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The Knowledge Gap Hypothesis in Singapore: The Roles of Socioeconomic Status, Mass Media, and Interpersonal Discussion on Public Knowledge of the H1N1 Flu Pandemic

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Abstract

This study applies the knowledge gap hypothesis to examine the direct and interactive influence of socioeconomic status, mass media, and interpersonal discussion on public knowledge of the H1N1 flu pandemic in Singapore. Using a nationally representative random digit-dialing telephone survey of 1,055 adult Singaporeans, results show that attention to newspapers was not associated with a widened knowledge gap about the H1N1 pandemic between the high and low socioeconomic status individuals. Conversely, attention to television news and interpersonal discussion were associated with a narrowed knowledge disparity between the high and low socioeconomic status individuals. Findings suggest that the knowledge gap hypothesis was not supported in this study. Instead, results suggest that attention to television news and interpersonal discussions were associated with a reduced knowledge gap. Household income and risk perceptions were also found to be positively associated with public knowledge about the H1N1 flu pandemic. Both theoretical and practical implications were discussed.

The Knowledge Gap Hypothesis in Singapore: The Roles of Socioeconomic Status, Mass Media, and Interpersonal Discussion on Public Knowledge of the H1N1 Flu Pandemic

Introduction

The global outbreak of the H1N1 influenza, also known as the swine flu, first emerged in Mexico in April 2009 and was declared a pandemic in June 2009 by the World Health Organization (WHO, 2010). The H1N1 virus is capable of human-to-human transmission and had spread to more than 214 countries and caused close to 18,000 deaths, as of April 25, 2010 (WHO, 2010). In Singapore, a city-state in Southeast Asia, widespread community transmission of the flu occurred within the country (Saad, 2009), which resulted in 21 H1N1-related deaths (Singapore Swine Flu Statistics Centre, 2010). The Ministry of Health in Singapore had to adopt the WHO guidelines for alert “yellow” and alert “orange” (indicating high levels of severity) during the peak of the pandemic for response planning and execution (Channel NewsAsia, 2009). Although the pandemic is now under control, some experts believe that this pandemic will be a recurring situation in the next few years (Moss, 2010). Hence, it is important for health authorities to continue to educate the public about the H1N1 influenza and encourage them to undertake preventive measures.

Generally, health knowledge and awareness are necessary precursors to the adoption of precautionary behaviors, although some studies have shown that the relationship between knowledge and behavior is somewhat weak (Viswanath et al., 2006). Public adoption of precautionary behavior can, in turn, help to prevent larger outbreaks of the pandemic, especially in densely populated countries such as Singapore. However, if vital health information and resources were not disseminated equally to the lower socioeconomic status (SES) segments of the population, a knowledge gap may develop that could hinder the efforts of health authorities to curb infection rates. In fact, studies have shown that the high SES

groups tend to be healthier than the low SES groups, in part due to the latter lack of general health knowledge (House & Williams, 2000).

The knowledge gap hypothesis (Tichenor, Donohue, & Olien, 1970) posits that “as the infusion of mass media information into a social system increases, segments of population with higher socio-economic status tend to acquire the information at a faster rate than the lower status segments,” and therefore “the gap between these segments tends to increase rather than decrease” (pp. 159–160). Hence, this study aims to apply the knowledge gap hypothesis (Tichenor et al., 1970) to examine the direct and interactive influence of SES, mass media, and interpersonal discussion on public knowledge of the H1N1 flu pandemic in Singapore, using a large-scale nationally representative survey of the population in the country. Specifically, this study investigates how different communication channels will narrow or widen the knowledge gap between the high and low SES groups.

This study contributes to the body of literature on the knowledge gap hypothesis in several important ways. First, this study is among the first to examine the theory in the aftermath of an infectious disease outbreak. The H1N1 flu pandemic is marked by a time-sensitive period of heightened media coverage and extensive amount of information flow. This offers a different context from most previous knowledge gap studies that looked at health issues that received consistent and moderate media coverage over time, such as AIDS, cancer, and cardiovascular health (Ettema, Brown, & Luepker, 1983; Viswanath et al., 2006; Wanta & Elliott, 1995). Therefore, the influence of communication channels on H1N1-related knowledge may potentially be different from previous studies. The findings from this study will help to inform health authorities on the means to effectively disseminate health information to the less privileged segments of the population during future outbreaks of new infectious diseases.

Second, this is also the first study to examine the knowledge gap theory in Singapore, which offers a different socio-political and cultural context from most previous studies that have examined the theory in North America. Singapore is a relatively westernized and cosmopolitan country that is among the top 10 most globalized cities in the world (Foreign Policy, 2010). As a densely populated city-state, the country has a total land area of 710.3 sq km; a population density of 7,022 per sq km; and a total multiracial population of about 5 million people, comprising of Chinese, Malays, Indians, and other minorities (Singapore Department of Statistics, 2010). The nation has a highly developed free-market economy and enjoys a gross domestic product per capita of US\$50,300 and a high literacy rate of 96.3% among its population (Central Intelligence Agency, 2009).

The political system in Singapore is characterized by a parliamentary structure governed by one dominant ruling party for the past four decades since its independence (Chang, 1999). Despite its economic success, Singapore ranked among the lowest globally in terms of press freedom (Freedom House, 2010). The main function of the mass media in Singapore is to serve the national interests and that of the elected government (K. Y. Lee, 2000). Mass media in Singapore is wholly state-owned and news information flow is tightly controlled and regulated by the ruling government (George, 2007). As such, in an environment where the government has a reasonable amount of control over the media agenda, the potential influence of mass media on SES-related differences in knowledge among Singaporeans may manifest differently from those of previous studies. Extant studies have examined the theory mostly in the contexts of such liberal media systems as the United States. This study therefore provides a worthwhile assessment of media effects in the knowledge gap hypothesis based on a unique cultural context.

Moreover, scholars in health communication have increasingly highlighted the need to focus research on Asia with regard to the emergence and control of new infectious

diseases, especially when Asia is a hotspot for infectious diseases that have the potential to cause pandemics (e.g., Coker, Hunter, Rudge, Liverani, & Hanvoravongchai, 2011; Haider, Frank, & Noreen, 2010; Sleight, Leng, Yeoh, Phua, & Safman, 2006). In particular, population growth, urbanization, and changing climate in Asia are some of the main factors that can encourage emerging infectious diseases in the region (Coker et al., 2011; Sleight et al., 2006). Leveraging on the multicultural and urbanized context of Singapore, the findings of this study will provide a basis for researchers to examine the knowledge gap theory on health issues in other Asian countries such as China, Taiwan, and Korea, in future.

The Knowledge Gap Hypothesis in Health Communication

The knowledge gap effects have been demonstrated to manifest in various health domains, in which under situations of increasing health information flow, the strength of the association between SES and health knowledge increases (Viswanath et al., 2006; Viswanath & Finnegan, 1996). Education is often regarded as the key indicator of SES in most knowledge gap research. Extant studies have shown that compared with less educated people, the more educated ones tend to be more knowledgeable about various health issues such as cancer prevention (Slater, Hayes, Reineke, Long, & Bettinghaus, 2009; Viswanath et al., 2006), cardiovascular health (Ettema et al., 1983), general health knowledge (C. J. Lee, 2009), and AIDS (Wanta & Elliott, 1995). Likewise, studies conducted in Singapore have shown that education tends to be positively associated with public knowledge of such health issues as colorectal cancer and breast cancer prevention (Jara-Lazaro, Thilagaratnam, & Puay, 2010; N. Y. Wong, Nenny, Guy, & Seow-Choen, 2002), HPV vaccination (Pitts et al., 2009), and Severe Acute Respiratory Syndrome (Seng, Lim, Ng, Wong, & Emmanuel, 2004). Therefore, based on these considerations, the following is postulated:

H1: Education level will be positively associated with H1N1-related knowledge among Singaporeans.

Some key factors that could shape the knowledge gap include individuals' communication skills, prior knowledge, ties to social community groups, motivation and engagement in the topics of interest, and attention to health information in different media (Eveland & Scheufele, 2000; Grabe, Lang, Zhou, & Bolls, 2000; Graber, 2001; Viswanath, Kosicki, Fredin, & Park, 2000). In other words, highly educated people have stronger cognitive structure that enables them to better manage communication, to possess more general health knowledge, to be more integrated into the relevant social networks that function as additional interpersonal information resources, and to be more motivated to acquire new information than the less educated people.

Mass Media, Interpersonal Discussion, and The Knowledge Gap

The H1N1 influenza in Singapore presented us with a unique situation to examine the knowledge gap hypothesis. As mentioned earlier, the mass media in Singapore are state owned, in which the Singapore Press Holdings, with its board of directors approved by the government, owns and publishes all eight newspapers in the country (Chang, 1999). Likewise, the broadcast media, including all eight local, free-to-air television and radio channels, are fully owned by the government (Hukill, 2000). The mass media are often described as a developmental press that educates the public about governmental policies and current global and national crises (K. Wong, 2004). Notably, the Singaporean government has often used mass communication to launch annual campaigns to increase health awareness among its citizens (Chang, 1999). Specifically, the Ministry of Health in Singapore worked closely with the mass media as a channel of communication to inform the public about the H1N1 flu pandemic. Between April 2009 and March 2010, the *Straits Time (ST)* published 460 articles on the H1N1 influenza (refer to Figure 1). First published in 1845, the *ST* is the English national flagship newspaper in Singapore, with the highest newspaper readership of 1.38 million and a circulation of 352,100 in the country, as of August 2010 (Chang, 1999;

Singapore Press Holdings, 2011). During the same period, *Channel NewsAsia*, the leading free-to-air television news channel in Singapore, offered 361 news segments on the H1N1 influenza. Therefore, the public in Singapore was potentially exposed to a relatively large amount of news related to the H1N1 pandemic, with a substantial amount of column space dedicated to educating the public on preventive measures. This highlights the health authorities' heavy use of the mass communication channels to disseminate information about the pandemic to the public.

[Insert Figure 1 about here.]

In fact, the mass media are the main source of information about health issues for most publics. The tone and volume of media coverage of infectious diseases such as the avian flu and SARS have been shown to correspond to the amount of attention people paid to news about these diseases (Ho, Brossard, & Scheufele, 2007; Shih, Wijaya, & Brossard, 2008). Numerous studies have shown that newspaper reading tends to promote knowledge about health issues among the public (S. H. Kim, 2008; C. J. Lee, 2009; Slater et al., 2009). Although results have been less conclusive, television news has been demonstrated to enhance knowledge levels among the public across various health issues (C. J. Lee, 2009; Viswanath et al., 2006). Similarly, research conducted in Singapore has shown that attention to mass media was positively related to public knowledge of health issues such as SARS prevention (Seng et al., 2004) and colorectal cancer prevention (N. Y. Wong et al., 2002). The following is therefore posited:

H2: Attention to newspapers will be positively associated with H1N1-related knowledge among Singaporeans.

H3: Attention to television news will be positively associated with H1N1-related knowledge among Singaporeans.

Besides the mass media, interpersonal communication could also have a bearing on public levels of knowledge about the H1N1 influenza. Recent research has demonstrated that higher levels of interpersonal discussion were associated with increased knowledge in a variety of scientific and health contexts (Conduit, Parrott, & Harris, 2002; C. J. Lee, 2009; Powell, Dunwoody, Griffin, & Neuwirth, 2007; Robinson & Levy, 1986; Stamm, Clark, & Eblacas, 2000). Discussions with friends, family members, and coworkers provide socially integrated individuals with greater opportunities to seek information about health (Dutta-Bergman, 2005; Gaziano, 1997; Granovetter, 1973; Johnson, 1997). As such, the following is hypothesized:

H4: Interpersonal discussion will be positively associated with H1N1-related knowledge among Singaporeans.

More important, the central argument of the knowledge gap hypothesis posits that people of different SES groups will acquire health knowledge at different rates from various communication channels. Past studies suggest that newspaper use may widen the SES-based knowledge gap (Gaziano, 1984; Griffin, 1990; Kleinnijenhuis, 1991; Tichenor et al., 1970), but television news use may reduce the knowledge gap (Kleinnijenhuis, 1991; Kwak, 1999; Neuman, 1976). With respect to newspapers, the information presented is usually somewhat complex and in-depth. Therefore, education equips the people in the higher SES group with the cognitive-processing skills to integrate the complex information from newspapers better than those in the lower SES group who lack the necessary cognitive training (Eveland & Scheufele, 2000). Besides this, people in the higher SES group tended to use newspapers to gain social understanding such as staying current on what is happening in the community and finding out what is happening in the world, which may accelerate their rate of knowledge gain (Loges & Ball-Rokeach, 1993). In essence, newspapers contribute to knowledge gain to a greater extent for high SES groups than for low SES groups.

On the other hand, television presents its audience with contextual information in the form of animating sounds and visuals, which effectively reduces the cognitive effort of storing and retrieving information. This, in turn, made conceptual and abstract issues easily comprehensible, especially for people in the lower SES groups who possess a lower set of cognitive training (Grabe, Kamhawi, & Yegiyani, 2009; Neuman, Just, & Crigler, 1992). Neuman et al. (1992) demonstrated that television was the preferred news source for those with low cognitive training, whereas those with high cognitive training preferred newspapers. Grabe et al. (2009) showed that the less educated group was able to encode, store, and recall television news information but they had less memory capacity for newspapers, as compared with the more educated group.

In fact, several studies have shown that television news tended to narrow the gap between the high and low SES groups (e.g., Griffin, 1990; Kwak, 1999; Miyo, 1983). For example, Kwak (1999) found that television news viewing during the 1992 U.S. presidential election was significantly associated with a reduced knowledge gap between the high and low SES groups. Griffin (1990) demonstrated a widened knowledge gap due to newspapers' positive influence on the higher SES groups and a null influence on the lower SES groups; conversely, a narrowed gap was found for television because of the negative influence of television use on the higher SES groups and a null influence on the lower SES groups.

Moreover, it is necessary to note that the knowledge gap tends to narrow or disappear when there is large amount of controversy, heightened media coverage, large amount of publicity, and when the topic is of national concern to the community (Donohue, Tichenor, & Olien, 1975; Gaziano, 1983; McLeod & Perse, 1994; Viswanath & Finnegan, 1996; Kwak, 1999; Rucinski, 2004). Scholars have argued that in less pluralistic communities with more highly concentrated power bases (i.e., few leaders holding positions of influence) and more informal communication patterns, the flow of information may be more efficient, resulting in

fewer or narrower knowledge gaps (e.g., Rucinski, 2004).

This seems to be reflected in the situation in Singapore, in which state ownership of the media allows the government to efficiently disseminate a massive amount of information about the H1N1 pandemic to the public through campaigns and saturated news coverage. This may potentially diminish the knowledge gaps across all communication channels. Despite this, previous studies have shown that the moderating influence of newspapers and television on knowledge were different due to the fundamental differences in characteristics and features between the two mediums (Grabe et al., 2009; Griffin, 1990; Kwak, 1999; Miyo, 1983; Neuman et al., 1992). Therefore, this study argues that a difference in the potential moderating influence of newspapers and television on H1N1-related knowledge would still manifest among Singaporeans. The following hypotheses are posited:

H5a: Gaps in H1N1-related knowledge between the more and less educated

Singaporeans will depend on individuals' attention to newspapers such that the gap will be *larger* among those who paid high amount of attention to newspapers than among those who paid low amount of attention.

H5b: Gaps in H1N1-related knowledge between the more and less educated

Singaporeans will depend on individuals' attention to television news, such that the gap will be *smaller* among those who paid high amount of attention to television news than among those who paid low amount of attention.

Moreover, this study contends that interpersonal discussion is likely to close the H1N1-related knowledge gap between the low and high SES Singaporeans. Interpersonal sources play an important role in news diffusion and are often cited as a primary source for hearing about breaking news stories (DeFleur, 1987; Katz & Lazarsfeld, 1955; Rogers, 2000). Exposure to diverse others through community organizations and frequent health-related conversations among friends and family likely expose the public to a wide variety of health-

related information (e.g., Ho, Scheufele, & Corley, 2010). Hafstad and Aaro (1997) asserted that people tend to tell their friends, family, and neighbors about particularly startling media content that they encounter to establish community boundaries and interpersonal bonding.

In particular, low SES individuals may acquire a lot more knowledge from interpersonal discussions relative to the high SES individuals. Due to the ceiling effect, high SES individuals' level of knowledge gain from interpersonal communication may increase only by a small extent. For the low SES individuals, conversation constitutes a mechanism for information repetition and exposure among them. Katz and Lazarsfeld (1955) observed the pivotal role played by opinion leaders as individuals who both engage news and elite media sources and, in turn, dispense information from those sources to their networks of followers. Because the H1N1 pandemic was a highly localized issue that directly affected the lives of most Singaporeans and information dissemination among the informal community networks was high, it is plausible that low SES individuals learn new information about specialized topics from talking with other people in their social networks, thus narrowing the knowledge gap. Therefore the following is postulated:

H5c: Gaps in H1N1-related knowledge between the more and less educated

Singaporeans will depend on individuals' interpersonal discussion, such that the gap will be smaller among those who engage more frequently in interpersonal discussion than among those who engage less frequently in interpersonal discussion.

Other Factors

In addition to education and the communication factors, this study takes into account age, gender, household income, race, marital status, and perception of risks as control variables. As important motivators, individuals' perceived risks and susceptibility to certain disease or health conditions have been shown to stimulate health knowledge gain (Ettema et al., 1983; Yows, Salmon, Hawkins, & Love, 1991). For example, perceived risk of cancer

was found to have a positive influence on cancer-related knowledge (Shim, 2008). Public education about health risks increased awareness (Hornik, 2002). Risk perception was shown to positively affect individuals' knowledge about HIV, HIV-testing uptake, and condom use (Rimal, Brown, Mkandawire, Folda, & Creel, 2009). Rimal (2001) showed that heightened risk perceptions could propel people to seek more information about cardiovascular disease. With regard to emerging infectious diseases, P. Kim, Sorcar, Un, Chung, and Lee (2008) showed that an avian influenza education program that used mass communicated fear appeals was effective in helping young children acquire knowledge about the infectious disease. Therefore, these relevant demographic and motivation factors will be controlled for in the current study.

Methods

Data for this study came from a nationally representative Computer Assisted Telephone Interview survey of 1,055 adult Singapore citizens and permanent residents aged 18 years and older. The fieldwork was conducted from 14 to 21 December 2009 at Nanyang Technological University in Singapore. To maximize the response rate of our telephone survey, the interview was conducted in either English or Mandarin. The youngest male/oldest female technique was used to randomize individuals within households. Interviewers asked to speak with "a male 18 years or older who is now at home," and if there was no eligible male at home, they asked to speak to the oldest female at home. This technique has been effective in yielding representative samples (Ho, Lee, & Shahiraa, 2008; Kennedy, 1993). Extensive amount of effort was invested in call-backs and refusal conversions to minimize systematic nonresponse. The final response rate was 34.3%, calculated based on AAPOR Formula 3. The margin of error was approximately +/-3% at a confidence level of 95%.

Measures

Demographic variables were used as control variables, including age ($M = 40.4$, SD

= 15.0), gender (1 = male, 2 = female; 54.7% female), and marital status (1 = married, 2 = single; 61.4% married). *Education* ranged from 1 (*no formal education*) to 10 (*postgraduate*) (*Mdn* = 6.00 or “A level,” *SD* = 2.16). The racial distribution of our sample was 73.5% Chinese, 13.3% Malays, 8.30% Indian, and 4.90% other racial groups. For *race*, three dummy variables were created: Malay Singaporeans, Indian Singaporeans, and other racial groups. Chinese Singaporeans were defined as the racial majorities and used as the comparison group for the others, who were regarded as racial minorities. *Monthly household income* ranged from 1 (*SGD1,000 and below*) to 11 (*above SGD10,000*) (*Mdn* = 4.00, or \$3001 to \$4000, *SD* = 3.01).

Perceived risks was measured using two items on a 10-point scale from 1 (*strongly disagree*) to 10 (*strongly agree*), in which respondents were asked to indicate the extent to which they agree with the following statements: (a) “The thought of H1N1 makes me feel scared” and (b) “The thought of H1N1 makes me feel worried.” The two items were averaged to create a composite index ($M = 4.85$, $SD = 2.77$, $r = .85$, $p < .001$).

Attention to newspapers was measured using two items in which respondents were asked to indicate on a 10-point scale from 1 (*little attention*) to 10 (*very close attention*) how much attention they paid to the following stories when they read the newspaper: (a) “Health news in general” and (b) “News related to the H1N1 pandemic.” The two items were averaged to create a composite index ($M = 5.06$, $SD = 3.10$, $r = .86$, $p < .001$).

Attention to television news was measured using two items in which respondents were asked to indicate on a 10-point scale from 1 (*little attention*) to 10 (*very close attention*) how much attention they paid to the following stories when they watch television: (a) “Health news in general” and (b) “News related to the H1N1 pandemic.” The two items were averaged to create a composite index ($M = 5.10$, $SD = 3.12$, $r = .79$, $p < .001$).

Interpersonal discussion was measured using four items in which respondents were

asked on a 10-point scale from 1 (*not at all*) to 10 (*very frequently*) how frequently they discuss issues related to the H1N1 influenza with their (a) friends, (b) family, (c) doctor, and (d) coworkers. Responses were averaged to form a scale, with higher scores indicating a higher level of interpersonal discussion ($M = 3.87$, $SD = 2.10$, *Cronbach's* $\alpha = .78$).

Knowledge was measured using eight questions, and the level of difficulty was varied. Questions were obtained from the information provided by the WHO and the Ministry of Health in Singapore. Respondents were asked to state true or false (1 = true, 2 = false) at the end of the following statements: (a) "A person carrying the H1N1 influenza can spread the virus by coughing in public," (b) "Fever can be a symptom of the H1N1 influenza," (c) "A person infected with the H1N1 influenza can remain free of signs and symptoms for up to 7 days," (d) "Diabetics are at a higher risk of complications from H1N1 infection than are nondiabetics," (e) "Wearing a N95 mask can effectively protect you from contracting the H1N1 influenza," (f) "Taking the H1N1 flu vaccine can effectively protect a person from the H1N1 influenza," (g) "The seven steps of washing hands with soap and water can help to reduce a person's chances of contracting the H1N1 virus," and (h) "A person infected with the H1N1 virus can be effectively treated using Tamiflu tablets." Responses were summed to create a composite scale for knowledge, in which the higher scores indicate higher level of H1N1-related knowledge ($M = 5.96$ $SD = 1.61$, $KR-20 = .61$).

Analytical Approach

An ordinary least squares regression analysis was conducted to test the hypotheses. The variables were entered into the regression model according to their assumed causal order. Demographic variables were entered in the first block, followed by perceived risks in the second block, the communication variables in the third block, and the hypothesized interaction variables in the last block. The interaction terms were created by multiplying the centered values of the respective main effect variables to reduce potential multicollinearity

problems between the interaction term and its components (Cohen, Cohen, West, & Aiken, 2003). Three multiplication terms were included in the final regression block: (a) the interaction between education and attention to newspapers, (b) the interaction between education and attention to television news, and (c) the interaction between education and interpersonal discussion.

Results

Table 1 shows the results from the ordinary least squares regression analysis predicting H1N1-related knowledge. Among the demographic variables, results show that education, household income, and race had statistically significant associations with H1N1-related knowledge. Specifically, the more educated individuals tended to have greater H1N1-related knowledge than the less educated individuals ($\beta = .09, p < .05$), lending support to H1. Individuals with a high household income tended to be more knowledgeable than those with a low household income ($\beta = .09, p < .01$). In addition, individuals who belong to the other racial groups tended to be less knowledgeable about the pandemic than Chinese Singaporeans ($\beta = .07, p < .05$). Other variables, including age, gender, and marital status had no significant associations with knowledge. The demographic variables explained 4.10% of the variance in our dependent variable.

[Insert Table 1 about here.]

With respect to motivation, results indicate that individuals who had a high-risk perception of the H1N1 pandemic tended to have greater knowledge of the influenza than those who had a low risk perception ($\beta = .12, p < .001$). Perceived risks accounted for 2.80% of the variance in H1N1-related knowledge.

Regarding the communication variables, results show that individuals who paid high amount of attention to newspapers tended to be more knowledgeable than those who paid a low amount of attention ($\beta = .08, p < .05$). Therefore, H2 was supported. Likewise,

individuals who paid a high amount of attention to television news tended to possess greater H1N1-related knowledge than those who paid a low amount of attention ($\beta = .09, p < .01$), lending support to H3. However, interpersonal discussion had no significant association with H1N1-related knowledge, failing to support H4. The communication variables explained 2.70% of the variance in the dependent variable.

More important, the interaction between education and attention to television news ($\beta = .07, p < .05$), and the interaction between education and interpersonal discussion ($\beta = .10, p < .001$) on knowledge were significant. As shown in Figure 2 among individuals who were less educated, those who paid a high amount of attention to television news were significantly more knowledgeable than those who paid a low amount of attention; conversely, such a difference was almost negligible among the more educated individuals. In other words, the knowledge gap between the low and high educated groups was reduced among those who paid high attention to television news.

As shown in Figure 3 among individuals who were less educated, those who frequently engaged in interpersonal discussion were significantly more knowledgeable than those who engaged less frequently in discussion, whereas the difference was very small among the more educated individuals. Put simply, the knowledge gap was less likely to exist among those who engaged frequently in interpersonal discussions. Therefore, H5b and H5c were supported. However, the expected interaction between education and attention to newspapers on knowledge was not significant. Hence, H5a was not supported. The overall regression model explained a total of 10.6% of the variance in H1N1-related knowledge.

[Insert Figures 2 and 3 about here.]

Discussion

This study sets out to examine the knowledge gap hypothesis in the context of a global flu pandemic, which was an important national issue that received ubiquitous media

publicity and coverage in Singapore when this survey was conducted. Although our findings suggest that the knowledge gap hypothesis was not supported in this study, attention to television news and interpersonal discussion were found to narrow the knowledge disparity between the high and low SES individuals.

Consistent with findings from previous studies (e.g., C. J. Lee, 2009; Viswanath et al., 2006), this study found that education was positively associated with public knowledge about the H1N1 influenza. In other words, the high SES group was indeed more knowledgeable than the low SES group. This suggests that a knowledge disparity exists between the high and low SES segments of the population regarding the H1N1 influenza.

Moreover, attention to newspapers and television news plays a significant role in public awareness of the flu pandemic, consistent with results from extant research (e.g., Eveland & Scheufele, 2000; Kwak, 1999; Viswanath et al., 2006). Newspapers provide the space for detailed information on health, with special sections devoted to the H1N1 influenza, especially during the peak of the outbreak. Television news offers short announcements about up-to-date developments of the flu pandemic that allows the public to acquire factual knowledge about the influenza quickly. Therefore, as expected, the two news media were demonstrated to be positively associated with levels of knowledge about the flu pandemic among Singaporeans.

Regarding the knowledge gap hypothesis, this study found that attention to newspapers did not amplify the knowledge gap about the H1N1 influenza between the high and low SES individuals, which is not consistent with the results of most previous studies (Gaziano, 1984; Griffin, 1990; Kleinnijenhuis, 1991; Tichenor et al., 1970). This null finding may be accounted for by several plausible explanations. It is possible that a ceiling effect exists in which saturated newspaper coverage of the pandemic resulted in the more educated group remaining at the highest level of knowledge, as those at lower education levels

eventually caught up. This is a distinct possibility in the social context of Singapore with its homogenous state-owned media system that conducts an intense public health campaign with consistent messages about the public role in containing the health threat.

During the initial stages of the H1N1 flu pandemic, the Singapore Ministry of Health swiftly effected public communication through press conferences, media coverage, and a website dedicated to the pandemic, as reflected in the relatively large volume of H1N1-related news. Government-initiated campaigns urging the public to adopt precautionary measures against the H1N1 flu were also prominently placed in the press, television, and radio in the early phase of the pandemic. Although Singaporeans are aware of the government's control of media information, studies have shown that Singaporeans had a high level of trust in the government and the media for similar health crises in the past (e.g., Deurenberg-Yap et al., 2005). For example, during the SARS crisis in 2003, the public indicated high levels of confidence with the government and the mass media for their handling and reporting of the epidemic, in which the public deemed government interventions as necessary for ensuring the collective interests of the nation (Deurenberg-Yap et al., 2005). Extending this notion to the current study, it is therefore not surprising that attention to newspapers was not associated with a widened knowledge gap between the high and low SES groups of Singaporeans.

On the contrary, attention to television news was associated with a narrowed knowledge gap between the high and low SES individuals, such that individuals in the low SES group gained significantly more H1N1-related knowledge when they pay greater attention to health news on television. This finding is consistent with the results of most previous studies (Eveland & Scheufele, 1998; Griffin, 1990; Kwak, 1999; Miyo, 1983). This could plausibly be explained by the fact that television offers contextual information in the form of animating sounds and visuals, which effectively lessen the cognitive effort for

individuals to store and retrieve information. The easy format made conceptual and abstract issues easily comprehensible, especially for people in the low SES groups who possess a lower set of cognitive training. Moreover, due to ceiling effect, high SES individuals' level of knowledge gain from television news may increase by a small extent, especially when television news offers quick summaries of the flu pandemic with more breadth than depth.

Similar to print news, the television media in Singapore is considered to be highly controlled and regulated by the government, in which the role of the television media is vital for nation and consensus-building (Birch & Philips, 2003; Kuo & Ang, 2000; K. Wong, 2001). Cottle and Rai (2008) demonstrated that communicatively restricted frames, such as reporting frames (i.e., news stories that present events in terms of up-to-date information in short durations), dominant frames (i.e., news stories which are dominated by a single external news source), and community service frames (i.e., news stories that explicitly inform the public on what the presented information means and how it impacts them) are perpetuated by the local television channels, suggesting ample opportunities for government sources to define news agendas. Therefore, the government's control of news presentation on the national television network could possibly explain the narrowing of the H1N1-related knowledge gap between the high and low SES Singaporeans.

Likewise, the knowledge inequality between the high and low SES groups was significantly reduced when the low SES individuals engaged more frequently in interpersonal discussion. For the low SES individuals, conversation constitutes a mechanism for information repetition and exposure among them. Often, low SES individuals can gain knowledge from opinion leaders in their communication network, in which the latter could disseminate relevant information about the flu pandemic to their followers. The H1N1 pandemic was a national yet highly localized issue that directly affected the lives of most Singaporeans. The information dissemination among the informal community networks was

high. Therefore, low SES individuals learn new information about specialized topics from talking with other people in their social networks, whereas high SES individuals' level of knowledge gain from interpersonal communication may increase by a small amount due to the ceiling effect, thus narrowing the knowledge gap.

In addition to the communication variables, other findings in this study are also worth mentioning. First, household income was positively associated with public knowledge about the H1N1 influenza, consistent with findings from previous studies (e.g., C. J. Lee, 2009; Viswanath et al., 2006). The findings show that age, gender, and marital status had no significant associations with public level of H1N1-related knowledge. This further highlights the important role of education and income in knowledge acquisition. Other minority racial groups were significantly less knowledgeable than were the Chinese Singaporeans, whereas the Malays and Indians were not significantly different from the Chinese Singaporeans. This implies that ethnic differences may be an important factor of H1N1-related knowledge, in which the smaller minority racial groups may be underserved in the government's messaging. This suggests that health authorities may need to improve on the avenues or means of communication so that the pandemic-related information could be disseminated swiftly to the smaller minority groups in the country.

Besides this, the results show that perception of risk was positively associated with H1N1-related knowledge, in line with findings from previous studies (e.g., Rimal, 2001; Shim, 2008; Yows et al., 1991). This suggests that health authorities can appeal to the motivation of risk perceptions by portraying health risks as essential to individuals' knowledge of the world and by emphasizing the negative consequences of ignorance to boost knowledge about the pandemic within the population. This also suggests that future research should control for perception of risks and perhaps other motivations when examining the roles of the communication variables.

This study has some limitations that could be overcome in future research. First, this is a cross-sectional study and causal order cannot be determined. That is, it is possible that greater knowledge spurs greater use of news media rather than the reverse. Future research should examine the knowledge gap hypothesis using panel studies that track individual changes over time. Next, only traditional news media are examined in this study, without regard for new media. Future research should examine the influence of Internet use on the knowledge gap hypothesis in similar health contexts. Likewise, interpersonal discussion was measured as a unidimensional concept in this study. Future research should assess different dimensions of interpersonal discussion (e.g., depth vs. breadth, heterogeneous vs. homogenous discussions, etc.) to broaden our understanding of the role of interpersonal communication in the knowledge gap literature.

Moreover, only factual knowledge was examined in this study, which could explain the small amount of variance in H1N1-related knowledge accounted for by the factors in our regression model. Future research should therefore examine the different dimensions of knowledge (e.g., knowledge structure density), in addition to factual knowledge. Besides this, the assertion that the amount of media publicity and the nature of the issue examined could explain the findings that television news and interpersonal discussion narrow the knowledge gap, were not directly verified in this study. Future research should therefore examine the knowledge gap hypothesis across issues receiving differing levels of media coverage.

Despite these limitations, the findings from this study have made a number of important theoretical and practical contributions. In particular, being the first study to examine the knowledge gap hypothesis in Singapore, this study shows that the major assertions of the theory are only applicable to issues under certain circumstances. In an important national issue like the H1N1 flu pandemic, the public may be very motivated to acquire more information as it has direct impact on their daily lives. Therefore, under this

circumstance, television news and interpersonal communication were shown to narrow the gap between the high and low SES groups, whereas newspaper use was not shown to widen the knowledge gap.

Of course, the contextual differences between Singapore and other North American countries such as the United States in terms of functions of the mass media may yield different results for the knowledge gap hypothesis. For example, in the United States, the mass media play the role of independent watchdogs by providing surveillance of the government to serve the needs of the citizens (Graber, 2010). Freedom of the press is important in the United States in which the journalists are expected to scrutinize government performance (Graber, 2010). In a diverse climate where the news media is mostly privately owned, different interest groups in the United States, including the public, have the chance to influence the news agenda (Dimaggio, 2008). In other words, information flow in the United States may be much more diverse and could come from many different sources.

In contrast to the more liberal model of democracy, the mass media in Singapore is state owned and its content mainly reflects the interests of the ruling government (George, 2007). Both internal and external news flows are mostly top-down and controlled by the ruling government (Kuo & Ang, 2000), which could lead to less opportunities for the public and other interest groups to influence news agenda. Given similar issues, the news media in Singapore may have a stronger impact on narrowing the knowledge gap among the public than its United States counterparts. Indeed, this is a speculation that should be verified in future research. It would be worthwhile for future studies to examine the knowledge gap hypothesis using similar issues and measures in the United States and Singapore for a direct comparison of the effects of the news media.

When it comes to practical implications, results of this study show that television news attention was associated with a narrowed knowledge gap between the high and low SES

segments of the population. The media information was associated with both an increase in the overall level of knowledge and a decrease in SES-related differences in H1N1-related knowledge among Singaporeans. This suggests that the local health authorities should continue to leverage on the news channels, especially television news, to successfully disseminate the necessary health information to the low SES segment of the population. Finally, the health authorities and practitioners should also reach out to the low SES groups through interpersonal communication channels. Health communication practitioners could rely on interpersonal utility strategies such as seminars and discussion circles at community events to encourage the general public to share their views about the pandemic and be exposed to various viewpoints (e.g., opinions from doctors and researchers) on the issue. This can promote learning and narrow the knowledge gap between the high and low SES segments of the population.

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Table(s)

Table 1. Ordinary Least Squares Regression Analysis Predicting Knowledge about the H1N1 Pandemic.

	<i>Zero-Order</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Block 1: Demographic variables				
Age	-.03	-.04	-.03	-.04
Gender (1=male, 2=female)	-.01	-.00	-.02	-.02
Education	.15***	.12***	.13***	.09*
Household income	.14***	.08*	.10**	.09**
Malay Singaporeans	.02	.04	.02	.01
Indian Singaporeans	.05*	.03	.01	.00
Other racial groups	-.05	-.06	-.08*	-.07*
Marital status (1=married, 2=single)	-.06*	-.08*	-.07	-.04
Incremental R^2 (%)		4.10***		
Block 2: Motivation				
Perceived risks	.15***		.17***	.12***
Incremental R^2 (%)			2.80***	
Block 3: Communication variables				
Attention to newspapers	.18***			.08*
Attention to television news	.18***			.09**
Interpersonal discussion	.18***			.07
Incremental R^2 (%)				2.70***
Block 4: Interactions				
Education \times Attention to newspapers	--			-.06
Education \times Attention to television news	--			-.07*
Education \times Interpersonal discussion	--			-.10***
Incremental R^2 (%)				1.00**
Total R^2 (%)				10.6***

Note. $N = 1,055$. Cell entries for all models are final standardized regression coefficients for Blocks 1, 2, and 3, whereas cell entries are before-entry standardized regression coefficient for Block 4; Chinese Singaporeans was used as a reference category among the dummy variables of race. * $p < .05$. ** $p < .01$. *** $p < .001$.

Figure(s)

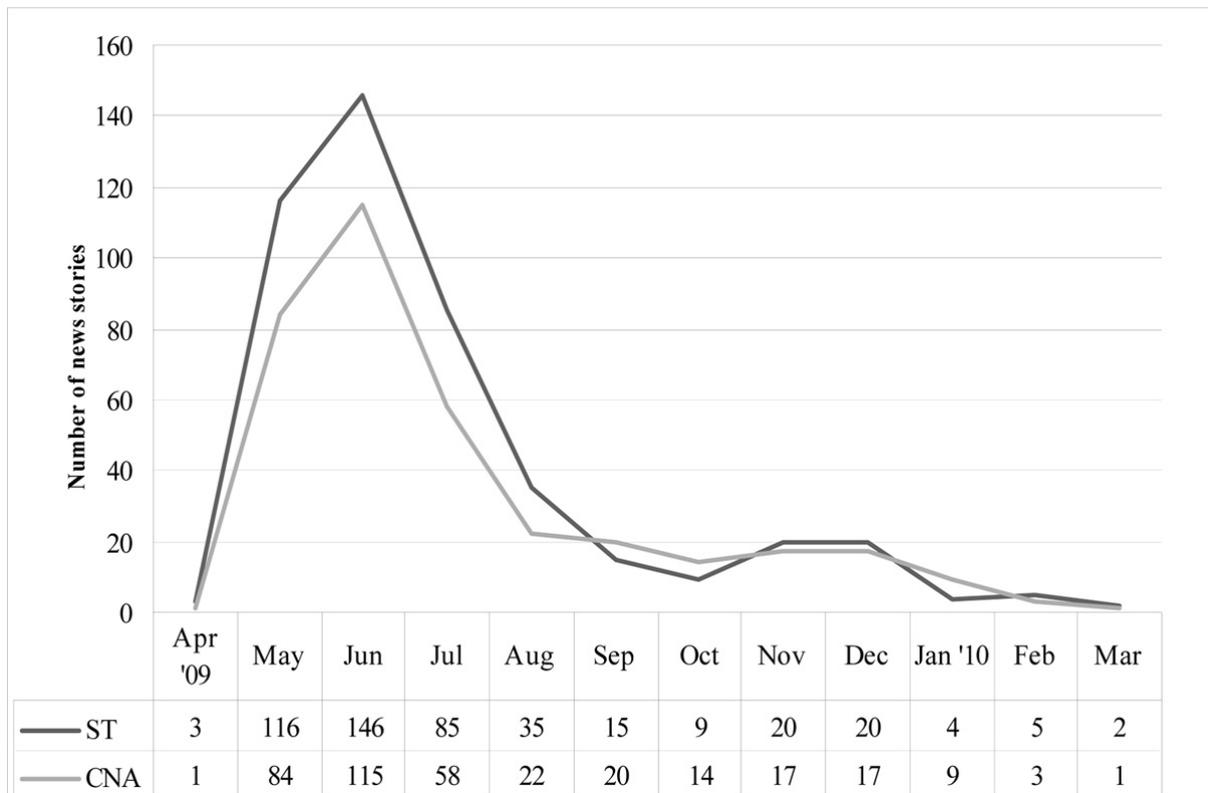


Figure 1. Volume of news coverage of the H1N1 flu pandemic in the *Straits Times* (ST) and *Channel NewsAsia* (CNA) between April 2009 and March 2010.

Note. The number of news stories was retrieved from the Lexis-Nexis Academic online database. The search term was “H1N1” in the headline or lead paragraphs of the news articles or broadcast transcripts.

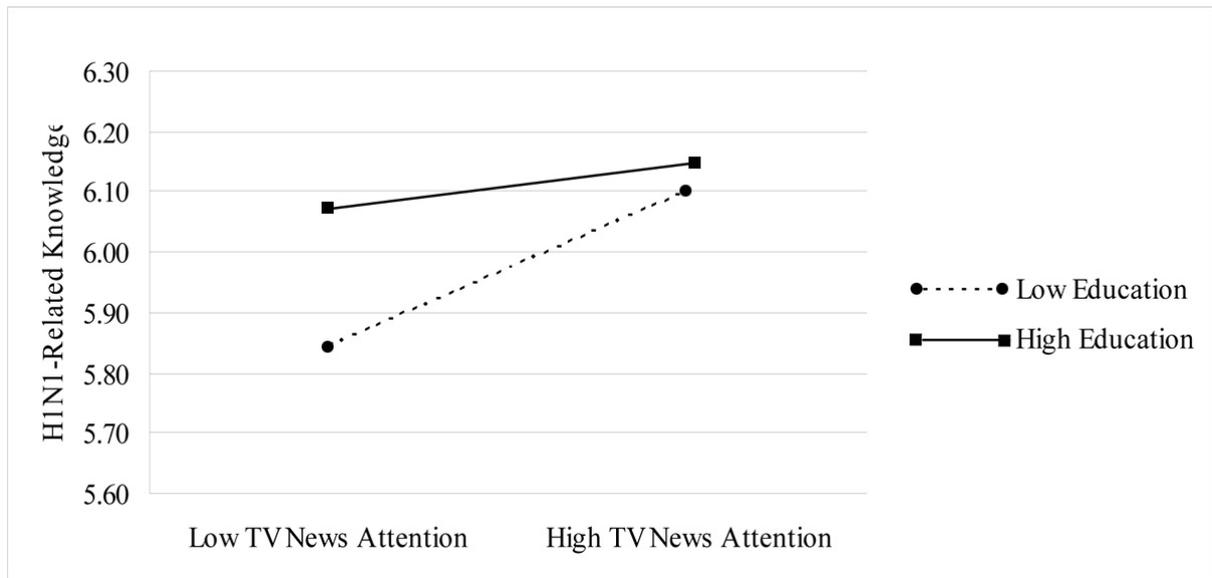


Figure 2. H1N1-related knowledge by education and attention to TV news. Note. Y-axis presents the estimated values of H1N1-related knowledge, which controlled for all the demographic and independent variables. Scale ranges were only partially displayed on the y-axis.

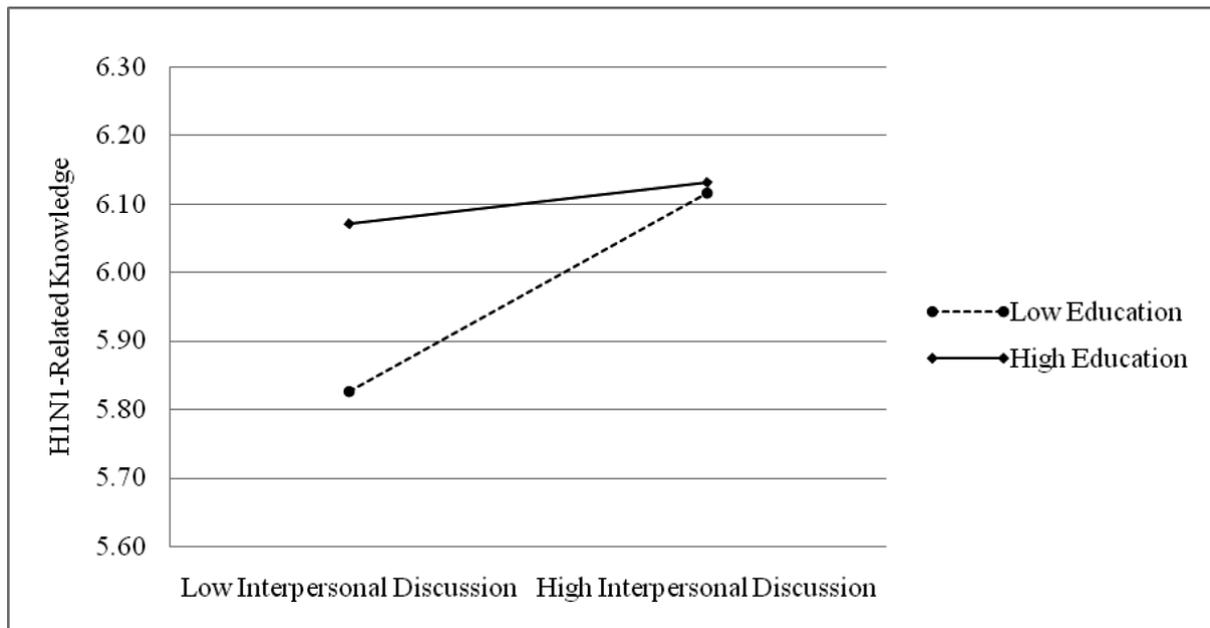


Figure 3. H1N1-related knowledge by education and interpersonal discussion. Note. Y-axis presents the estimated values of H1N1-related knowledge, which controlled for all the demographic and independent variables. Scale ranges were only partially displayed on the y-axis.