Lay Health Epistemics and Motivated Information Behaviors

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Abstract

This study examines relationships among health information orientation, situational perceptual frames, and active information behaviors pertinent to the safety controversy of genetically-modified (GM) food technology. A web survey was conducted in the US (N = 393). Based on our findings, an integrative model of Kim and Grunig's (2011) Situational Theory of Problem Solving (STOPS) and Dutta-Bergman's (2004) concept of health information orientation is suggested to explain lay health epistemics and various information behaviors about that new food technology. The study's theoretical and practical implications are discussed (86 words).

Key Words: GM food technology, health information orientation, lay health epistemics, situational theory of problem solving

Introduction

Genetically-modified (hereinafter GM) food increasingly concerns consumers due to its association with potential risks to public health and the environment. A national survey in Korea (Biosafety, 2013) shows potential health-risk is the main concern among 38.5% of those disbelieving GM food technology's utility, then ecosystems harm (10.8%); Swedes rated GM food technology as "very undesirable" (Sjöberg, 2008, p. 186). The 2010 Eurobarometer survey aligns with public anxiety (European Commission, 2010). Unease derives from perceptions that involuntary and uncontrollable risks might accompany such technology, and concerns over tech-tampering with nature (Bawa & Anilakumar, 2013).

Against this backdrop, social acceptance of GM food technology is still controversial. Consumers' demand for *non*-GM foods grows despite scientific reports showing GM foods are safe (Malcolm, 2016, May 19). This implies that people disregard science when their fears override logic. Notable is that consumers' concern about possible GM food risks orients more toward the technology's "*future safety"* than about actual illnesses (Wilcock et al., 2004, p. 60). Those concerns affect their health-related behaviors because of *overestimated uncertainty* about such risks (Yeung & Morris 2001). Still unaddressed in health communication research is examining interrelationships of factors affecting publics' diverse information behaviors in the context of food controversy.

This paper investigates the lay publics' active information behaviors about GM food issue from the publics' problem-solving perspectives. That is, the public no longer are isolated information consumers, but instead are active problem-*solvers* (Kim & Krishna, 2014). In the GM food matter, *active* publics gain knowledge and form opinions about it through multiple channels (McInerney et al., 2004). Kim and Ni (2013) point out that

"(Al)though lay citizens lack knowledge and understanding of scientific and technical details, they are beneficiaries or risk bearers of new technological or scientific advancement" (p. 137). Accordingly, scholars and policymakers should pay attention to lay publics' concerns and behaviors regarding this issue. In calling for scholars to empirically support the existence of such publics, Kim & Krishna (2014) aver that some active publics are likelier than others to hold highly-negative opinions and attitudes towards this controversy and likely are intolerant of opposing viewpoints while being active in sharing their own, often-misinformed convictions.

Relatively few studies, however, address the *active* public's *various* information behaviors such as information seeking, transmitting, and selecting (Kim & Lee, 2014). Kim and Lee (2014) refer to the importance

of the recent phenomenon where people produce, discuss, and exchange opinions to solve problems affecting them as problem-solvers. However, among various information behaviours, only information seeking has been interesting to scholars for improving public understanding of various health risks (e.g., Kelly et al., 2010; Rimal, 2001; Rothman et al., 2006; Stephenson and Southwell, 2006; Wright and Frey, 2008), and for understanding public health behaviors (Basu & Dutta 2008; Dutta-Bergman, 2004a, 2004b; Eastin, 2001; Niederdeppe et al., 2007; 2008; Sillence et al., 2007; Rutten *et al*., 2006). To design better public health campaigns or government policies, it is crucial to understand how and why lay publics engage in different types of information behaviors - instead of information seeking only - when questioning potential risks associated with new technologies. Such knowledge would help policy-makers and health campaigners devise better public-segmentation strategies.

This study aims to identify factors which predict individuals' information behaviors regarding the GM controversy. We also explain types of information behaviors exhibited by the lay publics as a way of problem-solving to address their GM food concerns. Specifically, we explicate intertwined linkages of cross-situational and situational variables in health communication behaviors regarding new technology, and public interpretation of its health risks. We synthesize Kim and Grunig's (2011) Situational Theory of Problem Solving and Dutta-Bergman's (2004) concept of Health-Information Orientation, to propose an integrative model of lay health epistemics and motivated communication of new technology risks.

Literature Review

Information Behaviors about Uncertain Health Risks and Situational Theory of Problem Solving

From previous literature regarding information behaviors about food risks (e.g., Yeung & Morris, 2001), different approaches to dealing with unexpected consequences from risks are discernible. Studies on risk relievers indicate people engage in information transmitting or seeking. Valente and Saba (2001) acknowledge the importance of interpersonal communication among peers. Kim and Lee (2014) find that chronic-disease patients' information seeking and forwarding behaviors associate positively with increases in emotion-focused-coping and problem-focused-coping. Information selection also gained scholarly attention. Kornelis et al. (2007) suggest that consumers seeking information concentrate on *selective* sources fulfilling their needs.

Extant research indicates that individuals engage in multiple information behaviors about risks. They also devise certain criteria determining the usefulness of their collected information. Given new media technologies, people who used to be *passive* information *consumers* have become *active* information *producers* (Jenkins, 2006; Lovari et al., 2011; van Dijck, 2009). The public now are better information takers, givers, and selectors (Kim & Ni, 2010; Kim & Vibber, 2012). Reynolds (2013) also notes the emergence of *issue* publics (i.e., publics engaged or interested) in GM issues with their diverse forms of active participation including village meetings and seed-list hearings. Previous research (Lezaun & Soneryd, 2007; Marres, 2007) confirms this notion of *issue* publics/*active* publics generating specific kinds of knowledge and insights.

We find the theoretical and practical utility of Kim and Grunig's (2011) Situational Theory of Problem Solving (hereinafter STOPS) in explaining the publics' various information behaviors regarding new technology and its potential risks. They envision three information behaviors individuals engage in: selection, transmission, and acquisition, of problem-specific information. These can be explained further by the activeness-passiveness continuum. These behaviors are predicted by situational perceptual, cognitive and motivational variables, discussed in our next section.

Understanding Antecedents to Information Behaviors for Public Segmentation

Hitherto, we argue that more investigation would benefit the various types of information behaviors people voluntarily exhibit in expressing concerns about new technology and its potential risks. Scholars and practitioners closely should note the situational perceptual and cognitive frames leading to those *active* and *voluntary* communicative and behavioral efforts for a specific health issue, before planning health-communication programs or public policies. When public-health communicators understand how people actively become motivated to seek, select, and forward health information of interest, communicators or policymakers can decrease their communication costs by identifying and targeting strategic subgroups of active information behaviors, and can increase communication effectiveness by setting realistic communication objectives (Kim, 2011). Example: Kim et al. (2011) used STOPS in designing target segmentation for an organ-donation campaign.

We suggest a more delicate design and use of the public segmentation approach, based on understanding of public's active information behaviors, is required for the GM food issue. Many risk communication researchers have advocated a targeted

approach for improving communication about health-related issues (e.g. Eggers et al., 2011; Noar et al., 2010; Renn, 2006; Smillie & Blissett, 2010). As for the GM food issue, several scholars support a targeted public segmentation approach (Verdurme & Viaene, 2003) and strategies for public engagement (Duncan, 2011). Of note is Clarke's and Moran's (1995) identifying difficulties in predicting the acceptability of still-controversial technological advancements.

Previously, many scholars focused on cross-situational variables in a public segmentation approach. Based on consumer beliefs and attitudes toward GM food, for example, Verdurme and Viaene (2003) propose four types of consumer profiles: Halfhearted, Green Opponents, Balancers, and Enthusiasts. Gaskell et al. (2004) identify demographics, education, and religious belief, as influential in shaping risk perceptions. Kornelis et al. (2007) suggest personal traits and sociodemographic variables. In these, however, scholars could not answer *why, how* and/or *when* people question their food safety and their different levels of activeness in their information behaviors about GM food and its risks. Since these personal traits are cross-situational factors that individuals carry over many different judgmental tasks, the effects of these variables may not be as strong as situational variables on GM issue.

Some unexplained variance still remains in explaining information behaviors about the GM food issue, a food-risk related situational issue in particular. Based on the discussion, we assume that *beyond cross-situational* there may be *situational* factors motivating active communication behaviors about GM food issue. Identification of factors explaining such behaviors may help suggest a better public segmentation approach. Suggested situational perceptual and cognitive variables follow below.

Situational Perceptual and Cognitive Predictors of Information Behaviors

STOPS provide a powerful frame to segment people into separate categories based on their situational perceptions of a problem. Activist publics comprise individuals reporting high levels of problem recognition and of involvement recognition, and low levels of constraint recognition, about issues. Such individuals also display high levels of situational motivation in problem solving, and are communicatively active; they proactively seek, select and transmit information about issues. The following text, explains STOPS variables.

*Problem recognition***.** People recognize a problem when they realize an issue needs resolution but none immediately applicable is available (Grunig, 2003, 2005; Kim & Krishna, 2014). When applied to the GM food case, people may recognise problems GM food might cause to human health and the environment, and would like to do something about them, but may perceive no immediate resolution exists.

Involvement recognition. Involvement recognition is a perceived connection between individuals and the problematic situation. When people perceive a high connection to a given problem, they likely will engage in active information behaviors. Here involvement does not necessarily mean people's actual involvement (Kim & Grunig, 2011). In this study, involvement recognition is explicable where people may perceive their involvement high if they worry about GM food's potential risks that may affect their family members or friends.

*Constraint recognition***.** Constraint recognition is individuals' perceptions of obstacles preventing resolution of an issue (Grunig & Hunt 1984; Grunig 1997). When people believe too many obstacles prevent fixing a problem, they less likely would engage in communication behaviors to resolve it, despite their problem recognition *and* involvement recognition being high. In this study, constraint recognition may be explained by people's perception of their inability to reduce the health risks associated with GM food, due to perceived obstacles in affecting public policies.

*Referent criterion***.** Referent criterion is a decision rule or knowledge drawn from individuals' prior experiences to resolve a problematic situation (Grunig, 1997). When an individual has judgmental rules regarding the problematic situation, she/he is likelier to engage in active information selection or transmission (Kim & Krishna, 2014). Example: Consumers previously facing similar food hazards or having knowledge about associated biotechnology risks, may be more active information-behavior than those lacking prior experience or knowledge.

Situational motivation in problem solving. Individuals stop to contemplate an issue when motivated to better understand it (Kim & Grunig, 2011). After individuals feel motivated to act on a given problem, they engage in information behaviors about it. Based on our review of Kim & Grunig's (2011) STOPS theory, we propose antecedents to the lay publics' active information behaviors about the GM food issue, and that situational motivation mediates between those antecedents and the publics' information behaviors. Once individuals perceive a lack of solution to a problem, perceive their connection to the problem, and realize their capability to resolve the problem or obstacles thereto, they will stop to think about the problem. If the publics perceive a strong association between GM food and adverse health effects they may contemplate the relationship between the issue and its probable impacts

on them, to address it. Therefore, the following hypothesis:

> **H-1:** *Individuals having high problem recognition* (**H1a**), *high involvement recognition* (**H1b**), *and low constraint recognition* (**H1c**) *about the GM food issue will have high situational motivation to engage in active information behaviors for problem solving.*

Cross-Situational Predictor of Information Behaviors: Health-Information Orientation

Situational perceptual and cognitive frames may be powerful in explicating the publics' motivated actions about specific issues they face (Kim & Grunig, 2011; Kim & Ni, 2013). However, as Kim et al. (2008) point out, public segmentation using situational variables is less pragmatically implementable, so two different approaches, cross-situational and situational segmentation, should be integrated for a more effective application. Additionally, some scholars argue the necessity of considering other factors explaining information behaviors in health communication, namely knowledge and lifestyle (Kelly et al., 2010; Shim et al., 2006). In the following section, we propose including health information orientation in the model of the lay publics' information behaviors about health risks.

*Health-Information Orientation***.** Dutta-Bergman (2004b) finds that Internet searchers of health issues are more health oriented than are non-Internet searchers. Health-information orientation is "the extent to which the individual is willing to look for health information" (p. 275). Basu and Dutta (2008) suggest that health-information-oriented individuals are motivated to use health information for their health behaviors. Regarding a relevant concept to health-information orientation, health communication scholars have paid attention to the role of health-consciousness (e.g., Bediako et al., 2004; Chen, 2009; 2011; Dutta & Feng 2007; Michaelidou & Hassan, 2008; Newsom et al., 2005). Dutta-Bergman (2004a) suggests health-information orientation and health consciousness are health-orientation indicators. In this study, health-information orientation is considered, it being more relevant than other health orientation indicators in explaining individuals' information behaviors.

A general health interest's explanatory power will be strengthened if combined with situational variables. Kim et al.'s (2012) study of predicting risk perception about GM foods demonstrates the power of joint effects of cross-situational and situational variables, suggests that risk perception about GM food is predicted, and that risk perception varies per public type. This indicates that risk perception is affected by one's situational perceptions of the discrepant states, and that the lay publics' motivated information behaviors will differ on the dynamics of cross-situational and situational variables. Kim et al. (2008) and Kim (2011) also suggest that a public segmentation approach could be more effective when it considers both situational and cross-situational factors.

Drawing upon these previous studies, this study proposes a model combining two determinants of information behaviors, namely cross-situational and situational antecedents. In this study a research question is how those different factors interplay in understanding when and why the publics are likely to communicate about new food technologies. An integrated model of the two theories is suggested as better explanation of the lay publics' motivated information behaviors , influenced by interplay of their subjective perceptions about the issue, and their general health interest.

Integration of Two Theories for a Better Model of Health Risk Communication

While Kim and Grunig (2011) believe that problem-, involvement-, and constraint- recognition are antecedents to motivation and multiple information behaviors, Basu and Dutta (2008) emphasize health-information orientation's role in the motivation for information seeking. When Dutta and Basu proposed health-information orientation, other types of information behaviors were not considered. If we consider the active information behavior dynamics of a problem-solver in the context of health risk communication, it is necessary to test the effects of individuals' general attitudes toward health issues on the motivation for other types of information behaviors such as information forwarding and selecting. Dutta-Bergman (2004b) found that - about health issues in general - health-information oriented individuals have more active attitudes than do non-oriented. Thus, those with generic health interest are likely also to be motivated to resolve a situation-specific health risk issue (in this study, GM's). Moreover, when people place more importance on their health, they likely are motivated to obtain and process food-safety information (Kornelis et al., 2007). Therefore we hypothesize:

> **H-2:** *Individuals with high health-information orientation will have high situational motivation to engage in active information behaviors for problem solving.*

This study examines relationships between health-information orientation, situational perceptual variables, and active information behaviors about the GM issue. The posited question merits theoretical importance because it tests validities of common claims in health communication literature regarding the

presumed power of certain health-attitude concepts and enduring personal traits of health-information behaviors.

Specifically, we ask whether one's generic health-information orientation directly would affect various information behaviors in specific health issues. High health-information orientation and health consciousness motivates engagement in active health information-seeking behaviors (Aldoory, 2001; Dutta-Bergman, 2004a, 2005a), so *that* might account for behaviors beyond mere information seeking. People worried about food-safety are more inclined to seek food-safety information (Kornelis et al., 2007). People also info-share to alleviate their concerns (Roselius, 1971) and become selective about info-sources (Kornelis et al., 2007). Dutta-Bergman (2003, 2004a, 2004c, 2005b) also aver that health-conscious people likely participate in public-health promotion/s. Hence the likelihood that health-information-oriented people engage in information- transmitting behaviors if they believe others also should know GM food's potential risks. Also, it is likely those health-oriented people would evaluate their collected information's utility, as they likely would use it for their health. We therefore hypothesize:

H-3: *Individuals with high health-information-orientation will have active information behaviors (**H3a**: information seeking, **H3b**: information forwarding, **H3c**: information forefending) about the GM food issue.*

However, Verbeke et al. (2007) argue that despite a tendency to overestimate risks, in reality many do not identify or seek information regarding food safety. This indicates that not everyone engages in active information behaviors, nor feels it personally relevant until *motivated* or affected by specific issues. Thus, examining the relationship between health-information orientation and Kim and Grunig's (2011) situational perceptual frames for health- information behaviors, we need to estimate the effects of situational perceptual and motivational variables to explain situational active communication after testing a direct effect of health-information orientation. By so doing, this study helps researchers and practitioners draw a boundary condition at the effects of enduring personal tendency or cross-situational characteristics.

Further, this study examines the usefulness of situational motivation as a proxy. If situational motivation measures are significant, in cases where time for a survey is limited, practitioners/policymakers can use fewer survey items. People encountering life-impacting problems experience heightened epistemic and communicative motivation, not only better to understand problem causes, but also to influence how problems are addressed (Kim & Krishna, 2014). Kim and Grunig (2011) suggest using situational motivation and referent as a simpler method of public segmentation.

Individuals are likelier to engage in active information behaviors about a problematic situation when motivated to resolve an issue (situational motivation) and when they have available and applicable knowledge or decision rules from their previous experiences (referent criterion). Verdurme and Viaene (2003) find the role of consumers' knowledge about GM food for their risk and benefit perceptions and behavioral intention. Similarly, Zhu and Xie (2015) find the impact of risk and benefit knowledge on attitude toward GM foods. Verbeke (2008) also supports the role of knowledge (subjective or objective) in terms of influencing information behaviors. Yang, Ames, and Berning (2015) find that previous knowledge of genetic engineering was a significant determinant of consumers' willingness to purchase either non-GM foods or GM foods. In accordance with STOPS, situational motivation and referent criterion may be more immediate predictors than other situational perceptual variables of an individual's information behaviors about the GM issue. This study, therefore, puts forth the following hypotheses:

H-4: *Individuals with high situational motivation for problem solving will show active information behaviors (**H4a**: information seeking*, **H4b:** *information forwarding*, **H4c:** *information forefending) about the GM food issue.*

H-5: *Individuals with high referent criterion will show active communication behaviors* (**H5a:** *information seeking,* **H5b:** *information forwarding*, **H5c:** *information forefending) about the GM food issue.*

To recap: We test STOPS claims in the context of GM food technology and its potential risks, better to understand the lay publics' information behaviors. And we propose a revised STOPS theory by adding health-information orientation. People's health risk communication behaviors of GM food may be influenced by:

1) Health information orientation
2) Situational perceptual variables
3) Joint effects of 1 and 2 above

By testing the integrated model, we propose that not only do the lay publics produce and give information to others as a way of problem-solving for food-risk issues, but also they choose useful information via their own criteria.

Method

Study design

From March to April 2009, a Web survey was conducted at a USA eastern university. In total, 393 - 162 male, 227 female - responded to the questionnaire. Sample median age was 23 (N=393, Mean=24.76, SD=10.101), with 82.6% Caucasian, white, or Euro-American; 5.4% Latino, Hispanic, or Hispanic American; 5.1% African American or black; 4.4% Asian, Pacific Islander, or Asian American; 0.5% American Indian, Native American, or Alaskan; and 2% other.

Procedure

Health-information orientation was measured by a modified version of Dutta-Bergman's (2004) health-information orientation scales. Among its 8 items, this study did *not* use the item "The amount of health information available today makes it easier for me to take care of my health." Instead, two were added: "When I am sick, I try to get as much information as possible about my disease," and "I like to get health information from a variety of sources." These were measured on five-point Likert scales (not at all =1, very much =5) (Table 1).

Table 1 *Health information orientation*

Item	M	SD	Cronbach's α
HO1. I make a point to read and watch stories about health.	3.97	.86	α = .90
HO2. I really enjoy learning about health issues.	3.85	1.01	
HO3. To be and stay healthy it's critical to be informed about health issues	3.37	1.10	
HO4. When I take medicine, I try to get as much information as possible about its benefits and side effects	3.93	.98	
HO5. I need to know about health issues so I can keep myself and my family healthy	3.66	1.04	
HO6. Before making a decision about my health, I found everything I can about the issue	3.72	1.03	
HO7. It is important to me to be informed about health issues	3.93	.90	
HO8. When I am sick, I try to get as much information as possible about my disease (newly added).	3.68	1.01	
HO9. I like to get health information from a variety of sources (newly added)	3.62	1.06	

(Source: Adopted from Dutta-Bergman, 2004)

Multiple questions measured Kim and Grunig's (2011) situational perceptual variables (Table 2) to check for consistency in responses and measured on 5-point Likert scales (not at all =1, very much =5). Reliability analysis was conducted using Cronbach's alpha (Table 2).

Table 2 *Variables of Situational Theory of Problem Solving*

Item	M	SD	Cronbach's α
(Problem recognition, 3 items)			α = .71
PR1. I consider this issue to be a serious problem	2.95	1.31	
PR2. How strong do you feel that something needs to be done to improve the situation for this problem?	3.24	1.23	
PR3. How much does the current situation deviate from what you think it should be?	2.80	1.12	
(Involvement recognition, 3 items)			α = .72
IR1. In your mind, how much of a connection do you see between yourself and this problem?	2.72	1.22	
IR2. To what extend do you believe this problem could involve you or someone close to you at some point?	3.31	1.23	
IR3. How much do you believe this problem could affect you personally?	3.13	1.22	
(Constraint recognition, 2 items)			α = .80
CR1. To what extent do you believe that you could affect the way this problem is eventually solved if you wanted to?	2.08	1.11	

CR2. To what extend do you believe this problem is a problem that you can do something about?	2.06	1.10	
(Referent criterion, 3 items)			α = .78
RC1. I strongly support a certain way of resolving this problem	2.84	1.35	
RC2. I know how I should behave for this problem.	2.51	1.28	
RC3. Past experience has provided me with guidelines for how to behave about this problem	2.19	1.25	
(Situational motivation, 3 items)			α = .77
SM1. How often do you stop to think about this problem?	2.03	1.00	
SM2. To what extent would you say you are curious about this problem?	3.14	1.28	
SM3. Please indicate how much you would like to understand this problem better	3.36	1.24	

(Source: Adopted from Kim & Grunig, 2011)

For active information behaviors (Table 2), three variables - information seeking, forwarding, and forefending - were measured by multiple questions then made into composite variables.

Table 3 *Active Information Behaviors on Safety Controversy of Genetically Modified Foods*

Item	M	SD	Cronbach's α
(information seeking, 3 items)			α=.71
ISK1. I regularly check to see if there is any new information about this problem on the Internet.	1.92	1.12	
ISK2. I would follow a link in an email to a Web site where I can find more information about the problem.	2.61	1.28	
ISK3. I visit an online or regular bookstore to find useful information about the problem.	1.65	.96	
(information forwarding, 4 items)			α=.83
IFW1. I find I am engaging in intense conversations about this problem.	2.31	1.30	
IFW2. If it is possible, I take time to explain this problem to others	2.21	1.27	
IFW3. I look for chances to share my knowledge and thoughts about this problem.	2.00	1.09	
IFW4. It is one of my top priorities to share my knowledge and perspective about this problem	1.73	1.02	
(information forefending, 3 items)			α=.88
IFF1. I have invested enough time and energy so that I understand this problem.	2.28	1.23	
IFF2. I know where to go when I need updated information regarding this problem.	2.64	1.29	
IFF3. I have studied this problem enough to judge the value of information	2.24	1.25	

(Source: Adopted from Kim & Grunig, 2011)

Results

Hierarchical regression analysis tested posited hypotheses. Results testing the relationship among health-information orientation, situational perceptual variables, and situational motivation, supported H1 and H2 (Table 3). After controlling for age and gender, when health orientation was entered at Step 2, R square change was .066 ($p < .001$). Health-information orientation was significant for predicting situational motivation about the GM food issue (B = .018, SE = .004, $p < .001$) (H2). Situational perceptual frames accounted for 38.5% ($p < .001$) of incremental variance for situational motivation (R square change=.38.5). These increments led to 39.3% of total variance for situational motivation. In individual contribution, all three situational variables were significant for predicting situational motivation: problem recognition (H1a, B=.311, SE=.046, $p <.001$), involvement recognition (B = .358, SE = .046, $p < .001$), and constraint recognition (B = .134, SE = .041, $p < .001$). The incremental contribution of health-information orientation to the total variance of situational motivation (6.6%) was less than that of situational perceptual variables (38.5%).

Table 4 Hierarchical Multiple Regression Analysis Predicting Situational Motivation

	Situational Motivation			
Predictor	B	SE	ΔR^2	VIF
Step 1				
Age	.012*	.005		1.001
Gender	.021	.101		1.001
Step 2			**.066*** **	
Age	.007	.005		1/040
Gender	-.069	.101		1.032
Health-information orientation	**.018*** **	.004		1.069
Step 3			**.385*** **	
Age	.001	.004		1.072
Gender	.019	.078		1.059
Health-information orientation	.005	.003		1.164
Problem recognition	**.311*** **	.046		1.469
Involvement recognition	**.358*** **	.047		1.521
Constraint recognition (R)	**.134** **	.041		1.243
Total R^2	.466			
n	393			

Note. *p< .05, ** p< .01, *** p<.001
(R) = reversed variable

Also reviewed was the influence of situational motivation and the referent criterion on active information behaviors. H3, H4 and H5 were supported (Table 5). On entering health-information orientation at Step 2 of the model predicting information seeking, the R square change was .036 (p < .001) and the coefficient was .012 (SE = .003, p < .001) (H3a). In Step 3 situational motivation contributed 30.3% of incremental variance to the model (p < .001) and it was statistically significant (B = .530, SE = .041, p < .001) for predicting information seeking (H4a). At entering the referent criterion at Step 4, R square change was .074 (p < .001). It was a significant predictor of information seeking (B = .281, SE = .041, p < .001) (H5a). This model accounted for 42.6% of total variance. In the model predicting information forwarding, the R square change caused by health-information orientation was .021 (p < .05). Health-information orientation was significant (B = .021, SE = .004, p < .001) (H3b). At Step 3 when situational motivation was entered, R square change was .259 (p < .001) and was statistically significant (B = .546, SE = .045, p < .001) (H4b). Finally, the referent criterion added 16.6% of additional variance to the total variance, and also was significant (B = .470, SE = .042, p < .001) (H5b). The model accounted for 52.6% of total variance. In the model predicting information forefending, health information (B = .017, SE = .004, p <.001) (H3c), situational motivation (B = .677, SE = .050, p < .001) (H4c), and the referent criterion (B = .576, SE = .045, p < .001) (H5c) all were significant in predicting information forefending. R square change was .041 (p <.001) by health-information orientation, .316 (p < .001) by situational motivation, and .198 (p < .001) by the referent criterion. The model accounted for total variance of 56.5%.

Table 5 Hierarchical Multiple Regression Analysis Predicting Active Information Behaviors (Information Seeking)

	Information seeking			
Predictor	B	SE	ΔR^2	VIF
Step 1			.014	
Age	.002	.005		1.001
Gender	-.211*	.093		1.001
Step 2			**.036*** **	
Age	-.002	.005		1.040
Gender	-.272**	.094		1.032
Health	**.012*** **	.003		1.069

Orientation				
Step 3			**.303*** **	
Age	-.005	.004		1.046
Gender	-.236	.078		1.033
Health Orientation	.003	.003		1.145
Situational Motivation	**.530*** **	.041		1.088
Step 4			**.074*** **	
Age	-.007	.004		1.050
Gender	-.152	.075		1.062
Health Orientation	.001	.003		1.157
Situational Motivation	.364***	.045		1.529
Referent Criterion	**.281*** **	.041		1.533
Total R^2		**.426**		
N		393		

Note. *p< .05, ** p< .01, *** p<.001

Table 6 Hierarchical Multiple Regression Analysis Predicting Active Information Behaviors (Information Forwarding)

	Information forwarding			
Predictor	B	SE	ΔR^2	VIF
Step 1				
Age	.001	.005	**.021***	1.001
Gender	-.292**	.104		1.001
Step 2				
Age	-.005	.005		1.040
Gender	-.395***	.102	**.081*** **	1.032
Health Orientation	**.021*** **	.004		1.069
Step 3				
Age	-.008	.004		1.046
Gender	-.357***	.087	**.259*** **	1.033
Health Orientation	.011**	.003		1.145
Situational Motivation	**.546*** **	.045		1.088
Step 4				
Age	-.011**	.004		1.050
Gender	-.217**	.076	**.166*** **	1.062
Health Orientation	.008**	.003		1.157
Situational Motivation	.268***	.046		1.529
Referent Criterion	**.470*** **	.042		1.533
Total R^2		**.526**		
N		393		

Note. *p< .05, ** p< .01, *** p<.001

Table 7 Hierarchical Multiple Regression Analysis Predicting Active Information Behaviors (Information Forefending)

	Information forefending			
Predictor	B	SE	ΔR^2	VIF
Step 1				
Age	.008	.006	.010	1.001
Gender	-.158	.116		1.001
Step 2				
Age	.003	.006	**.041*** **	1.040
Gender	-.240	.117		1.032
Health Orientation	**.017*** **	.004		1.069
Step 3				
Age	-.001	.005		1.046
Gender	-.194*	.097	**.316*** **	1.033
Health Orientation	.004	.004		1.145
Situational Motivation	**.677*** **	.050		1.088
Step 4				
Age	-.005	.004	**.198*** **	1.050
Gender	-.022	.081		1.062
Health Orientation	.000	.003		1.157
Situational Motivation	.336	.049		1.529
Referent Criterion	**.576*** **	.045		1.533
Total R^2	**.565**			
N	393			

Note. *p< .05, ** p< .01, *** p<.001

Discussion

Findings support the proposed model of health-information behaviors by identifying significant joint effects of health-information orientation, situational motivation, and the referent criterion on active information behaviors. However, the impact of health-information orientation on situational motivation and on active information behaviors was minimal. In the model predicting situational motivation, three situational perceptual variables were the strongest factors for situational motivation. Of the models predicting three active information behaviors, situational motivation was the strongest factor, followed by the referent criterion.

This study attempts to bridge the gap between health communication theory and public relations theory by providing better understanding of the lay public epistemics of new technology via a more general conceptualization of information behaviors. In the context of public health and risk communication, we tested the STOPS theory's suggestions. Based on our findings, we propose a revised STOPS theory for public health and risk communication application, by adding health-information orientation. We believe that better understandings of public perception, general health interest, and motivated communication are better ground for effective health communication practice, education, and design.

This study draws scholarly attention to other types of human communication behaviors in the context of risk communication. Previous research focused primarily on information acquisition (Kim & Krishna, 2014). As Ni and Kim (2009; 2013) contend, however, other types of human communication behaviors are underexplored. This study's analyses show that people not only conduct motivated searches for more information to reduce potential food risk, but also share information as part of their problem-solving efforts. And their active information-*acquisition* behaviors happen in conjunction with information-*selection* behaviors. The publics become active participants in the GM issue even if associated risk is unproven.

Although in this study the impact of health information orientation was not strong compared to situational perceptual variables, this study still confirms our predictions that the lay public's general health interest affects their situational motivation to deal with the risk-associated and controversial GM issue. Moreover, it is the first study of the impacts of Dutta-Bergman's (2004b) health-information orientation on various types of information behaviors beyond information-seeking. More attention is due the role of health-information orientation in understanding communicative actions of lay citizens who live in the digital media technology age and share information in their social networks. Information they share is expected to be useful as they carefully evaluate its utility when they seek and collect information about health risks.

However, we yet need to discern why individuals' general health interests do not influence more their situational motivation for solving the GM issue, compared to the impact of three situational variables. Possibly their problem recognition or involvement recognition might derive from their beliefs/attitude about GM technology's ethicality or transparency, rather than health risks (see Devos, Maeseele, Reheul, Speybroeck, & Waele, 2008, regarding ethics, and Brossard & Shanahan, 2003, regarding democratic process in science). Also they might believe that government or other organizations ought to do something to finish this endless discussion by preparing solid measures and policies regarding this new technology's safety.

Additionally, Bawa and Anilakumar (2013) listed several factors influencing people's buying behaviors: (a) product certification as GM-free, (b) interest in environment protection, and nutritional value, (c) marketing issues, and (d) price and quality (p. 1042). From their study, we can assume that several elements beyond people's general health interests might have driven situational perceptions of the GM safety controversy. Also, this having been conducted among students, to secure the validity of this study's framework and findings, repetitive studies should be done elsewhere and with better sampling methods. We expect different age groups would exhibit different levels of health information orientation and subsequent behaviors.

Unanswered are questions why the lay publics engage in active information behaviors for unproven risks. Overconfidence in new technology seems apace of overestimation of its risks (Kim & Krishna, 2014; Kim et al., 2012), an interesting phenomenon because the public are motivated to deal with *even anticipatory problems* that may exist or may not. Ironically, considering debate still exists about whether GM food poses *any* health risks, the *uncertainty* of health risks seems key in influencing subjective perceptions and motivations in related communicative actions. The remaining issue, then, is how to communicate with these publics.

As per Alaszewski (2005), risk study should provide not only theory, but also guidelines, for actionable programmes. Our findings have practical implications for health education and policymakers. We attempted to present a public segmentation approach for an effective health campaign on the GM food issue. We suggest that, by combining the concept and measures with situational variables, health communicators better can use the health-information orientation concept in research and practice in public segmentation (for more details, Kim et al. 2008, Kim & Ni, 2013). More important, this study confirms the usefulness of situational motivation as a proxy variable instead of these three situational frames for communication practitioners wanting to simplify survey design due to limited time.

This study suffers limitations. Caution is necessary in generalizing its findings to other countries. Composite variables also may contribute to this study's limitations. And potential triggers for the publics' situational perceptions about GM food are not included in this study's purpose. Example: imbalanced media reports often negatively drive public opinion and regulatory systems, while science reports remain overlooked. More, consumer publics can be segmented differently depending on GM food's specific situational issues. For example, Tsourgiannis et al. (2011) suggest consumers can be segmented as two groups: (a) those influenced by product price, quality, and marketing issues, and (b) those focused on product certification and environmental protection. A survey asking more specifically about GM food-technology issues would enable identification of main causes of situational perceptions about those.

Premature approval of, or chronic resistance to, new technology, health risks associated therewith, are interesting areas for future study (Kim & Krishna, 2014). Worthwhile also may be identifying differences in publics' behaviors about the GM issue across different public types, e.g., between experts and the lay publics. Previous studies examining different interpretations of risks between experts and the lay publics argue this gap can impede effective risk communication (Slovic et al., 1980). More, other individual traits - attitude toward technology (Chen, 2008), deference to science and/or fear of science, and dogmatism - better might explain why certain publics exhibit strong actions about new technology-related issues. Investigating extreme publics whose behaviors are *not* factual-info based would be also another promising research. Tracking cases of anti-GM activism/social movements (see Kinchy, 2010; Özdemir, 2012) may help researchers identify similar

patterns of activist publics or verify the theoretical model we proposed.

Appendix 1 *Bicorrelations-*

	HO1	HO2	HO3	HO4	HO5	HO6	HO7	HO8	HO9	PR1	PR2	PR3	IR1	IR2	IR3	CR1	CR2	RG1	RG2	RG3	SM1	SM2	SM3	ISK1	ISK2	ISK3	IFW1	IFW2	IFW3	IFW4	IFF1	IFF2	IFF3
HO1	1																																
HO2	.398**	1																															
HO3	.332**	.544**	1																														
HO4	.526**	.523**	.534**	1																													
HO5	.413**	.463**	.617**	.619**	1																												
HO6	.320**	.582**	.432**	.443**	.451**	1																											
HO7	.523**	.572**	.548**	.660**	.614**	.596**	1																										
HO8	.441**	.424**	.495**	.515**	.491**	.476**	.599**	1																									
HO9	.345**	.548**	.489**	.472**	.465**	.574**	.520**	.585**	1																								
PR1	.166**	.145**	.054	.158**	.111*	.060	.108*	.160**	.088	1																							
PR2	.215**	.220**	.118*	.245**	.225**	.189**	.252**	.217**	.178**	.572**	1																						
PR3	.154**	.090	.061	.091	.077	.091	.121*	.171**	.097	.347**	.433**	1																					
IR1	.162**	.138**	.112*	.192**	.161**	.153**	.180**	.177**	.163**	.273**	.339**	.241**	1																				
IR2	.253**	.166**	.108*	.221**	.209**	.176**	.221**	.166**	.124*	.308**	.446**	.292**	.576**	1																			
IR3	.196**	.156**	.108*	.215**	.207**	.115*	.206**	.128*	.151**	.298**	.379**	.422**	.326**	.465**	1																		
CR1	-.022	.015	.054	.043	.084	.037	.042	.063	.054	.263**	.232**	.294**	.303**	.267**	.219**	1																	
CR2	.068	.075	.099	.086	.027	.031	.064	.059	.068	.238**	.217**	.313**	.357**	.267**	.252**	.663**	1																
RG1	.120*	.277**	.197**	.177**	.212**	.172**	.201**	.165**	.199**	.362**	.508**	.422**	.336**	.389**	.377**	.348**	.362**	1															
RG2	.066	.104*	.077	.096	.111*	.131*	.114*	.131*	.113*	.249**	.315**	.440**	.280**	.298**	.426**	.352**	.394**	.478**	1														
RG3	.025	.102*	.097	.116*	.112*	.112*	.127*	.107*	.102*	.250**	.254**	.427**	.306**	.256**	.425**	.412**	.420**	.455**	.690**	1													
SM1	.019	.130*	.199**	.093	.135**	.112*	.106*	.111*	.140**	.242**	.311**	.421**	.396**	.297**	.357**	.483**	.528**	.434**	.487**	.506**	1												
SM2	.185**	.246**	.099	.232**	.212**	.202**	.250**	.196**	.197**	.283**	.410**	.551**	.406**	.447**	.498**	.276**	.273**	.475**	.455**	.368**	.464**	1											
SM3	.197**	.229**	.150**	.222**	.198**	.133**	.239**	.170**	.190**	.221**	.392**	.556**	.331**	.338**	.464**	.134**	.173**	.349**	.280**	.246**	.354**	.736**	1										
ISK1	-.032	.097	.163**	.099	.106*	.080	.101*	.093	.143**	.216**	.232**	.368**	.364**	.213**	.268**	.455**	.415**	.393**	.435**	.527**	.631**	.346**	.283**	1									
ISK2	.174**	.167**	.154**	.188**	.199**	.196**	.199**	.166**	.172**	.193**	.294**	.448**	.294**	.329**	.312**	.223**	.283**	.443**	.325**	.319**	.428**	.530**	.456**	.424**	1								
ISK3	-.090	.063	.146**	.006	.090	.026	.032	.002	.076	.157**	.085	.183**	.196**	.141**	.152**	.454**	.460**	.266**	.270**	.361**	.508**	.159**	.146**	.625**	.365**	1							
IFW1	.088	.234**	.285**	.212**	.245**	.238**	.210**	.225**	.259**	.298**	.371**	.389**	.380**	.258**	.321**	.405**	.401**	.469**	.459**	.457**	.573**	.406**	.292**	.587**	.436**	.409**	1						
IFW2	.072	.161**	.223**	.143**	.160**	.196**	.162**	.153**	.217**	.257**	.357**	.448**	.429**	.309**	.327**	.427**	.458**	.556**	.469**	.526**	.615**	.406**	.313**	.686**	.476**	.468**	.759**	1					
IFW3	.020	.092	.234**	.132**	.161**	.134**	.162**	.119*	.170**	.205**	.280**	.430**	.364**	.293**	.365**	.491**	.517**	.467**	.469**	.563**	.616**	.401**	.336**	.637**	.485**	.545**	.621**	.674**	1				
IFW4	-.015	.068	.131**	.059	.106*	.094	.082	.065	.161**	.143**	.151**	.341**	.276**	.160**	.292**	.538**	.532**	.318**	.395**	.539**	.590**	.234**	.186**	.582**	.348**	.628**	.518**	.564**	.732**	1			
IFF1	.038	.151**	.161**	.083	.098	.177**	.108*	.132**	.141**	.225**	.312**	.495**	.356**	.289**	.387**	.461**	.423**	.530**	.568**	.520**	.619**	.509**	.391**	.604**	.446**	.401**	.530**	.619**	.551**	.447**	1		
IFF2	-.020	.166**	.182**	.128*	.121*	.156**	.170**	.133**	.131*	.260**	.341**	.372**	.290**	.312**	.317**	.378**	.331**	.419**	.523**	.443**	.477**	.414**	.274**	.463**	.316**	.319**	.459**	.489**	.469**	.330**	.633**	1	
IFF3	.014	.142**	.167**	.095	.141**	.149**	.123*	.123*	.161**	.263**	.339**	.457**	.407**	.361**	.387**	.519**	.453**	.572**	.585**	.558**	.590**	.487**	.335**	.630**	.404**	.413**	.546**	.668**	.637**	.476**	.814**	.657**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

HO=health information orientation PR= problem recognition IR=Involvement recognition CR =constraint recognition RC= referent criterion SM = situational motivation

ISK= information seeking IFW= information forwarding IFF= information forefending

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