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Studying Heuristic-Systematic Processing of Risk Communication

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Using a model of risk information seeking and processing developed by Griffin, Dunwoody, and Neuwirth (1999), this study looks at predictors of the processing strategies that people apply to health risk information. Specifically, this article focuses on one relationship within the model—the relationship between perceived amount of information needed to deal with a risk and heuristic-systematic processing. Perceived amount of information needed refers to the gap between one's understanding of a risk and the level of understanding that one needs in order to make a decision about that risk. Building on the work of Chaiken (cf. 1980), the Griffin *et al.* model predicts—and finds—that the larger the gap, the more likely one will process information systematically. The study employs a novel measure of information processing in a survey setting by sending actual information to participants and then asking them how they attended to it; the researchers evaluate this strategy. Finally, the researchers discuss how these findings might help agencies and practitioners create more effective risk messages.

KEY WORDS: Heuristic-systematic processing; risk information; audience-oriented messages; fish consumption; information seeking; information processing model; risk communication

1. INTRODUCTION

The processing strategies that people apply to information encountered in the mass media or elsewhere can make a big difference in what they take away from messages about risks (Eagly & Chaiken, 1993; Petty & Cacioppo, 1986). If people process a message quickly, their understanding of its contents will likely be much more superficial than if they process that same message systematically. In addition, people who process information about a given topic systematically tend to develop attitudes toward that topic that are relatively stable and resistant to change as compared to more superficial processors (Eagly & Chaiken, 1993; Eagly & Kulesa, 1997). Moreover, various scholars have proposed that the kind of information processing people employ might eventually affect their behaviors, both in terms of the stability of behaviors over time (Griffin, Dunwoody, & Neuwirth, 1999) and in terms of the goodness-of-fit between their attitudes and behaviors (Ajzen & Sexton, 1999).

The goal of most risk information campaigns is to help people understand risks, make wise choices, and develop stable and beneficial changes in their risk-related behaviors. Therefore, it is important for scholars and practitioners of risk communication to understand the ways various audiences and audience segments seek and process the risk information that they encounter in the media and other communication channels.

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Taking their cue from psychology, a small number of risk communication scholars has begun to do just that. This is one such study. We build on groundwork laid by Griffin, Dunwoody, and Neuwirth (1999), a research team that recently developed a model for predicting information processing styles in risk settings. Our study goals are to test the model's ability to predict processing styles in one specific risk situation and to examine the efficacy of a novel information processing catalyst—a magazine article sent to respondents, who are then asked to read it and, in a survey setting, asked to respond to questions about their reading strategies. The goal is not to assess changes (e.g., in risk perception) brought about by the message, but instead to learn more about how people receive the risk information within the message.

1.1. Information Processing

1.1.1. The Heuristic-Systematic Model

Chaiken's (1980) model of heuristic and systematic processing provides a foundation for Griffin *et al.*'s conceptualization of risk information processing. The heuristic-systematic model applies to communication contexts in which people "are exposed to information about themselves, other persons and events, and have to make decisions or formulate judgments about these entities" (Chaiken, Liberman, & Eagly, 1989:239). When individuals are faced with such situations, they can process the information in one of two general ways, superficially (heuristically) or effortfully (systematically). Although individuals can switch back and forth between these modes while processing the same information, they are likely to gravitate toward one or the other based on their capacity to process the information and their motivation to invest the time and energy required to move beyond superficial processing toward more effortful processing (Chaiken, Liberman, & Eagly, 1989).

When processing information systematically, individuals are said to "exert considerable cognitive effort.... They actively attempt to comprehend and evaluate the message's arguments" (Chaiken, 1980: 752). Systematic processing, according to Chaiken (1980), will take place when an individual encounters information of significant personal importance. In such "high issue involvement" situations, information reliability and accuracy outweigh time or energy constraints (Chaiken, 1980:754), and the receiver focuses on message content rather than on peripheral characteristics of the message. Other reasons found for engaging in systematic processing have included perceived need to be accountable for one's judgments, need for cognition, and need for control (Maheswaran & Chaiken, 1991).

Conversely, when processing information heuristically, individuals are said to "exert comparably little effort.... Rather than processing argumentation, recipients may rely on (typically) more accessible information, such as the source's identity or other non-content cues in deciding to accept a message's conclusion" (Chaiken, 1980:752). Heuristic processing avoids detailed processing of content and focuses, instead, on the more peripheral characteristics of a message. This type of processing is more likely to occur with low issue involvement, low perceived capacity to process information, or when an individual does not perceive more in-depth processing to be of much consequence.

The Griffin *et al.* risk information processing model is an extension of the heuristic-systematic processing model in that it attempts to map predictors of these processing strategies within a risk setting. That is, the Griffin *et al.* model takes into account additional variables that apply specifically to a risk information context.

1.1.2. Out of the Lab and Into the Field

To date, much of the research on information processing has been conducted in experimental settings. Although this research has provided the foundation for what we know about processing strategies, it is important for researchers to move, eventually, from such controlled settings into more multivariate, generalizable ones. Thus, our current study joins a growing number of other mass communication studies that, over the course of the last quarter-century, have begun employing survey methods in their exploration of information processing strategies. Eveland (in press) offers a comprehensive history of these studies, which have looked at, most recently, gaps in public knowledge (Eveland & Scheufele, 2000; Eveland, Shah, & Kwak, 2001), risk communication (Griffin, Neuwirth, *et al.*, 2002), and civic participation (McLeod *et al.*, 2001).

Of course, moving the study of information processing strategies out of the laboratory and into the field has meant a shift in the way that we look at these strategies and the people who employ them. Most importantly, we have shifted from a reliance on our own "real-time" observations to a reliance on respondents' self-reports of past processing experiences. This shift

has required that we place a substantial amount of trust in our respondents' abilities to remember and reflect on their own processing strategies. Evidence suggests that this trust is warranted—patterns in processing styles have emerged in survey research that are consistent with the earlier research conducted in more controlled settings (cf. Eveland, in press).

Generally speaking, survey questions about information processing strategies have relied on hypothetical or habitual frameworks. For example, questions may ask participants to respond to statements such as, "When I read a newspaper story, I *typically* stop after the first couple paragraphs." However, psychologists assume that individuals will provide more accurate information about actual processing episodes rather than "typical" or hypothetical ones. Therefore, we decided to employ a real message in this study in order to ask questions about respondents' use of that message. Specifically, we created a "magazine" article about the health of the Great Lakes and related fish contamination, sent the article to respondents with a request that they read it, and then called them and asked a series of questions about the nature of their reading.

1.2. Risk Information Processing

1.2.1. The Model

The model of risk information seeking and processing developed by Griffin, Dunwoody, and Neuwirth (1999) posits linkages among various predictors of information processing that have been highlighted in the literature about risk (cf. Gregory & Mendelsohn, 1993; Slovic, 1992), communication (cf. Kosicki & McLeod, 1990; Eveland, in press), and social psychology (cf. Ajzen & Fishbein, 1980; Chaiken, 1980). The purpose of the model, therefore, has been to pull together important factors from different literatures and link them together in ways applicable to risk communication situations in general. As a result, the model consists of the following eight factors (see Fig. 1).

1. Individual characteristics, such as experience with risk, political philosophy, and various demographic characteristics.
2. Perceived hazard characteristics, such as perceived likelihood of coming to harm.
3. Affective response to risk, such as worry.
4. Perceived social pressures to be informed about risk (the model refers to these as informational subjective norms).
5. Perceived amount of information needed (the model refers to this as information sufficiency).
6. Beliefs about the usefulness and legitimacy of various media channels.
7. Perceived information gathering capacity.
8. Information seeking and processing strategies.

Within the model, there are 11 expected relationships among these factors (see Fig. 1). To date, several of these relationships have been supported, including relationships between:

1. Perceived hazard characteristics (e.g., risk judgments and institutional trust) and affective response to risk (e.g., worry) (Griffin, Neuwirth, & Dunwoody, 1998);
2. Affective response to risk (e.g., worry) and information sufficiency (perceived amount of information needed) (Griffin, Neuwirth, & Dunwoody, 1998);
3. Informational subjective norms (perceived social pressures to be informed) about risk and information sufficiency (Griffin, Neuwirth, & Dunwoody, 1998);
4. Relevant beliefs about media channels and processing strategies (Griffin, Dunwoody, *et al.*, 1999); and
5. Information sufficiency and processing strategies (Griffin, Dunwoody, *et al.*, 1999).

In our current study, we focus primarily on one very key linkage within the model: the relationship between information sufficiency and heuristic and systematic processing strategies. The other independent variables in this model (see Fig. 1) are treated here as controls. These control variables are:

1. Individual characteristics (e.g., demographics and hazard experience);
2. Perceived hazard characteristics (e.g., risk judgments);
3. Affective response to risk (e.g., worry);
4. Informational subjective norms;[4]

[4] According to the theory of planned behavior, a person's perception that significant others believe that he or she should perform a behavior can serve as a motivation to seek information that would facilitate that behavior (Ajzen & Fishbein, 1980). These perceived social expectations are often referred to as subjective norms. The relationship between subjective norms and behavior does not appear to be direct. For example, Hopper and Nielson (1991) found that social norms did not directly influence recycling behavior but did influence an equivalent personal norm, which in turn had a direct effect on behavior. This is consistent with the

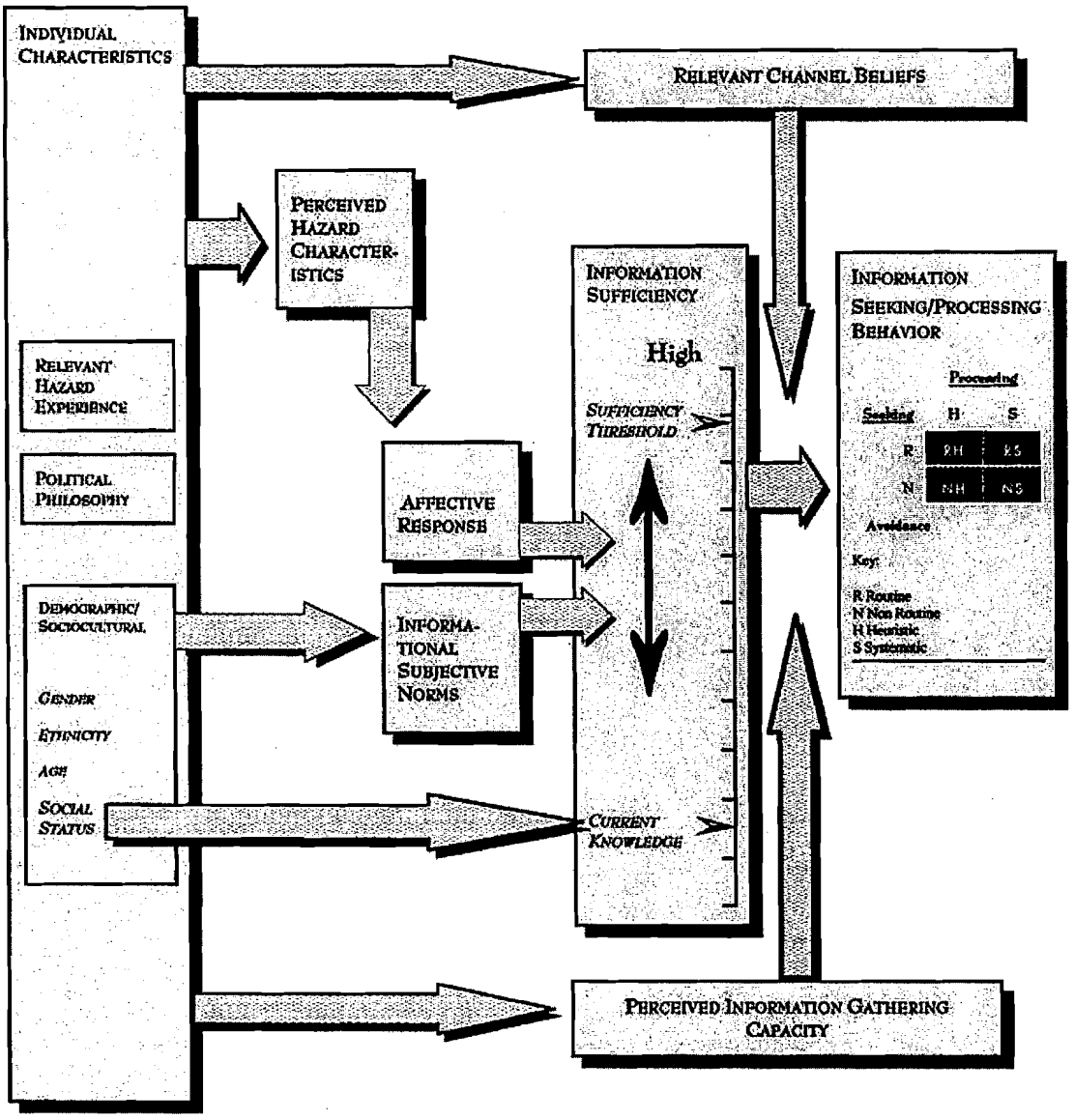

Fig. 1. Model of risk information seeking and processing (Griffin, Danwoody, & Neuwirth, 1999).

5. One's perceived capacity to process or gather information; and
6. Beliefs about the usefulness and legitimacy of various information channels.

1.2.2. Information Sufficiency

According to Chaiken and colleagues, one of the key motivators of effortful processing is the perceived need for additional information (Chaiken, Liberman, & Eagly, 1989; Maheswaran & Chaiken, 1991). The researchers base this perceived need on one's desire to have confidence in subsequent judgments about the content of the message being processed. The need to balance minimal processing with one's desired level of judgmental confidence has been dubbed the sufficiency principle (Chaiken, Liberman, & Eagly, 1989).

The sufficiency principle states that individuals will continue to actively engage in processing until they have reached the depth or breadth of understanding that they perceive to be necessary. Eagly and

literature on intrinsic and extrinsic motivations: a norm must be internalized (perhaps through in-depth processing) before it can more directly influence behaviors.

Chaiken (1993) explain that, according to the principle, "people will exert whatever effort is required to attain a 'sufficient' degree of confidence that they have accomplished their processing goals" (1993:330). According to Eagly and Chaiken (1993), the perception of a large gap between one's current level of understanding and the perceived level of understanding needed to make a confident decision (in this study, toward dealing with a personal health risk) should be associated with more systematic processing. Sufficiency gap size should also be associated with actively seeking additional information through the use of multiple information sources, regardless of processing style (Eagly & Chaiken, 1993).

1.2.3. Information Sufficiency and Information Processing Strategies: Our Hypotheses

Controlling for the independent variables in the model noted above, we hypothesize that information sufficiency will drive processing strategies such that:

H1: *The amount of information an individual perceives that he or she needs to deal with the risk will be positively related to level of systematic processing of information related to the risk.*

H2: *The amount of information an individual perceives that he or she needs to deal with the risk will be negatively related to level of heuristic processing of information related to the risk.*

2. METHOD

The health risk of concern in this study was Great Lakes fish consumption. Fish in the Great Lakes, like fish from other waters, can accumulate various chemicals, most notably PCBs (polychlorinated biphenyls), in fat. Human consumption of PCB-laden fish is a suspected cancer risk and has been associated with developmental problems in infants whose mothers had regularly eaten PCB-contaminated fish (Wisconsin Department of Natural Resources, 2002). Every year for the past quarter-century, states surrounding the Great Lakes, including Wisconsin and Ohio, have issued advisories that warn people to avoid or limit consumption of certain sizes and varieties of fish and that suggest ways to prepare the fish to reduce exposure to chemical contamination. This information is available in pamphlets, sometimes in the news media, and potentially via other sources as well.

Two metropolitan areas on the Great Lakes—Milwaukee, Wisconsin, on Lake Michigan and Cleveland, Ohio, on Lake Erie—were chosen as the research sites. Both metropolitan areas have ready access to commercially caught and sport-caught fish from the lakes.

The 144 respondents included in this analysis were part of a three-year panel study conducted between 1996 and 1999 in the Milwaukee and Cleveland metropolitan areas.[5] These annual surveys sought information about perceptions of the risk of eating contaminated fish from the Great Lakes. In Year 3 of the study, a random subset ($N = 166$) of the larger sample received a magazine-like article about the health of the lakes and its fish. The article was written by a freelance writer expressly for this study and offered factual information about the health of the lakes and their fish populations. An accompanying letter asked the respondent to read the article, as a researcher would call in a few days to ask questions about it.

Shortly thereafter, these individuals were contacted with questions about the article, including about how much attention they paid to the article, which parts of the article they found interesting or uninteresting, specific information processing

[5] The total sample size was 1,123 in the first wave and 887 in the second wave (including 716 from the first wave and 171 new respondents). Survey respondents in the first two waves were divided into three groups, each one queried about a separate risk. In the final wave, interviews were conducted only with those respondents who had been queried about fish contaminant risks, producing a final wave sample of 459 (295 of the fish path respondents left from the first wave, 60 who had been added in the second wave, and 104 new respondents). Response rate for the first wave was 55%. Samples of new respondents were added in both the second wave (response rate of 41%) and third wave (response rate of 34%) as a control for sensitization in the panel design. Reinterview rates were 64% in the second wave and 67% in the third wave.

Households were contacted by random-digit dialing (RDD) and respondents, when first interviewed, were chosen randomly within those households. The interviews, which took about 20 minutes apiece, focused on three risks related to the Great Lakes. Two of the risks entail potential for harm to personal health: eating Great Lakes fish and drinking tap water drawn from the Great Lakes. The third risk deals with a less personal topic, threats to the Great Lakes ecosystem. Once contacted, respondents were randomly assigned to a risk path that posed questions specific to only one of the three environmental risks. Respondents who remained in the survey across waves were kept within the same path for the duration. Although questions were specific to each path, they were, for the most part, identical in construction to allow for comparison across paths. Survey questions operationalized all of the components within the model.

strategies (to operationalize this study's dependent variables), and how long ago they had read it. After this follow-up interview, the respondents were told that the magazine article was written solely for purposes of this study (i.e., the magazine and the article do not actually exist), but that all the information presented in the article was factual. It is the 144 individuals who read and subsequently answered questions about the article who are the focus of this analysis.[6]

3. MEASUREMENT

3.1. Control Variables

The *individual characteristic* variables were hazard experience (experience with food-borne illness and/or water-borne illness), political conservatism, gender, ethnicity, age, education, and annual income.

Perceived hazard characteristic variables were captured using four measures: trust in government, perceived behavioral control over the risk, and two measures of risk judgment (perceived probability of illness from exposure to the hazard and the perceived severity of the resulting illness).[7]

Affect was captured with the following item: "When you think about the possible health risks posed to you from eating Lake Michigan [Erie] fish, how much worry do you feel?" The item was measured on a scale of zero to 10, with zero described as "having none of this feeling" and 10 described as "having a lot of this feeling."[8]

Informational subjective norms (perceived social pressure to be informed) was captured with a single item: "People who are important to me think that I should stay on top of information about risks from eating Lake Michigan [Erie] fish." The item was measured on a five-point, Likert-type scale ranging from strongly disagree (1) to strongly agree (5).[9]

Perceived information gathering capacity was assessed in regard to the magazine article. Subjects responded on a five-point, Likert-type scale to the following items: "The story was difficult to read," "I had difficulty seeing how the information I read fit together into a story that made sense overall," and "It took a lot of mental effort on my part to understand how the parts of the story fit together." Coding was reversed so that higher scores represented less difficulty and effort, and therefore more capacity. Reliability (Cronbach's alpha) for the three-item scale is 0.63, and, appropriately, it correlates positively ($r = 0.21$, $p < 0.05$) with education.[10]

Relevant beliefs about media channels are represented by factors measuring the channel's trustworthiness and usefulness.[11]

[6] Of the 22 people who did not read the article, responses to suggested reasons for not reading were as follows (responses were not mutually exclusive): nine said that the article did not seem very interesting; six believed that what they would gain from the article would not be worth the effort; five stated that they avoid information on this topic; three thought that the article looked too difficult to read; three said that they already knew enough about this topic; and three indicated that they didn't think that they would agree with what the article said. However, all 22 agreed that they would have read the article if they would have had more time.

[7] Trust in government was assessed by summing the standardized scores to three items, each originally measured using a five-point scale ranging from strongly disagree (1) to strongly agree (5): "I trust government to protect me from risks related to eating contaminated Lake Michigan [Erie] fish," "Government is doing a competent job of protecting people's health from risks of eating Lake Michigan [Erie] fish," and "Government officials care about the health and safety of people like me." Reliability (alpha) is 0.77. Based on Ajzen (1988), perceived behavioral control was measured by summing the standardized scores to two items, each originally measured using a five-point scale ranging from strongly disagree (1) to strongly agree (5): "If I wanted to, I could easily avoid eating fish from Lake [Michigan] [Erie]" and "I have personal control over whether or not I would eat the fish from Lake [Michigan] [Erie]." Reliability (alpha) is 0.74. In terms of risk judgment, perceived probability of illness was measured by the item "How likely are you to become ill in the future from eating contaminated fish caught in Lake Michigan [Erie]? Please use a scale from zero to 10, where zero means that you would have absolutely no chance whatsoever of becoming ill, and 10 means that you are certain to." Severity was assessed by the item "If you were to become ill from eating contaminated Lake Michigan [Erie] fish, how serious do you think this illness would be? Please use a scale of zero to 10, where zero means not serious at all and 10 means it would be as serious as it can possibly be."

[8] Worry was chosen as the affect variable of choice because it is a manifestation of anxiety, which Griffin, Dunwoody, and Neuwirth describe as "distinguished by a recurrent negative affective state provoked by a future hazard" (1999:S236). Preparatory focus group research showed that the colloquial term "worry" fit better into layperson lexicon than the term "anxiety." The mean response was 4.5 in both waves. Affective responses such as worry and dread have been explored extensively in the risk judgment literature. Increased fear and worry is often related to an increase in perceived vulnerability to a given risk. However, increased trust in institutions leads to less personal worry and perceived vulnerability (Slovic, 1993). Worry also is linked to increased knowledge about the causal events that lead to a potential risk (Kahlor, Dunwoody, & Griffin, 2000).

[9] The mean response was 3.3 in the second wave and 3.2 in the third wave (ns).

[10] Scale mean is 3.8 (1–5 scale).

[11] Focus groups and the literature (Kosicki & McLeod, 1990) generated eight specific beliefs about the general nature of the mass media and their products, to which the respondents stated their

Additional controls included: study characteristics such as sensitization (i.e., the number of previous times the respondent had been interviewed for this three-wave study) and the metropolitan area of the respondent's residence; the amount of time between when the respondent read the article and when he or she was interviewed (to help control for memory effects); whether the respondent said he or she would have read the story if he or she would have encountered it in a newspaper or magazine and whether the respondent believed the story to be factual (both variables were designed to enhance the external validity of the study); and the extent to which the respondent agreed with what the author had said.

3.2. The Catalyst for Information Processing

The magazine article used for this study was strategically developed as a catalyst for information processing. The focus of the article was the overall health of the Great Lakes with particular attention paid to the health risks posed by eating sport-caught fish. To develop the text, the research team first selected several topics that they believed to represent distinct cognitive domains relevant to the larger topic. They were: (1) the geologic history of the lakes, (2) environmental assaults on the lakes by humans, (3) risks to humans posed by the lakes and uncertainty about those risks, and (4) fish-specific risk-avoidance advice, similar to that found in state advisories dealing with the consumption of contaminated Great Lakes fish.

With the help of a freelance writer and copious source materials, a 6,000-word article was constructed, written to be accessible to the general public. A graphic designer laid out the text and photos in a standard magazine format. The article was then printed on glossy magazine paper stock and enclosed in the cover of a fabricated magazine, *Great Lakes Life* (see Fig. 2). The article was designed to look like a magazine reprint.

The respondents, who were part of a larger three-year panel study, had consented, by phone, to receive the article in the mail. The article was mailed out to respondents with an explicit request that they read it so that we could contact them with questions about its contents. We did this to maximize the likelihood that respondents would read the piece. To reiterate, our goal was not to see if respondents would read a Great Lakes text, but to create a situation in which reading was assured—allowing us to focus our efforts on the study of information processing strategies.

Although the pressure that we put on respondents was likely to create a relatively "unnatural" processing situation, our initial review of the data did reveal that there was still a healthy amount of variance in the ways respondents processed our information. In fact, despite our request that they read the article, 13% of the respondents did not.

3.3. Information Sufficiency Measures

Information sufficiency, the perceived amount of information needed to deal with the hazard, was assessed by juxtaposing in the analysis two self-report variables: (1) one's perceived knowledge about the risk and (2) the level of understanding that one feels is needed to make a confident decision. The gap between the two represents the perceived amount of information needed.

To access perceived knowledge, respondents were asked to rate, on a scale of zero to 100, their current knowledge about the risk. Specifically, respondents were asked: "Now, we would like you to rate your knowledge about this risk. Please use a scale of zero to 100, where zero means knowing nothing and 100 means knowing everything you could possibly know about this topic. Using this scale, how much do you think you currently know about the risk from eating Lake [Michigan] [Erie] fish?" (mean = 39.4). To access level of understanding needed, respondents were told: "Think of that same scale again. This time, we would like you to estimate how much knowledge you would need to deal adequately with the possible risk from eating Lake [Michigan] [Erie] fish in your own life" (mean = 67.6).

3.4. Information Processing

The measures we developed for this purpose were the result of an extensive literature review, focus groups, and pretesting. The Wisconsin Survey Research Laboratory conducted four focus groups with a random sample of Milwaukee area residents prior to the start of the first study wave in 1996. The focus groups were designed to gather information about

agreement or disagreement on five-point, Likert-type scales. Exploratory factor analysis using oblique rotation, combining data from all respondents across all three waves of the study, produced two distinct factors: beliefs that the media provide content that distorts reality and beliefs that media content provides cues about validity of the information they carry. These factors are similar to those found in previous research conducted by Kosicki and McLeod (1990).

Fig. 2. The catalyst for information processing (excerpts).

various components of the Griffin, Dunwoody, and Neuwirth (1999) model that needed exploratory investigation. Information processing strategies were the focus of some of the questions put to the focus groups.

A questionnaire was then developed and distributed to a convenience sample of 301 students at three Midwestern universities. Item and scale analysis yielded a subset of information processing measures that were incorporated into the larger survey

Table I. Factor Analysis of Information Processing Items

Information Processing	Factor Loadings: Systematic	Heuristic
Factor I: Systematic		
I thought about what actions I myself might take based on what I read.	0.77	−0.26
I found myself making connections between the story and what I've read or heard about elsewhere.	0.70	−0.22
I thought about how what I had read related to other things I know.	0.67	−0.26
I tried to think of the practical applications of what I read.	0.53	−0.37
I thought about what actions should be taken by policy-makers based on what I read.	0.50	−0.17
I tried to relate the ideas in the story to my own life.	0.41	−0.15
Factor II: Heuristic		
I skimmed through the story.	−0.27	0.81
I didn't spend much time thinking about the story after I read it.	−0.49	0.74
The story presented too many conflicting viewpoints.	−0.10	0.33
Eigenvalue	2.75	0.89
Percent of variance	30.5	9.8
Reliability: Cronbach's alpha	0.77	0.63
$N = 144$		

Note: Principal axis procedure, oblique rotation. Correlation: $r = -0.37$

instrument. Three telephone pretests were then conducted with random samples of Milwaukee and Cleveland residents to fine-tune the items before the actual survey was launched.

The result was 10 items, each measured on a five-point, Likert-type scale (ranging from strongly agree to strongly disagree). Oblique factor analysis of the 10 items produced two factors (see Table I for loadings and item wording) that clearly represented systematic processing and heuristic processing strategies. Measures of systematic processing survived the design process better than heuristic processing measures; the final systematic index contains six items with good reliability, while the heuristic index, composed of three items, has a lower reliability. These factors also correlate consistently with measures of more general patterns of heuristic and systematic risk information processing from the larger data set (Griffin, Dunwoody, *et al.*, 1999).[12] These correlations suggest that the processing strategies respondents applied to our information processing catalyst tend to be a manifestation of the strategies that they apply more generally when they encounter risk information in the mass media or elsewhere. An example of a systematic item is, "I thought about how what I had read related to other things I know." An example of a heuristic item is, "I skimmed through the story."

4. RESULTS

The data used in this analysis came from Years 2 and 3 of the larger three-year study. As a general analysis strategy, we turned to the Year 2 data for our independent variables and the Year 3 data for our dependent information processing variables. Since the dependent variables occurred early in the Year 3 questionnaire, we worried that those responses might

[12] The article-specific systematic processing factor correlates positively with the more general systematic processing factor measured the year prior to the post-reading survey ($r = 0.21$, $p < 0.05$) and with the general systematic processing factor measured in the same post-reading interview ($r = 0.44$, $p < 0.001$). The article-specific systematic processing factor also correlates negatively with the general heuristic processing factor in the year prior ($r = -0.28$, $p < 0.05$) and in the post-reading interview ($r = -0.39$, $p < 0.001$). Comparable correlation coefficients for the article-specific heuristic processing factor showed the same pattern of convergence and discriminance. The article-specific heuristic processing factor correlated positively with the general heuristic processing factor measured the year prior to the post-reading survey ($r = 0.20$, $p < 0.05$) and with the heuristic processing factor measured in the same post-reading interview ($r = 0.47$, $p < 0.001$). It also correlated negatively with the general systematic processing factor measured the year prior to the post-reading survey ($r = -0.18$, $p < 0.05$) and with the general systematic processing factor measured in the same post-reading interview ($r = -0.30$, $p < 0.001$)

influence responses to the independent variables that followed later in the questionnaire. Therefore, because we had also asked questions about the independent variables in earlier waves, using the independent variables from the Year 2 data seemed more appropriate for this analysis.

However, there are a couple of exceptions to the above rule, primarily where control variables are concerned. First, some variables gathered at each of the three waves (e.g., demographics) demonstrated such stability that the researchers compiled a universal set of items that took into account all three waves. Second, some measures of how individuals responded specifically to the "magazine" article (e.g., perceived validity of the article, elapsed time since reading it, agreement with the author, capacity to process) could be gathered only in the third wave.

The Statistical Package for the Social Sciences (SPSS) was used to perform hierarchical multiple regression analyses of our two article-specific information processing factors. These third-wave factors were each regressed on the following blocks, in order: (1) second-wave current knowledge; (2) third-wave study characteristic variables; (3) individual demographic and second-wave individual characteristics control variables; (4) second-wave perceived hazard characteristics; (5) second-wave worry and informational subjective norms; (6) second-wave channel beliefs; (7) third-wave story information processing capacity; and (8) second-wave perceived amount of information needed.

With this analysis strategy, the relationship of perceived amount of information needed with the dependent variable effectively represents the relationship of the information sufficiency gap (the gap between one's current level of understanding and the perceived level of understanding needed to make a confident decision) to systematic processing and to heuristic processing.[13]

Results from these regressions are shown in Table II. The margin of error (95% confidence interval) for percentages in this analysis is plus or minus 8.3%.

[13] We did not use difference scores to represent the "gap" between current knowledge and sufficiency threshold, since difference or change scores tend to suffer from ceiling effects and multiply reliability problems. Instead, the current knowledge measure was entered into the regression prior to the sufficiency threshold measure, an approach based on Cohen and Cohen (1983).

Table II. Regression of Information Processing on Model Predictors

Standardized Regression Coefficients (betas)		
	Article Information Processing	
Variable	Systematic	Heuristic
Current knowledge	0.12	−0.02
Incremental R^2	*0.05***	*0.00*
Study Characteristics		
Panel experience (sensitization)	−0.21**	0.18*
Metropolitan area	0.04	−0.04
Elapsed time since reading story	−0.13	0.19*
Perceived validity of story	0.09	−0.07
Interest in story (would have read elsewhere)	0.40***	0.01
Agreement with author	0.15	−0.09
Incremental R^2	*0.36****	*0.14***
Individual characteristics		
Minority	−0.01	−0.08
Formal education	0.00	0.00
Income	−0.05	0.07
Age	−0.02	−0.10
Gender (M = 1, F = 2)	0.02	0.14
Political conservatism	0.03	0.03
Hazard Experience: water-borne parasite	0.11	−0.14
Hazard Experience: food poisoning	0.05	0.05
Incremental R^2	*0.03*	*0.05*
Perceived hazard characteristics		
Illness probability	−0.06	0.20*
Illness seriousness	−0.10	0.05
Perceived behavioral control	−0.01	−0.05
Trust in government	−0.04	0.02
Incremental R^2	*0.01*	*0.04*
Worry	0.01	−0.07
Informational subjective norms	0.05	−0.02
Incremental R^2	*0.00*	*0.00*
Channel beliefs		
Media distort	−0.09	−0.01
Media content contains validity cues	−0.05	0.09
Incremental R^2	*0.01*	*0.00*
Story information processing capacity	0.13	−0.37***
Incremental R^2	*0.01*	*0.09****
Information sufficiency (threshold)	0.25**	0.00
Incremental R^2	*0.04***	*0.00*
Multiple R	0.72***	0.60**
Adjusted R^2	0.41	0.18
N	141	141

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

4.1. The Sample

Of the 144 individuals included in this analysis, the average respondent had at least some college education and was about 50 years old. Median annual

income was $39,000. Nearly 50% were female. About 80% of the sample was white.[14] Just over 20% of the respondents were liberal, about 44% were "middle of the road," and the rest were conservative. About 46% reported having experienced a food-borne illness and about 22% had experienced a water-borne illness (11% in Cleveland and 30% in Milwaukee, which in 1993 had experienced an outbreak of cryptosporidiosis from a contaminated city water supply). Fifty-five percent of the respondents lived in the Milwaukee area and the rest in the Cleveland area.

Most respondents (56%) had read the magazine article within 10 days prior to being interviewed, and nearly three-fourths (74%) had done so within the previous two weeks. The topic was of interest, as almost 8 in 10 respondents (79%) reported that they would have read the story if they had encountered it elsewhere. Nearly three-fourths (74%) agreed with the article and nearly three-fourths (73%) thought the story was accurate (5% thought it was not, and the rest were neutral on that score). When asked how much attention they had paid to various topics within the article, about 81% paid "some" or "a lot" of attention to information about how chemicals got into the lakes and fish and 74% paid at least some attention to a "sidebar" story in a box about how to minimize a person's risk from eating Great Lakes fish.

Other topics, in order of attention paid to them, included governmental attempts to solve the problem of PCBs and other chemicals in the lakes (73% paid "some" or "a lot" of attention"); scientific evidence about the effects on people of eating Great Lakes fish (70%); a series of illustrations about trimming the fat from fish (68%); how glaciers helped to form the lakes (65%); how parasites get into people's drinking water drawn from the lakes (62%); and how logging affected the lakes (56%). Attention to each of these topics within the article correlates positively with systematic processing of the article and negatively with heuristic processing, even when controlled for all the other variables in the analysis (partial coefficients average 0.39 in absolute magnitude and range in absolute value from 0.21 to 0.57), a result that helps to validate the heuristic and systematic processing measures.

[14] Although our ethnicity percentages were comparable to 1990 U.S. Census data for both the Milwaukee and the Cleveland metropolitan areas, the average age of our respondents was about 15 years older and the median income was about $10,000 higher.

4.2. The Hypotheses

The first hypothesis predicted that perceived amount of information needed would be positively related to systematic processing of risk information. As indicated in Table II, this hypothesis was supported (beta = 0.25, $p < 0.01$). However, the second hypothesis, that perceived amount of information needed would be negatively related to heuristic processing, was not supported. The study found no relationship between perceived amount of information needed and heuristic processing. However, a negative correlation emerged between heuristic processing and story information gathering capacity (beta = –0.37, $p < 0.001$).

Results also show that individuals who perceive a greater likelihood of becoming ill from eating contaminated fish caught in the Great Lakes were more likely to process the article heuristically (beta = 0.20, $p < 0.05$).

Among the remaining predictor variables, study characteristics accounted (as a block) for significant amounts of variance in both systematic processing (36%, $p < 0.001$) and heuristic processing (14%, $p < 0.01$). Specifically, greater likelihood of systematic processing is found among those who had greater interest in the story (beta = 0.40, $p < 0.001$) and those who were newer to the panel study (beta = –0.21, $p < 0.05$). Greater likelihood of heuristic processing is found among those who had been surveyed in previous waves of the panel study (beta = 0.18, $p < 0.05$) and among those who read the story closer to the time they received it (which means their interview occurred further from the day they read it) (beta = 0.19, $p < 0.05$).

5. DISCUSSION

Our intentions for this study were to test the relationship between processing strategies and perceived information need within a risk setting and to reflect on the efficacy of our information processing measure. In our discussion, we also will suggest ways the theoretical underpinnings of this study can be translated into practice.

5.1. Putting the Model into Practice

Our results indicate that perceived information sufficiency is indeed related to systematic processing strategies, which is consistent with prior research and with the Griffin *et al.* model. As the gap between

information held and information needed increases in this sample, so does systematic processing of the magazine article. Not only do these findings support the Griffin *et al.* model, they also bring decades of information processing research (cf. Chaiken, 1980; Eveland, in press) to bear on a risk-specific context.

Foremost, these findings confirm that there is value in focusing on the audience's information needs—both *perceived* and real. Although it may be tempting to craft our messages based on: (1) what we think the audience needs to know (the intended purpose of the message) and (2) our limitations for getting our message out to the audience (budgetary, political, or otherwise), this study suggests that we also consider the audience's *perceptions* of what they need to know. For example, if audience members don't perceive a need to know more about the consumption of sport-caught fish, it is likely that only a carefully crafted message, one that takes their perceptions as well as their motivations into account, can accomplish the communicator's intended goal.

Indeed, these findings suggest that information processing is *driven* by processors based on perceived need for information as it relates to existing knowledge. In a risk context specifically, this poses unique challenges to practitioners charged with crafting messages for target audiences whose perceived need for information to cope with a given risk may be quite low. Consumption of sport-caught fish is a good example of a behavior that is perceived by most people to be low risk. Past research has indicated that low levels of worry about such a risk will result in lower levels of perceived needed information—a situation that will work against any information campaign.

However, manipulating messages according to the relationships found within the model would be one way to change that scenario. Risk managers may most profitably focus on increasing level of worry, as that factor seems to bear directly on an individual's notion of whether he or she knows enough about a risk to feel comfortable making a decision about it. Social expectations also could be spotlighted within a carefully crafted message so that the message could, potentially, spur more systematic processing via its influence on perceived need for additional information. For example, a message to family meal preparers could focus on amplifying their perceptions that family members expect them to keep abreast of potential toxins in fish and other foods.

This study also demonstrated that level of interest may be a powerful driver of systematic information processing. Risk communicators may profit from investing effort in building interest in audiences before trying to influence knowledge or behaviors. Equally importantly, risk communication researchers need to better understand the antecedents of interest.

5.2. Measuring Information Processing in the Field

This study employed six control variables related to the study itself: sensitization, metropolitan area, elapsed time since reading the story, perceived validity of the story, interest in the story, and agreement with the author. This proved to be a useful tactic, as the variables accounted for 36% of the variance in systematic processing and 14% of the variance in heuristic processing.

Controlling for these variables helps ensure the external validity of these results. And these variables also offered some provocative patterns themselves. For example, the sensitization control variable was a significant predictor of both types of information processing, a negative predictor of systematic processing, and a positive predictor of heuristic processing. Since a higher sensitization score meant that a respondent had been engaged for a longer period in the study, this means that individuals newly engaged by the study were more likely to process the magazine information systematically than were individuals who entered the three-year study at its beginning. The novelty of the Great Lakes topic for newer panel members may have prompted more intensive efforts to understand it.

Another control variable that mattered was "elapsed time since reading the story," which correlated positively with heuristic processing. This means that individuals who indicated they read the article soon after it arrived were more likely to process information heuristically than were persons who read the article at a later time. Although we have no ready explanation for this pattern, one possible interpretation is that heuristic processors may have taken a quick and superficial look at the article immediately, then set it aside.

The most powerful control variable in this set of study characteristics—indeed, one of the most powerful predictors in the entire set of variables in this study—were respondents' assessments that they would have read the story if they had encountered it in a newspaper or magazine. Controlling for this item, in particular, serves to enhance the study's external validity by compensating for the fact that respondents received a copy of the magazine article in a highly artificial setting.

The most inexplicable relationship found in this study is the positive relationship (beta = 0.20) between a respondent's assessment of how likely she or he will become ill from eating Great Lakes fish and heuristic processing of the magazine article. Dual processing theorists predict that high-fear situations can result in less systematic processing of information, perhaps as a protective mechanism (Eagly & Kulesa, 1997). Is this pattern occurring here? Our closest measure of fear, worry, obviously did not pick up this variance.

One expected relationship in this study—a negative one between information sufficiency and heuristic processing—did not materialize. One thing that is clear is that a large perceived gap between knowledge held and knowledge needed does not preclude heuristic processing. However, those who felt they were more capable of processing the information in the story were much less likely to use heuristic strategies to do so.

Overall, these results also indicate that carefully constructed survey data can reveal distinctions between effortful and cursory processing of information. Although it was time consuming, asking respondents to read an extended message and then recall their specific processing behaviors appeared to provide a reasonably accurate measure of this specific information processing episode. People did read the stimulus, they remembered it, and they reported differential levels of attending to it. Thus, it appears we can have faith in our information processing measures, even though their reliability requires some improvement.

In fact, several indicators of concept validity support our strategy of employing the magazine article and then soliciting self-reports of processing strategies. For example:

- Article-specific information processing measures correlated positively with more general information processing measures.
- Measures of self-reported level of attention to sections of the article correlated positively and strongly with information processing strategies, even when we controlled for a host of other factors. For example, high levels of attention to the scientific content of the article correlated positively with systematic processing items (partial $r = 0.43$, $p < 0.001$) and negatively with heuristic processing items (partial $r = -0.52$, $p < 0.001$). Strong, consistent patterns like this suggest that the information processing strategy measures we employed in this study were valid and were able to tap into actual information use behaviors.
- Systematic processing measures correlated well with reported level of interest in the story, which is consistent with the information processing literature.

All these findings are substantial given that the kind of information processing strategies that people use when they encounter risk information might ultimately affect their risk-related behaviors (Griffin, Neuwirth, *et al.*, 2002). Certainly, future research should examine this complex relationship and the way the Griffin *et al.* model can assist risk communication practitioners in crafting messages that can effect positive behavior change.

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