Linking Heuristic-Systematic Processing to Adoption of Behavior

Shiyu Yang
Marquette University

LINKING HEURISTIC-SYSTEMATIC PROCESSING TO ADOPTION OF BEHAVIOR

by

Shiyu Yang

A Thesis Submitted to the Faculty of the Graduate School,
Marquette University,
in Partial Fulfillment of the Requirements for
the Degree of Master of Arts

Milwaukee, Wisconsin

August 2017

ABSTRACT
LINKING HEURISTIC-SYSTEMATIC PROCESSING TO
ADOPTION OF BEHAVIOR

Shiyu Yang

Marquette University, 2017

This study sets out to draw connections among key components within three conceptual models: the Risk Information Seeking and Processing model, the Heuristic-Systematic Model, and the Theory of Planned Behavior. Specifically, it proposes and tests the theoretical linkages among heuristic and systematic information processing, depth of processing, attitude stability, and behavioral intention. Archival data drawn from a panel survey that concerns health risks from drinking municipal tap water are used for theory testing. Findings reveal that systematic processing is positively related to number of strongly held behavioral beliefs, strength of belief outcome evaluations, and strength of cognitive structure—all indicated depth of processing, and that heuristic processing is negatively related to all three measures. Cognitive structure and attitude toward the behavior appear to be consistent in direction and strength. Attitude toward the behavior, subjective norms, and alternative behavior are positively related to behavioral intention. An anticipated positive relationship between perceived behavioral control and behavioral intention was not found. Finally, theoretical and practical implications of the findings are discussed.

ACKNOWLEDGEMENTS

Shiyu Yang

I wanted to extend my sincere gratitude to many people for their help and support during the past two years, without which this thesis could never come into shape. First among these people is my thesis chair and mentor, Dr. Robert J. Griffin. I owe Dr. Bob a huge debt of gratitude for the enormous amount of guidance, encouragement, and inspiration that he has generously given to me. I learned not only the specifics of risk communication knowledge and research methods, but also the integrity, intellectual curiosity, and scientific rigorousness of a real scholar from him. Dr. Bob is a true great and I will be forever grateful to him for the massive support and wisdom he has shown to me, the countless opportunities he has provided for me that would not have been available otherwise, and the numerous long conversations with him about research, life, and everything else. He has made my time at Marquette University such a rewarding, invaluable, and warm experience that I will always, immensely, treasure all my life.

I owe special thanks to my thesis committee members, Dr. Sumana Chattopadhyay and Dr. Joyce Wolburg, for their great help with the production of this thesis and their tremendous support during my time at Marquette. As my academic advisor, Dr. Chattopadhyay has offered me lots of valuable suggestions and warm support, of which I am deeply appreciative. I feel extremely lucky to have had the opportunity of working with Dr. Wolburg as her research assistant. Her amazing kindness and encouragement has added enormously to my loving memory of Marquette. It has been such a great honor and pleasure to learn from her and I am truly grateful to her for including me in her research project.

I am also highly indebted to my other supervisors of my research assistant work, Dr. Jean Grow and Dr. Young Kim. Dr. Grow is such a great personal friend who kept giving me massive encouragement that shone every moment of self-doubt. Words fail me when I wanted to thank her for generously including me in her research project, giving me abundant opportunities to hone my research skills, and offering me incomparable love and care that makes me feel at home when I am thousands of miles away from home. I am deeply thankful to Dr. Kim for his selfless and extremely helpful advice. His precious guidance and support has immensely helped me navigate through a world full of complexities (and excitement).

Last but not least, my deepest thanks are due to my parents. I feel extremely blessed every day for having the greatest father and mother I can ever imagine. They have taught me kindness, independence, and the purpose of life. Thanks for the immeasurable love and care you have been devoting to this kid's health and growth; nothing fills me with happiness and hope more than the thought of you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

Water quality issues have long been a subject that can command national spotlight. The recent incident of the Flint water crisis in Michigan that has been ongoing since 2014 has attracted extensive media attention and provoked heightened societal concerns regarding latent risks from municipal drinking water that could pose serious harms to human health. Historically, the United States suffered increased outbreaks of various waterborne illnesses in the 1990s that have raised public salience of water quality issues. Contamination of municipal tap water can result from a variety of sources such as toxins, chemicals, and organisms that occasionally slip past the public water treatment systems. Lead in service lines, especially those older, corroded pipes that run from the water mains to the house and that are in homes is a major concern to many municipalities. Although the levels of contaminants in drinking water are regulated and constantly monitored, accidents can happen. In their wake, people may be well motivated to resort to preventive actions, and one primary remedy is to drink bottled water instead of tap water (Anadu & Harding, 2000; Doria, 2006).

Under such conditions, it is relevant for risk communication research to examine the factors that lead to individuals performing a particular risk-reducing behavior, in this case, drinking bottled water instead of tap water. The present study investigates this issue by studying people's responses to potential hazards from waterborne parasites lurking in municipal tap water drawn from the Great Lakes—the largest group of fresh water bodies in the world, in the wake of a large waterborne disease outbreak in Milwaukee, Wisconsin, in the 1990s. Despite its age, the dataset allows for a close examination of the mechanisms underlying individuals' communication behaviors and risk-related decision-

making as well as for theory testing. Moreover, the current relevance of tap water risks adds to the value of digging into the dataset to the task of understanding how people come to drink bottled water instead of tap water in cope with the risks.

Relying on Griffin, Dunwoody, and Neuwirth's (1999) model of Risk Information Seeking and Processing (RISP) as the major theoretical framework, this study attempts to draw and test linkages among the key constructs within three conceptual models: the RISP model, Eagly and Chaiken's (1993) Heuristic-Systematic Model (HSM), and Ajzen's (1988) Theory of Planned Behavior (TPB), specifically the relationship of risk information processing to risk-related attitudes and behaviors. Griffin and his colleagues (Griffin, Neuwirth, Giese, & Dunwoody, 2002) presented a study that, for the first time in a field setting, linked heuristic and systematic processing to measures of depth of processing proposed in the TPB (i.e., number of salient beliefs, evaluation strength, cognitive structure strength). However, the researchers did not go beyond the initial elements within the TPB. This analysis adds to the current literature on relationships among the cognitions of risk information processing, depth of processing, attitude stability, and behavioral intention, as it expands the scope of theory testing to the rest of the TPB variables as well as an additional variable (i.e., attitude toward alternative behaviors).

Mainly drawn from the HSM and the TPB, as well as from risk perception and communication research, the RISP model was devised to illuminate how people seek and process information about risks, and how these activities shape attitude formation and behavior adoption. Of special interest to this study is the role of styles of risk information

processing in the development of preventive behavior. To begin with, relevant aspects of the RISP model are discussed as follows.

II. LITERATURE REVIEW

RISP Model and Heuristic and Systematic Processing

To form evaluative judgments and develop attitudes, people may exert varying levels of cognitive effort as they process judgment-relevant information. The RISP model accounts for these variations by incorporating mechanisms found in the Heuristic-Systematic Model (HSM; Eagly & Chaiken, 1993). As one of the family of dual-process theories, the HSM stipulates two basic modalities of information processing—heuristic processing and systematic processing. Heuristic modes of processing are less effortful and more limited as perceivers mobilize less cognitive resources and formulate information-relevant judgments based on simple decision rules, or heuristics, without fully absorbing "the semantic content of persuasive argumentation" (Eagly & Chaiken, 1993, p. 327). Essentially, heuristics are already-existing knowledge schemata stored in human memory that are later activated for judgment-relevant use in the presence of heuristic cues. Heuristic cue refers to "any variable whose judgmental impact is hypothesized to be mediated by a simple decision rule" (Eagly & Chaiken, 1993, p. 327). In other words, heuristic cues are any stimuli that activate existing heuristics and thereafter catalyze heuristic processing. For example, when risk information that contains the heuristic cue of expert opinion (e.g., experts recommending exercise as a strategy to cope with the risk of obesity) is presented, the existing heuristic that experts' statements can be trusted may be activated from the memory, and perceivers can form a favorable judgment about exercise based on this judgmental rule. Contrary to heuristic processing, systematic forms of processing involve more analytic, comprehensive treatment of

information (Chen & Chaiken, 1999), and dictate greater cognitive effort, as perceivers focus on the actual content of the information.

According to the HSM, how people process information is constrained by various situational, cognitive, and motivational factors. Situational constraints such as time pressure may restrict individuals to heuristic processing. Likewise, individuals who are lacking in cognitive capacity and resources (e.g., individuals who possess less knowledge in the judgment-relevant domain) are less likely to perform systematic processing. The HSM assumes that perceivers' information processing is guided by two principles: the economy principle of least effort and the sufficiency principle. Specifically, it is assumed that people are limited in cognitive resources and are generally prone to exerting as little cognitive effort as possible when they process information. As a result, less effortful heuristic modes of processing usually predominate the cognitive process of judgment formulation (Chen & Chaiken, 1999). However, when heuristic processing fails to deliver results of desired judgmental confidence, or when heuristic processing cannot take place (e.g., due to the absence of heuristic cues in the message), perceivers will be motivated to engage in more systematic forms of processing and exert whatever cognitive effort that is necessary and possible until they think that they have reached "a sufficient degree of confidence that their judgments will satisfy their accuracy goals" (Chen & Chaiken, 1999, p. 74). That is to say, people usually have to strike at a balance between the economy principle of mobilizing the least cognitive resources and their motivation to acquire sufficient relevant information to formulate an informed judgment. As Eagly and Chaiken (1993) point out, sufficiency threshold, or the gap between the level of desired judgmental confidence and the level of actual judgmental confidence, is "the fundamental

motivator of processing effort" (p. 344), or systematic processing. To note, the distinction between heuristic and systematic processing is relative and is not a strict dichotomy. Since judgmental confidence is a continuum anchored by actual judgmental confidence and desired judgmental confidence, the width of the confidence gap varies continuously along the scale, which instigates varying degrees of heuristic and systematic processing. In addition, heuristic and systematic modes of processing can co-occur as well as occur alone (Chen & Chaiken, 1999).

The RISP model applies dual processing to contexts where information about various risks is concerned. According to the RISP model, the continuum of information (in)sufficiency is anchored by two ends—perceivers' current knowledge and information sufficiency threshold. When a perceiver's information sufficiency threshold, or amount of knowledge that s/he thinks s/he should know about a risk, is located at a higher point of the information continuum than his or her perceived current knowledge, s/he will be motivated to seek risk information more actively and process such information more systematically, in order to close the information insufficiency gap and be confident enough in the accuracy and validity of his/her judgments about the risk. As the information insufficiency gap widens, the likelihood that perceivers will continue to engage in more systematic forms of processing increases (Kahlor, Dunwoody, Griffin, Neuwirth, & Giese, 2003). The information insufficiency gap can widen due to an elevated information sufficiency threshold (i.e., a heightened level of desired knowledge), and/or a decreased level of current knowledge. Nevertheless, the information insufficiency gap can motivate systematic processing only (a) when perceivers have the cognitive capacity to exercise systematic processing (Chen & Chaiken, 1999), (b) when

perceivers have the self-efficacy that they are able to gather and comprehend relevant information (Dunwoody & Griffin, 2015; Eagly & Chaiken, 1993), and (c) when perceivers believe that such information is useful and credible (Dunwoody & Griffin, 2014; Griffin et al., 2002; Griffin, Powell, Dunwoody, Neuwirth, Clark, & Novotny, 2004).

Because systematic processing entails fully absorbing the substance of the persuasive message whereas heuristic processing is focused only on a subset of the information that allows for the application of simple judgmental rules in formulating decisions, heuristic processing tends to yield judgments and attitudes that are "less stable, less resistant to counterpropaganda, and less predictive of subsequent behavior than those formed or changed on the basis of systematic processing" (Eagly & Chaiken, 1993, p. 327). Depth of information processing plays an important role in the development of preventive behaviors as beliefs are formed or altered in part from processing information from some sources such as mass media (Griffin et al., 1999). As Lutz (1977) suggests, communication processes can alter the structure of beliefs by creating a new salient belief, by altering the strength or salience of a belief, or by modifying its evaluation. Attitudes "develop in the course of acquiring information about the attitude object, and they keep evolving as existing beliefs change and new beliefs are formed" (Ajzen & Sexton, 1999, p. 119). The RISP model proposes that more active seeking and especially more intense processing of information about a risk-related behavior lead to (a) perceivers possessing a greater number of strongly held behavioral beliefs, and (b) more stable cognitive structures about the behavior. Both outcomes should produce more stable

appraisal of, or attitude toward the behavior (Griffin et al., 1999). To provide more background, we now look at the Theory of Planned Behavior in more detail.

Theory of Planned Behavior: The Role of Beliefs in Predicting Attitude and Behavior

In extending the implications of risk information seeking and processing to the realms of behavior, the RISP model incorporates concepts and measures of Ajzen's (1988) Theory of Planned Behavior (TPB). In brief, the TPB stipulates that attitude toward the behavior, subjective norms, and perceived behavioral control are three major variables that predict to intention to perform a behavior, and that behavioral intention and perceived behavioral control further predict to the actual performance of the behavior. Attitude toward the act (AAct) is defined as the extent to which a person has a favorable or unfavorable appraisal of a behavior. Subjective norms (SN) refer to the social pressures a person feels that s/he should or should not perform a behavior. Perceived behavioral control (PBC) indicates the perceived ease or difficulty of performing a given behavior (Ajzen, 1991). Adding the PBC variable to the Theory of Reasoned Action (Ajzen & Fishbein, 1980; Fishbein & Azjen, 1975), an earlier version of the TPB, improves the theory as it overcomes the original model's limitations in predicting behaviors over which people have incomplete volitional control. As individuals' volitional control over performing a behavior decreases, the predictive value of the PBC variable increases (Ajzen, 1991). PBC, along with behavioral intention (BI), can be a useful predictor of actual behavior to the extent that a person's perception of the ease or difficulty of performing a behavior realistically and accurately reflects actual behavioral control (Ajzen, 1991). Altogether, AAct, SN, and PBC predict to an individual's

intention to perform a given behavior (BI). It is assumed that the more favorable the AAct and the greater the SN that one should perform a behavior, as well as the higher the PBC, the stronger should be the BI (i.e., the more willingly a person will be to perform the behavior). A stronger BI and PBC also predict to a greater likelihood that the person will actually perform the behavior (B). It should be noted, nevertheless, that BI only finds its expression in behaviors that are under volitional control; if the person cannot decide at will whether or not to perform the behavior, then BI is out of the question (Ajzen, 1991).

Beyond predicting human behavior, the TPB sets out to *explain* it, by employing a belief-based approach to measuring antecedents to attitude, subjective norms, and perceived behavioral control. A belief about an object is defined as "the subjective probability that the object has a certain attribute" (Ajzen & Sexton, 1999, p. 118). In Fishbein's theory (Fishbein & Ajzen, 1975), evaluation of, or attitude toward, an object is determined by a set of salient beliefs about the object (Ajzen & Sexton, 1999). In the TPB, behavior is a function of a person's salient beliefs relevant to the behavior (Ajzen, 1991). People weigh each relevant belief amidst a number of other beliefs that they also hold about a behavior to form the basis of attitude toward performing the behavior. While a person may hold many beliefs about a given behavior, he or she can only attend to a relatively limited few of them at any given moment (Ajzen, 1991). It is these more readily accessible, or salient, beliefs that determine an individual's intentions and actions (Ajzen, 1991).

The TPB distinguishes three types of salient beliefs that influence a person's behavior development: behavioral beliefs, normative beliefs, and control beliefs. These three types of beliefs serve as antecedents to AAct, SN, and PBC, respectively.

Behavioral belief refers to the belief that performing a given behavior will bring about certain outcomes or is associated with certain attributes such as the cost incurred. In other words, a behavioral belief links a behavior to a certain outcome or attribute (e.g., drinking bottled water instead of Great Lakes tap water will help protect a person from being harmed by waterborne risks). Because the outcomes and attributes that come to be linked to a given behavior of interest are already valued positively or negatively, people automatically acquire an attitude (i.e., favorable or unfavorable appraisal) toward the behavior as they consider the various salient behavioral beliefs (Ajzen, 1991). The strength of a behavioral belief refers to the subjective probability that the behavior will produce a certain outcome or is associated with a certain attribute. The more a person believes that performing a behavior will bring about a certain outcome, the greater the subjective probability, and the greater the belief strength. Using the expectancy-value model, the strength of each salient behavioral belief is combined with the subjective evaluation of each belief's outcome (e.g., the goodness or badness) in a multiplicative manner, and the resulting products are summed across all salient behavioral beliefs, constituting what is termed the "belief-based measure of attitude", or the cognitive structure of attitude, which is hypothesized to be in direct proportion to the standard measure of attitude (AAct) toward the same behavior (Ajzen, 1988, 1991).

Normative belief refers to the belief that a person's important referent individuals or groups will approve or disapprove of performing a target behavior. That is, a normative belief links a behavior to the perceiver's expectation of an important referent's attitude toward the behavior. The strength of a normative belief refers to the subjective probability that an important referent will approve or disapprove of performance of the

target behavior. The more a person is convinced that an important referent will approve/disapprove of it, the greater the subjective probability, and the greater the belief strength. A belief-based measure of subjective norms (SN) can be obtained by summing across all salient normative beliefs the products of the strength of each normative belief multiplied by the person's motivation to comply with the referent in question (Ajzen, 1991). Consequently, the belief-based measure of SN should be in direct proportion to the global measure of SN.

Control beliefs speak to the "presence or absence of factors that facilitate or impede performance of the behavior" (Ajzen, 1988, p. 125). In other words, a control belief links the target behavior to a requisite resource or opportunity (or lack thereof). Each accessible control belief that a control factor will be present is multiplied by the perceived power of that control factor to facilitate or impede performance of the behavior, and the resulting products are summed across all accessible control beliefs to create a belief-based measure of perceived behavioral control (PBC), which should be in direct proportion to the global measure of PBC (Ajzen, 1991; Ajzen & Driver, 1991).

Linking Information Processing to Attitude and Behavior

The depth of information processing has implications for attitude formation and behavior adoption and maintenance. Petty and Krosnick (1995) defined attitude strength as the power to endure change and the power to have impact on people's lives. As is suggested by the heuristic-systematic model, attitudes formed through more intense systematic modes of processing tend to be more stable and resistant to change, whereas attitudes developed through heuristic forms of processing tend to be more volatile and

less firmly held (Griffin et al., 2002). Explicating their Elaboration Likelihood Model (ELM), Petty and Cacioppo posited that central route processing (an equivalent of systematic processing in HSM) leads to attitude changes that "will show greater temporal persistence, greater prediction of behavior, and greater resistance to counterpersuasion than attitude changes that result mostly from peripheral cues", or heuristic processing (1986, p. 175). Furthermore, the researchers reasoned:

> Thus, attitude changes induced via the central route involve considerably more cognitive work than attitude changes induced under the peripheral route…. Under the central route, then, the issue-relevant attitude schema may be accessed, rehearsed, and manipulated more times strengthening the interconnections among the components and rendering the schema more internally consistent, accessible, enduring, and resistant than under the peripheral route. (pp. 175-176)

This proposition regarding levels of processing and attitude stability has received indirect empirical support. Pierro, Mannetti, Kruglanski, Klein, and Orehek (2012) conducted a three-phase longitudinal study in which the researchers manipulated a) the presence of heuristic cue in the stimulus information, b) the length of the stimulus information, and c) message recipients' involvement in the issue at hand. Particularly, the researchers found that among individuals who had high (versus low) involvement in the issue, those who read the lengthy (versus brief) information acquired attitudes that were more persistent and were linked more strongly to actual behavior. Although the extent of information processing was not directly measured, the researchers reasoned that high issue involvement and lengthy judgment-relevant information disposed the perceivers to more extensive and systematic processing, which resulted in more stable attitude changes and higher attitude-behavior correspondence.

Perhaps a more detailed account of the psychological mechanism of the influence of levels of processing on attitude strength is provided by the TPB. According to the

TPB, the different modalities of processing can impact the number of strongly held behavioral beliefs and the strength of evaluation of the outcomes of these salient behavioral beliefs. As Ajzen and Sexton (1999) pointed out:

> The depth-of-processing dimension is of importance for our purposes because it speaks to the domain of beliefs that become accessible in a given context. Clearly, the number of accessible beliefs is likely to increase with processing depth, and the strength and evaluative implications of accessible beliefs may also change as a result of continued deliberation. (pp. 122-123)

The RISP model applies these constructs to risk-related contexts. Particularly, it is expected that the style of risk information processing (i.e., systematic and heuristic processing) and/or seeking (i.e., non-routine and routine seeking) affects behavioral beliefs, belief outcome evaluations, and consequently the cognitive structure of attitude toward the behavior (i.e., belief strength × outcome evaluation). More systematic processing of risk information is expected to lead to more stable cognitive structure as well as attitude toward the behavior. In addition, perceived hazard characteristics (PHC) including risk judgment, perceived salience of risk, self-efficacy, and institutional trust are also expected to affect people' behavioral beliefs and cognitive structure of attitude. The RISP model also proposes PHC variables as precursors to perceived behavioral control, and individual characteristics (especially demographic and sociocultural variables) as antecedents to normative belief structure (Griffin et al., 1999).

Prior risk communication research has examined some of the proposed antecedents to risk-related attitudes and behaviors. Griffin and his colleagues (Griffin, Neuwirth, Giese, & Dunwoody, 1999) found that greater use of systematic processing of risk information from the media and other sources is positively related to the number of behavioral beliefs that individuals consider to be important to their risk-coping decisions,

and that this positive relationship is further augmented among those with higher levels of educational achievement, a measure representing processing capacity. Yang and her colleagues (Yang et al., 2010a, 2010b) used the case of clinical trial enrollment as the study context wherein the researchers found that, among both cancer patients and healthy adults, systematic processing is positively related to favorable belief-based attitude (i.e., cognitive structure) toward clinical trial enrollment and, through the mediation of cognitive structure, individuals' behavioral intention to participate in clinical trials. In addition, the researchers found that trust in doctors is positively related to favorable belief-based attitude toward clinical trial participation and willingness to enroll in future trials, and that risk judgment is negatively related to favorable attitude and behavioral intention (Yang et al., 2010a). Other studies have also reported a positive relationship of systematic processing to risk-related attitude change (Munoz, Chebat, & Suissa, 2010), behavioral intentions (Munoz et al., 2010; Wei, Zhao, Wang, Cheng, & Zhao, 2016), health-protective action (Hovick, Freimuth, Johnson-Turbes, & Chervin, 2011), and policy support (Yang, Rickard, Harrison, & Seo, 2014). Nonetheless, previous studies have only examined the relationships that risk information processing has with a few of the TPB variables, and research that expands the scope of theory testing to the broader RISP processes is needed.

III. RESEARCH QUESTIONS AND HYPOTHESES

The research questions and hypotheses raised in this study represent the relationships among the major components within the Risk Information Seeking and Processing model, the Heuristic-Systematic Model, and the Theory of Planned Behavior, emphasizing the role of systematic and heuristic processing in shaping attitude strength and subsequent behavioral intention. To start with, cognitive processes of attitude formation that are more immediately associated with information processing are examined. Based on Ajzen's research (Ajzen, 1991; Ajzen & Sexton, 1999), three measures of depth of processing (i.e., number of strongly held behavioral beliefs, strength of outcome evaluations, strength of cognitive structure) antecedent to attitude strength are examined in relation to information processing. Specifically, the following research question is posed:

RQ1: What are the relationships between individuals' processing of risk information and the precursors of the strength of attitude toward the behavior?

Prior research has suggested that as information processing goes more in-depth, attitudes formed through it tend to be stronger and more intensely held than those developed on the basis of more superficial (i.e., heuristic) forms of processing (Eagly & Chaiken, 1993; Griffin et al., 2002). Therefore, six directional hypotheses regarding RQ1 are generated. Systematic processing is expected to be positively related to the:

H1a: number of strongly held behavioral beliefs associated with the performance of a behavior;

H1b: strength of outcome evaluation associated with behavioral beliefs;

H1c: strength of cognitive structure (indirect attitude) toward the behavior.

In the meanwhile, heuristic processing will be negatively related to the:

H1d: number of strongly held behavioral beliefs associated with the performance of a behavior;

H1e: strength of outcome evaluation associated with behavioral beliefs;

H1f: strength of cognitive structure (indirect attitude) toward the behavior.

The TPB sets out to explain human behaviors by adopting a belief-based approach to measuring antecedent to attitudes. Cognitive structure is the indirect (i.e., belief-based) measure of attitude toward the behavior. As a surrogate for attitude in the TPB, cognitive structure is expected to be consistent with attitude both in terms of strength and direction. Therefore:

RQ2: What is the relationship of cognitive structure with attitude toward the behavior? Specifically:

H2a: Strength of cognitive structure will be positively related to strength of attitude toward the behavior.

H2b: Cognitive structure will be positively related to attitude toward the behavior.

The TPB proposes three major predictors to behaviors, namely a person's attitude toward the behavior, subjective norms, and perceived behavioral control. From a dispositional perspective, individuals' attitude toward a behavior should to some extent be consistent with their intention to perform the behavior and their subsequent action.

The perception that one's important others approve of or perform a behavior also motivates individuals to perform the behavior. Finally, increases in perceived ease of performing a behavior may also boost a person's behavioral intention and motivates action. Therefore, the following research questions and hypotheses are posited:

RQ3: What is the relationship of attitude toward the behavior with behavioral intention? Specifically:

H3: Attitude toward the behavior will be positively related to behavioral intention.

RQ4: What is the relationship of subjective norms with behavioral intention? Specifically:

H4: Subjective norms will be positively related to behavioral intention.

RQ5: What is the relationship of perceived behavioral control with behavioral intention? Specifically:

H5: Perceived behavioral control should be positively related to behavioral intention.

In addition to the TPB predictors, the present study investigates how attitude toward alternative behaviors may potentially influence the intention to perform a given risk-reducing behavior. Because this investigation is exploratory, the relationship will be examined via the following research question without directional hypothesis:

RQ6: What relationship does attitude toward alternative behaviors have with behavioral intention?

IV. METHOD

Study Context

The analysis of the present study is based on archival data drawn from the second wave of a three-wave panel design study conducted in two medium-sized metropolitan areas on the shores of the Great Lakes: Milwaukee, WI, on Lake Michigan, and Cleveland, OH, on Lake Erie, in the late 1990s. The survey was funded by a federal grant from the Agency for Toxic Substances and Disease Registry. In 1993, a tiny parasite called cryptosporidium entered the municipal drinking water system of Milwaukee from Lake Michigan, and produced the largest waterborne disease outbreak that has been ever documented in the history of the United States. Cryptosporidium can cause diarrhea and other illnesses in humans (Blair, 1995; Eisenberg, Lei, Hubbard, Brookhart, & Colford, Jr., 2005) and is hard to detect and remove from municipal tap water systems. Both Milwaukee and Cleveland draw their drinking water from the Great Lakes, and questions examining people's responses to potential hazards from waterborne parasites were included in the survey.

Besides the municipal tap water risk, the panel survey also examined people's responses to two other risks: one is a health risk that concerns the potential hazards from consuming Great Lakes fish that may contain polychlorinated biphenyls (PCBs) and other dangerous chemicals, and the second risk is an environmental risk that concerns threats posed to the health of the Great Lakes ecosystem by the cumulative effects of pollutants from industry, cities, and farms as concentrations of toxins such as dioxin,

lead, mercury, mirex, and toxaphene increased. To the purpose of the present study, data collected on people's responses to the municipal tap water risk were utilized.

Survey

The data in this study are drawn from the second wave of a panel design study conducted in Milwaukee, WI, and Cleveland, OH in the late 1990s. From October 1996 to March 1997, the Wisconsin Survey Research Laboratory (WSRL), a professional research organization associated with the University of Wisconsin-Extension, conducted telephone interviews with a random sample of 1,123 adult residents from the two cities (579 in Milwaukee and 544 in Cleveland), using random digit dialing. Respondents from contacted residences were chosen randomly within the households. The combined response rate was 55.2% (61.3% in Milwaukee and 50% in Cleveland) for the first wave of the study. From October 1997 through March 1998, the WSRL conducted the second wave of the study and successfully reinterviewed 716 (63.8%) of the respondents from the first wave (376 in Milwaukee and 340 in Cleveland). In order to control for sensitization in the panel, 171 new respondents were interviewed for the second wave, using the same procedures as were used for recruiting survey respondents in the first wave. The resulting sample size is a total *N* of 887 (441 in Milwaukee and 446 in Cleveland) in the second wave. Because of cost constraints, TPB variables were not included in the survey questionnaire until the second wave, and the third wave had to concentrate on PCBs in the fish. Therefore, only the second wave data are used in this analysis.

At the beginning of the telephone interview in the first wave, respondents were asked if they had consumed fish caught from the Great Lakes that year, or if they had intentionally avoided eating Great Lakes fish due to health concerns, in order to net those for whom eating Great Lakes fish is a relevant personal matter. Respondents who had eaten or refrained from eating Great Lakes fish were interviewed with questions covering fish consumption risks. Respondents to whom eating Great Lakes fish is not a relevant personal matter were randomly assigned to one of the other two hazard topics: tap water risks and risks to the Great Lakes ecosystem. New respondents in the second wave were similarly questioned at the beginning of the interview and assigned to one of the three hazard topics. Most questions covering the three hazard topics were constructed in an identical manner so that meta-testing of the RISP model across risks would be possible. During the interview process, items within a battery of questions (e.g., 5-point, Likert-type, agreement scale) were presented to respondents starting at a random point in the set, so as to minimize potential order effects. Each interview took about 27 minutes. Altogether, in the second wave, a total of 528 respondents provided their views about fish consumption risks (260 in Milwaukee and 268 in Cleveland), 204 were asked about tap water risks (111 in Milwaukee and 93 in Cleveland), and 155 were questioned about risks to the Great Lakes ecosystem (70 in Milwaukee and 85 in Cleveland). All required IRB and informed consent practices were followed throughout the study.

Measurement

Systematic Information Processing

Integrating major constructs from the HSM, the RISP model identifies systematic and heuristic processing as two basic modes of risk information processing. Systematic processing of risk information were measured with five items: “After I encounter information about this topic, I am likely to stop and think about it;” “If I need to act on this matter, the more viewpoints I get the better;” “After thinking about this topic, I have a broader understanding;” “It is important for me to interpret information about this topic in a way that applies directly to my life;” and “When I encounter information about this topic, I read or listen to most of it, even though I may not agree with its perspective.” Respondents indicated their agreement or disagreement with the statements on 5-point, Likert-type scales. Factor analysis of the five systematic processing variables and the four heuristic processing variables (see below) produced two distinct factors (see Appendix A). Systematic processing index was constructed using the weighted factor score (five items, omega = .69).

Heuristic Information Processing

Heuristic processing of risk information was measured similarly as respondents were asked to indicate on 5-point Likert-type scales their agreement or disagreement with four statements about how people personally deal with information about the given risk: “When I see or hear information about this topic, I rarely spend much time thinking about it;” “When I encounter information about this topic, I focus on only a few key points;” “If I need to act on this matter, the advice of one expert is enough for me;” and “There is far more information on this topic than I personally need.” Heuristic processing index was constructed using the weighted factor score (four items, omega = .68).

Strongly Held Behavioral Beliefs

The survey questionnaire in the second wave included items measuring TPB variables. Depending on the assigned hazard topic, respondents were asked to assess various aspects related to one of three target behaviors: avoiding eating fish from the local Great Lake (Lake Michigan for Milwaukee residents and Lake Erie for Cleveland residents), drinking bottled water instead of tap water drawn from the local Great Lake, and taking used or leftover oil and chemicals to a disposal center instead of tossing them into the trash or pouring them down the drain.

Respondents assigned to each hazard topic were asked to indicate the degree to which they took into account a set of behavioral beliefs when deciding whether or not to perform the given target behavior, their agreement or disagreement that the given target behavior would bring about certain outcomes or is associated with certain attributes, and their evaluations (i.e., the goodness or badness) of these outcomes and attributes. These behavioral beliefs items were derived from presurvey focus groups that were conducted by the WSRL in the spring of 1996 to elicit relevant, salient behavioral beliefs. In the tap water hazard scenario, respondents rated on 5-point Likert-type scales the extent to which they took into account (a) risk from a waterborne parasite, (b) time, (c) convenience, (d) expense, (e) risk from chemicals in the water, (f) refreshment, and (g) taste of the water when deciding whether or not to drink bottled water instead of tap water drawn from the local Great Lake. They also indicated their agreement or disagreement with how drinking bottled water instead of Great Lakes tap water would influence these factors, and whether they valued or disliked such outcomes.

Respondents can strongly (dis)agree with, (dis)agree with, or feel neutral about a behavioral belief that drinking bottled water would cause a certain outcome. Extreme

agreement or disagreement was coded as 1, and (dis)agreement and neutral were coded as 0. The number of strongly held behavioral beliefs was calculated for each respondent by counting how many of these seven behavioral beliefs the respondent strongly agreed or disagreed with (M = .36, SD = .93). Including those extreme responses only was expected to help minimize social desirability biases and respondent agreeability in the telephone interview situation.

Strength of Outcome Evaluations

Respondents were asked to evaluate the outcome of each of the seven behavioral beliefs. On 5-point Likert-type scales, respondents indicated how they agreed or disagreed with the following statements: "Anything that lowers my risk of becoming ill from a parasite is good;" "Anything that takes a lot of time is bad;" "Anything that is convenient is good;" "Anything that lowers my risk of becoming ill from chemicals is good;" "Anything that is inexpensive is good;" "Any water that is not refreshing is bad;" and "Tap water drawn from Lake Michigan/Erie tastes good." Responses were folded over around "feel neutral" such that strong agreement or disagreement was coded as high (coded as 3), (dis)agreement as medium (coded as 2), and feel neutral as low (coded as 1). The seven items were then summed to create a single index reflecting strength of belief outcome evaluations (Cronbach's Alpha = .70).

Cognitive Structure

Following the expectancy-value model on which TPB is relied, each behavioral belief was multiplied by its corresponding outcome evaluation. The resulting product compounds were then summed to create the variable of cognitive structure (Cronbach's Alpha = .57).

Because the strength of cognitive structure, not direction, is especially relevant to depth of information processing, a measure of strength of cognitive structure was obtained by converting each negative belief × evaluation compound into positive one, with positive and zero-value compounds remaining the same. Then a measure of strength of cognitive structure was obtained by summing all the belief × evaluation compounds.

Attitude toward the Behavior

Attitude toward the behavior of drinking bottled water instead of Great Lakes tap water was measured using five items. Respondents were asked to rate on 5-point Likert-type scales how they agreed or disagreed with the following statements: "For me to drink bottled water instead of tap water drawn from Lake Michigan/Erie would be a good thing to do;" "For me to drink bottled water instead of tap water drawn from Lake Michigan/Erie would be unpleasant for me" (reversely coded); "For me to drink bottled water instead of tap water drawn from Lake Michigan/Erie would be beneficial for me;" "For me to drink bottled water instead of tap water drawn from Lake Michigan/Erie would be a useless thing to do" (reversely coded); and "For me to drink bottled water instead of tap water drawn from Lake Michigan/Erie would be a rewarding thing to do." A summated scale reflecting attitude toward the behavior was obtained by averaging the five items (Cronbach's Alpha = .78).

As noted earlier, because the strength of attitude toward the behavior, not direction, is of primary relevance to depth of information processing, a measure of strength of attitude was obtained by folding the original attitude measure, which centered around 3 ("Feel Neutral"), such that a continuum of attitude strength was formed with

neutral at the lowest end (coded as 3) and strong (dis)agreement at the highest end (coded as 5) (M = 3.54, SD = .38).

Subjective Norms

One 5-point Likert-type scale item was used to measure respondents' subjective norms as they rated the extent to which they agreed with the statement: "Most people who are important to me think that I should drink bottled water instead of tap water drawn from Lake Michigan/Erie."

Perceived Behavioral Control

Perceived behavioral control was measured using two items. Respondents were asked to indicate their agreement with the following statements on 5-point Likert-type scales: "If I wanted to, I could easily drink bottled water instead of tap water drawn from Lake Michigan/Erie;" and "I have personal control over whether or not I would drink bottled water instead of tap water drawn from Lake Michigan/Erie." A summated scale of perceived behavioral control was obtained by averaging the two items (Cronbach's Alpha = .74).

Behavioral Intention

Behavioral intention in regard to drinking bottled water rather than Great Lakes tap water was measured with one item, as respondents rated on a 5-point Likert-type scale their agreement with the statement that "Given the opportunity to drink tap water from Lake Michigan/Erie in the next few days, I would definitely drink bottled water instead."

Alternative Behavior

In addition to the RISP and TPB variables, attitudes toward alternative risk-coping behaviors were also measured in order to investigate how these attitudes may influence a person's intention to perform a given risk-coping behavior. Besides drinking bottled water instead of tap water drawn from the local Great Lake, three other alternative behaviors were examined: boiling the tap water, using a filtering device before drinking the tap water, and drinking other beverages instead of the tap water. Respondents indicated on 5-point Likert-type scales their attitudes toward these three alternative behaviors. A single index was then created by summing the three alternative behavior items (M = 9.25, SD = 2.49, Cronbach's Alpha = .70).

Control Variables

Five demographic variables, panel sensitization, and community were used as control variables for the present study. The demographic variables include gender, age, minority status (White or non-White), education (eighth grade or less coded as 1, some high school 2, high school graduate 3, some college 4, college graduate 5, and post graduate or professional 6), and annual household income (before taxes). Descriptive statistics for the demographic variables are as below: gender (53.4% females), age (M = 49.08, SD = 16.45), minority status (24% non-Whites), education (M = 4.06, SD = 1.21), and income (M = 42,410, SD = 25,070). Respondents who were newly added to the second wave were coded 0 for panel sensitization (20.6%); those who were interviewed during the previous wave were coded 1. Respondents' community—Milwaukee (54.4%) or Cleveland—was also used as a control variable.

V. RESULTS

The analyses performed were focused on two sets of relationships: a) relationships that the two variables of risk information processing had with the four measures of depth of processing—the number of strongly held behavioral beliefs, the strength of evaluations of belief outcomes, the strength of cognitive structure (or belief-based measure of attitude), and the strength of attitude toward the behavior. Systematic processing was expected to be positively related to the first three measures (H1a through H1c), while heuristic processing negatively related to the same three variables (H1d through H1f). In particular, because cognitive structure is an indirect measure of attitude, a positive relationship between the strength of cognitive structure and attitude strength (H2a) and between cognitive structure and attitude toward the behavior (H2b) was also anticipated; and b) relationships of the three predictors (i.e., attitude toward the behavior, subjective norms, and perceived behavioral control) as proposed by the TPB to behavioral intention, as well as how attitude toward alternative risk-coping behaviors might affect intention to perform a target behavior (RQ6). Specifically, attitude toward the behavior was expected to be positively related to behavioral intention (H3). Subjective norms and perceived behavioral control should also correlate positively with behavioral intention (H4 and H5).

Results from partial correlation analyses reveal that the number of strongly held behavioral beliefs regarding the performance of a target risk-coping behavior is positively related to systematic processing (partial $r = .29$, $p \leq .001$, one-tailed), and negatively related to heuristic processing (partial $r = -.17$, $p \leq .01$, one-tailed), as shown in Table 1.

Table 1
Relationship of Risk Information Processing to Number of Strongly Held Behavioral Beliefs, Evaluation Strength, Strength of Cognitive Structure, and Attitude Strength
Partial Correlation Coefficients

	Number of Strongly Held Behavioral Beliefs	Strength of Outcome Evaluation	Strength of Cognitive Structure	Strength of Attitude toward the Behavior
Systematic Processing	.289***	.227***	.222**	.040
Heuristic Processing	-.173*	-.134^{+}	-.119^{+}	-.123^{+}

Note. N = 204. Control variables: gender, age, education, minority status, income, community, and panel sensitization.
Significance key: *$p \leq .05$ **$p \leq .01$ ***$p \leq .001$, two-tailed. $^{+}p \leq .05$, one-tailed.

Evaluation strength of belief outcomes is also positively related to systematic processing (partial r = .23, $p \leq .001$, one-tailed), and negatively related to heuristic processing (partial r = -.13, $p \leq .05$, one-tailed). Furthermore, this pattern is repeated for cognitive structure strength, as it is positively related to systematic processing (partial r = .22, $p \leq .001$, one-tailed) and negatively related to heuristic processing (partial r = -.12, $p \leq .05$, one-tailed). Additionally, strength of attitude toward the behavior is also found to be negatively related to heuristic processing (partial r = -.12, $p \leq .05$, one-tailed). Thus, controlling for gender, age, education, minority status, income, community, and panel sensitization, H1a through H1f were supported.

A further look at the path analysis of strength of attitude toward the behavior (see Figure 1 and Table 2), with all demographic, community, and panel sensitization variables being controlled for, shows that systematic processing has an indirect positive effect on attitude strength, through the mediation of cognitive structure strength ($\beta = .06$, $p \leq .05$, one-tailed). Strength of cognitive structure, in the meanwhile, has a direct positive effect on attitude strength ($\beta = .31$, $p \leq .01$, one-tailed). Hence H2a received empirical support. Together, systematic processing, heuristic processing, and strength of cognitive structure account for approximately 9% of variance in attitude strength ($R^2 = .09$, $p \leq .05$). Moreover, systematic processing has direct positive influence on number of strongly held behavioral beliefs ($\beta = .27$, $p \leq .01$, one-tailed) and strength of outcome evaluations ($\beta = .21$, $p \leq .01$, one-tailed), in addition to cognitive structure strength ($\beta = .21$, $p \leq .05$, one-tailed). No such relationships, however, were found for heuristic processing. Nonetheless, since heuristic processing and systematic processing are inter-correlated (partial r = -.44, $p \leq .05$), it is likely that the effects of heuristic processing on

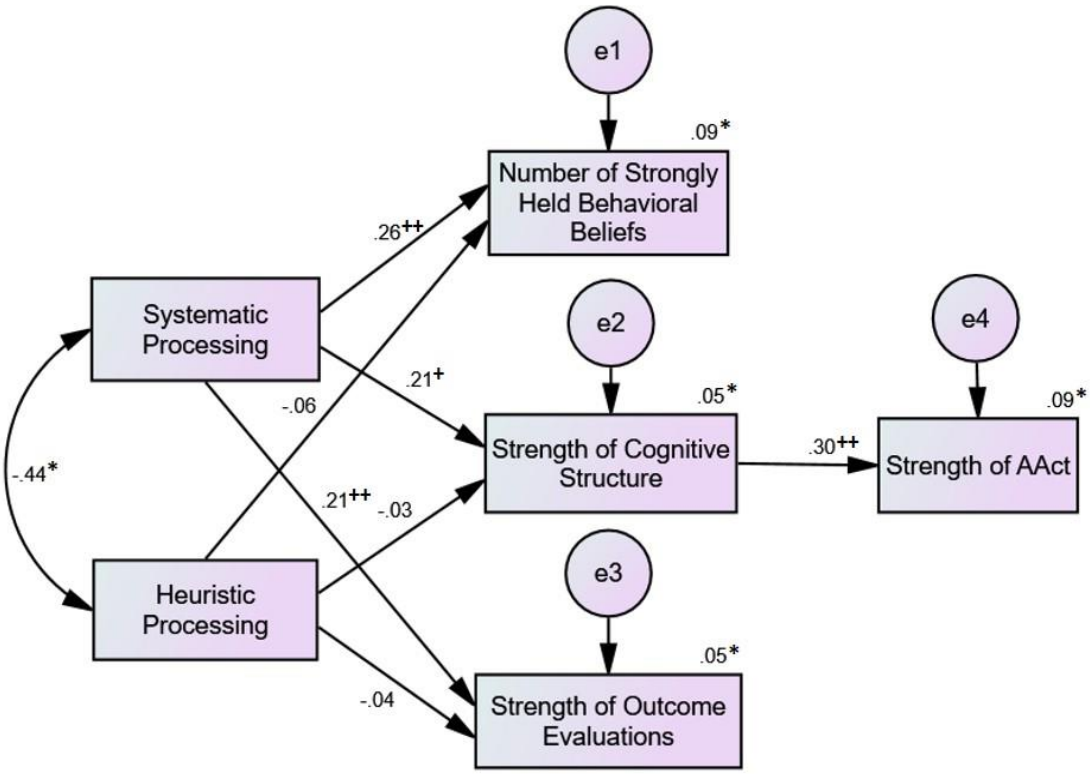

Figure 1 *Path Diagram of Strength of Attitude toward the Behavior*

Notes. N = 204. Control variables: gender, age, education, minority status, income, community, and panel sensitization.
RMSEA = .261. PCLOSE = .000.
Significance key: $^{*}p \leq .05$ $^{**}p \leq .01$ $^{***}p \leq .001$, two-tailed. $^{+}p \leq .05$ $^{++}p \leq .01$ $^{+++}p \leq .001$, one-tailed.

Table 2
Standardized Total and Indirect Effects of Predictors of Strength of Attitude toward the Behavior
Path Coefficients beta

	Heuristic Processing	Systematic Processing	Strength of Cognitive Structure
Number of Strong Beliefs	-.056	.265^{++}	
Evaluation Strength	-.042	.209^{++}	
Strength of Cognitive Structure	-.026	.210^{+}	
Attitude Strength	-.008 (-.008)	.064^{+} (.064^{+})	.305^{++}

Notes. N = 204. Table entries are standardized total effects. Parenthetical entries are standardized indirect effects. Control variables: gender, age, education, minority status, income, community, and panel sensitization. Significance key: $^{+}p \leq .05$ $^{++}p \leq .01$ $^{+++}p \leq .001$, one-tailed.

the four endogenous variables were reduced to non-significance when covariance with systematic processing was controlled for in path analysis. This may indicate that systematic processing is a more robust predictor to depth of processing and attitude strength than is heuristic processing (Griffin et al., 2002). Altogether, controlling for demographic, community, and panel sensitization variables, systematic processing and heuristic processing account for approximately 9% of variance in number of strongly held behavioral beliefs ($R^2 = .09$, $p \leq .05$), 5% of variance in strength of cognitive structure ($R^2 = .05$, $p \leq .05$), and 5% of variance in strength of outcome evaluations ($R^2 = .05$, $p \leq .05$), as shown in Figure 1.

Path analysis was also conducted to test the relationships that behavioral intention had with its potential predictors (see Figure 2 and Table 3). With all demographic, community, and panel sensitization variables being controlled for, cognitive structure has a direct positive effect on attitude toward the behavior ($\beta = .59$, $p \leq .01$, one-tailed), accounting for approximately 35% of variance in attitude toward the behavior ($R^2 = .35$, $p \leq .05$). Additionally, attitude toward the behavior has a direct positive impact on behavioral intention ($\beta = .36$, $p \leq .01$, one-tailed), and serves as a mediator of the influence of cognitive structure on behavioral intention ($\beta = .21$, $p \leq .01$, one-tailed). Subjective norms also have a direct positive effect on behavioral intention ($\beta = .29$, $p \leq .01$, one-tailed). Therefore, H2b, H3, and H4 were empirically supported. Unlike what is proposed in the TPB, however, a hypothesized positive relationship between perceived behavioral control and behavioral intention is not found in the present analysis. This is consistent with a considerable portion of prior research (Cheung, Chan, & Wong, 1999; Kaiser & Gutscher, 2003; Shaw, Radler, Chenoweth, Heilberger, & Dearlove, 2011).

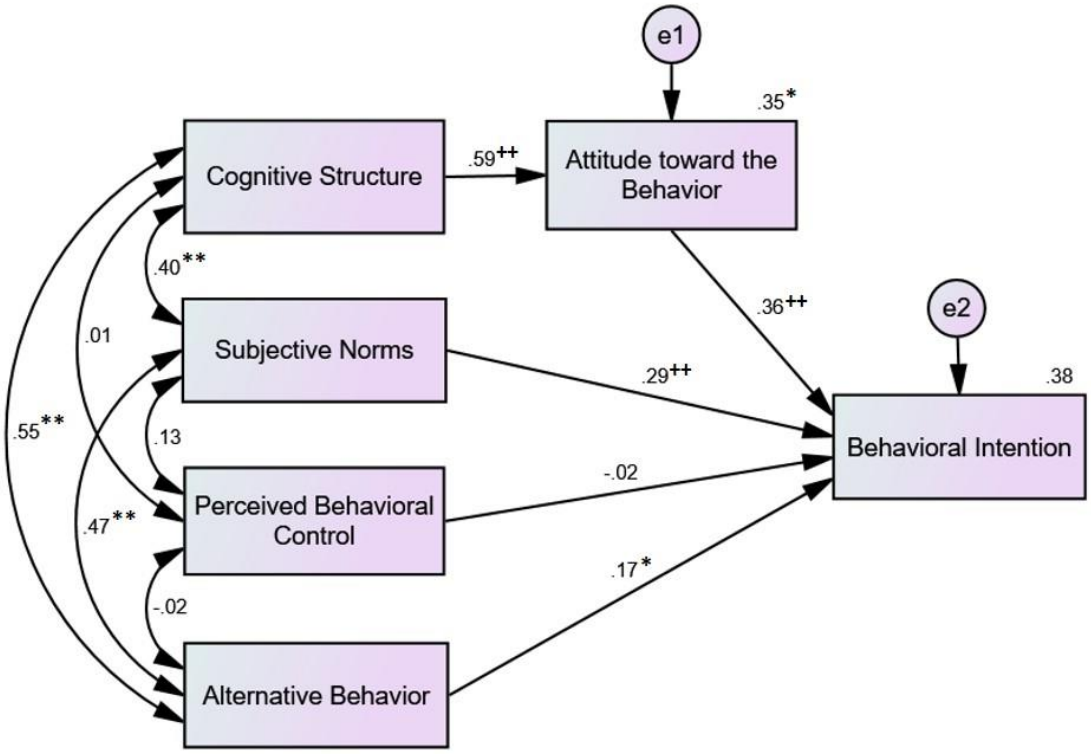

Figure 2 *Path Diagram of Behavioral Intention*

Notes. N = 204. Control variables: gender, age, education, minority status, income, community, and panel sensitization.
RMSEA = .136. PCLOSE = .009.
Significance key: *$p \leq .05$ **$p \leq .01$ ***$p \leq .001$, two-tailed. $^{+}p \leq .05$ $^{++}p \leq .01$ $^{+++}p \leq .001$, one-tailed.
Multiple regression shows R squared for behavioral intention as significant at $p \leq .001$.

Table 3
Standardized Total and Indirect Effects of Predictors of Behavioral Intention
Path Coefficients beta

	Cognitive Structure	Subjective Norms	Perceived Behavioral Control	Alternative Behavior	Attitude toward the Behavior
Attitude toward the Behavior	.588^{++}				
Behavioral Intention	.213^{++} (.213^{++})	.292^{++}	-.024	.174*	.363^{++}

Notes. N = 204. Table entries are standardized total effects. Parenthetical entries are standardized indirect effects.
Control variables: gender, age, education, minority status, income, community, and panel sensitization.
Significance key: $^{*}p \leq .05$, two-tailed. $^{+}p \leq .05$ $^{++}p \leq .01$ $^{+++}p \leq .001$, one-tailed.

Given the high level of PBC among respondents (M = 4.06, SD = .54), the predictive strength of PBC to behavioral intention may have diminished as a result of the elevated volitional control over the performance of drinking bottled water (Ajzen, 1991). H5 was hence rejected. In addition, the potential relationship between behavioral intention and individuals' attitude toward alternative behaviors was also explored. Unexpectedly, alternative behavior has a direct positive effect on behavioral intention ($\beta = .17$, $p \leq .05$). Multiple regression analysis reveals that among the three alternative behaviors examined (boiling tap water, using filtering device, drinking other beverages), boiling tap water carries more weight than the other two alternative behaviors in predicting behavioral intention (data not shown). The path analysis also finds three positive correlations between cognitive structure and alternative behavior (partial $r = .55$, $p \leq .01$), between cognitive structure and subjective norms (partial $r = .40$, $p \leq .01$), and between subjective norms and alternative behavior (partial $r = .47$, $p \leq .01$), as shown in Figure 2.

Hierarchical regression analyses reveal that with all demographic, community, and panel sensitization variables being controlled for, the hypothesized relationships account for about 42.5% of variance in behavioral intention (Adjusted $R^2 = .43$, $p \leq .001$), as shown in Table 4. The model by model comparison indicates that attitude toward the behavior is the main intervening variable between cognitive structure and behavioral intention, as the relationship between cognitive structure and behavioral intention was largely reduced when AAct was entered as a block. The relationship between cognitive structure and behavioral intention was further reduced, though not as much, when SN was controlled for. This might suggest some crossover effects between attitude toward the behavior and subjective norms, as these predictors may not always be independent

Table 4
Predictors of Behavioral Intention
Hierarchical Regression Analyses Standardized Coefficients beta

Predictors	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Gender[a]	.032	.005	-.050	-.058	-.057	-.060
Age	-.047	.034	.105	.083	.079	.098
Education	-.114	-.082	-.039	-.053	-.050	-.032
Minority status[b]	.117	.059	.062	.050	.054	.047
Income	-.110	-.135	-.090	-.064	-.065	-.052
Community[c]	.010	.008	-.030	-.014	-.016	-.014
Panel sensitization[d]	-.105	-.081	-.082	-.105	-.106	-.119*
Cognitive structure		.429***	.165*	.082	.079	.029
Attitude toward the behavior			.466***	.387***	.388***	.353***
Subjective norms				.314***	.319***	.276***
Perceived behavioral control					-.033	-.023
Alternative behavior						.166*
Multiple R	.267*	.493***	.606***	.666***	.667***	.677***
Adjusted R2	.038	.212	.338	.415	.413	.425

Note. N = 204.
a. Coding: females high, males low.
b. Coding: non-White high, White low.
c. Coding: Cleveland high, Milwaukee low.
d. Coding: panel member high, new respondent low.
Significance key: *$p \leq .05$ **$p \leq .01$ ***$p \leq .001$

from each other. Unexpectedly, the alternative behavior variable appears to be a suppressor of the negative relationship between panel sensitization and behavioral intention. When attitude toward alternative behaviors was controlled for, it turned out that new respondents had stronger behavioral intention to drink bottled water instead of local Great Lake tap water in the following days ($\beta = -.12$, $p \leq .05$). Possible explanations are discussed in the next section.

The main analyses performed in the present study suggest several follow-up analyses as well. First, an intriguing question is whether number of strongly held behavioral beliefs and strength of outcome evaluations also predict to attitude strength, since conceptually they are surrogates for attitude strength as well. Controlling for gender, age, education, minority status, income, community, and panel sensitization, follow-up path analysis found that number of strongly held behavioral beliefs had a direct positive effect on attitude strength ($\beta = .30$, $p \leq .01$, one-tailed), while no such relationship was found between evaluation strength and attitude strength. Moreover, linking number of strongly held behavioral beliefs and attitude strength lowered the relationship between cognitive structure strength and attitude strength to non-significance, although the relationship remained positive. It should be noted that cognitive structure strength contains both belief strength and evaluation strength. Controlling for belief strength in particular might have sapped the relationship between cognitive structure strength and attitude strength by removing much of the role of belief strength within cognitive structure strength. Nonetheless, whether that is a measurement issue, an analytic issue, or a theoretical issue should be the key focus of future investigations.

A second follow-up question concerns whether heuristic processing and systematic processing also predict to cognitive structure (bidirectional), not just cognitive structure strength. Controlling for demographic, community, and panel sensitization variables, path analysis showed that systematic processing indeed had a direct positive effect on cognitive structure ($\beta = .21$, $p \leq .05$, one-tailed). Moreover, systematic processing had indirect positive effects on AAct (mediated by cognitive structure; $\beta = .12$, $p \leq .01$, one-tailed) and on BI (mediated by cognitive structure and AAct; $\beta = .05$, $p \leq .01$, one-tailed). These findings are consistent with previous research (Yang et al., 2010a). From a theory development perspective, these results showed empirical support for the usefulness of integrating HSM and TPB variables by incorporating systematic processing as antecedent to risk-related attitudes and behaviors.

VI. DISCUSSION AND CONCLUSIONS

Utilizing the Risk Information Seeking and Processing (RISP) model (Griffin et al., 1999), the Heuristic-Systematic Model (Eagly & Chaiken, 1993), and the Theory of Planned Behavior (Ajzen, 1988) as the theoretical foundations, this study sets out to examine the central proposition that the basic modalities of systematic processing and heuristic processing of risk information are related to depth of processing, which predicts to attitude stability and behavioral intention related to the performance of a given risk-coping behavior. The theoretical underpinnings can be found in the HSM proposition that more intense, effortful systematic processing leads to more stable attitudes, whereas attitudes developed on the basis of heuristic processing are more volatile and less resistant to counterargument (Eagly & Chaiken, 1993). The TPB provides a more detailed account of this psychological mechanism. Specifically, as processing effort increases, individuals tend to hold a greater number of strong behavioral beliefs, their evaluations of the outcomes of these behavioral beliefs tend to become more extreme, and the resulting cognitive structure, or the belief-based measure of attitude of which beliefs and evaluations are a part, strengthens at the same time. Cognitive structure then predicts to attitude toward the behavior, which, along with other TPB variables including subjective norms and perceived behavioral control, further predicts to behavioral intention, and ultimately, behavior.

Findings from the present analysis have largely supported these theoretical propositions. Individuals who engaged in more systematic processing of information about tap water risks turned out to possess a greater number of strongly held behavioral beliefs regarding drinking bottled water, have more polarized evaluations of the goodness

and badness of the outcomes of those behavioral beliefs, and have stronger cognitive structure and attitude when considering drinking bottled water instead of Great Lakes tap water. Furthermore, the findings showed that cognitive structure, both in terms of direction and strength, appears to be consistent with attitude toward the behavior. Individuals who harbored a favorable attitude toward drinking bottled water indicated greater intention to drink bottled water instead of local Great Lake tap water. Those who felt greater social pressures to drink bottled water instead of Great Lakes tap water also reported stronger intention to do so.

The present analysis did not find a hypothesized positive relationship between perceived behavioral control and intention to drink bottled water, however. This may be due at least to two reasons. First, there are only two items in the PBC index, which may have lowered the reliability of the scale given that reliability is largely a function of the number of items in a scale when there are adequate inter-item correlations (Griffin et al., 2002). The moderate reliability may have also attenuated the effect size of the relationship being examined to the extent that it vanishes. Future studies should refine the measurement of the PBC variable and include more items as time and cost allow. Another possible explanation for the poor performance of the PBC variable concentrates on the theorizing of PBC as an independent behavior motivator. While having a greater sense of volitional control over performing a behavior may increase the possibility that a person performs the behavior *when s/he wants to*, a person is not necessarily motivated to perform the behavior on the mere basis that s/he thinks s/he has the ability to do so. Ajzen (1991) also pointed out that as individuals' volitional control over performing a behavior increases, the predictive value of the PBC variable decreases. Other researchers have

suggested that PBC is a significant predictor in some behavioral domains but not in others and thus is a non-universally applicable and nongeneralizable part of the TPB (Kaiser & Gutscher, 2003; Shaw et al., 2011).

Less examined in prior risk communication research, how alternative behaviors may affect intention to perform a given risk-reducing behavior was explored in the present analysis. In contrast to the plausible prospect that a favorable attitude toward alternative behaviors may dilute people's intention to perform a target risk-reducing behavior, individuals who expressed a more favorable attitude toward boiling tap water before drinking it also showed greater behavioral intention to drink bottled water. One possibility, grist for future research, is that folks who perceive higher risks from drinking Great Lakes tap water and who have stronger intention to avoid such risks are open to a wider range of strategies that show the promise of protecting them from the risks, and that they tend to be more willing to carry out those risk-coping behaviors than their less risk-averse counterparts. Future research should examine these factors and associated processes more fully.

Although not central to the research concerns of this study, an additional finding warrants particular comment. Attitude toward alternative behaviors appears to suppress the negative relationship between panel sensitization and behavioral intention. In other words, previous panel members have lesser behavioral intention to drink bottled water than new respondents, but this relationship is suppressed under the influence of attitude toward alternative behaviors. One possible scenario here is that respondents who participated in the first wave became sensitized with the risk issue of drinking Great Lakes tap water. It is likely that those first wave interviews made potential hazards

lurking in Great Lakes tap water a more salient concern to these panel members and evoked thoughts on the risk topic. As panel members continued to process relevant risk information and reflect on available coping strategies, they might figure that drinking bottled water was not the best option to handle the risks, leading to a dampened intention to drink bottled water. In the meanwhile, these previous panel members were motivated to consider an array of available risk-reducing options and might conclude that other methods such as boiling tap water before drinking it would be as good as, if not better than, drinking bottled water. Given the finding that favorable attitude toward alternative behaviors are associated with stronger intention to drink bottled water, panel members' preferences for alternative risk-reducing strategies may have counterbalanced their lack of enthusiasm for drinking bottled water. In fact, post hoc analysis reveals a positive relationship between panel sensitization and attitude toward alternative behaviors (partial $r = .14$, $p \leq .05$), with gender, age, education, minority status, income, community, and behavioral intention being controlled for. This unanticipated finding opens avenues for new research. Sorting these dynamics out could be empirically and theoretically fruitful for future investigations.

There are several limitations of this study that need to be acknowledged. First, the data on which this analysis is based were collected in the late 1990s, and therefore do not necessarily reflect current trends in public opinion on the risk issue of drinking tap water as well as on associated risk-coping behaviors such as drinking bottled water. Nonetheless, the age of the dataset is irrelevant to the research concerns raised in this study as the major focus here is theory testing based on three conceptual models. Second, the measures of some variables such as perceived behavioral control could be improved.

If time and cost allow, future studies should include more items in constructing single scales in order to enhance reliabilities. Third, the telephone interview setting dictated the use of 5-point Likert-type scales, instead of 7-point scales, which may have attenuated the effect size for some relationships examined, and may have diminished what would otherwise be significant relationships.

Nonetheless, findings from this study have important theoretical and practical implications. From the standpoint of enhancing the effectiveness of risk communication practice, these findings confirm that there is value in engaging the audience in more in-depth and effortful deliberations of given risk issues and available coping options. Risk communication campaigns that are aimed at inducing sustainable behavioral changes should seek ways to catalyze systematic processing of judgment-relevant risk information in the audience, given that attitudes formed on the basis of systematic processing are more enduring and are more likely to lead to behavioral changes. On the one hand, risk managers may attain this goal by investing effort in public engagement practices and outreach activities (Chen & Deng, 2007; Rose, Korzekwa, Brossard, Scheufele, & Heisler, 2017). One the other hand, as previous RISP research (Griffin, Dunwoody, Neuwirth, & Giese, 1999; Griffin, Dunwoody, & Yang, 2012; Griffin et al., 2004; Griffin, Yang, ter Huurne, Boerner, Ortiz, & Dunwoody, 2008; Kahlor, Dunwoody, Griffin, & Neuwirth, 2006; Kahlor et al., 2003; Yang et al., 2014; Yang, Seo, Rickard, & Harrison, 2015) has noted, risk managers should also take into account elements that may lead to systematic processing when they are crafting and delivering risk messages.

In spite of the noble goal of facilitating systematic processing, situations can arise where systematic processing can hardly be instigated in audience members, due to their

lack of capacity and/or motivation to exert necessary processing effort (Eagly & Chaiken, 1993). When this is the case, risk managers should find ways to identify and utilize effective heuristic cues that may help promote health attitudes and behaviors in specific audiences. Particularly, as the present study finds, the role of subjective norms in perpetuating behavioral adoption and maintenance is worthy of practical attention. Subjective norms may work as a powerful heuristic that triggers heuristic processing in audience members in the presence of information that contains normative cues and thereafter fosters the establishment of health attitudes and adoption of preventive actions. Hence, risk managers may profit from incorporating normative cues into message design. Previous studies have also found that heightened perceptions of associated social pressures can boost perceived issue salience (Spartz, Su, Griffin, Brossard, & Dunwoody, 2015) and behavioral intention (Griskevicius, Cialdini, & Goldstein, 2008; Howell, Shaw, & Alvarez, 2015; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007; Shaw et al., 2011).

Furthermore, from a theory development perspective, results from the current analysis suggest the usefulness of linking the HSM, RISP, and TPB variables, particularly that of incorporating systematic processing as antecedent to cognitive structure, attitude, and behavior. This theory integration allows for a richer understanding of the cognitive processes of risk-related attitudes and behaviors, and for more precise prediction of these persuasive outcomes. Findings from this study identify important pathways to enhance communication effort aimed at facilitating adoption of health behaviors, which are still applicable to many of today's issues of concern including water quality risk issues. For example, research to date suggests that capacity (both actual and

perceived capacity) to exercise effortful processing is a prerequisite for systematic processing of risk information (Eagly & Chaiken, 1993; Griffin et al., 2008). It appears that processing capacity is positively associated with formal education and with knowledge that individuals already possess in the risk domain (Griffin et al., 2008). Therefore, risk managers may need to make extra effort to ensure that risk information is sufficiently comprehensible for those less educated and less knowledgeable audiences in order for systematic processing to happen. One such effort, for instance, is to initiate public educational programs that are intended to improve various audiences' capacity to understand and evaluate risk information. In the meanwhile, risk managers are advised to take steps to minimize potential situational constraints on effortful processing. For instance, to allow for ample time for systematic processing and reduce the cost incurred on the audience's part, risk managers could consider distributing risk information through information channels that are more readily accessible to the audience.

Finally, findings from this study confirm the value of an audience-based approach to risk communication, which means understanding audience members' processing needs and catering to these needs with individualized communication strategies. Moreover, the linked mechanisms of processing modalities, depth of processing, attitude stability, and behavioral intention have implications that go beyond the realm of risk communication, to other research contexts where information processing, attitude, and behavior are the key elements of inquiry.

BIBLIOGRAPHY

Ajzen, I. (1988). *Attitudes, personality, and behavior*. Milton Keynes, UK: Open University Press.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

Ajzen, I., & Driver, B. L. (1991). Prediction of leisure participation from behavioral, normative, and control beliefs: An application of the theory of planned behavior. *Leisure Science, 13*, 185-204.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I., & Sexton, J. (1999). Depth of processing, belief congruence, and attitude-behavior correspondence. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 117-138). New York: Guilford.

Anadu, E. C., & Harding, A. K. (2000). Risk perception and bottled water use. *Journal - American Water Works Association, 92*(11), 82-92.

Blair, K. (1995). Cryptosporidium and public health. *Journal of Environmental Health, 58*(2), 34-36.

Chen, S., & Chaiken, S. (1999). The heuristic-systematic model in its broader context. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 73-96). New York: Guilford.

Chen, D.-S., & Deng, C.-Y. (2007). Interaction between citizens and experts in public deliberation: A case study of consensus conferences in Taiwan. *East Asian Science Technology and Society an International Journal, 1*(1), 77-97.

Cheung, S. F., Chan, D. K., & Wong, Z. S. (1999). Reexamining the theory of planned behavior in understanding wastepaper recycling. *Environment and Behavior, 31*(5), 587-612.

Doria, M. F. (2006). Bottled water versus tap water: Understanding consumers' preferences. *Journal of Water and Health, 4*(2), 271-276.

Dunwoody, S., & Griffin, R. J. (2014). The role of channel beliefs in risk information seeking. In J. Arvai & L. Rivers III (Eds.), *Effective risk communication* (pp. 220-233). New York, NY: Routledge.

Dunwoody, S., & Griffin, R. J. (2015). Risk information seeking and processing. In H. Cho, T. Reimer, & K. A. McComas (Eds.), *The sage handbook of risk communication* (pp. 102-116). Thousand Oaks, CA: Sage Publications.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes.* Fort Worth, TX: Harcourt Brace and Jovanovich.

Eisenberg, J. N. S., Lei, X., Hubbard, A. H., Brookhart, M. A., & Colford, Jr., J. M. (2005). The role of disease transmission and conferred immunity in outbreaks: Analysis of the 1993 cryptosporidium outbreak in Milwaukee, Wisconsin. *American Journal of Epidemiology, 161*(1), 62-72.

Fishbein, M., & Azjen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Griffin, R. J., Dunwoody, S., & Neuwirth, K. (1999). Proposed model of the relationship of risk information seeking and processing to the development of preventive behaviors. *Environmental Research, 80*, S230-S245.

Griffin, R. J., Dunwoody, S., Neuwirth, K., & Giese, J. (1999, May). *The relationship of information sufficiency to seeking and processing risk information*. Paper presented at the annual convention of the International Communication Association, San Francisco, CA.

Griffin, R. J., Dunwoody, S., & Yang, Z. J. (2012). Linking risk messages to information seeking and processing. In C. T. Salmon (Ed.), *Communication yearbook 36* (pp. 323-362). New York, NY: Taylor & Francis.

Griffin, R. J., Neuwirth, K., Giese, J., & Dunwoody, S. (1999, August). *The relationship of risk information processing to consideration of behavioral beliefs*. Paper presented at the annual meeting of the Association for Education in Journalism and Mass Communication, New Orleans, LA.

Griffin, R. J., Neuwirth, K., Giese, J., & Dunwoody, S. (2002). Linking the heuristic-systematic model and depth of processing. *Communication Research, 29*(6), 705-732.

Griffin, R. J., Powell, M., Dunwoody, S., Neuwirth, K., Clark, D., & Novotny, V. (2004, August). *Testing the robustness of a risk information processing model*. Paper presented at the annual meeting of the Association for Education in Journalism and Mass Communication, Toronto, Ontario, Canada.

Griffin, R. J., Yang, Z., ter Huurne, E., Boerner, F., Ortiz, S., & Dunwoody, S. (2008). After the flood: Anger, attribution, and the seeking of information. *Science Communication, 29*(3), 285-315.

Griskevicius, V., Cialdini, R. B., & Goldstein, N. J. (2008). Social norms: An underestimated and underemployed lever for managing climate change. *International Journal of Sustainability Communication, 3*, 5-13.

Hovick, S. R., Freimuth, V. S., Johnson-Turbes, A., & Chervin, D. D. (2011). Multiple health risk perception and information processing among African Americans and Whites living in poverty. *Risk Analysis, 31*(11), 1789-1799.

Howell, A. P., Shaw, B. R., & Alvarez, G. (2015). Bait shop owners as opinion leaders: A test of the theory of planned behavior to predict pro-environmental outreach behaviors and intentions. *Environment and Behavior, 47*(10), 1107-1126.

Kahlor, L., Dunwoody, S., Griffin, R. J., & Neuwirth, K. (2006). Seeking and processing information about impersonal risk. *Science Communication, 28*(2), 163-194.

Kahlor, L. A., Dunwoody, S., Griffin, R. J., Neuwirth, K., & Giese, J. (2003). Studying heuristic-systematic processing of risk communication. *Risk Analysis, 23*(2), 355-368.

Kaiser, F. G., & Gutscher H. (2003). The proposition of a general version of the theory of planned behavior: Predicting ecological behavior. *Journal of Applied Social Psychology, 33*(3), 586-603.

Lutz, R. J. (1977). An experimental investigation of causal relations among cognitions, affect, and behavioral intention. *Journal of Consumer Research, 3*, 197-208.

Munoz, Y., Chebat, J. C., & Suissa, J. A. (2010). Using fear appeals in warning labels to promote responsible gambling among VLT players: The key role of depth of information processing. *Journal of Gambling Studies, 26*(4), 593-609.

Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 19, pp. 123-205). New York, NY: Academic Press.

Petty, R. E., & Krosnick, J. A. (1995). Attitude strength: An overview. In R. E. Petty & J. A. Krosnick (Eds.), *Attitude Strength: Antecedents and consequences* (pp. 1-24). Mahwah, NJ: Lawrence Erlbaum Associates.

Pierro, A., Mannetti, L., Kruglanski, A. W., Klein, K., & Orehek, E. (2012). Persistence of attitude change and attitude-behavior correspondence based on extensive processing of source information. *European Journal of Social Psychology, 42*(1), 103-111.

Rose, K. M., Korzekwa, K., Brossard, D., Scheufele, D. A., & Heisler, L. (2017). Engaging the public at a science festival: Findings from a panel on human gene editing. *Science Communication, 39*(2), 250-277.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychological Science, 18*(5), 429-434.

Shaw, B. R., Radler, B., Chenoweth, R., Heilberger, P., & Dearlove, P. (2011). Predicting intent to install a rain garden to protect a local lake: An application of the theory of planned behavior. *Journal of Extension, 49*(4), 204-218.

Spartz, J. T., Su, L. Y.-F., Griffin, R., Brossard, D., & Dunwoody, S. (2017). YouTube, social norms and perceived salience of climate change in the American mind. *Environmental Communication, 11*(1), 1-16.

Wei, J., Zhao, M., Wang, F., Cheng, P., & Zhao, D. (2016). An empirical study of the Volkswagen crisis in China: Customers' information processing and behavioral intentions. *Risk Analysis, 36*(1), 114-129.

Yang, Z. J., McComas, K., Gay, G., Leonard, J. P., Dannenberg, A. J., & Dillon, H. (2010a). Applying the theory of planned behavior to study health decisions related to potential risks. *Journal of Risk Research, 13*(8), 1007-1026.

Yang, Z. J., McComas, K., Gay, G., Leonard, J. P., Dannenberg, A. J., & Dillon, H. (2010b). From information processing to behavioral intentions: Exploring cancer patients' motivations for clinical trial enrollment. *Patient Education and Counseling, 79*(2), 231-238.

Yang, Z. J., Rickard, L. N., Harrison, T. M., & Seo, M. (2014). Applying the risk information seeking and processing model to examine support for climate change mitigation policy. *Science Communication, 36*(3), 296-324.

Yang, Z. J., Seo, M., Rickard, L. N., & Harrison, T. M. (2015). Information sufficiency and attribution of responsibility: Predicting support for climate change policy and pro-environmental behavior. *Journal of Risk Research, 18*(6), 727-746.

Appendices

Appendix A: Table of Factor Analysis of Systematic and Heuristic Risk Information Processing Items (Reproduced from Griffin et al., 2002)

Item	Factor Loadings	
	Factor 1 Systematic Processing	Factor 2 Heuristic Processing
After I encounter information about this topic, I am likely to stop and think about it.	.59	-.14
If I need to act on this matter, the more viewpoints I get the better.	.50	-.12
After thinking about this topic, I have a broader understanding.	.49	.11
When I encounter information about this topic, I read or listen to most of it, even though I may not agree with its perspective.	.42	-.09
It is important for me to interpret information about this topic in a way that applies directly to my life.	.41	-.01
When I encounter information about this topic, I focus on only a few key points.	.11	.56
There is far more information on this topic than I personally need.	-.11	.48
When I see or hear information about this topic, I rarely spend much time thinking about it.	-.21	.43
If I need to act on this matter, the advice of one expert is enough for me.	-.06	.41
Sum of squared loadings	1.93	0.43
Percentage of variance	21.4	4.7

Note. Principle axis factoring procedure. Oblique rotation. Factor correlation = -.48.