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Full length article

# The impact of social media on risk perceptions during the MERS outbreak in South Korea

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## ABSTRACT

Analyzing nationally representative online panel survey data during the MERS outbreak in South Korea, this study examined the role of social media exposure in shaping public's risk perceptions of MERS. The present study also investigated the moderating role of heuristic-systematic processing and self-efficacy in the relationship between social media exposure and risk perceptions. The findings of this study showed that social media exposure was positively related to forming risk perceptions. Moreover, heuristic-systematic processing and self-efficacy were found to moderate the impact of social media on risk perceptions. The interaction effects suggested that the role of social media in increasing risk perceptions of MERS was heighted by heuristic-systematic processing and self-efficacy. The results and implications of this study are discussed in greater details.

## 1. Introduction

Since the first patient of Middle East respiratory syndrome coronavirus (MERS-CoV; hereafter MERS) was identified on May of 2015 in South Korea, nearly 40 people had died, almost 190 people had been infected, and more than 16,500 people had been quarantined until the outbreak ended on December 23, 2015 (Korea Centers for Disease Control and Prevention, 2015). Because MERS was regarded as an emerging infectious disease outbreak in South Korea (Kim, 2015; WHO, 2016), South Koreans were largely uninformed about it. Since they were unfamiliar with MERS, they became increasingly uncertain and concerned about the outbreak.

When a public health issue emerges, such as MERS, it is necessary to communicate health-related information to individuals so that they can understand the issue and respond effectively (Reynolds & Seeger, 2005; Vos & Buckner, 2016). Especially, for government and risk communicators, the public's risk perceptions of the public health issues can help individuals

understand the situation and manage it better. Media outlets, including television and newspapers, have played a large role in informing the public of health issues as well as shaping the public perception of those issues (Lin & Lagoe, 2013; Morton & Duck, 2001; Shim & You, 2015). In recent years, the numbers of people using social media, such as Facebook or Twitter, has increased, and the use of social media as an informational source for health can influence people's cognition or behavior related to health issues, including risk perceptions and preventive behaviors (Barman-Adhikari et al., 2016; Young & Rice, 2011).

As people tend to interpret information depending on their information processing mode (Eveland, 2005; Kosicki & McLeod, 1990), the way they process information is likely to influence their cognition, such as risk perceptions, of particular issues (Lee & Oh, 2013). For example, the heuristic and systematic processing model suggests that people's systematic or heuristic information processing can play a role in shaping risk perceptions (Trumbo, 1999; 2002). Moreover, information processing mode can interact with social media to influence people's perception formation. Social media users encounter various sources of information, including elites news information, users' unfiltered or uncensored information, and tailored information that shows their personal backgrounds or interests according to their online networks (Austin, Liu,

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& Jin, 2012; Lee & Oh, 2013). Thus, social media use could interact with information processing mode in order to interpret the differential information. As a result, it is likely that the interaction between social media and information processing mode plays a role in shaping ones' perceptions.

In the case of public health issue, it is important for individuals to believe that they can confidently deal with health issues (e.g., Bandura, 1990; Strecher, DeVellis, Becker, & Rosenstock, 1986). This belief (i.e., self-efficacy) can influence how people shape risk perceptions on a public health issue (Coleman, 1993; Han, Zhang, Chu, & Shen, 2014). Moreover, since an individual's belief influences the impact that media has on forming their perceptions (e.g., Cacciatore, Binder, Scheufele, & Shaw, 2013), it is also likely that the self-efficacy can moderate the impact of social media use on the formation of risk perceptions.

Within this context, this study examines how social media could influence people's risk perceptions during the MERS outbreak in South Korea. We also investigate the moderating role that individuals' information processing mode and self-efficacy have on the association between social media and risk perception. To examine these relationships, the study relies on the original survey data from a national online panel sample of South Korean adults. The results of this study may improve our understanding of the impact of social media on the formation of risk perceptions during an infectious disease outbreak.

## 2. Theoretical background

### 2.1. Risk perception

Risk perception is a major conceptual component of the health and risk communication areas. In general, risk perception refers to people's subjective estimation of the possibility that negative health-related outcomes or incidents (e.g., diseases) can occur (El-Toukhy, 2015; Menon, Raghubir, & Agrawal, 2008; Slovic, 1987). It is specifically constructed by two dimensions: susceptibility and severity (Pask & Rawlins, 2016). Susceptibility reflects one's perception of the likelihood of contracting a disease, whereas severity refers to one's perception of the seriousness or harmfulness of a disease (El-Toukhy, 2015; Rimal & Real, 2003). In particular, when people perceive health-related risks, they not only rely on the cognitive aspects of the likelihood and severity of a health-related disease, but also use affective aspects of the worry, concern, or dread that a person feels about a health-related disease (e.g., Freimuth & Hovick, 2012; Oh, Paek, & Hove, 2015).

When a public health issue occurs, people tend to perceive risks (e.g., Bish & Michie, 2010; Pask & Rawlins, 2016). The occurrence of emerging infectious diseases, which is not anticipated in a specific time or area, such as MERS or H1N1 flu, can lead to the public's immediate risk perception (Oh et al., 2015; Reynolds & Seeger, 2005). Thus, understanding the public's risk perception can help manage public health issues and help them escape from it during an outbreak. Moreover, because MERS is a disease that was previously unknown to South Koreans, few studies have examined how people form their risk perceptions during the MERS outbreak. It is important to explore the factors that influence the formation of risk perceptions during the emerging infectious disease outbreak.

### 2.2. Social media and risk perception

There are some key factors that can influence people's risk perception. In a situation where people have not directly experienced an infectious disease, traditional media, such as television and newspapers, have played a considerable role as major sources of information to the public (Coleman, 1993; Dudo, Dahlstrom, & Brossard, 2007; Paek, Oh, & Hove, 2016). The media produce and deliver news and information to citizens regarding public health issues (Lin & Lagoe, 2013; You & Ju, 2015). Since people rely on media as a source of information, the media can help people understand the risks and can shape their perception of the issue. For example, Chang (2012) has shown that exposure to H1N1 flu news in television is associated with the formation of people's risk perception of the pandemic disease.

Given the rapid change in communication technology, people have recently exhibited an increase in their use of social media, such as Facebook or Twitter, as health information source (Lin, Zhang, Song, & Omori, 2016; Mano, 2014). Social media use has transformed the way in which people obtain and use information. Unlike traditional media that allow people to engage in limited media activities, social media users can obtain, create, and share health information by receiving health information from other users, posting their health-related comments, and joining health-related groups (Fox, 2011). For example, during the H1N1 flu virus outbreak, people used social media as a public discussion forum to exchange information and opinions regarding H1N1 (e.g., Davies, 2009).

Moreover, social media use can influence people's risks perceptions of the public health issues (Chung, 2016). Social media users often express their emotional responses, such as fear, worry, or anxiety, on infectious diseases, such as H1N1 influenza (Chew & Eysenbach, 2010; Signorini, Segre, & Polgreen, 2011). Particularly in social media, negative experiences or messages spread largely through online social networks (Pfeffer, Zorbach, & Carley, 2014; Stieglitz & Dang-Xuan, 2013). Moreover, because social media users tend to construct their online social networks to include their acquaintances, such as colleagues, friends, and family members, they are more likely to respond seriously to their online contacts' information or opinions on the health or disease-related issues.

More specifically, during the MERS outbreak, social media played a role in providing factual information, including medical information, and subjective information, including users' comments. Recent studies have used big data analytics to demonstrate that people mentioned and/or shared factual information related to MERS, such as symptoms and prevention methods, in online media platforms, including social media (Song, 2015). Moreover, negative emotions concerning the disease, such as anxiety or fear, were more prevalent than positive emotions in social media during the infectious outbreak (Song, Song, Seo, Jin, & Kim, 2017).

Since risk perception encompasses the severity of and susceptibility to a health issue (El-Toukhy, 2015), social media exposure to MERS information is likely to be associated with both of those components of risk perception. In media presentation, it was suggested that perceived susceptibility is related to information that would increase achieving a given health condition, such as numerical risk information, while perceived severity is related to information that would include specific outcomes of a health condition, such as death or negative emotions (McWhirter & Hoffman-Goetz, 2016). In this regard, it is likely that exposure to users' negative emotions, symptoms, or pain concerning MERS could be positively associated with the perceived severity of the infectious disease while exposure to factual information on MERS, such as an increase in number of MERS patients or mortality and fatality rates of the infectious disease, could also be associated with the perceived susceptibility to the infectious disease. As previous studies have examined the risk perceptions embracing both perceived severity and perceived susceptibility as one concept (Hovick, Kahlor, & Liang, 2014; Pask & Rawlins, 2016; Shim & You, 2015), this study also integrates the two components into one dimension to examine the impact of social media on risk perception. Thus, during the MERS outbreak, social media exposure for

MERS-related information is assumed to contribute to an increase in people's risk perception for the infectious disease. We propose the following hypothesis.

**H1**.  Exposure to social media for MERS information will be positively related to risk perception of MERS.

### 2.3. Information processing and risk perception

Information processing mode can also influence individuals' risk perceptions. When people access information regarding public health-risk issues, their risk perception is shaped and/or changed by how they process risk-related information (Griffin, Neuwirth, Giese, & Dunwoody, 2002). For example, it was found that people who engage less in elaborative information processing are more likely to perceive a greater risk for an emerging technology issue (Ho, Scheufele, & Corley, 2013).

In particular, as a type of information processing methods, the heuristic-systematic model (HSM) suggests that individuals tend to process information systematically or heuristically when assessing information in order to make a judgement about health issues, such as risk perceptions (Trumbo, 2002). The heuristic-systematic processing assumes that people are generally motivated to process information to satisfy their needs in the most efficient ways possible (Eagly & Chaiken, 1993). Thus, individuals who engage in the heuristic-systematic processing choose either one or both between the sufficiency principles (i.e., systematic processing) and the least effort (i.e., heuristic processing) depending on their motivation (Trumbo, 1999).

More specifically, systematic processing reflects a comprehensive and analytic orientation to information processing in which individuals access and carefully scan a great amount of information based on its relevance to their judgmental task (Eagly & Chaiken, 1993). Systematic processing is motivated by ones' information sufficiency needs. When people are motivated to reach a sufficient degree of confidence so that their information processing is satisfactorily accomplished, they engage in systematic processing (Yang et al., 2010). Thus, systematic processing requires more cognitive and motivational efforts and abilities to analyze and understand the information than heuristic processing (Griffin et al., 2008). This processing tends to yield more stable attitudes and perceptions than heuristic processing.

On the other hand, heuristic processing involves relatively simple decision rules that require less cognitive efforts and fewer cognitive resources to formulate their attitudes or perceptions than systematic processing (Fiske & Taylor, 1991). Specifically, because heuristics are represented in a person's memory, people tend to rely on information that is more easily accessible or available stored in their memory when making a judgement that engages in heuristic processing (Kahlor, Dunwoody, Griffin, Neuwirth, & Giese, 2003; Zuckerman & Chaiken, 1998). As a quick processing mode that allows people to conserve their cognitive resources (i.e., time and effort), individuals who engage in heuristic processing often use superficial cues, such as previously existing knowledge or similar past experiences, when arriving at a judgment about information (Eagly & Chaiken, 1993; Trumbo, 2002). For example, in order to form their attitudes toward the GM food issue, people who engage in heuristic processing relied on past experiences from other situations similar to the GM food and their existing knowledge without seeking additional information on the issue (Kim & Paek, 2009). Trumbo's research (1999) also showed that under heuristic processing, individuals employed their prior experiences from other situations similar to caner problems and their existing knowledge for arriving cancer risk judgement. In this sense, when engaging in heuristic processing to shape a risk perception of MERS,

people are more likely to rely on their past experiences from other infectious diseases similar to MERS and their existing knowledge without seeking additional information on MERS. Thus, the formation and change of an attitude or perception via the basis of heuristic processing may tend to be less stable than that through systematic processing.

Some studies have examined how heuristic-systematic processing is associated with risk perceptions (e.g., Ryu & Kim, 2015; Trumbo, 2002). For example, it was found that people who engage in systematic processing are more likely to perceive a greater risk regarding the Fukushima Daiichi nuclear disaster than those with heuristic processing mode (Ryu & Kim, 2015). In particular, the association between heuristic-systematic processing and risk perceptions could differ according to a certain context or situation surrounding people. For example, under an uncertain or high concern environment, systematic processing mode was significantly related to a higher level of risk perception for cancer, whereas heuristic processing was significantly related to a lower level of risk perception on the health issue (Trumbo, 1999). Thus, in an uncertain or high concern situation, such as the MERS outbreak, it is likely that systematic processing may increase people's risk perception, whereas heuristic processing may decrease their risk perception. Therefore, we put forth the following two hypotheses.

**H2**.  Systematic processing for MERS will be positively related to risk perception on MERS.

**H3**.  Heuristic processing for MERS will be negatively related to risk perception on MERS.

### 2.4. Self-efficacy and risk perception

When a public health issue occurs, such as the MERS outbreak, self-efficacy plays an important role in motivating individuals to overcome their social difficulties (Bandura, 1990). Self-efficacy refers to a person's belief in his or her own capabilities to manage a specific difficult task they are facing (Bandura, 1997). In the public health areas, this belief results in protection motivation leads to changes in attitudes, perceptions, or behaviors (Dorsey, Miller, & Scherer, 1999). In particular, some studies have examined the relationship between self-efficacy and risk perceptions, showing that self-efficacy affects people's risk perceptions of a public health issue (e.g., Coleman, 1993; Han et al., 2014). It has been suggested that optimistic confidence from one's self-efficacy serves as a major predictor for risk perceptions (Han et al., 2014). That is, people with higher self-efficacy have lower risk perceptions on a health issue, whereas those with lower self-efficacy have higher risk perceptions on the same health issue. Thus, it is likely that self-efficacy for MERS influences decreasing people's risk perceptions on this health issue. Based on this consideration, we propose the following hypothesis.

**H4**.  Self-efficacy for MERS will be negatively related to risk perceptions on MERS.

### 2.5. Interaction effects of social media, HSM, and self-efficacy on risk perception

In addition to the main effects that social media, the heuristic-systematic processing, and self-efficacy have on risk perceptions of MERS, this study also posits that heuristic-systematic processing and self-efficacy will moderate the effect of social media on risk perceptions of MERS. In recent years, some studies have suggested that the impact of media use, including social media, on people's cognitions, attitudes or behavior can depend on their individual differences, such as information processing ability or personality

traits (e.g., Kim, Hsu, & Gil de Zúñiga, 2013; Lee & Oh, 2013; Yoo & Gil de Zúñiga, 2014). Especially, because social media are designed to customize individual's interests or needs based on users' active behaviors, such as constructing his/her profile, building online networks, or selecting news information (Boyd & Ellison, 2008; Glynn, Huge, & Hoffman, 2012; Lin & Lu, 2011), individual's differences could play an important role in considering the impact of social media. Specifically, people tend to seek and acquire varying gratifications when they use media, such as social media (Hyun & Kim, 2015; Kim et al., 2013). Moreover, individuals often perceive risks depending on their psychological or cognitive characteristics (Sjöberg, 2000; Slovic, 1987), such as information processing mode (e.g., Trumbo, 2002) or self-efficacy (e.g., Coleman, 1993). Thus, people may utilize social media satisfying their personal needs from their psychological or cognitive differences to formulate risk perceptions (Smock, Ellison, Lampe, & Wohn, 2011), that which would lead to various levels of risk perceptions toward a given health issue. For example, one's information processing mode has been found to moderate the effects of media on his or her risk perceptions (Ho et al., 2013). Since heuristic-systematic processing motivates individuals to process information to reach their risk judgements (Eagly & Chaiken, 1993), it is likely that this information processing moderates the relationship between social media and risk perception. That is, heuristic-systematic processing of MERS may help people process MERS-relevant information from social media, which could differently perceive the risk of the infectious disease. Moreover, because self-efficacy indicates the differences in individual abilities to respond or manage situations (Bandura, 1990), it has found that self-efficacy moderates the impact of media on one's cognition or behavior (e.g., Lee, Kwak, Campbell, & Ling, 2014), suggesting that the potential to moderate the association between social media and risk perceptions. That is, in an uncertain situation, such as the MERS outbreak, as individuals hold different levels of self-efficacy, and when they rely on social media for information regarding MERS to form a risk judgement, the interaction between self-efficacy and social media would lead to different levels of risk perception of the infectious disease. From this perspective, we examine how heuristic-systematic processing and self-efficacy interact with social media regarding people's risk perceptions.

However, because very little empirical research has been performed on these interaction effects on risk perceptions, directional hypotheses regarding their effects could not be developed. Therefore, the following research questions are to be addressed.

**RQ1**. How do social media and heuristic-systematic processing interact to influence risk perceptions of MERS?

**RQ2**. How do social media and self-efficacy interact to influence risk perceptions of MERS?

## 3. Method

### 3.1. Data

This study employed data from an online panel survey data provided by a major Korean online research firm. It secured a panel of about 1 million adults aged 19 years and older reflecting nationally representative demographics, including age, gender, and area of residence, by relying on a proportionate quota sampling strategy. The survey was conducted during July of 2015, the peak of the largest MERS outbreak in South Korea. A recruiting email message was sent to a 10,000-member online panel that was randomly selected using a computer algorithm. Among these, 1000 people participated in the survey, and their responses were

included in the analysis, reaching at a completion rate of 35.0%. The mean age of the respondents was 45.24 years old ($SD = 13.46$, ranging from 21 to 69), and 50.2% were male ($N = 502$). The mean education range was between associate degree and bachelor's degree ($SD = 0.96$), and the median monthly household income fell into the range of 4—5 million Korean won (equivalent to approximately \$3500—4500; $SD = 1.37$). According to the Korean Statistical Information Service (2015), the mean age of the total population of South Korea in 2015 was 40.4 years old, and 50.1% were male. In addition, 45% of the South Korean adults aged 25 years and older held an associate or higher degree, and the median monthly household income was of about 4.2 million Korean won. Although people with higher education were somewhat oversampled, the socio-demographic characteristics of the study participants were similar to those of the general Korean adults in general.

### 3.2. Measurement

#### 3.2.1. Risk perception

As a dependent variable, *risk perception* was included in the study to measure how people perceive risk about MERS. Respondents were asked to indicate on a 5-point scale (1 = strongly disagree to 5 = strongly agree) how much they agreed with the following statements: (1) "It is likely that Koreans would be affected by MERS" and (2) "I am worried that Koreans would be affected by MERS." These responses were averaged to construct an index of risk perception ($M = 3.46$, $SD = 0.80$, $r = 0.62$).

#### 3.2.2. Social media

*Social media exposure* was measured using a 5-point scale (1 = never to 5 = very often) by asking how often respondents during the past month were exposed to news and information about MERS on social media, such as Facebook, Twitter, and etc. ($M = 3.13$, $SD = 1.20$).

#### 3.2.3. Heuristic-systematic processing (HSM)

For information processing, this study measured two groups of heuristic-systematic processing variables. *Heuristic processing* was measured using a 5-point scale (1 = strongly disagree to 5 = strongly agree) by asking how much they agreed with the following statements: (1) "I am able to make a decision about MERS based on my existing knowledge without seeking additional information" and (2) "I can make fully informed decision about MERS based on my previous experience." The two items were averaged to construct a heuristic processing index ($M = 2.76$, $SD = 0.80$, $r = 0.69$). *Systematic processing* was also measured using a 5-point scale (1 = strongly disagree to 5 = strongly agree) based on how much they agreed with the following statements: (1) "When I encounter information about MERS, I make an effort to carefully analyze it" and (2) "When I encounter information about MERS, I am likely to stop and think about it." The two items were averaged to construct an index of systematic processing ($M = 3.19$, $SD = 0.75$, $r = 0.64$). The questionnaires for HSM measurements were adopted and modified from previous studies (e.g., Griffin et al., 2008; Kim & Paek, 2009; Trumbo, 1999).

#### 3.2.4. Self-efficacy

*Self-efficacy for MERS* was measured by asking three items on a 5-point scale (1 = strongly disagree to 5 = strongly agree) based on how much respondents agreed with the following statements: (1) "I can avoid MERS infection," (2) "I know how to avoid MERS," and (3) "I can overcome infection even if I am infected by MERS." These three items were averaged to construct an index of self-efficacy for MERS ($M = 3.58$, $SD = 0.69$, *Cronbach's alpha* = 0.75).

*3.2.5. Control variables*

We statistically controlled for four socio-demographic variables: *age*, *gender* (1 = male, 2 = female), *education level* (1 = no education to 7 = graduate degree), and monthly *household income*. Additionally, the study controlled for two media exposure variables (traditional mass media and the Internet) to affect the dependent variables. Respondents were assessed in a 5-point scale (1 = never to 5 = very often) by asking them how often they during the past month were exposed to news and information about MERS on the *traditional mass media* ($M = 4.22$, $SD = 0.76$), such as newspapers and television, and on *the Internet* ($M = 4.06$, $SD = 0.81$).

*3.3. Analysis*

An ordinary least squares (OLS) regression model was implemented to examine the research hypotheses and questions described above. We entered our independent variables into the regression model in blocks, based on their assumed causal order. Socio-demographics and media variables were entered into the first block, followed by a social media variable, information processing variables, and a self-efficacy variable. In the final block of the regression model, three multiplicative terms were included, tapping (1) the interaction between social media exposure and systematic processing, (2) the interaction between social media exposure and heuristic processing, and (3) the interaction between social media exposure and self-efficacy for MERS. These interactions were created by multiplying the standardized main effect variables in order to avoid multicollinearity issues between the interaction terms and their component parts (Cohen, Cohen, West, & Aiken, 2003).

## 4. Results

Table 1 demonstrates the findings of the OLS regression analysis predicting the dependent variable "risk perception." All independent main and interaction effects variables together accounted for 20.7% of the total variance in risk perception.

Among the socio-demographic variables in the first block, gender had a significant and positive relationship with risk perception ($\beta = 0.09$, $p < 0.01$) and income had a significant and negative relationship with the dependent variable ($\beta = -0.07$, $p < 0.05$). Theses suggest that female respondents were more likely than male respondents to perceive risk regarding MERS and respondents with higher levels of income tended to perceive more risk than those with lower level of income. We also found that the use of the Internet was positively related to risk perceptions of MERS ($\beta = 0.08$, $p < 0.05$), indicating that respondents who were more exposed to news and information on the Internet about MERS were more likely to perceive risk regarding the infectious disease.

In the second block, social media exposure was found to be positively associated with risk perceptions of MERS ($\beta = 0.07$, $p < 0.05$). This finding suggests that respondents who were more exposed to news and information on social media about MERS were more likely to perceive greater levels of risks about the infectious disease. Thus, H1 was supported.

In the third block, which included the information processing mode (HSM), we found that systematic processing was positively related to risk perceptions of MERS ($\beta = 0.34$, $p < 0.001$). In support of H2, this finding indicates that respondents who engaged more in systematic processing were more likely to perceive risks of the infectious disease. However, there was no significant relationship between heuristic processing and the dependent variable. Thus, H3 was not supported.

In the fourth block, self-efficacy for MERS displayed a significant

**Table 1**
Hierarchical liner regressions predicting risk perception toward MERS ($N = 971$).

|  | Risk Perception |
| --- | --- |
| **Block 1: *Control Variables*** |  |
| Age | −0.00 |
| Gender (1 = "male," 2 = "female") | 0.09** |
| Education | −0.02 |
| Income | −0.07* |
| Traditional Mass Media | 0.05 |
| The Internet | 0.08* |
| Incremental $R^2$ (%) | 4.9*** |
|  |  |
| **Block 2: *Social Media*** |  |
| Social Media Exposure | 0.07* |
| Incremental $R^2$ (%) | 1.7*** |
|  |  |
| **Block 3: *Information Processing*** |  |
| Systematic Processing | 0.34*** |
| Heuristic Processing | −0.01 |
| Incremental $R^2$ (%) | 10.5*** |
|  |  |
| **Block 4: *Efficacy*** |  |
| Self-Efficacy for MERS | −0.14*** |
| Incremental $R^2$ (%) | 1.8*** |
|  |  |
| **Block 5: *Two-Way Interactions*** |  |
| Social Media Exposure x Systematic Processing | 0.08** |
| Social Media Exposure x Heuristic Processing | 0.12*** |
| Social Media Exposure x Self-Efficacy for MERS | 0.08** |
| Incremental $R^2$ (%) | 1.7*** |
|  |  |
| Total $R^2$ (%) | 20.7 |

Notes: Cell entries are standardized regression coefficients for Blocks 1, 2, 3, and 4 and while cell entries are before-entry standardized regression coefficients for Block 5. ***p < 0.001, **p < 0.01, *p < 0.05.

and negative relationship with risk perceptions of MERS ($\beta = -0.14$, $p < 0.001$), lending support for H4. This suggests that respondents who reported greater self-efficacy for MERS were less likely to perceive risks of the infectious disease.

In addition to these main effects, the final block demonstrates the interactive effects among social media exposure, heuristic-systematic processing, and self-efficacy on risk perceptions. After accounting for all controls, and in response to RQ1, we found that there was a significant interaction effect between social media exposure and systematic processing ($\beta = 0.08$, $p < 0.01$, See Fig. 1). As shown in Fig. 1, this interaction suggests that the relationship between social media exposure and risk perception was significantly stronger for respondents who engaged in high systematic processing than for those who engaged in low systematic processing. That is, the influence of social media exposure on risk perceptions was significantly more pronounced among those who engaged in high systematic processing. We also found a positive and significant interaction effect between social media exposure and heuristic processing on risk perception ($\beta = 0.12$, $p < 0.001$, See Fig. 2). Fig. 2 shows that the relationship between social media exposure and risk perceptions was stronger for individuals who engaged in high heuristic processing than for those engaged in low heuristic processing. This finding suggests that the impact of increased social media exposure on risk perceptions was much more significant among those who engaged in high heuristic processing, even though increased social media exposure positively impacts risk perception among all people (as our significant main effect has already shown).

In response to RQ2, the study found a significant interactive effect between social media exposure and self-efficacy for MERS on risk perception ($\beta = 0.08$, $p < 0.01$, See Fig. 3). As indicated in Fig. 3, this interaction suggests that the impact of social media exposure in increasing risk perceptions was stronger for those who reported
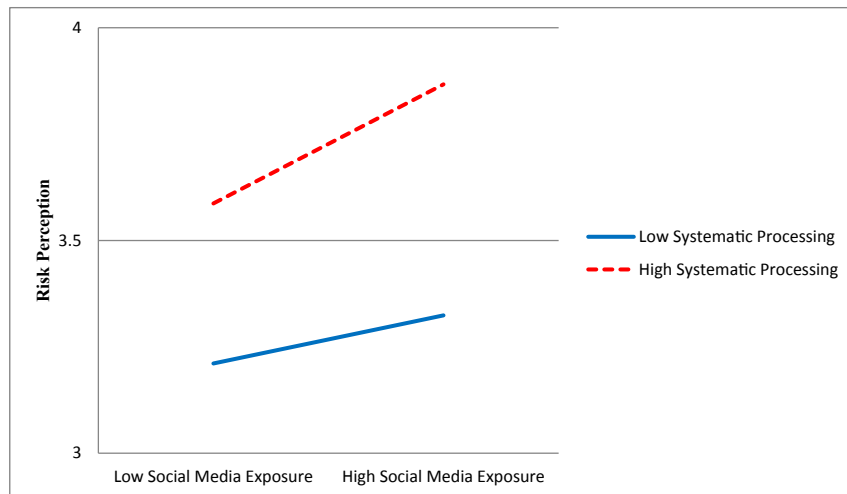
(Note: Scales are partially displayed)

**Fig. 1.** Interaction between social media exposure and systematic processing on risk perception.
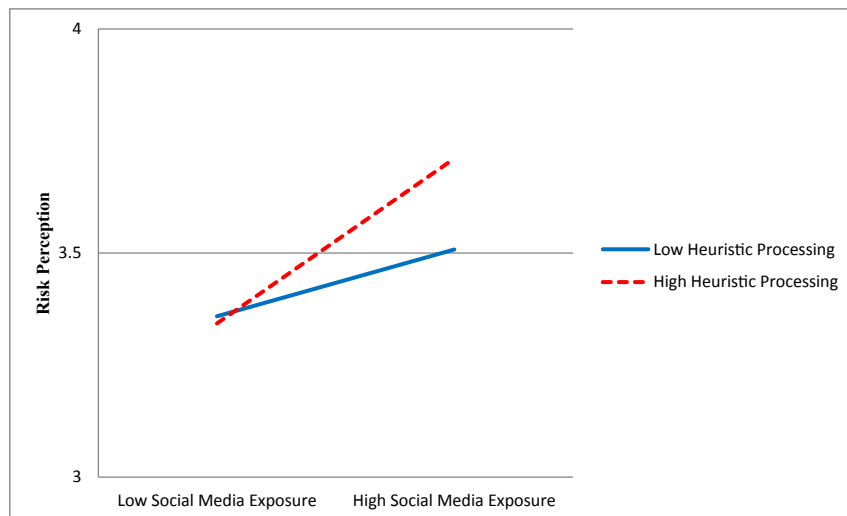


(Note: Scales are partially displayed)

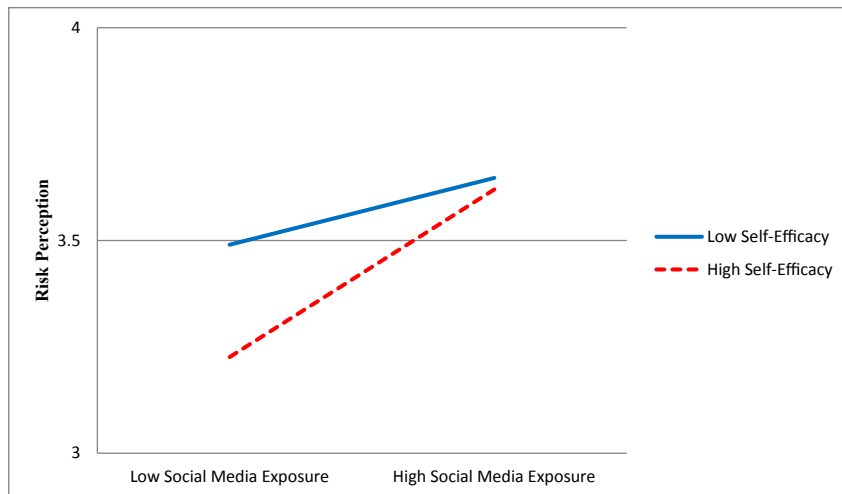**Fig. 2.** Interaction between social media exposure and heuristic processing on risk perception.

greater self-efficacy for MERS compared to those with lower self-efficacy for MERS.

## 5. Discussion

Analyzing data from a national online panel survey during the MERS outbreak in South Korea, this study examined the impact of social media in shaping people's risk perceptions of MERS. To examine the relationship between social media and risk perceptions, this study further explored the moderating effect of heuristic-systematic processing and self-efficacy for MERS on the association. Considering the impact of social media with risk perceptions of a public health issue, the study produced several important results. We focus on the following four main findings.

First, social media exposure was positively correlated with risk perceptions of MERS. As people use social media as a useful tool to obtain relevant information during the outbreak period (Yoo, Choi, & Park, 2016), this study suggests that social media can affect the

formation of risk perception of the infectious disease. At the beginning of the outbreak, traditional media, such as television and newspapers, did not provide sufficient information about the infectious disease (Yoo et al., 2016), so people might rely on social media as an alternative information source to satisfy their information needs. Moreover, when individuals are not able to access to information from traditional media, they tend to produce information and to disseminate it themselves on the Internet (Tai & Sun, 2007). For example, people in China largely relied on the Internet as an alternative source of information because the Chinese government and mainstream media controlled the relevant information during the 2003 SARS epidemic (Tai & Sun, 2007). Social media provide such a public space where users can readily create and share unfiltered or uncensored information that does not appear in traditional media (Austin et al., 2012). During the MERS outbreak period, social media users were also found to largely express negative words, such as anxiety, fear, uncertainty, risk, and suspicion, with respect to the infectious disease (SBS, 2015). Because

(Note: Scales are partially displayed)

**Fig. 3.** Interaction between social media exposure and self-efficacy on risk perception.

people tend to focus more on negative information (i.e., negativity bias; Meffert, Chung, Joiner, Waks, & Garst, 2006), an increase social media exposure could promote shaping people's risk perceptions of the infectious disease.

Second, our findings showed that systematic processing was positively correlated with risk perceptions of MERS. Individuals who engaged more in systematic processing were more likely to have greater levels of risk perception for the infectious disease. This is consistent with previous findings (Ryu & Kim, 2015; Tortosa-Edo, López-Navarro, Llorens-Monzonís, & Rodríguez-Artola, 2014) that systematic processing could increase risk perceptions, especially under an uncertain situation (Trumbo, 1999), such as MERS, for which South Koreans were unfamiliar and uninformed regarding the infectious disease. This result also suggests that the relationship between heuristic-systematic processing and risk perception should be interpreted in a specific context or situation. As Trumbo (1999) argued, the notion that only people's rational and systematic judgement can decrease unnecessary overreactions to risks needs to be reexamined. Moreover, since systematic processing requires greater attention for acquiring information (Eagly & Chaiken, 1993), the increased attention could lead to people's risk acceptability by evaluating the information. As a result, people who systematically process information relevant to MERS might arrive at the conclusion that the infectious disease is a serious concern.

On the other hand, the study showed that heuristic processing was statistically unrelated to risk perception of the infectious disease. Contrary to systematic processing, heuristic processing did not exert a significant main effect on risk perception. This suggests that heuristics, such as individuals' past experiences with situations similar to the MERS outbreak or existing knowledge without additional information seeking on MERS, did not solely help them perceive risks toward the infectious disease. It would be partially that making a quick, less effortful information processing does not affect the risk perception of MERS because people were largely uninformed about the infectious disease in an environment with a high degree of uncertainty. Instead, it is likely that people who engage in heuristic processing may need other sources of information, such as media, to formulate a risk judgement, suggesting the potential to have interaction effects with social media during the infectious outbreak.

Third, as predicted, this study found that self-efficacy for MERS was negatively associated with risk perceptions of the infectious disease. Individuals with greater self-efficacy for MERS tended to perceive lesser risks to the infectious disease. Intuitively, this finding makes sense because people who have a higher level of confidence in their ability to deal with MERS might perceive lower risks regarding the infectious disease. This explanation seems to be supported by optimistic confidence bias that a person believes that he or she is less likely to be at risk of experiencing negative events compared to similar other people (Han et al., 2014; Wei, Lo, & Lu, 2007; Weinstein, 1989).

Finally, the study demonstrated that the heuristic-systematic processing and self-efficacy for MERS had a moderating effect on the link between social media and risk perceptions. Specifically, systematic processing was found to moderate the effects of social media exposure on risk perceptions. When people who engaged more in systematic processing were exposed more to information relevant to MERS on social media, they tended to perceive greater risks of the infectious virus compared to those who engaged less in systematic processing. Similarly, heuristic processing played a role in moderating the influence of social media exposure on risk perceptions. The positive impact of social media in increasing people's risk perceptions for MERS was stronger for people who engaged more in heuristic processing than for those who engaged less in heuristic processing. These significant interactions suggest that people process information systematically or heuristically from social media to shape risk perceptions about MERS. This finding shows that exposure to MERS relevant information in social media could play a role in reinforcing the impact of heuristic-systematic processing on elevating risk perception of the infectious disease. The use of heuristic-systematic processing was heightened when individuals were further exposed to information relevant to MERS on social media which might reflect upon the information they obtained.

Self-efficacy for MERS also moderated the relationship between social media exposure and risk perceptions of MERS. The increased effect of social media in elevating risk perceptions of MERS was pronounced for individuals with high levels of self-efficacy. This interaction suggests that social media exposure could contribute to a decrease in optimistic confidence bias for individuals with higher levels of self-efficacy, which in turn can increase their risk perceptions of MERS. This finding reveals that increased exposure to MERS relevant information from social media, such as negative emotions (e.g., fear or anxiety) toward the infectious disease, may

play a role in increasing people's risk perception of the infectious disease by reducing their beliefs in the ability to respond to an uncertain situation.

### 5.1. Limitations and suggestions for future research

Before concluding, several limitations of this study should be addressed. First, this study relied on cross-sectional survey data to examine the relationships. Therefore, interpreting the results from the analysis should be made with care regarding inferences that consider the causal relationships between variables. For example, although social media exposure was correlated with risk perceptions, this relationship alone does not present that social media exposure always precedes risk perceptions. However, the within regression model in the analysis was grounded with strong theoretical reasoning between variables and results from prior research. Future research needs to take a longitudinal approach to make a stronger causal claims.

Second, some variables in this study were all simple measures and can be susceptible to measurement errors and reliability issue.[1] In particular, a single measure of social media exposure may not completely capture social media effects because social media exposure is somewhat different than traditional media exposure. For example, it is hard to deliver specific messages to a large targeted audience through social media, and measuring exposure can be more demanding than with traditional media sources (Hornik, 2016). For greater validity, future studies should consider more sophisticated measures for the variable. Moreover, since some studies have indicated that exposure could not be sufficient to measure media influence on people's attitude or belief (Shim & You, 2015), future research needs to use social media attention as a complementary approach to measure social media influence.

Third, this study used a self-reported measure of social media exposure, which may be underreported or overreported regarding the degree of exposure. Although self-reported measures are very convenient and common in some fields of media research (de Vreese & Neijens, 2016), the measurement accuracy heavily depends on respondents' ability or willingness to recall their behaviors. This is particularly problematic when answering survey questions about the frequency of media exposure. To solve this problem, researchers should consider many "gold standard" measures, such as media diaries, behavioral measures, and video observation for social media exposure (Fikkers, Piotrowski, & Valkenburg, 2017).

Finally, we did not consider the sources and types of messages when testing the effectiveness of exposure to social media messages. Social media exposure occurs via various types of content, ranging from news, advertising, and entertainment, from various sources, including government agencies, news media, professionals, friends, and family members. Although this study focused not on the influence of exposure to a specific message but exposure to social media message, the different sources and types of news and information might result in different exposure effects. For instance, the perceived trustworthiness of information sources, such as media, government, and general public, is a significant factor determining the level of perceived risk and control over an infectious disease outbreak (Pickles & Goodwin, 2006). Thus, future research needs to explore the role of social media information in terms of the sources and types of information in risk communication contexts.

### 6. Conclusion

Despite the limitations discussed above, this study sheds light on the impact of social media in shaping people's risk perceptions during the MERS outbreak period. Notably, the growing popularity of social media to access information about public health issues has the potential to influence the formation of risk perceptions. As for a practical implications, this result suggests that public health communicators should pay more attention to the role of social media in shaping risk perceptions. People's perceptions of potential risks are critical elements to consider in public health (Rudisill, 2013; Yang, Ho, & Lwin, 2014). For example, risk perceptions can facilitate protective motivation, which increases disease-preventive behaviors during infectious disease outbreaks (Bish & Michie, 2010). It is particularly important to promote disease-preventive behaviors to prevent the rapid spread of infectious disease.

This study also contributes to the current understanding in that it takes into account the moderating role of heuristic-systematic processing and self-efficacy in the association between social media and risk perceptions. The influence of social media, which increases the public's risk perceptions of MERS, appears to be heightened by the extent to which individuals engaged in heuristic-systematic processing mode and hold self-efficacy for MERS. In other words, the impact of social media on risk perceptions differs depending on the media users' cognitive characteristics. Given the reinforcing effectiveness of information processing strategies and self-efficacy, risk communication practitioners should consider the potential factors motivating heuristic-systematic processing and self-efficacy in designing persuasive messages on social media during infectious disease outbreaks.

During the emerging infectious diseases outbreak, media use for effective risk communication strategies is important for public safety (Oh et al., 2015). In recent years, social media seem to play an important role in accessing (and disseminating) risk information and shaping the public's risk perceptions of the public health issues such as a disease outbreak. More research is thus encouraged to explore how social media can affect the public's risk perceptions in the public health areas in greater details.

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[1] The reviewer suggested that some variables did not meet acceptable reliability standards. We used inter-item correlation as a measure of reliability for two-item variables such as risk perception, heuristic processing, and systematic processing. Although there are several arguments on the inter-item correlation cutoff for two-item scales, Meade and Craig (2012) used an inter-item correlation cutoff of 0.60 to identify synonymous item pairs. Based on the cutoff criteria, the inter-item correlation values for three variables (risk perception = 0.62, heuristic processing = 0.69, and systematic processing = 0.64) could be acceptable.

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