



The effects of SNS communication: How expressing and receiving information predict MERS-preventive behavioral intentions in South Korea



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ABSTRACT

Individuals use social network sites (SNSs) as an effective tool for communicating relevant information with others during the outbreak of infectious diseases. However, little is known about the underlying mechanism through which communicative behaviors influence preventive behaviors. Thus, in the context of Middle East respiratory syndrome (MERS) in South Korea, this study investigated how two communicative behaviors (message expression and reception) in SNSs affected the communicators' intentions to engage in MERS-preventive behaviors. Using data collected from a nationally representative panel survey of 1000 Korean adults aged 19 or older, we examined a theoretical expression and reception effects model. Results support the presence of effects from expressing and receiving MERS-related information via SNSs and their underlying mechanism during South Korea's MERS outbreak. Public health officials and communication professionals should actively use SNS communication in coping with public health crisis caused by emerging infectious diseases.

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1. Introduction

Between May and July 2015, the largest outbreak of Middle East respiratory syndrome coronavirus (MERS-CoV; hereafter MERS) infection occurred in South Korea. Since the first case of MERS infection was reported on May 20, 186 people were found to be infected, 36 of whom died, while a total of 16,693 were quarantined to prevent the spread of the virus (Korea Centers for Disease Control and Prevention, 2015). Thousands of schools were closed at the peak of the outbreak; in addition, as people became more concerned and afraid, they frequently avoided public places, including markets, theaters, and restaurants, which took a heavy toll on the national economy (Byun, 2015).

Despite this widespread social and economic panic, the South Korean government withheld important information such as the names of MERS-affected hospitals early in the outbreak. Traditional news media such as newspapers and television, also avoided providing sufficient information about MERS at the request of the

government and the medical profession. In this situation, the majority of South Koreans began to rely on social network sites (SNSs) as an alternative source of information about MERS. When people are caught up in the outbreak of an infectious disease, their information needs tend to increase (Bults et al., 2011; Li et al., 2014; Wong & Sam, 2010). Althaus and Tewksbury (2000) suggested that audiences might shift toward the web and away from newspapers and television if the web meets their information needs better than traditional news media or if it satisfies demands that cannot be fulfilled by traditional media. In addition, individuals seek out the web, because it often provides an unfiltered, up-to-date line of communication and information that cannot be found elsewhere (Johnson & Kaye, 2010). SNSs have been defined as web-based services that allow individuals to build knowledge and disseminate information within a bounded system (Boyd & Ellison, 2007). Thus, in South Korea, SNSs became an attractive avenue through which to communicate with and learn from others about MERS.

There is substantial evidence that people use SNSs as an effective tool for communicating relevant information with their peers, friends, and families during the outbreak of infectious diseases (Tausczik, Faasse, Pennebaker, & Petrie, 2012; van Velsen, van

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Gemert-Pijnen, Beaujean, Wentzel, & van Steenberghe, 2012). However, researchers have not explored the effect of communicating information about infectious diseases via SNSs on disease-preventive behaviors. In particular, little is known about the cognitive mechanisms underlying the effects of SNS communication on preventive behaviors. In addition, when people communicate via SNSs, they not only read messages posted by others, but also send messages to others (Sundar, 2004). However, despite this bidirectional nature of SNS communication, few studies have been conducted to examine the effects of both expression and reception of SNS messages in the context of an infectious disease outbreak.

Accordingly, this research has a twofold purpose. First, during South Korea's MERS outbreak, it examines the effects of the expression and reception of SNS messages on cognitive characteristics and intentions to engage in MERS-preventive behaviors. Second, it delineates the cognitive mechanisms underlying the effects of expression and reception of SNS messages.

2. Theoretical background

2.1. SNSs as a communication tool for infectious disease information exchange

In a public health crisis, people seek information from a variety of sources and constantly update it. Traditional news media have been identified as a dominant source of health information in public health risk events (Hobbs, Kittler, Fox, Middleton, & Bates, 2004). They provide a wide range of highly segmented audiences with critical information for reducing harm or even resolving the crisis (Hooker, Leask, & King, 2012). However, the proliferation of SNSs has changed the way people access information, such that they typically no longer need to rely solely on the government or traditional news media as their primary information source during a public health emergency. For example, Twitter was primarily used as a public sphere for the exchange of information, opinions and experiences among people during the 2009 H1N1 virus outbreak (Chew & Eysenbach, 2010; Signorini, Segre, & Polgreen, 2011). Additionally, at the peak of the flu pandemic, H1N1 discussions were conducted within more than 500 Facebook groups (Davies, 2009). In May 2013, a measles outbreak began in the Netherlands, and Mollema et al. (2015) analyzed the tweets sent via Twitter during this outbreak. They found that individuals used Twitter not only to inform others about the measles outbreak and preventive measures such as vaccination but also to express their frustration regarding persons who did not vaccinate because of religious reasons.

In particular, SNSs can become popular venues for the public to exchange information when traditional news media offer very limited information about an infectious disease outbreak because of official restraints and pressure. According to the media system dependency theory, the public's dependency on media tends to intensify at times of major crises (Ball-Rokeach & DeFleur, 1976). However, when information is not readily available from traditional news media, many individuals serve as information producers and disseminators themselves in order to build alternative means of information exchange (Tai & Sun, 2007). For example, during the severe acute respiratory syndrome (SARS) epidemic of 2003, Chinese people heavily utilized the Internet and short message services to exchange information not available from the mainstream media, before the Chinese government allowed full disclosure of information on SARS.

The SARS case sheds light on the prospect of SNSs as a communication tool for individuals to serve as alternative sources of information. The increased frequency of Internet use via computer or mobile devices allows SNSs users to offer health

information quickly and directly (Yang, Horneffer, & DiLisio, 2013). However, not all individuals provide helpful and accurate information; in fact, SNSs are often used for spreading misinformation and false rumors in an emerging pandemic (Morozov, 2009). For example, Oyejemi, Gabarron, and Wynn (2014) analyzed the messages on Twitter during the Ebola outbreak in West Africa and found that most tweets and retweets included false information and that this had a much larger reach than truthful information. Gu et al. (2014) also found that 84% of the rumors regarding H7N9 outbreaks were disseminated and transmitted by social media during the outbreaks in China. The spreading of rumors and misinformation via social media can cause panic among people and further lead to social chaos during an infectious disease emergency.

However, despite these problems, SNSs can be very helpful in reducing the extent of a pandemic. Timely, accessible, and credible health information is very important for taking action during the outbreak of an infectious disease (McNab, 2009). With the ubiquity and immediacy of SNSs, information regarding a public health crisis can be rapidly provided through them. Ding and Zhang (2010) found that students from a university in China first reported the outbreak of the H1N1 flu via SNSs, personal blogs, and discussion forums. This information was quickly spread online among the general public. Additionally, SNSs are perceived as more credible than traditional news media for obtaining crisis information in some cases (Jin, Liu, & Austin, 2014). Thus, SNSs can be useful for the rapid identification and prompt management of infectious disease outbreaks (Yang et al., 2013).

2.2. Linking SNS communication to cognitive characteristics and preventive behavioral intentions

Previous research provides evidence that social media are very effective in reinforcing or changing attitudes and behaviors in a crisis. For instance, Mou and Lin (2014) examined whether the public's use of social media was related to any forms of prevention action in relation to food safety in China. Their findings showed that the use of microblog or Weibo in China was positively associated with public awareness of a series of food safety incidents and factual awareness, in addition to preventive actions regarding food risks. However, in the case of infectious disease outbreaks, the impact of using SNSs on people's attitudes and behaviors has been largely overlooked (Lin, Savoia, Agboola, & Viswanath, 2014). Given that SNSs have been recognized as useful communication tools to raise awareness during an infectious disease outbreak (Chew & Eysenbach, 2010; Ding & Zhang, 2010; Liu & Kim, 2011), it is reasonable to assume that communication via SNSs of disease-related information influences people's perceptions, concerns, and behaviors in relation to the outbreak.

SNSs are an example of Web 2.0 technology applications, which have significantly changed the health communication domain in recent years. Based on the ideological and technological foundations of Web 2.0 (Kaplan & Haenlein, 2010), SNSs have contributed to a shift in the online environment, from a one-way and "read-only" communication model (whereby information is "pushed" onto passive audiences) to a two-way model characterized by participation, collaboration, and openness (Eysenbach, 2008; Kreps & Neuhauser, 2010). In other words, SNSs allow users not only to receive messages, but also to send out their thoughts and ideas to their social networks. Therefore, through SNSs, the public can play a critical role in message expression such as creating content, transmitting information, and amplifying or commenting on traditional news stories during public health crises (Chew & Eysenbach, 2010).

In fact, message expression has been a form of psychotherapy. Pennebaker and Beall (1986) suggested that "writing about earlier

traumatic experience was associated with both short-term increases in physiological arousal and long-term decreases in health problems” (p. 280). Researchers have proved that numerous therapeutic interventions using the writing paradigm can lead to various health benefits (see Pennebaker, 1997a). Two theories have been proposed to explain the mechanisms by which writing exerts its positive effects. The inhibition theory holds that a great deal of stress goes into constraining thoughts, feelings, or behaviors regarding an emotional upheaval, and that such stress may be reduced by disclosing these experiences (Pennebaker, 1989). Moreover, the cognitive change theory asserts that writing helps individuals organize their thoughts and feelings about traumatic experiences, and create more coherent or meaningful narratives about the events in their lives (Pennebaker & Seagal, 1999). Both theories share the idea that writing helps relieve the stress or other difficulties associated with repression, and make sense of a chaotic emotional experience.

Aside from the field of psychotherapy, message expression has long been a focus of communication studies. Some scholars have argued that message expression has important effects on the message producer, because it relies on a self-reflective process and extensive cognitive activity (Blumler & Katz, 1974; Chaffee & Schleuder, 1986; Eveland, 2001). While the reception of messages is generally a passive activity, message construction requires cognitive elaboration, as one considers not only what one wishes to express, but also the way in which that expression is likely to be received (Eveland, 2001, 2004). Indeed, after one has expressed a message, the perception of its meaning can change through the awareness that others will read it. This process, also called reasoning, refers to mental elaboration or collective consideration, and it encompasses both intrapersonal and interpersonal ways of thinking (Cho et al., 2009; Shah et al., 2007). The very process of writing out one's thoughts can exert their impact on the message writer (Pennebaker, 1997b; Pingree, 2007). Specifically, message composers can be influenced by their own message in a variety of ways, for instance, by mentally elaborating on what they expect that the message will mean to others, how they expect readers to react and respond to it, and by preemptively preparing their own responses (McLaughlin et al., 2016).

Researchers studying computer-mediated support groups have applied the expression-effects paradigm to examine the health benefits of specific types of expression. Shaw, Hawkins, McTavish, Pingree, and Gustafson (2006) found that insightful disclosure within online cancer support groups improved emotional well-being and reduced negative mood. Similarly, Shim, Cappella, and Han (2011) found that insightful expression led to lower cancer concerns, which resulted in a greater improvement in health self-efficacy, as well as in emotional and functional well-being. Other scholars found that religious expression within computer support groups was a beneficial form of coping when facing a life threatening diagnosis such as cancer (McLaughlin et al., 2016; Shaw et al., 2007).

As discussed above, message expression has important effects on message composers because it relies on a self-reflective process and purposeful cognitive activity. Given the bidirectional nature of the online communication environment, the influence of SNS messages should be examined from this expression-effects perspective. In other words, the effects of message expression, including the individual's reformulation of the message and the subsequent dissemination of their personal thoughts on it, should be explored in the participation-driven realm of SNSs (Nekmat, 2012). Adopting an expression-effects paradigm in the context of SNS communication during an infectious disease outbreak, allows us to assume that expressing information via SNSs influences the information producer's cognitive characteristics and the intention to participate in preventive behaviors. SNSs have become not only

an important source of health information during epidemics, but also a medium for expressing anxiety and discussing concerns about the disease (Chew & Eysenbach, 2010; Davies, 2009; Tausczik et al., 2012). Prior studies found that individuals expressed their perceptions, concerns, and behaviors by posting relevant messages on SNSs during infectious disease outbreaks (Mollema et al., 2015; Signorini et al., 2011). Thus, it is necessary to examine the potential effects of expressing information via SNSs on the information producer in the context of the MERS outbreak in South Korea. To do so, we hypothesize that expressing MERS-related information will affect self-efficacy, perceived risk, and precautionary behavioral intentions in response to the MERS outbreak. Specifically, this study focuses on the effectiveness of SNS communication in promoting intentions to engage in handwashing and cough etiquette, as these were identified as key preventive behaviors in MERS-prevention guidelines provided by the World Health Organization (WHO) (2015). Thus, the following hypotheses are proposed.

H1. Expressing MERS-related information will be positively related to self-efficacy for MERS (H1a) and perceived threat of MERS (H1b).

H2. Expressing MERS-related information will be positively related to handwashing intention (H2a) and cough etiquette intention (H2b).

On the other hand, message reception has also been a main research area within the study of health communication. Health communication research has traditionally been dominated by a reception-effects paradigm in which most effects of communication are conceived as a consequence of informational or persuasive message reception (Fishbein & Cappella, 2006). In the case of an infectious disease outbreak, there is substantial evidence to support this message reception-effect perspective. According to results from 36 national surveys in the United Kingdom, exposure to media coverage or advertising about swine flu (H1N1 virus) increased not only people's perceived efficacy, but also their adoption of recommended preventive behaviors during the early stages of the outbreak (Rubin, Potts, & Michie, 2010). The effects of receiving information regarding an infectious disease outbreak can be replicated, or even be more substantial, in the context of SNS communication. SNSs usage increases during a health crisis event, as individuals seek information about the event itself and check on their social networks such as family and friends (Faustino, Liu, & Jin, 2012). Furthermore, SNSs users are likely to be exposed to messages that affect their perception and preventive behaviors related to health risks and the crisis event. Vos and Buckner (2015) found that SNS messages mainly consisted of sense-making messages to educate about the nature of the risk, and efficacy messages to encourage appropriate responses in the 2013 outbreak of the H7N9 virus. In a similar line, it seems plausible that receiving MERS-related information via SNSs stimulates increased self-efficacy, perceived threat, and preventive behavioral intentions during South Korea's MERS outbreak. Thus, the following hypotheses are proposed.

H3. Receiving MERS-related information will be positively associated with self-efficacy for MERS (H3a) and perceived threat of MERS (H3b).

H4. Receiving MERS-related information will be positively associated with handwashing intention (H4a) and cough etiquette intention (H4b).

2.3. Cognitive mechanisms: mediating roles of self-efficacy and perceived threat

According to a systematic review of the literature on infectious disease outbreaks (Lin et al., 2014), predicting preventive behaviors, or at least preventive behavioral intentions has been the focus of many studies. Understanding how individuals experience and respond to an infectious disease outbreak can be derived from the extended parallel process model (EPPM) (Witte, 1992, 1994). The EPPM has been widely employed in predicting preventive behaviors during infectious disease outbreaks (e.g., Balicer et al., 2010; Siu, 2008; Zhang, Kong, & Chang, 2015). It posits two important determinants of willingness to undertake preventive health behaviors: self-efficacy and perceived threat (Witte, 1992, 1994). When both self-efficacy and perceived threat are high, individuals are likely to employ recommended preventive behaviors to avoid threat in a danger control process (Shi & Smith, 2016).

Self-efficacy refers to one's belief in their own ability to manage a particular difficult task that they are facing (Bandura, 1997). Individuals' beliefs about their capabilities influence their behavior, such as what they choose to do or how they respond, in order to effectively manage situations (Bandura, 1990). People with low self-efficacy tend to feel powerless and fatalistic (Solomon, 2003), which makes them less likely to engage in preventive behaviors (Crowell & Emmers-Sommer, 2001). Self-efficacy has been also identified as a strong predictor of preventive behaviors during outbreaks of infectious diseases. For example, perceived self-efficacy was associated with taking preventive measures during the 2009 influenza pandemic in the Netherlands (Bults et al., 2011). As a similar concept to that of self-efficacy, perceived behavioral control was an important predictor of SARS-preventive behaviors among working adults in Hong Kong and Canada (Cheng & Ng, 2006). In addition, self-efficacy beliefs were positively associated with intentions to perform frequent handwashing and sanitizing in the context of a campus influenza outbreak (Kim & Niederdeppe, 2013).

Perceived threat refers to individuals' perceptions of the probability (susceptibility) and seriousness (severity) of a particular danger or harm such as contracting an illness (Rimal, Böse, Brown, Mkandawire, & Folda, 2009; Zhang, Zhang, & Chock, 2014). In general, people tend to change their behaviors, including specific public health behaviors (e.g., preventive actions), when they perceive threats or risks, or experience fears (Umeh, 2004). In other words, perceived threat can facilitate protective motivation, thereby increasing behavioral intentions to engage in health-promoting behaviors such as condom use, seat belt use, or breast self-examination (Umeh, 2004). Supporting this suggestion, perceived threat has been shown to be a critical factor in predicting disease-preventive behaviors during infectious disease outbreaks. A review of literature on the SARS, avian influenza (H5N1), and swine influenza (H1N1) pandemics found that perceived susceptibility to and perceived severity of the diseases were important predictors of the preventative behaviors recommended against them (Bish & Michie, 2010).

Based on the theoretical reasoning and empirical findings described above, we expect that self-efficacy and perceived threat are the most important predictors of people's adoption of preventive behaviors. To investigate the predictive roles of the two cognitive characteristics in South Koreans' MERS-preventive behavioral intentions, this study proposes the following hypotheses.

H5. Self-efficacy for MERS will be positively associated with handwashing intention (H5a) and cough etiquette intention (H5b).

H6. Perceived threat of MERS will be positively associated with

handwashing intention (H6a) and cough etiquette intention (H6b).

According to protection motivation theory (PMT), both self-efficacy and perceived threat are major tenets of cognitive mediation processes caused by health risk messages (McMath & Prentice-Dunn, 2005). These cognitive mediation processes arouse protection motivation, which results in danger control actions. "Protection motivation is an intervening variable that has the typical characteristics of a motive: It arouses, sustains, and directs activity" (Rogers, 1975, p. 98), and it is operationalized as intentions (Rogers, 1983). PMT provides a potentially useful framework for understanding how communicating about an infectious disease outbreak via SNSs affects disease-preventive behavioral intentions through cognitive processes (self-efficacy and perceived threat). For example, during an outbreak of a new infectious disease, communicating relevant information via SNSs can influence the communicator's self-efficacy regarding the disease and perceived threat of the disease, thereby influencing their intentions to adopt preventive measures. Thus, the following hypotheses are proposed to explore how self-efficacy and perceived threat mediate the relationships between SNS communication and preventive behavioral intentions in the context of South Korea's MERS outbreak.

H7. The relationships between expressing MERS-related information and handwashing intention, and cough etiquette intention were mediated by self-efficacy for MERS (H7a) and perceived threat of MERS (H7b).

H8. The relationships between receiving MERS-related information and handwashing intention, and cough etiquette intention were mediated by self-efficacy for MERS (H8a) and perceived threat of MERS (H8b).

Based on the hypotheses discussed above, a model is proposed to illustrate the potential interrelationships between expressing and receiving MERS-related information, cognitive characteristics, and MERS-preventive behavioral intentions (see Fig. 1).

3. Method

3.1. Procedure and participants

We hired a leading research firm to recruit survey participants in South Korea, which provided a panel of respondents with nationally representative demographic characteristics, including age,

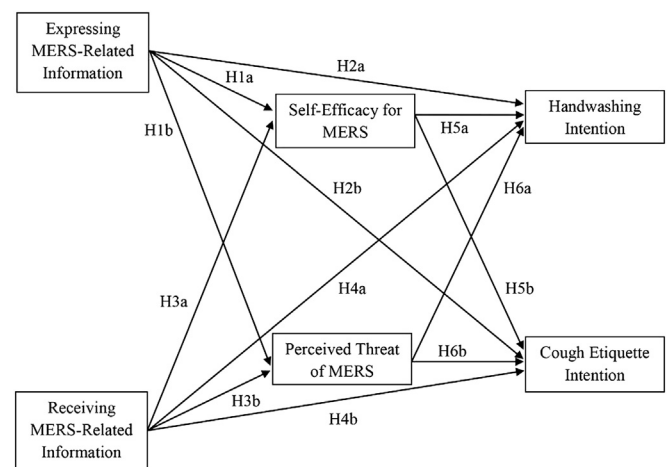


Fig. 1. Hypothesized model for examining the effects of expressing and receiving MERS-related information on handwashing intention and cough etiquette intention.

gender, and area of residence. The survey was conducted over the course of a week, July 6 to 13, 2015. An invitation e-mail was sent to a 10,000-member online panel, which was randomly chosen via a computer algorithm. Once participants completed the survey via a link to the online questionnaire, they earned points for their participation, which could be redeemed for gifts. The survey was closed after reaching our target of at least 1000 eligible people completing the survey. Of the 1150 surveys completed, 1000 were finally included in the study after excluding those with inadequate or missing answers.

Table 1 presents the sociodemographic characteristics of this study sample. The mean age of participants was 45.24 years old ($SD = 13.46$, range = 21–69 years) and 50.2% were male ($N = 502$). Education background was diverse, with 52.5% having a bachelor's degree, 19.5% having a high school diploma, 15.9% having an associate degree, and 11.3% having a graduate degree. The median category for monthly household income was the range \$3501–4500. Finally, about 50% rated their health as good ($N = 499$), while only about 7% rated it as poor ($N = 73$).

3.2. Measures

3.2.1. Expression and reception of MERS-related information

Expressing information about MERS was measured using a single question to ask how often participants had posted or shared comments, questions, pictures, videos, or other information about MERS on SNSs (e.g., Facebook, Twitter, Instagram, Pinterest, Kakao Story, Kakao Group, Naver Band, or Between) in the past 30 days. Responses were based on a five-point scale (1 = *never* to 5 = *very often*) ($M = 2.31$, $SD = 1.15$). Similarly, receiving information about MERS was assessed using a single item to ask how often the respondents had heard or seen comments, questions, pictures, videos, or other information about MERS on SNSs in the past 30 days. Responses ranged along a five-point scale (1 = *never* to 5 = *very often*) ($M = 3.14$, $SD = 1.21$).

3.2.2. Cognitive characteristics

Self-efficacy for MERS was measured with four items (adapted

Table 1
Sociodemographic characteristics.

	Participants ($N = 1000$)
Age	
Mean (SD)	45.24 (13.46)
Gender	
Male	502 (50.2%)
Female	498 (49.8%)
Education	
Did not complete junior/middle high	2 (0.2%)
Did not complete high school	6 (0.6%)
High school diploma	195 (19.5%)
Associate degree	159 (15.9%)
Bachelor's degree	525 (52.5%)
Graduate degree	113 (11.3%)
Monthly Household Income	
Below \$1500	114 (11.4%)
\$1501 – \$2500	153 (15.3%)
\$2501 – \$3500	189 (18.9%)
\$3501 – \$4500	221 (22.1%)
\$4501 and more	294 (29.4%)
Don't know	29 (2.9%)
Health Status	
Very poor	9 (0.9%)
Poor	73 (0.6%)
Moderate	341 (34.1%)
Good	499 (49.9%)
Very good	78 (7.8%)

from Han, Zhang, Chu, & Shen, 2014) on a five-point scale (1 = *strongly disagree* to 5 = *strongly agree*): (a) “I can avoid MERS infection”; (b) “I can figure out how to avoid MERS infection”; (c) “I can recover even if I contract MERS”; and (d) “I am fully informed about MERS.” Responses were averaged to create a scale with higher scores indicating higher levels of self-efficacy for MERS ($M = 3.50$, $SD = 0.66$, Cronbach's $\alpha = 0.78$). Perceived threat of MERS was measured with eight items regarding perceived susceptibility and severity (derived from Yang, 2015). Specifically, perceived susceptibility was measured with four items on a five-point scale (1 = *strongly disagree* to 5 = *strongly agree*): (a) “MERS infection could happen to me”; (b) “MERS infection could happen to my family”; (c) “MERS infection could happen to my neighbors and friends”; (d) “MERS infection could happen anytime to anyone, even a healthy individual.” Perceived severity was measured with four items on a five-point scale (1 = *strongly disagree* to 5 = *strongly agree*): (a) “MERS causes death quickly”; (b) “Many people can die from MERS”; (c) “A person who contracts MERS will die if not treated”; (d) “MERS-coronavirus is fatal.” Responses to the two measures were averaged to form a scale, with higher scores indicating higher levels of perceived threat of MERS ($M = 3.47$, $SD = 0.71$, Cronbach's $\alpha = 0.89$).

3.2.3. MERS-preventive behavioral intentions

Handwashing intention was measured using a five-point scale (1 = *least likely* to 5 = *most likely*), in which respondents were asked how likely they were to engage in frequent handwashing with soap in the coming months ($M = 4.25$, $SD = 0.67$). Cough etiquette intention was measured using a five-point scale (1 = *least likely* to 5 = *most likely*), in which respondents were asked how likely they were to cover their mouth and nose with their arm when they coughed or sneezed in the coming months ($M = 4.24$, $SD = 0.71$).

3.2.4. Control variables

Five variables served as exogenous variables in our model, and their paths were linked to all endogenous variables for control purposes. A review of studies on demographic determinants of protective behaviors during infectious disease outbreaks showed that older, female, and more educated people were more likely to adopt the behaviors (Bish & Michie, 2010). Therefore, assuming the potential influence of sociodemographic differences between study participants, their age, gender, education, and monthly household income were included as control variables. In view of prior research suggesting the potential influence of health status on preventive behaviors during a pandemic (Cowling et al., 2010), self-reported health status was also included as a control variable.

4. Results

To test the overall hypothesized model described in Fig. 1, this study performed structural equation modeling (SEM) with observed variables in Mplus 6.1. SEM enables researchers to examine the links from exogenous and antecedent endogenous variables to the consequent endogenous variables, as well as the relations among all exogenous and antecedent endogenous variables (Kelloway, 1998). In the proposed model for this study, control variables were used as exogenous variables, and the other variables were treated as endogenous variables. The maximum likelihood mean-adjusted (MLM) estimator was used to address non-normally distributed data. The MLM estimator is appropriate for continuous but non-normal data as it applies robust corrections to the test statistic and standard errors (Chou, Bentler, & Satorra, 1991; Krueger, Chentsova-Dutton, Markon, & Goldberg, 2003; Satorra & Bentler, 1994).

This study first assessed the hypothesized model with several

goodness-of-fit indices, including the chi-square statistic, the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Specifically, the chi-square statistic assesses the magnitude of discrepancy between the hypothesized covariance matrix and the observed covariance matrix (Hu & Bentler, 1999). A nonsignificant value of chi-square is usually accepted as evidence of a good model fit. Other model fit indices are categorized into incremental and absolute indices. The most commonly used incremental indices are the CFI and the TLI. Both measure the proportionate improvement in model fit by comparing the hypothesized model with the less restricted baseline model (Byrne, 2012). CFI and TLI values of 0.95 or greater are indicative of a good model (Hu & Bentler, 1999). The RMSEA and the SRMR belong to the category of absolute indices of fit and determine how well the hypothesized model fits the sample data (Byrne, 2012). RMSEA values under 0.08 and under 0.06 for SRMR are considered good model fits (Hu & Bentler, 1999). Based on the cutoff criteria summarized above, our proposed model presented a reasonably good fit to the data: $\chi^2 = 2.60$, $df = 1$, $p = 0.11$, RMSEA = 0.04 (90% CI = 0.00 to 0.10), CFI = 0.99, TLI = 0.94, and SRMR = 0.01.

Table 2 presents all structural parameters in the model and Fig. 2 indicates the results of all hypothesized paths. H1 predicted that expressing MERS-related information would be positively related to self-efficacy for MERS (H1a) and perceived threat of MERS (H1b). The findings supported H1a ($\beta = 0.16$, $p < 0.001$) but failed to support H1b.

Contrary to H2a and H2b, expressing MERS-related information was negatively associated with handwashing intention ($\beta = -0.16$, $p < 0.001$) and cough etiquette intention ($\beta = -0.20$, $p < 0.001$).

H3 predicted that receiving MERS-related information would be positively related to self-efficacy for MERS (H3a) and perceived threat of MERS (H3b). We found support for H3b ($\beta = 0.18$, $p < 0.001$) but not for H3a.

As proposed in H4a and H4b, receiving MERS-related information was positively associated with handwashing intention ($\beta = 0.11$, $p < 0.01$) and cough etiquette intention ($\beta = 0.12$, $p < 0.01$). Hence, H4a and H4b were supported.

Supporting H5a and H5b, self-efficacy for MERS was positively related to handwashing intention ($\beta = 0.32$, $p < 0.001$) and cough etiquette intention ($\beta = 0.30$, $p < 0.001$). Similarly, perceived threat of MERS was positively associated with handwashing intention ($\beta = 0.22$, $p < 0.001$) and cough etiquette intention ($\beta = 0.22$, $p < 0.001$). Thus, H6a and H6b were supported.

H7 predicted that the relationships between expressing MERS-related information and handwashing intention, and cough etiquette intention would be mediated by self-efficacy for MERS

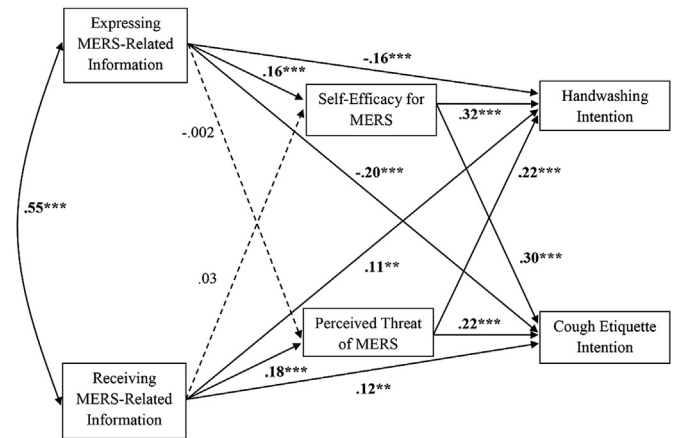


Fig. 2. The effects of expressing and receiving MERS-related information on handwashing intention and cough etiquette intention. Estimates are standardized coefficients. Age, gender, education, income, and health status are included as exogenous variables, but not shown here. $\chi^2 = 2.60$, $df = 1$, $p = 0.11$, RMSEA = 0.04 (90% CI = 0.00 to 0.10), CFI = 0.99, TLI = 0.94, SRMR = 0.01. ** $p < 0.01$, *** $p < 0.001$.

(H7a) and perceived threat of MERS (H7b). As shown in Table 3, higher levels of expressing MERS-related information led to higher levels of self-efficacy for MERS, which resulted in greater handwashing intention (standardized coefficient = 0.05, $p < 0.001$) and cough etiquette intention (standardized coefficient = 0.05, $p < 0.001$). However, perceived threat of MERS did not mediate the relationships between expressing MERS-related information and handwashing intention, and cough etiquette intention. Thus, H7a was supported but H7b was not supported.

H8 posited that the relationships between receiving MERS-related information and handwashing intention, and cough etiquette intention would be mediated by self-efficacy for MERS (H8a) and perceived threat of MERS (H8b). As shown in Table 4, higher levels of receiving MERS-related information led to higher levels of perceived threat of MERS. This in turn predicted higher levels of handwashing intention (standardized coefficient = 0.04, $p < 0.001$) and cough etiquette intention (standardized coefficient = 0.04, $p < 0.001$). However, self-efficacy for MERS was not shown to mediate the relationships between receiving MERS-related information and handwashing intention, and cough etiquette intention. Therefore, H8a was not supported, while H8b was supported.

Table 2
Relationships among exogenous and endogenous variables.

	Expressing MERS-Related Information	Receiving MERS-Related Information	Self-Efficacy for MERS	Perceived Threat of MERS	Handwashing Intention	Cough Etiquette Intention
Age (γ)	0.07*	0.001	0.12***	−0.04	0.09**	0.12***
Gender (Male = 0) (γ)	0.03	0.04	−0.02	0.12***	0.10**	0.10***
Education (γ)	0.02	0.05	0.03	0.07	0.002	0.07*
Monthly Household Income (γ)	0.04	0.09*	0.03	− 0.07*	−0.003	−0.03
Health Status (γ)	0.09**	0.13***	0.35***	− 0.10*	0.04	0.11**
Expressing MERS-Related Information (β)	—	—	0.16***	−0.002	− 0.16***	− 0.20***
Receiving MERS-Related Information (β)	—	—	0.03	0.18***	0.11**	0.12**
Self-Efficacy for MERS (β)	—	—	—	—	0.32***	0.30***
Perceived Threat of MERS (β)	—	—	—	—	0.22***	0.22***

Note. Coefficients are standardized Gamma (γ) and Beta (β).

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3

Mediating pathways between expressing MERS-related information and handwashing intention, and cough etiquette intention.

Significant Path				Estimate	SE	
Expressing MERS-Related Information	→	Self-Efficacy for MERS	→	Handwashing Intention	0.05***	0.01
Expressing MERS-Related Information	→	Self-Efficacy for MERS	→	Cough Etiquette Intention	0.05***	0.01
Expressing MERS-Related Information	→	Perceived Threat of MERS	→	Handwashing Intention	0.00	0.01
Expressing MERS-Related Information	→	Perceived Threat of MERS	→	Cough Etiquette Intention	0.00	0.01

Note. Estimates are standardized coefficients.

*** $p < 0.001$.**Table 4**

Mediating pathways between receiving MERS-related information and handwashing intention, and cough etiquette intention.

Significant Path					Estimate	SE
Receiving MERS-Related Information	→	Self-Efficacy for MERS	→	Handwashing Intention	0.01	0.01
Receiving MERS-Related Information	→	Self-Efficacy for MERS	→	Cough Etiquette Intention	0.01	0.01
Receiving MERS-Related Information	→	Perceived Threat of MERS	→	Handwashing Intention	0.04***	0.01
Receiving MERS-Related Information	→	Perceived Threat of MERS	→	Cough Etiquette Intention	0.04***	0.01

Note. Estimates are standardized coefficients.

*** $p < 0.001$.

5. Discussion

The purpose of the present study was to examine the influence of expressing and receiving MERS-related information via SNSs on perceived self-efficacy regarding MERS and perceived threat of MERS, and the subsequent effects of these variables on MERS-preventive behavioral intentions such as handwashing intention and cough etiquette intention. Our findings support the presence of effects from expressing and receiving information via SNSs and their proposed underlying mechanisms in a unique health context: that is, an infectious disease outbreak.

The findings pertaining to the direct influence of SNS communication during the 2015 MERS outbreak in South Korea demonstrate that expression and reception behaviors have unique effects on cognitive characteristics. Expressing MERS-related information was found to have a positive relationship with self-efficacy for MERS, but not with perceived threat of MERS. In contrast, receiving MERS-related information was positively related to perceived threat of MERS, but not with self-efficacy for MERS. The mixed findings regarding the effectiveness of communicating MERS-related information might stem from the difference in attributes between message expression and reception. In an online communication environment, the expression of messages is a self-involved and goal-directed behavior, since composing messages and reflecting on them are cognitively demanding activities (Namkoong et al., 2013). SNSs continue to grow in popularity as sites for users to share information about their thoughts and activities (Vitak et al., 2011). Because of the affordances they provide, SNSs may be well suited for individuals to express their attitudes and opinions on specific health issues. Thus, SNSs users might gain satisfaction from purposefully expressing themselves on these sites (Fogg & Iizawa, 2008). As individuals successfully pursue activities they find satisfying, their involvement in these activities becomes internalized and they continue relevant, purposeful information seeking, thereby contributing to enhanced levels of self-efficacy (Bandura, 1997). The extent to which online content generation is gratifying is an important variable in determining its impact on general self-efficacy (Leung, 2009). Previous studies have provided empirical evidence on the link between online expression and health self-efficacy (Shaw et al., 2006; Shim et al., 2011).

On the other hand, in comparison to the expression of messages, their reception is a more incidental or passive behavior (Kelly,

Niederdeppe, & Hornik, 2009). Indeed, during infectious disease outbreaks, individuals can encounter a great deal of relevant information via SNSs in a purely incidental manner. For example, the absolute volume of H1N1-related tweets increased sharply after major H1N1 news events, such as the WHO pandemic level 6 announcement (Chew & Eysenbach, 2010). Similarly, during South Korea's MERS outbreak, the largest peak of SNS messages regarding MERS appeared on June 2, 2015, when the first MERS death case was reported (Hyun, 2015). In this situation, individuals do not need to invest much effort or time in order to obtain all the information they seek. Thus, for them to have any impact, messages must attract sufficient attention which generates a minimal memory trace that can be recalled later (Southwell, Barnada, Hornik, & Maklan, 2002). Among the factors associated with high attention to a message, the message components can be most important in determining its consequences. According to prior research conducted on the extended parallel process model (EPPM), the reception effects of a threatening message can only appear as long as the message also includes a high-efficacy component (Stephenson & Witte, 1998; Witte, 1992). In other words, highly threatening messages that stand alone, without any means of efficacy, can serve only to heighten audience members' perceptions of susceptibility and severity (Gore & Bracken, 2005). In this sense, the nonsignificant relationship between receiving MERS-related information and self-efficacy might have been caused by the absence of a self-efficacy component within the MERS-related information that participants received via SNSs.

With respect to MERS-preventive behavioral intentions, there was a notable distinction in the direction of causality between expression and reception actions. As expected, receiving MERS-related information was positively related to handwashing and cough etiquette intentions. However, in contrast to our expectations, expressing MERS-related information was negatively associated with handwashing and cough etiquette intentions. One possible reason for these unexpected relationships could be that participants who posted more messages on SNSs inherently might have greater levels of optimistic bias regarding their probability of infection by MERS. Because of optimistic bias about health risks, people have a tendency to underestimate their own susceptibility to risks in comparison with that of others (e.g., Hoorens, 1995; Perloff & Fetzer, 1986; Weinstein, 1987). Underestimating one's own risk can elicit inaccurate judgments about the likelihood of

preventive actions (Kim & Niederdeppe, 2013; Rudisill, 2013). In addition, this tendency might be more remarkable among older people, since they were more likely to express MERS-related information via SNSs than younger people. This assumption is consistent with previous research, which showed evidence of unrealistic optimism among older people (Chowdhury, Sharot, Wolfe, Düzel, & Dolan, 2014; Park & Ju, 2016).

Furthermore, this study contributes to the literature on online expression and reception effects by further elaborating on the cognitive processes involved. Specifically, the two types of SNS communication were found to predict preventive behavioral intentions through different cognitive mechanisms. Expressing MERS-related information predicted higher levels of self-efficacy for MERS, and then led to higher levels of handwashing and cough etiquette intentions. Interestingly, expressing MERS-related information had a direct negative relationship with MERS-preventive behavioral intentions. As a result, this mediation effect shows that expressing MERS-related information worked properly only through self-efficacy in order to trigger participants's intentions to engage in MERS-preventive behaviors. On the other hand, receiving MERS-related information predicted a high level of perceived threat of MERS and then predicted a high level of handwashing and cough etiquette intentions. Therefore, receiving MERS-related information led to greater intentions to adhere to advised handwashing and cough etiquette, mediated by increased perceived threat of MERS.

5.1. Limitations

This study has some limitations that should be addressed in future research. First, the use of cross-sectional data limits the ability to make causal inferences regarding the relationships among key variables. Although the relationships among the variables proposed in the model were based on strong theoretical rationales, future research should employ longitudinal panel data to better understand dynamic relationships between expressing and receiving MERS-related information, cognitive characteristics, and MERS-preventive behavioral intentions.

A second limitation concerns the measures of MERS-preventive behavioral intentions that were employed in our study. It is widely accepted that behavioral intentions are a significant predictor of actual behavior (Fishbein & Ajzen, 2010). However, no one knows for certain whether participants actually engaged in the behaviors, even when they stated their intention to do so. Future studies need to employ actual preventive behavioral measures instead of preventive behavioral intentions as the main outcomes of communicating information via SNSs.

Third, we did not consider the effects of content and sources of the MERS-related information that participants expressed and received via SNSs. During infectious disease outbreaks, SNSs contain a variety of content (e.g., resources, personal experiences, humor, concerns, and questions) from a wide range of sources (e.g., general public, government, traditional media, and public health agencies) (Chew & Eysenbach, 2010; Mollema et al., 2015). The content expressed on SNSs and their sources might affect intentions to engage in preventive behaviors. For this reason, future research should look further into the effects of communicating specific messages via SNSs and the information sources in the context of an infectious disease outbreak.

Fourth, future studies should consider attempts to examine the effects of different types of SNS platforms. Not all SNSs have the same status, and different kinds of platforms (e.g., profile-based, content-based, and micro-blogging) lend themselves to various types of motives and social networking activities (Davenport, Bergman, Bergman, & Fearrington, 2014). Likewise, different

platforms of SNSs may facilitate unique types of SNS communication and consequently exert unique effects on public perceptions and behavioral changes during infectious disease outbreaks.

Finally, people with lower incomes and educational levels were underrepresented among our study participants. It can be a major drawback of using an online panel survey. People who volunteer to be part of such a panel might be more likely to be frequent Internet users than others (Hines, Douglas, & Mahmood, 2010), who in turn tend to be more educated and have higher incomes (Mesch, 2012). Therefore, it might be difficult to find participants from lower socioeconomic and educational backgrounds using this recruitment method. Future research should consider using a random digit dialing (RDD) sample of landline and cell phone households in order to recruit an online panel who is representative of the entire population.

6. Conclusion

SNSs have become common spaces for individuals to interact and exchange information during infectious disease outbreaks. In particular, SNSs function as alternative information sources when full disclosure of information to the public is delayed or prohibited. In addition to these roles, this study highlights the effects of SNS conversations on public risk perceptions and preventive behaviors. In light of these results, public health officials and communication professionals need to use SNSs in order to effectively manage the social and economic disruptions caused by an infectious disease outbreak. Specifically, SNSs monitoring tools can enable public health organizations to understand more about what diverse social groups are saying about an infectious disease outbreak, to identify information needs, and to adjust their messages accordingly. In order to strategically optimize these tools, the application of theory-grounded models deserves careful consideration. For example, the blog-mediated crisis communication model (Jin & Liu, 2010) and the social-mediated crisis communication model (Austin, Liu, & Jin, 2012) can help to better understand how people provide, receive, and/or share crisis information via SNSs.

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