's level of education.

2. Literature review

2.1 Mobile news consumption and political knowledge

Citizens need to be equipped with sufficient political knowledge to make reasoned decisions and be engaged in public affairs (Delli Carpini and Keeter, 1996). News media are the primary

venue in which people learn about politics and public affairs (Hollander, 2014). Many studies have documented the positive influence of traditional forms of news consumption, such as reading newspapers, on political knowledge (e.g. Eveland and Scheufele, 2000). More recent scholarship has focused on the use of new media technologies, such as the internet and social media, and their relationship with such knowledge (Goh, 2015; Hollander, 2014; Kenski and Stroud, 2006).

Given that mobile media provide flexibility for accessing and sharing news through mobile news applications, text messages, social networking services (SNSs), and so forth, mobile news consumption has become common across demographic and SES groups (Kim and Kim, 2022; Martin, 2015). Due to the technological convergence of mobile phones, users have become increasingly able to get diversified news in various ways via their smartphones. For instance, smartphone users are able to easily get news content anytime, anywhere by using mobile news applications, visiting news websites using the phone's Internet access, or using MMS (Multimedia Messaging Service) news alerts (Shim *et al.*, 2015). In addition, they can access news content by logging into SNSs on their smartphone given that social media comprise a large segment of online news use as SNS users share, post, like, and reproduce news stories (Shim *et al.*, 2015). Because smartphone owners use their devices to follow a variety of news events happening in their community, distribute information, and express their own thoughts about the news, it is likely that smartphone use for news and information would make unique contributions to helping users be aware of current political events.

Although scholars have begun to examine the influence of smartphone use on everyday life, most of these studies have focused on how this use is associated with participatory activities (Campbell and Kwak, 2011; Kim *et al.*, 2016). Stroud *et al.* (2020) recently conducted an experimental study to test whether enabling news applications to send push notifications affects individuals' learning. Their results showed some evidence of learning from the use of mobile apps. Specifically, participants who were instructed to enable CNN's push notifications knew more about the content of the notifications they received than participants in other conditions such as those who had the app installed with the notifications disabled. Ohme (2020) also found a direct relationship between news app use and political knowledge. However, the possible underlying mechanism has not yet been explored—that is, how and why mobile news use could have a positive relationship with knowledge gain. Information sharing through instant messaging apps may also prompt political learning through mobile phones. For instance, Valenzuela *et al.* (2021) found that information sharing on WhatsApp exerts a significant influence on learning about politics. We examine this relationship by exploring the mediating role of discussion network heterogeneity because it is important to understand to what extent and how smartphone use could influence citizens' political knowledge.

2.2 Mobile news consumption and discussion network heterogeneity
The relationship between news consumption and political knowledge can be explained by individuals' elaborative information processing. Cognitive elaboration, the process of making associations between new information and prior knowledge, leads to higher levels of learning because elaborative processing facilitates the connections between news content, news users' past experiences, and existing knowledge (Eveland, 2001). Many studies have provided considerable evidence that elaborating on the news (e.g. linking new information from the news with previously stored knowledge) plays an important role in the influence of news on learning (e.g. Yang *et al.*, 2017).

Our study focuses on the role of political discussion in gaining political knowledge given that talking with others entails a cognitive elaboration process (Jung *et al.*, 2011).

Interpersonal political discussion plays a significant role in the positive effect of news consumption on political outcomes (Eveland and Hively, 2009; Shah *et al.*, 2005). Some researchers have shown that citizens' news media use facilitates their political discussion, which in turn increases political knowledge (e.g. Jung *et al.*, 2011). According to the communication mediation model, news/informational media use can facilitate interpersonal political discussion, which consequently increases citizens' political knowledge (McLeod *et al.*, 2001). That is, the more individuals consume news/information, the more they obtain agendas or issues to discuss with other people, which could lead to greater levels of political knowledge.

The literature has provided evidence for the possibility that digital media technologies create opportunities to be exposed to heterogeneous opinions (Brundidge, 2010; Wojcieszak and Mutz, 2009). The structural boundaries of the online public sphere have been shifting, sometimes allowing individuals to unintentionally expose themselves to divergent opinions (Brundidge, 2010). In other words, people cannot completely avoid differing perspectives online.

In our study, rather than focusing on general political discussion, we specifically examine discussion network heterogeneity—the extent to which individuals discuss politics with different or heterogeneous others (Scheufele *et al.*, 2006)—as a potential link between smartphone news use and political knowledge. The link might result from specific characteristics of news consumption via mobile smartphone, which could be associated with individuals' discussion network heterogeneity.

People discuss political issues with dissimilar others for many reasons, such as to know about rationales for oppositional views (e.g. Mutz, 2006) and to utilize dissonant information for a future debate (Knobloch-Westerwick and Meng, 2009). Prior studies have shown that online messaging, social media use, and news consumption contribute to discussion network heterogeneity, both on- and offline (Brundidge, 2010; Wojcieszak and Mutz, 2009). These findings imply a positive role of smartphone use for news and information in promoting discussion network heterogeneity.

Lee and Kwak (2016) documented the relationship between media use for news and discussion network heterogeneity in a mobile context in two different countries (the US and Korea), showing that mobile phone use for information gathering and exchange enhance users' engagement in political discussion with non-likeminded people. Although individuals tend to selectively expose themselves to consonant information, smartphone technology has the potential to increase their discussion network heterogeneity. First, informational use has the potential for opinion deliberation, and mobile news consumption further overcomes the constraints of space and time (Campbell, 2013), providing the means and increasing the opportunities to discuss politics with heterogeneous others who may have different backgrounds and dissimilar political opinions.

Second, smartphones can be considered an important resource for filling in the gaps between face-to-face contacts (Ling, 2004). Thus, similar mechanisms of how digital media use is associated with exposure to diverse perspectives can be applied to mobile communication platforms. Smartphone users are able to access diverse sets of news and information through various functions, such as visiting news websites and using news apps and message services at any time they wish. Due to these unique characteristics of mobile technology (i.e. mobility and ubiquity of affordances of smartphones), smartphone users can discuss news and information with others easily in their present location. They can immediately check news and information they are uncertain about when talking with others both offline and online, which could prompt their motivation and confidence to discuss with dissimilar others.

Third, the possibility to engage in discussion with diverse others can be facilitated in different social settings. Individuals move in spaces such as workplaces, schools, volunteer groups, and neighborhoods where they interact with coworkers or other group members who may have diverse backgrounds and different political views (Mutz, 2006; Scheufele *et al.*, 2006).

Smartphones not only allow information-seeking at any time and place but also make it easy to talk with others in social settings where these devices are used. For example, the workplace is likely to foster opportunities to interact with diverse sets of people because it is a relatively apolitical place that is not likely to be selected based on one's political preferences (Brundidge, 2010; Mutz, 2006; Scheufele *et al.*, 2004). Therefore, when people get news and information via their smartphone in their workplace and other social settings, they are likely to talk about what they see on their smartphone with the heterogeneous others who comprise their coworkers or acquaintances.

In sum, the way people consume news via smartphones, which are characterized by their mobility and ubiquity in various social settings, is unique and distinct from news consumption from mass media or other digital devices such as desktop computers in that it can promote discussion network heterogeneity. Based on the discussion above, we propose the following hypothesis:

H1. Smartphone use for news and information is positively related to discussion network heterogeneity.

2.3 Discussion network heterogeneity and political knowledge
Discussion with heterogeneous people allows individuals to express their points of view and become accustomed to encountering divergent opinions. Such discussion is therefore associated not only with accelerated deliberative processes but also with improved opinion quality. Studies have provided evidence that discussion with diverse people can increase one's level of political knowledge (Huckfeldt *et al.*, 2004; McLeod *et al.*, 1999). Exposure to political views that differ from one's own can enable greater cognitive activity because it allows individuals to learn about alternative perspectives and reflect more cautiously on what they already recognize (Huckfeldt *et al.*, 2004; Mutz, 2006). Indeed, Eveland and Hively (2009) demonstrated that those who engage in more heterogeneous discussions are likely to have denser knowledge structures. These insights gained from the literature lead us to the second hypothesis:

H2. Discussion network heterogeneity is positively related to political knowledge.

In order to better understand the mechanism of gaining political knowledge from news consumption via smartphone, we test a mediating role of discussion network heterogeneity in the relationship between smartphone use for news and political knowledge.

Given that previous studies have provided evidence that news/information consumption via media use is associated with one's level of political knowledge and that this relationship can be mediated through political discussion (e.g. Eveland and Scheufele, 2000; Hollander, 2014; Jung *et al.*, 2011; Liu and Eveland, 2005), we bring the relationship to the context of mobile communication. As discussed above, discussion network heterogeneity is a potential explanation for how mobile smartphone use can be associated with greater levels of political knowledge. In sum, this study specifically examines the role of discussion network heterogeneity as an important discussion characteristic that enhances individuals' cognitive processing in mediating the relationship between smartphone use for news/information and political knowledge. We therefore propose the following hypothesis:

H3. Smartphone use for news and information has indirect effects on political knowledge through discussion network heterogeneity.

2.4 Conditional indirect effect of mobile news consumption: education as a moderator
The rise of new information communication technologies has aroused scholarly concern as to whether and how these technologies could be associated with the knowledge gap.

The literature on the knowledge gap hypothesis has demonstrated that mass media results in gaps in political knowledge between lower- and higher-SES (e.g. levels of education) segments of the population (Tichenor *et al.*, 1970). The knowledge gap between people with more and less education happens because persons with more formal education tend to have higher reading and comprehension abilities, greater levels of existing knowledge, and a larger number of social contacts, which makes more-educated people better able to understand and acquire public affairs knowledge quickly from mass media (e.g. Tichenor *et al.*, 1970; Wei and Hindman, 2011).

Studies have demonstrated that even with Internet use, the knowledge gap has remained the same or even widened between different SES groups, belying the hope that the internet would narrow this gap by making information more accessible to citizens (Wei and Hindman, 2011). Accordingly, when smartphones enable easy access to the internet, people with higher levels of education are likely to gain more political knowledge than less educated individuals.

However, a possibility remains that smartphone use might reduce the knowledge gap. Mobile technology is distinct from other information communication technologies in that it affords constant access to the internet and convergent applications (Shim *et al.*, 2015). Prior researchers have considered this accessibility to be a unique dimension of motivation related to mobile news usage, similar to the convenience motive of using a mobile phone to achieve the gratification of multitasking (Shim *et al.*, 2015). Mobile technologies are a more accessible venue than PCs or PC-based Internet in reaching the public and creating opportunities for more of the world to be connected electronically (Donner, 2008). For example, while broadband Internet access is predominantly accessed by white people in the US, other racial groups, such as African Americans and Latinos, rely more on smartphones for online access as well as various functions such as apps that help them communicate with their friends and family (Pew Research Center, 2015). Furthermore, young adults and those with lower household incomes and levels of educational attainment use smartphones more often than other groups for online access (Pew Internet & American Life Project, 2011). Because young adults, minorities, those who are less educated, and those with lower household income are more likely than other groups to use smartphones as their main source of Internet access, these devices may bridge the digital divide between low and high SES segments to a certain degree (Alam and Imran, 2015; Mossberger *et al.*, 2012).

In sum, the aforementioned specific characteristics of news consumption on mobile phones, as opposed to other types of news media exposure, suggest that mobile news consumption would create or close the knowledge gap because the accessibility, ubiquity, and easiness of mobile news use for different groups of people in a society might matter to the distribution of knowledge across social groups.

Although the increasing popularity of smartphone use raises this important question, the current literature does not offer explorations of this inquiry in the context of smartphone use. Previous studies on the knowledge gap have mainly examined a direct relationship between informational media use and political knowledge and how this direct relationship differs across different SES groups. In other words, they have used SES as a moderator in the relationship between informational media use and political knowledge (e.g. Goh, 2015; Wei and Hindman, 2011; Yoo and Gid de Zúñiga, 2014). However, focusing on a direct relationship between informational media use and knowledge limits our understanding of how and why this relationship is the case. Furthermore, there is no way to empirically know how and why the knowledge gap between different SES groups occurs or narrows. Testing the indirect effect (i.e. mediation test) allows us to understand the relationship between the independent and dependent variables (Holbert and Stephenson, 2003). Therefore, proposing a mediation relationship in which informational media use (i.e. smartphone use for news) influences political knowledge via a potential mediating variable and how such a mediating

relationship would be contingent upon individuals' SES should provide empirical evidence of how smartphone use for news influences the knowledge gap.

This study, therefore, aims to fill the gap in the current knowledge gap literature, which has mainly focused on the moderating role of education in the direct relationship between informational media use and political knowledge, by investigating whether and how education moderates the proposed mediating relationship between smartphone use for information/news, discussion heterogeneity, and political knowledge. The proposed moderated mediation model is essential to understand the mechanism of the knowledge gap hypothesis in the context of smartphone use. If the moderated mediation model is significant, it means that the indirect effect of smartphone use for news on political knowledge via discussion network heterogeneity is contingent upon individuals' levels of education.

However, as explained above, the extant literature did not lead us to the influence of smartphone use on the knowledge gap between low- and high-SES people. In other words, the indirect effect of smartphone use on political knowledge via discussion network heterogeneity could be stronger for either highly educated people or those with a lower level of education. If the former is the case (i.e. a stronger indirect effect for people with more education), the knowledge gap is increased or widened between low- and high-SES people because more educated people are more likely to discuss with heterogeneous others when or after they use a smartphone for news and information. Alternatively, it could be that the indirect effect is stronger for those with lower levels of education, indicating a narrowed knowledge gap between low- and high-SES people, if individuals with lower levels of education take more advantage of smartphones to discuss with heterogeneous others. Given these two possibilities, education would moderate the proposed mediation relationship in either way. Thus, we propose the following hypothesis:
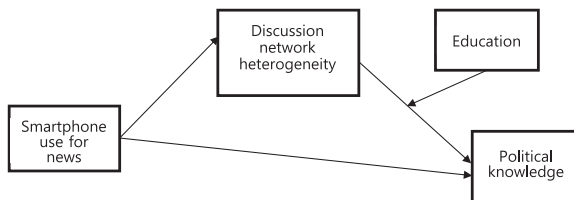
H4. Education moderates the indirect effects of smartphone use for news/information on political knowledge via discussion network heterogeneity? That is, the proposed mediation relationship (i.e. smartphone use → discussion heterogeneity → political knowledge) is moderated by levels of education.

A conceptual research model is illustrated in Figure 1.

3. Method
3.1 Data
The data for this study were collected from a two-wave panel survey in Hong Kong. We used panel data to better ensure the causal relationship examined in the current paper. The survey was conducted by Survey Sampling International (SSI; now called Dynata), a web survey panel company, and both waves were administered online. W^1 was conducted a week before the election for the Hong Kong Legislative Council in September 2016. A total of 1,141 participants completed the survey. W^2 took place in October 2016. In W^2, 813 original respondents completed the survey questionnaire, yielding a retention rate of 71.3%.

To proportionally represent the Hong Kong population, SSI employed a stratified quota sampling method based on gender, age, and income so that the sample would match the Hong Kong Census as closely as possible.

3.2 Measures

3.2.1 Political knowledge. In the second wave, respondents were asked to answer eight questions about Hong Kong politics, such as "we elect a legislator for how many years?" and "who is the Chief Secretary for Administration?" correct responses were coded as "1" and combined in an additive index (W^2 range 0–8, $M = 4.32$, $SD = 2.04$; see Appendix 1 for the complete items of all measures)

3.2.2 Smartphone use for news and information. Following the knowledge gap hypothesis literature and previous studies that measured news media and mobile phone use for news (e.g. Campbell and Kwak, 2011), informational smartphone use was measured by asking respondents how frequently on a 4-point scale ($1 = never$ to $4 = frequently$) they use their smartphone for (1) getting news and (2) searching for information. The two items were averaged to form an index (W^1 $M = 3.39$, $SD = 0.68$, Spearman-Brown coefficient $= 0.81$)

3.2.3 Discussion network heterogeneity. Based on previous studies (Scheufele *et al.*, 2006), we define discussion network heterogeneity as the extent to which individuals discuss politics with people who have different opinions. Respondents were asked on a scale from $1 = never$ to $4 = frequently$ how frequently they discussed politics and public affairs in daily life with people who had dissimilar views (W^2 $M = 2.08$, $SD = 0.71$)

3.2.4 Education. Most of the studies on the knowledge gap hypothesis measured respondents' levels of education as a valid indicator of SES (see Tichenor *et al.*, 1970; Wei and Hindman, 2011). Respondents' level of education was measured by asking about their highest level of formal education completed, from $1 = no\ education/kindergarten$ to $9 = doctoral\ degree$ (W^1 $Mdn =$ some college or associate degree, $M = 5.97$, $SD = 1.55$)

3.2.5 Control variables. A host of variables, including demographic characteristics, news media use, and political predisposition, were controlled in the analysis to avoid confounding effects on the proposed relationship (see Appendix 2 for the descriptive statistics of the control variables)

4. Results

To test H1, H2, and H3, we used the PROCESS macro Model 4, which shows the direct effects of independent and mediating variables on the dependent variable and uses the bootstrapping method to calculate the indirect mediation effect (Hayes, 2013). H1 posits that smartphone use for news and information is positively related to discussion network heterogeneity. The results in Table 1 show that the more individuals use their smartphones for news and information, the more they discuss public affairs with heterogeneous others (Model 1: $b = 0.087$, $SE = 0.037$, $p < 0.05$), supporting H1. However, discussion heterogeneity did not significantly influence political knowledge (Model 2: H2: $b = 0.092$, $SE = 0.099$, $p = 0.36$). Accordingly, the indirect effect of smartphone use for news and information on political knowledge through discussion heterogeneity was not significant either (H3: $b = 0.008$, $SE = 0.011$, $CI = -0.010$ to 0.032).

To estimate the proposed moderation mediation model (H4), we used Hayes' (2013) PROCESS macro Model 14, which examines the conditional indirect effects of the independent variable on the dependent variable through a mediating variable moderated by a moderating variable based on bootstrapping confidence intervals.

The results of the moderated mediation analysis are reported in Table 1 Model 2A and Table 2, which present the significant moderating effect of education on the mediating

	Discussion network heterogeneity[W2] Model 1	Political knowledge[W2] Model 2	Model 2A
Predictors and mediators			
Mobile news consumption[W1]	0.087 (0.037)*	0.385 (0.104)***	0.382 (0.103)***
Discussion network heterogeneity[W2]		0.092 (0.099)	1.243 (0.366)***
Moderator			
Education[W1]	0.006 (0.018)	0.147 (0.049)**	0.538 (0.130)***
Interactions			
Discussion network heterogeneity[W2] × Education[W1]			−0.190 (0.059)**
Control variables			
Age[W1]	−0.024 (0.012)**	0.011 (0.033)	0.018 (0.033)
Income[W1]	0.003 (0.011)	0.080 (0.030)**	0.076 (0.030)*
Male[W1]	0.064 (0.048)	0.965 (0.135)***	0.963 (0.134)***
Political efficacy[W1]	0.139 (0.018)***	−0.014 (0.053)	−0.008 (0.052)
Political ideology[W1]	−0.007 (0.018)	−0.278 (0.051)***	−0.277 (0.051)***
Political interest[W1]	0.073 (0.030)*	0.371 (0.084)***	0.378 (0.084)***
News media use[W1]	0.006 (0.015)	0.073 (0.043)	0.073 (0.043)
Social network heterogeneity[W1]	0.120 (0.023)***	−0.011 (0.067)	−0.023 (0.066)
Adjusted R^2	0.155	0.206	0.217

Note(s): Entries are final unstandardized regression coefficients. Standard errors in parentheses. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 1.
Regressions for the mediation and moderated mediation models

Mediator	Education condition	Conditional indirect effects at education B	SE	Boot 95% CI
Discussion Network Heterogeneity	Low	0.035	0.020	[0.003 to 0.082]
	Middle	0.009	0.011	[−0.008 to 0.034]
	High	−0.016	0.015	[−0.052 to 0.008]

Note(s): Entries are unstandardized regression coefficients. Bootstrap resample = 10,000. Conditions for moderator (education) are the mean and plus/minus one standard deviation from the mean. SE = standard errors; CI = confidence interval

Table 2.
Indirect effect of smartphone use for news/information on political knowledge through discussion network heterogeneity moderated by education (Hong Kong)

relationship in which the indirect effects of smartphone use for news and information on political knowledge through discussion heterogeneity vary according to level of education (Table 1 Model 2A: $b = -0.190$, $SE = 0.059$, $p < 0.01$). The index of moderated mediation shows that the proposed moderated mediation is significant ($b = -0.017$, $SE = 0.010$, $CI = -0.038$ to -0.002). As presented in Table 2, the indirect effect of smartphone use for news and information on political knowledge through online discussion heterogeneity was not significant at the high education level ($b = -0.016$, $SE = 0.015$, $CI = -0.052$ to 0.008) and the middle education level ($b = 0.009$, $SE = 0.011$, $CI = -0.008$ to 0.034), but it was significant at the low education level ($b = 0.035$, $SE = 0.020$, $CI = 0.003$ to 0.082). In addition, the indirect effects were stronger for individuals with lower levels of education (i.e. one standard deviation below the mean, $b = 0.035$) compared to those at the mean ($b = 0.009$) and one standard deviation above the mean ($b = -0.016$). The effect that smartphone use for news and information enhances political knowledge through discussing with heterogeneous others online becomes stronger as the level of education decreases.

5. Discussion

5.1 Summary and discussion of findings

This study examined whether smartphone use for news/information is associated with individuals' levels of discussion network heterogeneity, which in turn increases their political knowledge, as well as whether and how the relationships are moderated by education. The results of this study showed that the use of news and information via smartphone is positively associated with the level of discussion network heterogeneity, suggesting that individuals' smartphone use for news and information may help facilitate their communicative activities with heterogeneous others who have different opinions. These findings provide empirical evidence supporting the existing literature, which has shown that social media use is positively associated with individuals' network heterogeneity (Kim and Kim, 2017). The results suggest that smartphone use enables people to discuss public affairs with diverse others as soon as they obtain news and information about public issues in their everyday lives as the affordance of mobility allows for "flows of information and communication to be more seamlessly weaved into the rhythms of everyday life" (Campbell, 2013, p. 10).

We hypothesized that discussion with dissimilar others could further play a significant role in making citizens more informed. However, the relationship between discussion with heterogeneous others and political knowledge was not significant. The results indicated a non-significant mediating role of discussion network heterogeneity in the relationship between smartphone use for news/information and political knowledge.

Nevertheless, it is important to note that the moderated mediation model turned out to be significant—that is, the indirect effect of smartphone use for news and information on individuals' political knowledge via discussion network heterogeneity was significantly moderated by levels of education. Specifically, the effect that smartphone use for news and information enhances people's political knowledge through discussing with dissimilar others was stronger for those with lower levels of education. These findings suggest an optimistic view about the role of digital mobile technology in enhancing democratic society by providing more opportunities for citizens, especially those with lower levels of education, to be exposed to diverse perspectives (e.g. Brundidge, 2010; Huckfeldt *et al.*, 2004; Scheufele *et al.*, 2004) and increase their level of political knowledge (e.g. Kenski and Stroud, 2006; Shah *et al.*, 2005).

Smartphones are influential in individuals' everyday lives as more and more people use them for various purposes, including accessing online services for information and news (Wong *et al.*, 2019). The current media situation shows this significant role in daily life, and our findings highlight the contribution of this role to healthy democracy through enhancing individuals' exposure to heterogeneous others and increasing political knowledge.

5.2 Theoretical and practical implications

The results of this study contribute to the understanding of how news consumption via smartphones is positively associated with citizens' political knowledge. Some researchers have showed that mobile news consumption may not be contributing to an informed citizenry given that traditional and offline media platforms have a greater influence on learning (Andersen and Strömbäck, 2021). However, the current findings suggest that smartphone use for news does contribute to citizens' political learning by facilitating discussion with dissimilar others; in particular, it decreases the knowledge gap between lower- and higher-SES people. The existing literature has shown that the use of news increases individuals' political knowledge because news consumption could facilitate the cognitive elaborating process (i.e. deliberation about news content) and political talk (Eveland, 2001; Eveland and Hively, 2009; Shah *et al.*, 2005). The findings of this study add to the literature by showing

that network heterogeneity may explain the link between news use, especially via smartphone, and political knowledge.

More importantly, the findings from the moderated mediation model contradict the original knowledge gap hypothesis (Tichenor *et al.*, 1970). Although the knowledge gap hypothesis has demonstrated that news media use tends to broaden the gap in knowledge between segments of people with higher and lower SES (e.g. Wei and Hindman, 2011), the findings of this study suggest that smartphone use instead narrows this gap.

A couple of studies have demonstrated that news media use does not always lead to a greater knowledge gap but rather could reduce the gap between individuals of high and low SES in some cases (Goh, 2015). This can be the case when news or information is more accessible and easily comprehensible to less-educated people, including alternative media such as online news sites and blogs. However, little is known about the mechanism underlying this phenomenon. Thus, we propose a moderated mediation model to explore why and how widening or narrowing the knowledge gap between different SES groups happens. In this regard, this study advances our understanding of how the knowledge gap hypothesis might work in the opposite way (i.e. narrowing the gap) by highlighting the role of discussion with heterogeneous people, which could help less-educated people to catch up with political knowledge once they receive news and information through smartphones.

One of the reasons why the knowledge gap between high- and low-SES groups appears to widen with news media use is relevant social contact. Because education in general indicates "a broader sphere of everyday activity, a greater number of reference groups, and more interpersonal contacts" (Tichenor *et al.*, 1970, p. 162), individuals with more education are more likely to discuss public affairs topics with others. We found that the knowledge gap can be narrowed if such social contact is facilitated among less-educated individuals. Individuals with lower levels of education may enhance their level of political knowledge via smartphone use for news and information consumption because such usage, based on the affordance of mobility, could increase their social contact or facilitate social interaction with heterogeneous others. Given that individuals with less education may not have sufficient information resources and opportunities for interaction with diverse social contacts to follow current events, the smartphone can play an important role in helping people of lower SES learn about current political events and thereby increase their political knowledge.

This study is one of the first to shed light on the effect of smartphone use for news and information in light of the knowledge gap hypothesis. Specifically, the findings indicate that the existing knowledge gap can be narrowed between individuals with low and high levels of education in a society.

These findings have practical implications. The effects of smartphone use for news on political knowledge suggest that there is a need to develop various smartphone apps or social media platforms that people can use for news and information. For instance, app developers of news organizations and public policymakers need to create open news apps or platforms that are easier for ordinary citizens to use, given that open e-learning platforms can bridge gaps for diverse user groups (e.g. McCarthy *et al.*, 2022). In particular, based on the results that communication with heterogeneous people has a positive effect on political knowledge, this study suggests that it is necessary to develop sharing functions that people can easily use when they want to share specific news or content with others in their circle.

In addition, since the positive effect of smartphone use for news on political knowledge is greater for those with lower SES, educational projects to enhance media literacy can be considered so that those with low SES can learn how to effectively use smartphone apps or platforms for political learning.

5.3 Limitations and suggested future research

Even though this study extends our understanding of the effects of smartphone use for news and information on a democratic society, it has a few limitations that suggest that the findings should be considered with caution. First, it should be noted that a contributing role of smartphone use to political knowledge via discussion network heterogeneity was not found because discussion with dissimilar others did not significantly influence political knowledge. These results may be attributed to the measures of political knowledge and discussion network heterogeneity. The measurement items for political knowledge in this study involved somewhat general political knowledge (e.g. "How many years does Hong Kong elect a legislator for?") rather than current issues and structural aspects of political knowledge. For example, previous research has demonstrated that those who have more diverse discussions tend to have more dense knowledge structures which tap "the interconnectedness of a particular domain within the cognitive network of an individual" (Eveland and Hively, 2009, p. 214). Current issue knowledge and structural knowledge are likely to be responsive to mediated and interpersonal communication (Delli Carpini and Keeter, 1996; Eveland and Hively, 2009). Therefore, future researchers should consider various types of political knowledge when they examine the relationship between discussion network heterogeneity and political knowledge.

In addition, the measure of discussion network heterogeneity used a single item that focused on discussion disagreement, which is a key element of discussion heterogeneity (Huckfeldt and Sprague, 1995; Huckfeldt *et al.*, 2004; Lu and Lee, 2021; Scheuefele *et al.*, 2004). In future studies, discussion heterogeneity should be measured with multiple items that encompass discussion with people who disagree with one's views as well as people who do not share one's SES and background.

Another point that should be noted is the independent variable of this study. Following the knowledge gap hypothesis literature (e.g. Goh, 2015; Wei and Hindman, 2011), smartphone use for news and information was measured by asking respondents how frequently they use their smartphone to get news and information. There are, however, various types of news consumption via smartphones. For instance, while some people actively seek and engage with news, others sometimes accidentally or unintentionally stumble upon news when they use digital media platforms (Van Damme *et al.*, 2015). In addition, attention to news on mobile devices such as smartphones is not the same as attention to news for those on computers due to smartphone properties such as screen size, which provides different formats and types of content configurations (Dunaway *et al.*, 2018). Specific types and attributes of smartphone use for news might differently influence individuals' cognitive information processing, so future researchers need to consider these factors when testing the knowledge gap hypothesis.

The purpose of the present study was to test a theoretically informed model using data from a two-wave panel in Hong Kong. Nevertheless, the two waves are only about one month apart. Future researchers can conduct a panel survey with a longer time gap to examine the proposed relationship. Furthermore, the measurement items for political knowledge involved general political knowledge rather than current issues. The measure of discussion network heterogeneity used only a single item that focused on discussion disagreement, which is a key element of discussion heterogeneity. Future researchers could measure various types of political knowledge and discussion heterogeneity with multiple items.

6. Conclusion

Despite these limitations, this study advances our understanding of the role of smartphone use in contributing to the functioning of deliberative democracy as this use enhances discussion network heterogeneity and general levels of political knowledge. Moreover, our study contributes to the literature on the knowledge gap by not only examining

the relationship between smartphone use, discussion heterogeneity, and political knowledge but also taking into consideration individual levels of education. The findings, in general, highlight an optimistic view of smartphone use in individuals' political life and the functioning of a democratic society. More research is warranted to understand the role of emerging digital media technologies in a democratic society as media technologies continue to change rapidly.

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Appendix 1

Political knowledge

(1) We elect a legislator for how many years?

- 3 years
- 4 years
- 5 years
- 6 years
- Don't know

(2) Which party has the most seats in the House of Representatives?

- Democratic Alliance for the Betterment and Progress of Hong Kong (DAB)
- The Democratic Party
- Civic Party
- Hong Kong Federation of Trade Unions (HKFTU)
- Don't know

(3) Who is the Chief Secretary for Administration?

- Jasper Tsang Yok-sing

- Rimsky Yuen Kwok-keung

- Carrie Lam Cheng Yuet-ngor

- Raymond Tam Chi-yuen

- Don't know

(4) The 2016 Hong Kong Legislative Council election that was held on 4 September 2016 is the
_____ Legislative Council of Hong Kong (LegCo).

- 5th

- 6th

- 7th

- 8th

- Don't know

(5) How many seats were available for geographical constituencies in the 2016 election of the
Legislative Council of the Hong Kong Special Administrative Region?

- 24

- 30

- 35

- 40

- Don't know

(6) Please list one candidate who was disqualified in the 2016 election of the Legislative Council of
the Hong Kong Special Administrative Region. (open-ended answer)

(7) After the 2016 election of the Legislative Council of the Hong Kong Special Administrative
Region, which party became the biggest party in the pro-democracy camp?

- Labour Party

- The Democratic Party

- People Power

- Civic Party

- Don't know

(8) Who proposed the ThunderGo plan? (Open-ended answer)

Smartphone use for news and information
How frequently do you use your smartphone for _____?

(1) Getting news

(2) Searching for information

- Never

- Seldom

- Sometimes

- Frequently

Discussion network heterogeneity
How frequently do you discuss politics and public affairs in daily life with people who had dissimilar views?

(1) Never

(2) Seldom

(3) Sometimes

(4) Frequently

Appendix 2

Demographic control variables include gender (male = 47%), age (M = 5.58, standard deviation [SD] = 2.36, 6 = 40–44 years old), and household income per month (M = 7.26, SD = 2.47, 7 = HK\$30,000–HK\$39,999, equivalent to US\$3800–US\$5100). For news media use, respondents were asked to rate on a 7-point scale (1 = never to 7 = everyday) how often they used the following media to get news and information about current events: television, radio, online newspaper, print newspaper, magazine, mobile phone, desktop, tablet, and social media (M = 4.86, SD = 1.08, Cronbach's α = 0.76). Political predisposition includes political ideology (M = 3.65, SD = 1.33), political interest (M = 3.83, SD = 1.56), and political efficacy (M = 3.37, SD = 1.34).

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