UC Davis
UC Davis Electronic Theses and Dissertations

Title
Processing and Effects of Contradictory Health Information

Permalink
https://escholarship.org/uc/item/9ht4637n

Author
Zimbres, Thais M.

Publication Date
2021

Peer reviewed|Thesis/dissertation

eScholarship.org Powered by the California Digital Library
University of California

Processing and Effects of Contradictory Health Information

By

THAIS MENEZES ZIMBRES
DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Communication

in the

OFFICE OF GRADUATE STUDIES

of the

UNIVERSITY OF CALIFORNIA

DAVIS

Approved:

_____

Robert A. Bell, Chair

_____

Lisa M. Soederberg Miller

_____

Jingwen Zhang

Committee in Charge

2021

Dedication

My sincere gratitude to my daughters Julia and Stella, for their everyday love and joy.

To my partner Marcio, who supported me unconditionally. I love you dearly.

Acknowledgements

I am especially grateful to my wonderful committee for their outstanding guidance during these years. Dr. Bell, your mentorship during my PhD was fundamental to my professional growth. Thank you for your patience, generosity, and support to all my academic endeavors. Your passion and creativity for research are admirable and inspiring. I am especially thankful for all the times that you gently helped me get back in the right direction when needed. Thank you for teaching me so many important things, and for showing me that there is always room for improvement. I am also deeply grateful for your understanding and support of my very busy mom-life.

Dr. Miller, I cannot thank you enough for your contribution to this dissertation. Your genuine curiosity, precise comments, and promptness have not gone unnoticed. Your excitement with my work was uplifting and essential in many moments of this journey. Dr. Zhang, your smartness, creativity, and kindness are inspiring! Thank you for always being available and welcoming to my ideas. I appreciate all your sincere and thoughtful feedback.

Many thanks to Dr. Ruiz and Dr. Taylor for their earlier insights to the CHIP model during my qualifying exams.

I would also like to note the professors that contributed to my teaching experience. Dr. Hether, I always enjoyed and admired your teaching – I have learned a lot from you. Dr. Yegiyan, it was a pleasure to be your student and your teaching assistant – I will miss you!

Thanks to my friends who have made my journey so much lighter and meaningful: Neha Kumari, Irena Acic, Ingrid Zhou, Jooyoung Jang, Jade Featherstone, and Yoyo Zhan.

Finally, thanks to all my family overseas for the multiple times you have come to help me with the girls so that I could finish my studies. I am so lucky!

Table of Contents

Abstract

Guided by Uncertainty Management Theory (UMT) (Brashers, 2001), the objective of this dissertation was to develop and test a model of the effects of contradictory health information on uncertainty and information seeking, dubbed therein as The Contradictory Health Information Processing (CHIP) Model. Three empirical studies were conducted to accomplish this objective. In the first investigation, the model of the effects of uncertainty-arousing nutrition information was developed and tested. Generic measures that can be used across a range of health topics were also developed for each of the CHIP model's concepts. These measures enabled the three experiments that comprise this dissertation. In Study 2, a revised CHIP model and several moderators of the causal relations identified in Study 1 were tested in the nutrition context. Finally, Study 3 tested the most recent version of the CHIP model, but in the context of a completely different kind of health topic, consumer health product safety. This third study also tested the moderating role of health self-efficacy and cognitive outcome expectations for the purpose of assessing the relationship between threat emotions and information-seeking intentions. Overall, the findings from these three studies support the CHIP model.

Chapter 1. Introduction

Chapter 1

Introduction

Contradictory health information is both prevalent in the media and consequential. Its prevalence has been documented in numerous domains, such as nutrition (Clark et al., 2019; C. J. Lee et al., 2018; Nagler, 2010, 2014), cancer screening (Nagler et al., 2019; Shi et al., 2019), and e-cigarettes (Katz et al., 2018; Tan et al., 2017). The negative effects of exposure to contradictory information include confusion (Clark et al., 2019; Nagler, 2014), uncertainty (Chang, 2015; Jensen & Hurley, 2012), increased worry (Han et al., 2006), and changes in the nature of information-seeking behaviors (Rains & Tukachinsky, 2015).

Contradictory health messages contain information that is logically inconsistent (Carpenter et al., 2016), leading to the subjective perception that one lacks sufficient knowledge about some aspect of reality, known as uncertainty (Han et al., 2011, 2019). Uncertainty on health issues usually pertains to lack of knowledge about future outcomes, but can also derive from unpredictability of the outcomes of a health behavior or an illness (Babrow et al., 1998; Bradac, 2001; Brashers, 2001). Outcomes of health-related uncertainty remain poorly understood (Hillen et al., 2017; Strout et al., 2018). Especially needed is programmatic research of how uncertainty is managed through information seeking (Brashers, 2001; Brashers & Hogan, 2013).

Guided by Uncertainty Management Theory, UMT (Brashers, 2001), The Contradictory Health Information Processing (CHIP) Model was developed and tested across three empirical studies. Overall, the findings from these studies support the CHIP model, which specifies that perceptions of contradiction give rise to issue uncertainty, resulting in negative appraisals and decision uncertainty. The effects of issue uncertainty on information-seeking intentions were consistently found to be mediated by negative appraisals and threat emotions. The effects of

decision uncertainty on information-seeking intentions, as well as the moderating role of health self-efficacy and outcome expectations, need further exploration because their influence appear to be topic-specific.

Organization of the Dissertation

The five chapters of this dissertation reflect a sequence of investigations about how individuals encounter, experience, and manage health-related uncertainty through information seeking. This introductory chapter provides a review of literature about the messages factors that give rise to uncertainty on health issues and their effects on health information seeking intentions and behaviors. Also provide here, is a review of literature supporting the theoretical framework guiding this dissertation, and a preview of findings of the three studies conducted to test a model of the effects of uncertainty-arousing health information. Chapters 2 through 4 contain the final manuscripts for the three experiments that were carried out. The fifth and final chapter provides a general discussion of the dissertation's findings and suggestions for future research.

Uncertainty in Health Contexts

Defining Uncertainty. "Uncertainty" refers to the subjective consciousness, metacognitive awareness of one's lack of knowledge about an issue (Han et al., 2011, 2019). It is a "subjective, cognitive experience of people – a state of mind rather than a feature of the objective world" (Han et al., 2011, p. 829). The perception of "not knowing enough" is the most common theme among all the multiple definitions of uncertainty that exist (Powell et al., 2007).

Uncertainty is a central focus of illness experience, medical research and interventions, and health communication (Han et al., 2011). UMT guides most of the theoretical predictions in this dissertation because of its objective to explain message processing under health-related uncertainty. In addition to cognitive responses to uncertainty, UMT also takes into account

emotional responses, which is particularly relevant in the context of health-related uncertainty (Knobloch & McAninch, 2014). According to UMT, uncertainty exists "when people feel insecure in their own state of knowledge or the state of knowledge in general" (Brashers, 2001, p.478).

Sources of Uncertainty. Han et al. (2011) advanced a taxonomy of uncertainty in health care based on an extensive review from many fields of research, including communication (Babrow et al., 1998), health services (Mishel, 1988, 1990), and decision science (Ellsberg, 1961; Smithson, 1999). The taxonomy is integrative, and its first dimension represents three main characteristics of information that give rise to uncertainty: *probability*, *ambiguity*, and *complexity*. These sources of uncertainty, while not specific to health care (Han et al., 2011), are also sources of health-related uncertainty discussed in UMT.

Probability ("risk") refers to the likelihood of future outcomes and has been examined extensively in risk communication research (Spiegelhalter et al., 2011). For this reason, this dissertation focuses on the other two understudied sources of uncertainty: ambiguity and complexity.

Ambiguity refers to message content that is inadequate due to its provision of imprecise, incomplete, or contradictory information about the likelihood of future outcomes. Among the various forms of ambiguity (imprecision, incompleteness, or contradiction), this dissertation focuses on messages containing contradiction because of their prevalence in the media (Alexander & Rowe, 2006). *Complexity* refers to features of a phenomenon that make it difficult to comprehend, such as the existence of multiple potential causes, effects, and interpretive cues related to a health issue.

Ambiguous and complex messages do not contain adequate and clear information that allow an individual to properly structure or categorize an object. In the impossibility of assigning meaning to that object or to accurately predict its outcomes, people experience uncertainty (Brashers, 2001; Mishel, 1988, 1990). Further, each of these sources of uncertainty are thought to produce different cognitive, emotional, and behavioral outcomes, hence the importance of distinguishing them (Han et al., 2011; Hillen et al., 2017).

Contradiction. Messages containing this form of ambiguity have "two or more health-related propositions that are logically inconsistent with one another [such that] a person could not simultaneously engage in or believe both propositions at once" (Carpenter et al., 2016, p. 1175) – for example: *coffee is bad for your heart* versus *coffee is good for your heart*. In this example, it is not possible for coffee to be both bad and good for your heart; the contradiction is self-evident. A more nuanced example of contradiction would be *coffee is bad for your heart* versus *coffee is bad for your heart if you drink more than three cups per day* (Carpenter et al., 2016). The latter example is contradictory because the first statement makes a blanket claim about the dangers of coffee, whereas the second statement claims that coffee is not dangerous unless a threshold dose is reached.

Complexity. Complexity refers to characteristics of information that make it difficult to understand, such as the existence of multiple causes, effects, decisional alternatives, conditional relations, or interactions (Han et al., 2011, 2019). Following this definition, an example of complexity frequently found in the media is a message stating that *coffee improves memory*, followed by a message claiming that *coffee increases the risk of heart disease*. These messages are not contradictory (not logically inconsistent), but convey a multiplicity of both (plausible)

positive and negative effects of a behavior, representing complex messages according to Han et al. (2011, 2019).

Perceived Contradiction and Complexity

According to UMT, "uncertainty exists when details of situations are ambiguous, complex, unpredictable, or probabilistic; when information is unavailable or inconsistent; and when people feel insecure in their own state of knowledge or the state of knowledge in general" (Brashers, 2001, p. 478). Although UMT acknowledges contradiction and complexity as sources of health-related uncertainty, the theory does not make distinctions between the objective existence of contradiction and complexity versus perceptions of contradiction and complexity. This distinction is important. First, individuals' perceptions, rather than objective indices of contradiction and complexity, shape their responses to uncertainty (Carpenter et al., 2016; Yoon et al., 2017). Second, this distinction justify efforts to systematically differentiate (conceptually and operationally) between the different sources of uncertainty and their potential distinct outcomes (Hamilton et al., 2013; Han et al., 2011; Hillen et al., 2017). Finally, it also allows for the exploration of individual factors that influence such perceptions.

Perceived Contradiction. Perceived contradiction is the degree of perceived information inconsistency from an individual's perspective (e.g., *in my opinion, information across these messages are incompatible)*. Attention to contradictory health information should result in perceptions of contradiction that varies among individuals. For example, people with limited scientific literacy might have higher perceptions of contradiction toward conflicting messages (Carpenter et al., 2016).

Perceived Complexity. Perceived complexity is the degree to which information is judged to be difficult to understand from an individual's perspective (e.g., *in my opinion,*

information across these messages are complicated). Attention to complex health information should result in perceptions of complexity that varies among individuals. For example, people with low health literacy tend to feel more confused when being aware of the harms and benefits of a health behavior (Shi et al., 2019). In this dissertation, it was hypothesized that perceptions of contradiction and perceptions of complexity would lead to different types of uncertainty, as described below.

Issue and Decision Uncertainty

UMT also does not make distinctions between different types of uncertainty. In this dissertation, *issue* uncertainty is distinct from *decision* uncertainty, as each pertains to different aspects of uncertainty management.

Issue Uncertainty. The concept of issue uncertainty refers to a state of uncertainty about the health outcomes of a behavior (e.g., *is fish oil healthy?*). Issue uncertainty stem from perceptions of contradiction (Chang, 2015; Jensen & Hurley, 2012). The illogical nature of contradictory messages impairs the construction of personal knowledge about an issue, since the individual does not know which is the correct proposition. As a result, individuals may doubt their own state of knowledge.

Decision Uncertainty. Decision uncertainty is a state of uncertainty about what course of action to take (e.g., *should I take fish oil supplements for improved heart health even though I might be poisoning myself with mercury?*). Decision uncertainty stems from issue uncertainty, especially when issue relevancy is high (O'Connor, 1995; O'Connor et al., 1998). This dissertation provides initial investigation of how issue uncertainty mediates the effects of message perceptions on decision uncertainty.

Uncertainty Management Theory

UMT explains the role of communication and psychological processes involved in the encounter, appraisal, and management of health-related uncertainty (Brashers & Hogan, 2013; Rains & Tukachinsky, 2015). As previously noted, UMT does not discuss the relationship between the objective existence of contradiction and perceptions of contradiction, nor does it differentiation between issue uncertainty and decision uncertainty. Rather, the theory focuses on how individuals appraise uncertainty, on the emotions resulting from such appraisals, and on the management of that uncertainty. The main tenets of UMT are explained below.

Cognitive Appraisals. Uncertainty prompts cognitive evaluations of what an issue implies for one's well-being (such as harm or benefit), followed by corresponding emotions (anxiety or hope) and by psychological and behavioral reactions (Brashers, 2001). Other theories also posit that, in the face of ambiguous health situations, initially, certain cognitive evaluations take place, which are accompanied by specific emotions (Lazarus & Folkman, 1987; Smith & Lazarus, 1993). Although a key assumption of UMT is that uncertainty is not inherently good or bad (Rains & Tukachinsky, 2015), people generally desire the world to be predictable and controllable (Klein et al., 2015) and, therefore, health-related uncertainty is typically associated with negative evaluations. For this reason, negative appraisal was the focus of this dissertation.

Studies have documented the negative cognitive effects of contradictory and complex health messages, such as lower perceived disease preventability (Han et al., 2006), reduced beliefs about the benefits of certain health behaviors (Tan, Lee, Nagler, & Bigman, 2017), increased negative beliefs about nutrition recommendations (Lee et al., 2017; Nagler, 2014), and less favorable attitude toward healthy foods (Aschemann-Witzel & Grunert, 2015; Chang, 2013).

Affective Reactions. Cognition and affect have been treated as separate constructs in health communication research, with a focus on cognitions (Keer, Van Den Putte, & Neijens, 2012; Kiviniemi et al., 2018). This is also the case for studies on the effects of contradictory and complex health messages in the media. The importance of exploring both cognitive and affective outcomes of uncertainty has been emphasized by many researchers (Han et al., 2011; Hillen et al., 2017; Strout et al., 2018). Positive affect emerges from appraised benefits, while negative affect emerges from appraised harms (Brashers, 2001; Lazarus & Folkman, 1987; Smith & Lazarus, 1993). The most common emotions associated with uncertainty is worry, anxiety, and fear (Rosen et al., 2014), known as threat emotions (Folkman & Lazarus, 1985).

Information Seeking. Psychological and behavioral reactions to uncertainty are shaped by cognitive and emotional responses, such that individuals feel motivated to reduce uncertainty experienced as negative – most directly accomplished by additional information seeking (Brashers, 2001). In this dissertation, information seeking is defined as an intentional and active effort to acquire information in response to one's perceived lack of knowledge (Mai, 2016). Information generally helps individuals to make sense of an issue and, by purposefully looking for additional information, people attempt to attenuate uncertainty and its negative reactions (Carcioppolo, Yang, & Yang, 2016; Fung, Griffin, & Dunwoody, 2018; Lipshitz & Strauss, 1997; Rains & Tukachinsky, 2015). Less known, however, is how individuals behave during actual information search. The limited research suggests that information search motivated by threat emotions is selective (Nabi, 2003) and "widely and shallowly as possible" (Rains & Tukachinsky, 2015, p. 347), in order to locate any information that could reduce worry, anxiety, and fear.

Preview of Findings

Study 1. Titled *Effects of Contradictory and Complex Health Information on Uncertainty Perceptions and Information-Seeking Intention*, this experiment identified characteristics and perceptions of media messages that elicit uncertainty, and the effects of uncertainty on appraisals, emotions, and information-seeking intentions. The idea that distinct sources of uncertainty produce different cognitive, emotional, and behavioral outcomes assumes that individuals actually perceive these sources of uncertainty as different (Han et al., 2011; Hillen et al., 2017). It was hypothesized that contradictory and complex health messages would foster perceptions of contradiction and complexity, respectively. In turn, perceptions of contradiction and complexity would generate issue and decision uncertainty, respectively.

Unique to this program of research are the distinctions embedded in the CHIP model between objective and perceived contradiction and complexity, and between issue uncertainty and decision uncertainty. These distinctions were not incorporated into UMT. Perceptions of contradiction were expected to foster *issue* uncertainty, a state of uncertainty about the health outcomes of adopting a health behavior. In contrast, the multiple (but noncontradictory) outcomes conveyed in complex messages should cause *decision uncertainty*, a state of uncertainty about what course of action to take. The remaining hypotheses in the study were based on the theoretical predictions of UMT. It was expected that the experience of uncertainty should prompt appraisals of what an issue implies for one's well-being, followed by the experience of certain emotions that motivate information seeking as means to manage that uncertainty and its outcomes. Finally, generic measures of health-related uncertainty were developed.

In an online experiment, 584 U.S. adults were randomly assigned to one of three conditions: contradictory messages, complex messages, or no-message control condition. Participants in the two message conditions read contradictory or complex messages and completed measures of perceived contradiction and complexity, issue and decision uncertainty, appraisals of health outcomes, emotions, and information-seeking intentions. Baseline levels of issue and decision uncertainty were measured in the control condition. The topic of nutrition (dairy consumption) was chosen because of its importance in everyday life and its prominence in the media (Alexander & Rowe, 2006).

Both messages were perceived as contradictory and did not generate different levels of issue uncertainty, negative appraisals, threat emotions, or information-seeking intentions. These results indicated that the theoretical distinction between contradiction and complexity are not necessarily noticed by lay people. The distinction between issue and decision uncertainty proved to be important, as both messages increased decision uncertainty in comparison to the control. Results supported a refinement in the model in which perceptions of contradiction and complexity give rise to issue uncertainty, leading to decision uncertainty which, in turn, affects information seeking through the mediation of negative emotions and threat emotions.

The study contributes to the field of health communication by differentiating conceptually and empirically contradictory and complex health messages; introducing the role of decision uncertainty; explicating the process that leads individuals to manage health-related uncertainty though information-seeking intentions; and creating generic measures of uncertainty and related constructs that can be used across a range of health topics. The limitations of this study pointed to opportunities for investigation in the subsequent investigations. Specifically, this study was limited to a single health topic and no moderators of the relations depicted in the

model developed was explored. Some of these aspects were explored in Study 2.

Study 2. The second experiment, titled *When Media Health Stories Conflict: Test of the Contradictory Health Information Processing (CHIP) Model*, extended the main findings and addressed some of the limitations of Study 1. Results from the first study suggested that the effect of issue uncertainty on negative appraisals is mediated by decision uncertainty. Using a different nutrition topic (a new vegan burger), Study 2 tested this modified version of the original model, as well as a series of potential moderators of causal paths that have not incorporated into UMT. These moderators were diet information overload, need for cognition, intolerance for uncertainty, health self-efficacy, and outcome expectations of the information search.

Diet information overload is the perception that there is excessive diet recommendations in the information environment (Ramondt & Ramírez, 2019). This large amount of information requires considerable mental resources for message processing (Jensen et al., 2014), making individuals confused and overwhelmed (Khaleel et al., 2020). When individuals experiencing high diet information overload perceive message contradictions, they should also experience more issue uncertainty than individuals with lower diet information overload.

Need for cognition refers to a person's tendency to engage in effortful thinking. Individuals with high NC also tend to reflect more on information to make sense of issues in their lives (Cacioppo et al., 1996). Processing contradictory messages requires cognitive effort (Lang, 1995). High need for cognition individuals should reflect more upon contradictory health information, resulting in more issue uncertainty than that experienced by people with low need for cognition (Kardash & Scholes, 1996).

Intolerance for uncertainty refers to an individual's tendency to react to uncertainty in a predictable manner. Individuals with high intolerance for uncertainty have a stronger preference

for previsibility and tend to appraise uncertainty as a source of threat (Buhr & Dugas, 2002; Carleton et al., 2007), therefore, the relation between decision uncertainty and negative appraisals should be stronger among individuals with higher intolerance for uncertainty.

Health self-efficacy refers to individuals' beliefs about their ability to control their own health habits (Bandura, 2004). Individuals with stronger HSE are more likely to adopt positive health behaviors, such as health information seeking (Zhao & Cai, 2009). In addition, negative emotions are strong predictors of information seeking when health self-efficacy is high (Lee et al., 2008), therefore, threat emotions should be more strongly related to information-seeking intentions when health self-efficacy is higher.

Expectations of how new information would impact uncertainty (outcome expectation) are also thought to influence information seeking intentions (S. Y. Lee et al., 2008; Nabi, 1999). Threat emotions should be more strongly related to information-seeking intentions when individuals believe that the new information can provide a sense of coherence (cognitive outcome expectation) and reduce threat emotions (emotional outcome expectation) (Brashers, 2001; Brashers & Hogan, 2013; Sweeny et al., 2010).

In an online experiment, 763 U.S. adults were randomly assigned to one of three conditions: contradictory, non-contradictory, and control message conditions. Participants in the contradictory and non-contradictory conditions answered questions about their perceptions of contradiction in conflicting messages, issue and decision uncertainty, negative appraisals and emotions, information-seeking intentions. They also completed measures of moderator variables, including diet information overload, need for cognition, intolerance for uncertainty, and health self-efficacy. Baseline levels of issue and decision uncertainty were measured in the control condition. UMT and model main tenets were confirmed again: perceptions of contradiction led to

issue uncertainty which, in turn, prompted cognitive appraisals directly, and indirectly through increased decision uncertainty. The effects of issue and decision uncertainty on information-seeking intentions were mediated by negative appraisals and threat emotions. Individuals with high health self-efficacy and positive outcome expectations of information search were more likely to manage uncertainty through information seeking.

The study contributed to the field of health communication by providing further support of the causal relations between health information contradiction, uncertainty, and information-seeking intentions. Unique to this study was the test of a series of potential moderators, and the findings that individuals with high health self-efficacy and positive cognitive outcome expectations are more likely to engage in information seeking when experiencing threat emotions. Study 3 investigated individuals' information search intentions on a health topic beyond the nutritional context.

Study 3. Titled *Effects of Contradictory Health Information on Information Processing and Information Seeking*, this experiment provided further testing of the CHIP model's propositions in the context of consumer health product safety. The topic chosen was the use of antiperspirants with aluminum. Some media messages have suggested that the use of this product is related to negative health outcomes, such as Alzheimer's disease and women's breast cancer.

In an online experiment, 478 U.S. women were randomly assigned to one of three conditions: experimental conditions consisting of two messages about the safety of a consumer health product that were (1) contradictory or (2) non-contradictory, or a (3) control condition with two messages unrelated to that consumer product. Participants in the two experimental conditions provided ratings of the CHIP model constructs, including perceived message contradiction, issue uncertainty, decision uncertainty, negative appraisals, threat emotions, and

information-seeking intentions. They also provided measures of health self-efficacy and cognitive outcome expectations. Control participants provided baseline ratings of issue and decision uncertainty.

As in Study 2, message contradiction generated perceptions of contradiction that gave rise to issue uncertainty. Issue uncertainty, in turn, prompted negative appraisals and decision uncertainty. The effects of issue uncertainty on information-seeking intentions were mediated by negative appraisals and threat emotions. These findings contribute to research by verifying the core predictions of the CHIP model in a different health domain, by confirming the importance of distinguishing between the objective presence of contradiction and perceptions of contradiction, and by providing further evidence that issue uncertainty is a precursor to decision uncertainty.

Unique to this study, however, was that decision uncertainty did not affect information-seeking intentions. Health self-efficacy and outcome expectations were also not significant moderators of the relation between threat emotions and information-seeking intentions. Given that the main difference between Study 2 and Study 3 pertained to the health issue under consideration, these findings were mainly attributed to potential differences in topic familiarity.

The safety of antiperspirants with aluminum could have been a topic unfamiliar to most participants, leading individuals to focus more on the contradictions surrounding the issue than on considering personal behavior changes. Hence, the lack of effects of decision uncertainty on information-seeking intentions. Similarly, given the focus on the contradictions surrounding the issue, beliefs about the ability to control their own behaviors (i.e., health self-efficacy) might not have been relevant. As for outcome expectations, its measurement included expectations of how

additional information could reduce both issue and decision uncertainty but, as discussed, expectations about reducing decision uncertainty might not have been relevant.

As with the previous two studies, this third study also had limitations that can serve as an opportunity for future research. First, the CHIP model was tested with one single health issue at a time. For this reason, potential explanations pertaining topic familiarity remains to be empirically tested. Second, a convenience sample of participants who selected themselves into the studies was used, limiting the generalizability of the findings. Third, information-seeking intentions, rather than actual information-seeking behavior, was assessed. Finally, only a specific type of contradictory message was tested (two synchronous and seemgly believable sources of contradictory information). Overall, however, the core propositions of the CHIP model were validated.

References

Alexander, N., & Rowe, S. (2006). Can nutrition research change its mind? *Nutrition Today*, *41*(4), 185–188.

Babrow, A. S., Kasch, C. R., & Ford, L. A. (1998). The many meanings of uncertainty in illness: Toward a systematic accounting. *Health Communication*, *10*(1), 1–23.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, *31*(2), 143–164.

Bradac, J. J. (2001). Theory comparison: Uncertainty reduction, problematic integration, uncertainty management, and other curious constructs. *Journal of Communication*, *51*(3), 456–476.

Brashers, D. E. (2001). Communication and uncertainty management. *Journal of Communication*, *51*(3), 477–497.

Brashers, D. E., & Hogan, T. P. (2013). The appraisal and management of uncertainty: Implications for information-retrieval systems. *Information Processing & Management*, *49*(6), 1241–1249.

Buhr, K., & Dugas, M. J. (2002). The intolerance of uncertainty scale: Psychometric properties of the English version. *Behaviour Research and Therapy*, *40*(8), 931–945.

Cacioppo, J. T., Petty, R. E., Feinstein, J. A., & Jarvis, W. B. G. (1996). Dispositional differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin*, *119*(2), 197–253.

Carleton, R. N., Norton, M. P. J., & Asmundson, G. J. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders*, *21*(1), 105–117.

Carpenter, D. M., Geryk, L. L., Chen, A. T., Nagler, R. H., Dieckmann, N. F., & Han, P. K. J. (2016). Conflicting health information: A critical research need. *Health Expectations*, *19*(6), 1173–1182.

Chang, C. (2015). Motivated processing: How people perceive news covering novel or contradictory health research findings. *Science Communication*, *37*(5), 602–634.

Clark, D., Nagler, R. H., & Niederdeppe, J. (2019). Confusion and nutritional backlash from news media exposure to contradictory information about carbohydrates and dietary fats. *Public Health Nutrition*, *22*(18), 3336–3348.

Ellsberg, D. (1961). Risk, ambiguity, and the Savage axioms. *The Quarterly Journal of Economics*, *75*(4), 643–669.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, *48*(1), 150–170.

Hamilton, J. G., Hutson, S. P., Moser, R. P., Kobrin, S. C., Frohnmayer, A. E., Alter, B. P., & Han, P. K. J. (2013). Sources of uncertainty and their association with medical decision making: Exploring mechanisms in Fanconi anemia. *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine*, *46*(2), 204–216.

Han, P. K. J., Babrow, A., Hillen, M. A., Gulbrandsen, P., Smets, E. M., & Ofstad, E. H. (2019). Uncertainty in health care: Towards a more systematic program of research. *Patient Education and Counseling*, *102*(10), 1756–1766.

Han, P. K. J., Klein, W. M., & Arora, N. K. (2011). Varieties of uncertainty in health care: A conceptual taxonomy. *Medical Decision Making*, *31*(6), 828–838.

Han, P. K. J., Moser, R. P., & Klein, W. M. (2006). Perceived ambiguity about cancer prevention recommendations: Relationship to perceptions of cancer preventability, risk, and worry. *Journal of Health Communication*, *11*(S1), 51–69.

Hillen, M. A., Gutheil, C. M., Strout, T. D., Smets, E. M., & Han, P. K. J. (2017). Tolerance of uncertainty: Conceptual analysis, integrative model, and implications for healthcare. *Social Science & Medicine*, *180*(2017), 62–75.

Jensen, J. D., Carcioppolo, N., King, A. J., Scherr, C. L., Jones, C. L., & Niederdeppe, J. (2014). The cancer information overload (CIO) scale: Establishing predictive and discriminant validity. *Patient Education and Counseling*, *94*(1), 90–96.

Jensen, J. D., & Hurley, R. J. (2012). Conflicting stories about public scientific controversies: Effects of news convergence and divergence on scientists' credibility. *Public Understanding of Science*, *21*(6), 689–704.

Kang, Y. (2003). Testing the mediating effect of appraisal in the model of uncertainty in illness. *Journal of Korean Academy of Nursing*, *33*(8), 1127–1134.

Kardash, C. M., & Scholes, R. J. (1996). Effects of preexisiting beliefs, epistemological beliefs, and need for cognition on interpretation of controversial issues. *Journal of Educational Psychology*, *88*(2), 260–271.

Katz, S. J., Erkkinen, M., Lindgren, B., & Hatsukami, D. (2018). Assessing the impact of conflicting health warning information on intentions to use e-cigarettes: An application of the Heuristic-Systematic Model. *Journal of Health Communication*, *23*(10–11), 874–885.

Khaleel, I., Wimmer, B. C., Peterson, G. M., Zaidi, S. T. R., Roehrer, E., Cummings, E., & Lee, K. (2020). Health information overload among health consumers: A scoping review. *Patient Education and Counseling*, *103*(1), 15–32.

Klein, W. M. P., Hamilton, J. G., Harris, P. R., & Han, P. K. J. (2015). Health messaging to individuals who perceive ambiguity in health communications: The promise of self-affirmation. *Journal of Health Communication*, *20*(5), 566–572.

Knobloch, L. K., & McAninch, K. G. (2014). Uncertainty management. In C. R. Berger (Ed.), *Interpersonal Communication* (pp. 297–319). De Gruyter, Inc.

Lang, A. (1995). Defining audio/video redundancy from a limited- capacity information processing perspective. *Communication Research*, *22*(1), 86–115.

Lee, C. J., Nagler, R. H., & Wang, N. (2018). Source-specific exposure to contradictory nutrition information: Documenting prevalence and effects on adverse cognitive and behavioral outcomes. *Health Communication*, *33*(4), 453–461.

Lee, S. Y., Hwang, H., Hawkins, R., & Pingree, S. (2008). Interplay of negative emotion and health self-efficacy on the use of health information and its outcomes. *Communication Research*, *35*(3), 358–381.

Mishel, M. H. (1988). Uncertainty in illness. *Journal of Nursing Scholarship*, *20*(4), 225–232.

Mishel, M. H. (1990). Reconceptualization of the uncertainty in illness theory. *Journal of Nursing Scholarship*, *22*(4), 256–262.

Nabi, R. L. (1999). A cognitive-functional model for the effects of discrete negative emotions on information processing, attitude change, and recall. *Communication Theory*, *9*(3), 292–320.

Nabi, R. L. (2003). Exploring the framing effects of emotion: Do discrete emotions differentially influence information accessibility, information seeking, and policy preference? *Communication Research*, *30*(2), 224–247.

Nagler, R. H. (2010). *Steady diet of confusion: Contradictory nutrition messages in the public information environment*. Philadelphia, PA: (Unpublished doctoral dissertation). Annenberg School for Communication, University of Pennsylvania.

Nagler, R. H. (2014). Adverse outcomes associated with media exposure to contradictory nutrition messages. *Journal of Health Communication*, *19*(1), 24–40.

Nagler, R. H., Yzer, M. C., & Rothman, A. J. (2019). Effects of media exposure to conflicting information about mammography: Results from a population-based survey experiment. *Annals of Behavioral Medicine*, *53*(10), 896–908.

O'Connor, A. M. (1995). Validation of a decisional conflict scale. *Medical Decision Making*, *15*(1), 25–30.

O'Connor, A. M., Tugwell, P., Wells, G. A., Elmslie, T., Jolly, E., Hollingworth, G., McPherson, R., Bunn, H., Graham, I., & Drake, E. (1998). A decision aid for women considering hormone therapy after menopause: Decision support framework and evaluation. *Patient Education and Counseling*, *33*(3), 267–279.

Powell, M., Dunwoody, S., Griffin, R., & Neuwirth, K. (2007). Exploring lay uncertainty about an environmental health risk. *Public Understanding of Science*, *16*(3), 323–343.

Rains, S. A., & Tukachinsky, R. (2015). An examination of the relationships among uncertainty, appraisal, and information-seeking behavior proposed in uncertainty management theory. *Health Communication*, *30*(4), 339–349.

Ramondt, S., & Ramírez, A. S. (2019). Assessing the impact of the public nutrition information environment: Adapting the cancer information overload scale to measure diet information overload. *Patient Education and Counseling*, *102*(1), 37–42.

Rosen, N. O., Ivanova, E., & Knäuper, B. (2014). Differentiating intolerance of uncertainty from three related but distinct constructs. *Anxiety, Stress & Coping*, *27*(1), 55–73.

Shi, W., Nagler, R. H., Fowler, E. F., & Gollust, S. E. (2019). Predictors of women's awareness of the benefits and harms of mammography screening and associations with confusion, ambivalence, and information seeking. *Health Communication, 36*(3), 1–12.

Smithson, M. (1999). Conflict aversion: Preference for ambiguity vs conflict in sources and evidence. *Organizational Behavior and Human Decision Processes*, *79*(3), 179–198.

Spiegelhalter, D., Pearson, M., & Short, I. (2011). Visualizing uncertainty about the future. *Science*, *333*(6048), 1393–1400.

Strout, T. D., Hillen, M., Gutheil, C., Anderson, E., Hutchinson, R., Ward, H., Kay, H., Mills, G. J., & Han, P. K. J. (2018). Tolerance of uncertainty: A systematic review of health and healthcare-related outcomes. *Patient Education and Counseling*, *101*(9), 1518–1537.

Sweeny, K., Melnyk, D., Miller, W., & Shepperd, J. A. (2010). Information avoidance: Who, what, when, and why. *Review of General Psychology*, *14*(4), 340–353.

Tan, A. S., Lee, C. J., Nagler, R. H., & Bigman, C. A. (2017). To vape or not to vape? Effects of exposure to conflicting news headlines on beliefs about harms and benefits of electronic cigarette use: Results from a randomized controlled experiment. *Preventive Medicine*, *105*, 97–103.

Yoon, H., Sohn, M., Choi, M., & Jung, M. (2017). Conflicting online health information and rational decision making: Implication for cancer survivors. *The Health Care Manager*, *36*(2), 184–191.

Zhao, X., & Cai, X. (2009). The role of risk, efficacy, and anxiety in smokers' cancer information seeking. *Health Communication*, *24*(3), 259–269.

Chapter 2. Processing and Effects of Contradictory and Complex Health Information

Chapter 2. Processing and Effects of Contradictory and Complex Health Information

Abstract

Contradictory and complex health information is prevalent in the media. Guided by Uncertainty Management Theory, we examine the effects of such information. U.S. adults were randomly assigned to one of three conditions: contradictory messages, complex messages, or no-message control. Both messages were perceived as contradictory, generating similar levels of issue uncertainty, negative appraisals, threat emotions, and information-seeking intentions. Both messages increased decision uncertainty in comparison to control. Perceptions of contradiction and complexity generated issue uncertainty, leading to decision uncertainty which, in turn, affects information seeking through the mediation of negative appraisals and emotions. Theoretical and practical implications are discussed.

Processing and Effects of Contradictory and Complex Health Information

Are coffee, soy, and coconut oil good or bad for us? Does eating fish benefit our cardiovascular health or poison us with heavy metals? As a result of the contradictory and complex nature of health claims found in the media, consumers often experience uncertainty about health topics. Uncertainty is the perception that one lacks sufficient knowledge about some aspect of reality (Han et al., 2011, 2019). Among its numerous negative effects, uncertainty leads to worry and anxiety, altering the nature of individuals' information-seeking efforts (Rains & Tukachinsky, 2015) and dampening their interest in altering health behaviors (Lee et al., 2018; Nagler, 2014).

Uncertainty is an important concept in health communication (Babrow et al., 1998). Uncertainty Management Theory, UMT (Brashers, 2001), has been an influential framework for explaining the communication and psychological processes that individuals go through when facing health-related uncertainty. According to the theory, uncertainty prompts appraisals of what an issue implies for one's well-being (such as a potential harm or benefit), followed by certain emotions. Such appraisals and emotional responses, in turn, motivate individuals to engage in or avoid communication activities to manage that uncertainty.

The objective of the present study was to test a revised version of UMT that expands its scope of explanation and incorporates advances in our understanding of uncertainty management (Table 2.1). The revised model builds upon UMT in two important ways. First, it differentiates between objective and perceived message contradiction and complexity, as described below. Second, it identifies two different forms of uncertainty, issue and decision uncertainty.

In the literature review that follows, we identify characteristics and perceptions of media messages that can elicit uncertainty. We then examine the effects of uncertainty on appraisals,

emotions, and information-seeking, a common strategy to manage uncertainty (Brashers, 2001; Rains & Tukachinsky, 2015). Finally, we report an experimental test of the revised UMT using nutritional messages typically found in the media and that might elicit uncertainty. The topic of nutrition was chosen because of its importance in everyday life (Alexander & Rowe, 2006).

Sources of Uncertainty

Han et al., (2011, 2019) advanced a taxonomy of uncertainty in health care whose first dimension represents characteristics of information that give rise to uncertainty: *probability*, *ambiguity*, and *complexity*. These sources of uncertainty, while not specific to health care (Han et al., 2011), are the main causes of health-related uncertainty discussed in UMT: "uncertainty exists when details of situations are ambiguous, complex, unpredictable, or probabilistic; when information is unavailable or inconsistent; and when people feel insecure in their own state of knowledge or the state of knowledge in general (Brashers, 2001, p. 478)."

Probability ("risk") pertains to the likelihood of future outcomes and has been examined extensively in risk communication research (Spiegelhalter et al., 2011). *Ambiguity* refers to message content that is inadequate due to its provision of imprecise, incomplete, or contradictory information about the likelihood of future outcomes. *Complexity* denotes features of a phenomenon that make it difficult to comprehend, such as the existence of multiple potential causes, effects, and interpretive cues related to a health issue. Each of these sources of uncertainty produces different cognitive, emotional, and behavioral outcomes, hence the importance of distinguishing them (Han et al., 2011; Hillen et al., 2017). This study focuses on nutrition messages containing *contradiction* (a form of ambiguity) and *complexity*, given their prevalence in the media (Alexander & Rowe, 2006). A primary goal was to model how individuals' experience of uncertainty differs between contradictory and complex messages.

Conceptual Model and Hypotheses

Message Characteristics

Our model distinguishes between messages that contain contradictory versus complex information (Figure 2.1). *Contradictory health messages* contain propositions that are logically inconsistent (Carpenter et al., 2016). This definition relates to the properties of information itself, not perceptions of the information. An example is two messages that respectively recommend the initiation of mammography screening at age 40 and age 50. These recommendations are opposing and cannot be simultaneously true (Carpenter et al., 2016).

Complex health messages represent characteristics of information that make understanding potentially difficult. These message characteristics include the existence of multiple causes, effects, decisional alternatives, conditional relations, or interactions (Han et al., 2011, 2019). An example of complexity frequently found in the media is a message stating that coffee improves memory, followed by a message claiming that coffee increases the risk of heart disease. In these messages, information about the health outcomes of coffee consumption is not contradictory (not logically inconsistent); both claims can be true. However, this message set conveys a multiplicity of positive and negative potential effects of a behavior, representing complexity in the Han et al. (2011) taxonomy of uncertainty. (Messages with this structure also have been referred as "conflicting" in the health communication literature; see Nagler & LoRusso (2018) for a detailed discussion.)

Perceived Contradiction and Complexity

The model specifies that exposure to contradictory and complex messages fosters *perceptions* of contradiction and complexity, respectively. We refer to *perceived contradiction* as the degree of information inconsistency perceived by an individual, and to *perceived complexity*

as the degree to which information is judged to be difficult to understand. This distinction between objective and perceived sources of uncertainty is not established in UMT, but is important for many reasons. Individuals are thought to develop different perceptions of objective contradiction and complexity influenced by situational and individual characteristics not clearly identified yet (Carpenter et al., 2016; Han et al., 2009). In addition, the theoretical distinction between sources of uncertainty is based on the objective existence of contradiction and complexity but, ultimately, how individuals perceive this distinction determines their experience of uncertainty. By empirically testing if individuals perceive contradictory and complex messages as different in the first place, we thus further justify efforts to systematically distinguish (conceptually and operationally) between the different sources of uncertainty and their potential distinct outcomes (Hamilton et al., 2013; Han et al., 2011). This model refinement also points to the need to understand individual differences in the capacity to perceive contradiction and complexity.

H1: Contradictory and complex health messages will foster different perceptions such that (a) contradictory messages will produce perceptions of contradiction and (b) complex messages will produce perceptions of complexity.

State of Uncertainty

Uncertainty is the subjective perception of one's own lack of knowledge about some aspect of reality (Han et al., 2011). Building upon UMT, the model we test suggests a distinction between *issue* uncertainty and *decision* uncertainty, as they pertain to different aspects of uncertainty. We expect perceptions of contradiction to foster *issue* uncertainty, a state of uncertainty about the health outcomes of a behavior (e.g., *is fish oil healthy?*). This is because the illogical nature of contradictory messages hinders the coherent construction of personal

knowledge about an issue. In the absence of additional information, the individual does not know which proposition is valid, and which proposition should be dismissed. In contrast, we expect that the multiple outcomes conveyed in complex messages do not necessarily impair the construction of knowledge, but are likely to cause *decision uncertainty* – a state of uncertainty about what course of action to take (e.g., *should I take fish oil supplements for improved heart health even though I might be poisoning myself with mercury?*). In the absence of information about how to weigh benefits against risks, individuals will likely experience decisional conflict on whether to adopt the behavior (O'Connor, 1995; O'Connor et al., 1998).

H2a: Perceptions of contradiction will be positively related to issue uncertainty.

H2b: Perceptions of complexity will be positively related to decision uncertainty.

Appraisals and Emotions

In accordance with UMT, the revised model specifies that uncertainty prompts cognitive appraisals of what an issue means for one's well-being, followed by corresponding emotions. Negative appraisals occur when individuals are more concerned with the possibility of negative health outcomes than positive ones. As a consequence, relatively stronger negative emotions emerge (Brashers, 2001; Mishel, 1988). Negative appraisals of uncertainty on health issues dominate (Kang, 2003) and, therefore, are the focus of our model predictions. It should be noted, however, that positive appraisals can occur (Brashers, 2001; Mishel, 1988).

Negative appraisals, and their corresponding emotions, have been classified as *anticipatory* appraisals of threat (e.g., anxiety) and *outcome* appraisals of harm (e.g., anger) (Folkman & Lazarus, 1985). The most common negative emotions associated with uncertainty on health issues are the "threat emotions" of worry, anxiety, and fear (Rosen et al., 2014).

H3: a) Issue uncertainty and b) decision uncertainty will be positively related to negative appraisals.

H4: Negative appraisals will be positively related to threat emotions.

Uncertainty Management

Threat emotions that result from negative appraisals motivate individuals to manage perceived risks (Brashers, 2001; Smith & Lazarus, 1993). In particular, strong negative reactions to uncertainty usually motivate individuals to search for additional information in order to reduce their uncertainty and attenuate negative emotions (Brashers et al., 2000; Rains & Tukachinsky, 2015). Individuals may do so, for example, by searching broadly and superficially for any information that could reduce uncertainty (Rains & Tukachinsky, 2015).

H5: Threat emotions will be positively related to information-seeking intentions.

Materials and Methods

The issue selected pertains to the health consequences of full-fat dairy consumption because uncertainty has consequences only for issues relevant to individuals (Brashers, 2001). Dairy consumption is prevalent in the American diet, as is contradictory health information about high-fat dairy products (Rozenberg et al., 2016). The content of the articles was taken from the internet to reflect typical dairy consumption information found in the media. The content was then structured according to the definitions of contradictory and complex messages, and presented as faux articles with similar lengths (Figure 2.2). Since one of our objectives was to explore if the theoretical distinction between (objective) contradictory and complex messages corresponds to individuals' perceptions, they were not pre-tested. Importantly, perceived contradiction and complexity are not considered manipulation checks, but rather measures that enable investigation of the theoretical distinction just described.

Procedure

The study was approved by the authors' Institutional Review Board. A total of 750 participants were recruited in January 2019 through Mturk, a crowdsourcing platform used often in experimental social research (Peer et al., 2014). Respondents were randomly assigned to one of three conditions: *contradictory messages*, *complex messages*, or a stand-alone *no-message control*. The purpose of the control group was to make an initial assessment of baseline levels of issue and decision uncertainty only and, for this reason, it did not include any message. The control group was not included in model testing because the model variables assessing cognitive, emotional and behavioral responses to messages were not relevant to this group.

Participants in the experimental conditions read two articles, presented separately. In the contradictory condition, the first article provided evidence that *full-fat dairy consumption increases the risk of heart diseases* while the second article conveyed the idea that *full-fat dairy consumption decreases the risk of heart diseases*. In the complex messages condition, the first article presented the notion that *full-fat dairy consumption increases the risk of heart diseases* (the same first article from the contradictory condition) while the second article stated that *full-fat dairy consumption helps promote a healthy weight*. Participants had to spend at least one minute reading each article before being allowed to move forward. The back button was disabled. Respondents were then presented with a survey containing measures of study variables. The control condition only assessed baseline levels of issue and decision uncertainty.

Measures

Generic measures of health-related uncertainty that could be used across a range of health topics were developed (Table 2.3). Unless otherwise noted, measures were Likert-type scales

from 1 (strongly disagree) to 7 (strongly agree). The survey concluded with demographic questions.

Attention Check. Participants were presented with four statements taken from the messages and four faux statements. They then indicated if each statement appeared in the messages they read, or not. Respondents who did not answer correctly at least six of the eight attention check questions were excluded.

Issue Relevance. Measured by having participants type in the number of servings of dairy products that they consumed in a typical day (e.g., full-fat milk, reduced-fat milk, yogurt).

Perceived Contradiction. Aimed to capture perceptions of information conflict between the messages. Participants rated the extent to which the information presented in the articles about the health consequences of full-fat dairy products was contradictory, inconsistent, and incompatible. This scale was adapted from Chang (2015).

Perceived Complexity. Measured the degree of message comprehension. Participants rated the extent that information was complex, complicated, and difficult to understand. The scale was created by the authors and, to assure construct validity, the items were consistent with the conceptual definition of complexity provided by Han et al. (2011).

Issue Uncertainty. Assessed using four items. Each item asked about the participant's perceived lack of knowledge on the health effects of full-fat dairy products (e.g., "I have a lot of questions without answers"). Items were adapted from Mishel (1981).

Decision Uncertainty. Assessed using three items (e.g., "It is not clear what choice is best for me"). This scale captured an individual's conflict about actions to take (O'Connor, 1995).

Negative Appraisals. Assessed using four items (e.g., "I am concerned that consuming full-fat dairy products can cause harm to my health"). Items were adapted from earlier research (Ahmad, 2005).

Threat Emotions. Accessed by asking participants to indicate the extent to which they experienced certain emotions after reading the articles. Three items were used (worry, fear, anxiety) (Folkman & Lazarus, 1985). Likert scales ranged from 1 (*not at all*) to 7 (*very much*).

Information-Seeking Intention. Measured using three questions adapted from earlier research (Liu et al., 2005) (e.g., "I intend to ask my healthcare provider about the health outcomes of full-fat dairy product consumption at my next appointment"). Likert scales ranged from 1 (*definitely will not*) to 7 (*definitely will*).

Data Analysis

Descriptive statistics described study variables and sample characteristics. Confirmatory factor analysis (CFA) was used to assess our measurement model, using the maximum likelihood method of estimation (StataCorp, 2017). Structural equation modeling (SEM) was used to test our hypotheses, with the experimental manipulation represented as a dummy variable with the complex condition serving as the reference group. The control group is not in the analysis, as there were no perception measures in this no-message condition.

Model fit was deemed to be "good" if its root mean square of error of approximation (RMSEA) was $\leq .06$ and comparative fit index (CFI) was $\geq .95$ (Hu & Bentler, 1999). The criterion for an "acceptable" fit was RMSEA $\leq .08$, CFI $\geq .90$ (Browne & Cudeck, 1992; Hu & Bentler, 1999). Following best practices, model χ^2 was not used as a goodness-of-fit measure due to its sensitivity to sample size (Schermelleh-Engel et al., 2003). Modification indices were examined when an unsatisfactory fit was obtained to identify theoretically appropriate changes.

Model respecification is appropriate when theoretically justifiable (Acock, 2013; Kline, 2016). Such modifications are, in fact, "a part of most SEM analyses" (Kline, 2016, p. 463).

Results

Preliminary Analyses

We initially obtained complete data from 739 MTurk respondents, from which 129 (17.5%) respondents were excluded because they did not answer correctly at least six of the eight attention check questions. This cutoff of 75% correct answers has been adopted in previous research (Chen et al., 2015). Next, 26 respondents (3.5%) were excluded because they did not spend at least 22 seconds answering the questions about issue uncertainty, decision uncertainty, and issue relevance. This amount of time was deemed appropriate for a fast reader to respond to those questions. The final sample consisted of 584 participants.

Sample Characteristics. The final sample was primarily of males (52.1%), white (76.3%), and of middle age (M = 37.3 years, SD = 11.59). About 95% of individuals consumed at least one serving of dairy products per day, suggesting high topic relevance (Table 2.1).

Randomization. There were no significant differences across conditions with regard to age, gender, marital status, ethnicity, education, and income ($p > .05$ for all measures), indicating comparable groups in terms of these measures.

Reliabilities. Reliabilities for the scales were good: *perceived contradiction* (α = .94), *perceived complexity* (α = .85), *issue uncertainty* (α = .88), *decision uncertainty* (α = .96), *negative appraisals* (α = .91), *threat emotions* (α = .93), *information-seeking intentions* (α = .85). Means and standard deviations are in Table 2.2.

Baseline Levels of Uncertainty. Measured in the control group. There were no differences in issue uncertainty among conditions, F [2, 581] = 1.32, p = .27. There were

significant differences in decision uncertainty, F [2, 581] = 5.68, p = .004. Higher levels of decision uncertainty resulted from exposure to contradictory (M = 3.88, SD = 2.08) and complex (M = 4.01, SD = 1.98) messages than the control condition (M = 3.39, SD = 1.82).

Measurement Model

Latent factors were allowed to correlate in the CFA analysis. Complete data were obtained from 353 participants in the contradictory and complex experimental conditions. The initial model provided an acceptable fit to the data (RMSEA = .073, CFI = .93, SRMR = .057). High correlations were identified between the error terms of two different pairs of negative appraisals indicators. The items for one pair concerned ongoing harm from full-fat dairy consumption whereas the items for the other pair addressed the possibility of harm from full-fat dairy already having occurred for the respondent. In addition, two issue uncertainty items that referenced lack of knowledge had substantially correlated error terms. When the error terms were allowed to correlate for these three item pairs a good fit was obtained (RMSEA = .048, CFI = .975, SRMR = .044, model χ2 (206) = 372.63, p < .001). These are appropriate respecification because when a pair of items for a latent variable has the same unique content, the two items should be expected to have stronger correlations with each other than with the other indicators of the latent variable in question (Acock, 2013). Table 2.3 reports results for the final CFA.

Structural Model Fit

The data fit the structural model poorly, χ^2 (242) = 593.32, p < .001, RMSEA = .064, CFI = .948, SRMR = .142. A review of the modification indices identified two theoretically justifiable alterations: a path from perceived complexity to issue uncertainty, and a path from issue uncertainty to decision uncertainty. The first modification recognizes that complex issues can raise doubts about what one should believe on an issue. The second modification

acknowledges the now-transparent notion that decisions are more difficult to make for issues of higher uncertainty. After these modifications, a good fit was obtained, χ^2 (240) = 415.06, $p < .001$, RMSEA = .045, CFI = .974, SRMR = .06. Results for this final model are reported in Figure 2.2.

Hypothesized Direct Effects

As shown in Figure 2.3, H1a was supported; contradictory health messages fostered greater perceptions of contradiction, in comparison to complex messages. H1b was not supported; complex health messages did not produce greater perceptions of complexity in comparison with the contradictory message. In support of H2a, perceptions of contradiction were positively related to issue uncertainty. Contrary to H2b, perceptions of complexity were not associated with decision uncertainty. H3a was not supported; issue uncertainty was not related to negative appraisals. In support of H3b, decision uncertainty was positively related to negative appraisals. H4 was supported, as negative appraisals were positively related to threat emotions. In support of H5 threat emotions were positively related to information-seeking.

Indirect Effects

Only theoretically meaningful indirect effects are highlighted (Kline, 2016) in Table 2.4. Perceived contradiction and perceived complexity both had positive, indirect effects on decision uncertainty that were mediated by issue uncertainty. Issue uncertainty had a positive, indirect effect on negative appraisals mediated by decision uncertainty. Decision uncertainty had a positive, indirect effect on threat emotions mediated by negative appraisals. Appraisals had a positive, indirect effect on information-seeking intentions that were mediated by threat emotions.

Discussion

We investigated how individuals encounter, experience, and manage health-related

uncertainty, as suggested by UMT (Brashers, 2001). Different message characteristics that give rise to uncertainty are thought to have distinct cognitive, emotional, and behavioral effects (Hamilton et al., 2013; Han et al., 2011). We thus determined if contradictory and complex health messages actually resulted in perceived contradiction and complexity, respectively. Contradictory messages did generate stronger perceptions of contradiction than complex health messages, but complex messages did not lead to stronger perceptions of message complexity in comparison with the contradictory message. There were no significant mean differences between contradictory and complex messages in issue uncertainty, negative appraisals of health outcomes, threat emotions, and information-seeking intentions. This suggests that the distinction between contradiction and complexity is not always noticed by individuals.

The failure of complex messages to generate perceptions of information complexity needs further investigation. We tested a particular case of complex messages about competing effects of full-fat dairy consumption. Nonetheless, multicausality, contingency, reciprocity, and other forms of complexity have also been identified (Babrow et al., 1998) and, potentially, could lead to stronger perceptions of complexity. For this reason, we cannot yet rule out the possibility that contradictory messages and other forms of complex messages might generate unique cognitive, emotional, and behavioral effects.

Our operationalization of message contradiction and complexity align with definitions of these *message* constructs provided by Carpenter et al. (2016) and Han et al. (2011, 2019), respectively. However, it is possible that at a higher level of abstraction, the distinction is not *perceptually* real to laypersons. To return to an example used at the outset, we noted that the claims “coffee improves memory” and “coffee damages the heart” are complex, not contradictory, because both propositions can be true. At a more abstract level, however, the

messages might be *perceived* as contradictory because they support a broader inference that "coffee is good for you, but it is also bad for you." Previous research has considered that perception of contradiction toward messages about a health behavior producing competing outcomes likely stems from countervailing harms and benefits of the behavior, even though the information itself is not contradictory (Carpenter et al., 2016; Nagler, 2014).

The distinction between objective and perceived contradiction and complexity can also be useful in identifying individual characteristics that influence such perceptions. For example, individuals with limited scientific literacy might have higher perceptions of contradiction toward conflicting messages reporting results of research using different methodologies (Carpenter et al., 2016). Older age, lower education, non-white race, and high mass-media exposure are also associated with higher perceived contradiction about preventive health behaviors (Han et al., 2009). Similarly, individuals with low health literacy tend to feel more confused when being aware of the harms and benefits of a health behavior (Shi et al., 2019).

This study also extends UMT by differentiating between issue and decision uncertainty. In support of previous experimental studies, the perception of contradiction led to issue uncertainty (Chang, 2015; Jensen & Hurley, 2012) which, in turn, fostered decision uncertainty (O'Connor, 1995; O'Connor et al., 1998). Perceived complexity also had positive, indirect effects on decision uncertainty that were mediated by issue uncertainty. A more detailed treatment of how issue uncertainty mediates the effects of message perceptions on decision uncertainty is needed: when people are exposed to two messages advanced by different, but believable, communicators making contradictory claims, their task is likely to determine the relative credibility of these sources. In contrast, messages conveying the possibility of both positive and negative health consequences lead to a focus on relative costs and benefits.

Moderators of the relation between message perceptions and issue uncertainty also need to be investigated further. These include such variables as need for cognition, prior knowledge (objectively assessed), and relevance of the health issue. Individuals with a high need for cognition have greater motivation to engage in effortful thinking (Cacioppo et al., 1996; Cacioppo & Petty, 1982). They should, therefore, be more aware of the extent to which messages presented to them make incompatible claims, which would strengthen the relationship of such perceptions to uncertainty (Kardash & Scholes, 1996). On the other hand, individuals with greater prior knowledge of the issue would better appreciate complexities, in this case, the nuanced effects of nutrition on health (Miller et al., 2011). Specifically, samples with relatively high knowledge may demonstrate large differences between contradictory and complex messages on perceptions, but not on intentions of information seeking. Finally, to the extent that age influences the processing of online health information, it is important to consider how the salience of health may influence perceptions as well as intentions (Miller et al., 2013; Miller & Bell, 2012). Although our study included a wide age range of adults, the typical participant was middle-aged and thus may have been less concerned with health than an older sample.

Another objective of the study was to test a model that links perceptions of message contradiction and complexity to health information seeking through the mediation of uncertainty, negative appraisals and threat emotions. The results are consistent with the main predictions of UMT: uncertainty prompts negative appraisals that generate threat emotions and motivates information seeking to manage uncertainty. Further study of the contextual and individual factors that influence the relation between decision uncertainty and negative appraisals is also needed. For example, individuals with low tolerance for uncertainty usually avoid contradictory situations and may experience decision paralysis when lacking the information they need to act.

Their appraisals under uncertainty tend to be highly negative, followed by disproportionate experiences of fear, worry, and anxiety (Carleton et al., 2007; Rosen et al., 2014).

In support of elements of UMT, uncertainty led to negative appraisals and threat emotions. Moving forward, we believe that cognitive response data would allow for a better understanding of the reasoning people engage in during these appraisals. Also in need of study are the factors that strengthen the relationship of negative appraisals to threat emotions. For example, individuals with a low sense of control over their health should experience greater threat emotions in response to a negative appraisal (Lazarus & Folkman, 1987).

Results from this study confirmed that threat emotions that arise from negative appraisals motivate information-seeking by helping individuals to make sense of an issue, thereby attenuating uncertainty and its negative effect (Brashers, 2001; Rains & Tukachinsky, 2015). Since we did not explore actual information-seeking behaviors, the nature and benefits of such information-seeking await additional studies. Also of importance is the incorporation of dysfunctional methods of uncertainty management, such as information avoiding (Brashers & Hogan, 2013), or biased assimilation (Nan & Daily, 2015).

Finally, the study makes a methodological contribution by developing reliable measures that can be used to test the model's constructs on a wide range of health-related topics. In particular, we sought to develop measures that disentangled the assessment of perceived contradiction and complexity, and health-related issue uncertainty and decision uncertainty. The construct validity of these measures is suggested by their theory-consistent interrelationships.

This research has limitations. We relied upon a convenience sample of adults that was not representative of the general U.S. population. The study was also limited to a single health topic, but the effects of contradictory information vary by issue in ways not yet understood (Jensen &

Hurley, 2012). Finally, we used a measure of intentions to seek health information as a proxy for actual information-seeking behavior.

The present research contributes to the field's efforts to understand the effects of contradictory and complex health messages. We identified slippage between the distinction and the perception of contradiction and complexity in messages, and evidenced the importance of distinguishing between issue and decision uncertainty. In doing so, we offer a revised version of UMT that links uncertainty about one's best course of action to information-seeking through the mediation of appraisals and emotions. The general public must make sense of new scientific findings that challenge past research and strongly held beliefs on a seemingly daily basis. The refinement of models that lead to an understanding of how the public manages complex and conflicting information is thus of critical importance.

References

Acock, A. C. (2013). *Discovering structural equation modeling using Stata*. Stata Press.

Ahmad, M. M. (2005). Psychometric evaluation of the cognitive appraisal of health scale with patients with prostate cancer. *Journal of Advanced Nursing*, *49*(1), 78–86.

Alexander, N., & Rowe, S. (2006). Can nutrition research change its mind? *Nutrition Today*, *41*(4), 185–188.

Babrow, A. S., Kasch, C. R., & Ford, L. A. (1998). The many meanings of uncertainty in illness: Toward a systematic accounting. *Health Communication*, *10*(1), 1–23.

Brashers, D. E. (2001). Communication and uncertainty management. *Journal of Communication*, *51*(3), 477–497.

Brashers, D. E., & Hogan, T. P. (2013). The appraisal and management of uncertainty: Implications for information-retrieval systems. *Information Processing & Management*, *49*(6), 1241–1249.

Brashers, D. E., Neidig, J. L., Haas, S. M., Dobbs, L. K., Cardillo, L. W., & Russell, J. A. (2000). Communication in the management of uncertainty: The case of persons living with HIV or AIDS. *Communications Monographs*, *67*(1), 63–84.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research*, *21*(2), 230–258.

Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology*, *42*(1), 116–131.

Cacioppo, J. T., Petty, R. E., Feinstein, J. A., & Jarvis, W. B. G. (1996). Dispositional differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin*, *119*(2), 197–253.

Carleton, R. N., Norton, M. P. J., & Asmundson, G. J. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders*, *21*(1), 105–117.

Carpenter, D. M., Geryk, L. L., Chen, A. T., Nagler, R. H., Dieckmann, N. F., & Han, P. K. J. (2016). Conflicting health information: A critical research need. *Health Expectations*, *19*(6), 1173–1182.

Chang, C. (2015). Motivated processing: How people perceive news covering novel or contradictory health research findings. *Science Communication*, *37*(5), 602–634.

Chen, M., McGlone, M. S., & Bell, R. A. (2015). Persuasive effects of linguistic agency assignments and point of view in narrative health messages about colon cancer. *Journal of Health Communication*, *20*(8), 977–988.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, *48*(1), 150–170.

Hamilton, J. G., Hutson, S. P., Moser, R. P., Kobrin, S. C., Frohnmayer, A. E., Alter, B. P., & Han, P. K. J. (2013). Sources of uncertainty and their association with medical decision making: Exploring mechanisms in Fanconi anemia. *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine*, *46*(2), 204–216.

Han, P. K. J., Babrow, A., Hillen, M. A., Gulbrandsen, P., Smets, E. M., & Ofstad, E. H. (2019). Uncertainty in health care: Towards a more systematic program of research. *Patient Education and Counseling*, *102*(10), 1756–1766.

Han, P. K. J., Klein, W. M., & Arora, N. K. (2011). Varieties of uncertainty in health care: A conceptual taxonomy. *Medical Decision Making*, *31*(6), 828–838.

Han, P. K. J., Moser, R. P., Klein, W. M. P., Beckjord, E. B., Dunlavy, A. C., & Hesse, B. W. (2009). Predictors of perceived ambiguity about cancer prevention recommendations: Sociodemographic factors and mass nedia exposures. *Health Communication*, *24*(8), 764–772.

Hillen, M. A., Gutheil, C. M., Strout, T. D., Smets, E. M., & Han, P. K. J. (2017). Tolerance of uncertainty: Conceptual analysis, integrative model, and implications for healthcare. *Social Science & Medicine*, *180*(2017), 62–75.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55.

Jensen, J. D., & Hurley, R. J. (2012). Conflicting stories about public scientific controversies: Effects of news convergence and divergence on scientists' credibility. *Public Understanding of Science*, *21*(6), 689–704.

Kang, Y. (2003). Testing the mediating effect of appraisal in the model of uncertainty in illness. *Journal of Korean Academy of Nursing*, *33*(8), 1127–1134.

Kardash, C. M., & Scholes, R. J. (1996). Effects of preexisiting beliefs, epistemological beliefs, and need for cognition on interpretation of controversial issues. *Journal of Educational Psychology*, *88*(2), 260–271.

Kline, R. B. (2016). *Principles and practice of structural equation modeling*. The Guilford Press.

Lazarus, R. S., & Folkman, S. (1987). Transactional theory and research on emotions and coping. *European Journal of Personality*, *1*(3), 141–169.

Lee, C., Nagler, R. H., & Wang, N. (2018). Source-specific exposure to contradictory nutrition information: Documenting prevalence and effects on adverse cognitive and behavioral outcomes. *Health Communication*, *33*(4), 453–461.

Liu, Y., Doucette, W. R., Farris, K. B., & Nayakankuppam, D. (2005). Drug information–seeking intention and behavior after exposure to direct-to-consumer advertisement of prescription drugs. *Research in Social and Administrative Pharmacy*, *1*(2), 251–269.

Miller, L. M. S., & Bell, R. A. (2012). Online health information seeking: The influence of age, information trustworthiness, and search challenges. *Journal of Aging and Health*, *24*(3), 525–541.

Miller, L. M. S., Gibson, T. N., Applegate, E. A., & de Dios, J. (2011). Mechanisms underlying comprehension of health information in adulthood: The roles of prior knowledge and working memory capacity. *Journal of Health Psychology*, *16*(5), 794–806.

Miller, L. M. S., Zirnstein, M., & Chan, P. K. (2013). Knowledge differentially supports memory for nutrition information in later life. *Journal of Health Psychology*, *18*(9), 1141–1152.

Mishel, M. H. (1981). The measurement of uncertainty in illness. *Nursing Research*, *30*(5), 258–263.

Mishel, M. H. (1988). Uncertainty in illness. *Journal of Nursing Scholarship*, *20*(4), 225–232.

Nagler, R. H. (2014). Adverse outcomes associated with media exposure to contradictory nutrition messages. *Journal of Health Communication*, *19*(1), 24–40.

Nagler, R. H., & LoRusso, S. M. (2018). Conflicting information and message competition in health and risk messaging. In R. L. Parrott (Ed.), *Encyclopedia of health and risk message design and processing*. Oxford University Press. https://dx.doi.org/10.1093/acrefore/9780190228613.013.292

Nan, X., & Daily, K. (2015). Biased assimilation and need for closure: Examining the effects of mixed blogs on vaccine-related beliefs. *Journal of Health Communication*, *20*(4), 462–471.

O'Connor, A. M. (1995). Validation of a decisional conflict scale. *Medical Decision Making*, *15*(1), 25–30.

O'Connor, A. M., Tugwell, P., Wells, G. A., Elmslie, T., Jolly, E., Hollingworth, G., McPherson, R., Bunn, H., Graham, I., & Drake, E. (1998). A decision aid for women considering hormone therapy after menopause: Decision support framework and evaluation. *Patient Education and Counseling*, *33*(3), 267–279.

Peer, E., Vosgerau, J., & Acquisti, A. (2014). Reputation as a sufficient condition for data quality on Amazon Mechanical Turk. *Behavior Research Methods*, *46*(4), 1023–1031.

Rains, S. A., & Tukachinsky, R. (2015). An examination of the relationships among uncertainty, appraisal, and information-seeking behavior proposed in uncertainty management theory. *Health Communication*, *30*(4), 339–349.

Rosen, N. O., Ivanova, E., & Knäuper, B. (2014). Differentiating intolerance of uncertainty from three related but distinct constructs. *Anxiety, Stress & Coping*, *27*(1), 55–73.

Rozenberg, S., Body, J.-J., Bruyere, O., Bergmann, P., Brandi, M. L., Cooper, C., Devogelaer, J.-P., Gielen, E., Goemaere, S., & Kaufman, J.-M. (2016). Effects of dairy products consumption on health: Benefits and beliefs - a commentary from the Belgian Bone Club and the European Society for Clinical and Economic Aspects of Osteoporosis, Osteoarthritis and Musculoskeletal Diseases. *Calcified Tissue International*, *98*(1), 1–17.

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-offit measures. *Methods of Psychological Research*, *8*(2), 23–74.

Shi, W., Nagler, R. H., Fowler, E. F., & Gollust, S. E. (2019). Predictors of women's awareness of the benefits and harms of mammography screening and associations with confusion, ambivalence, and information seeking. *Health Communication, 36*(3), 1–12.

Smith, C. A., & Lazarus, R. S. (1993). Appraisal components, core relational themes, and the emotions. *Cognition & Emotion*, *7*(3–4), 233–269.

Spiegelhalter, D., Pearson, M., & Short, I. (2011). Visualizing uncertainty about the future. *Science*, *333*(6048), 1393–1400.

StataCorp. (2017). *Stata statistical software: Release 15* (Version 15) [Computer software].

Table 2.1
Sample Characteristics (N = 584)

Characteristic	Frequency	Percent
Male	303	52.1
White race	444	76.3
Age, mean (SD)	37.3	-
Married or living as married	282	48.5
Education		
No H.S. diploma	3	.5
H.S. diploma or GED	158	27.1
Associate's degree	89	15.3
Bachelor's degree	260	44.7
Professional or graduate degree	72	12.4
Household income		
<$20,000	67	11.5
$20,000 - $39,999	144	24.8
$40,000 - $59,999	134	23.0
$60,000 - 79,999	93	16.0
$80,000 - $99,999	49	8.4
≥$100,000	80	13.7
Declined to answer	15	2.6
Dairy consumption (servings per day, SD)		
Full-fat milk (1 serv=8 oz.)	0.44	1.11
Reduce-fat milk (1 serv.=8 oz.)	0.61	1.00
Yogurt (1 serv.=8 oz.)	0.53	.70
Cottage or ricotta cheese (1 serv.=8 oz.)	0.20	.54
Other types of cheese (1 serv.=1 slice)	1.28	1.27
Butter or margarine (1 serv.=1 tbsp)	1.22	1.33

Table 2.2
Means and Standard Deviations for Study Variables by Experimental Condition

	Contradictory Messages (n = 177)		Complex Messages (n = 177)		No-Message Control (n = 230)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Perceived Contradiction	6.03[a]	1.54	5.51[a]	1.66	-	-
Perceived Complexity	2.98	1.53	3.05	1.41	-	-
Issue Uncertainty	4.09	1.59	3.88	1.54	3.86	1.51
Decision Uncertainty	3.88[a]	2.08	4.01[b]	1.98	3.39[ab]	1.82
Negative Appraisals	3.84	1.76	3.82	1.51	-	-
Threat Emotions	2.73	1.69	2.68	1.59	-	-
Info-Seeking Intentions	3.05	1.69	2.98	1.67	-	-

Note. Info = Information; Means within rows with the same superscript are significantly different ($p < .05$ criterion).

Table 2.3
Maximum Likelihood Estimates for a 7-Factor Solution for Model Variables (N = 353)

Plot Symbol	Measure/Items	Unst. Coef.	SE	Stand. Coef.	M	SD
	PERCEIVED CONTRADICTION[a]					
A	The information in the articles I read…was contradictory.	1.0[b]	-	.92	5.89	1.70
B	The information in the articles I read…was inconsistent.	1.01	.036	.92	5.71	1.74
C	There were incompatible claims about the health outcomes…	0.98	.035	.91	5.71	1.69
	PERCEIVED COMPLEXITY[a]					
D	The information in the articles I read…was complex.	1.0[b]	-	.83	3.42	1.74
E	The information in the articles I read…was complicated.	1.17	.066	.96	3.24	1.78
F	The information…was difficult to understand.	0.68	.051	.65	2.38	1.51
	ISSUE UNCERTAINTY[a]					
	When it comes to the health outcomes of consuming full-fat dairy products…					
G	I know very little.	1.0[b]	-	.81	3.72	1.78
H	I have a lot of questions without answers.	0.98	.068	.76	4.22	1.83
I	I am very uninformed.	0.95	.041	.78	3.71	1.76
J	I am not very confident that I know all of the most important health effects.	1.10	.067	.84	4.31	1.88
	DECISION UNCERTAINTY[a]					
	Now, think about the choice you might have to make on whether you should change your full-fat dairy products consumption or not…					
K	This decision is difficult for me to make.	1.0[b]	-	.94	3.87	2.11
L	I am unsure what to do.	1.04	.025	.98	3.86	2.11
M	It is not clear what choice is best for me.	0.97	.031	.90	4.09	2.12

Plot Symbol	Measure/Items	Unst. Coef.	SE	Stand. Coef.	M	SD
	NEGATIVE APPRAISAL[a]					
	When it comes to the health outcomes of consuming full-fat dairy products...					
N	I am concerned that consuming full-fat dairy… can cause harm to my health.	1.0[b]	-	.89	4.35	1.88
O	I worry about what can happen to my health if I consume full-fat dairy...	1.07	.029	.95	4.22	1.90
P	I have a sense that my health has been hurt by consuming full-fat dairy...	0.80	.071	.74	3.54	1.81
Q	I have been harmed in some way by consuming full-fat dairy products.	0.69	.067	.67	3.21	1.75
	THREAT EMOTIONS[a]					
	When you think about the health outcomes of consuming full-fat dairy products, to what extent do you experience the following emotions?					
R	Worry	1.0[b]	-	.90	3.05	1.82
S	Fear	0.89	.040	.89	2.37	1.63
T	Anxiety	0.99	.040	.90	2.68	1.81
	INFORMATION-SEEKING INTENTIONS[a]					
U	Over the next 7 days, I intend to search for information about the healthfulness of full-fat dairy products online or at my local library.	1.0[b]	-	.81	3.33	
V	I intend to ask my healthcare provider about the health outcomes of full-fat dairy products consumption at my next appointment.	0.98	.065	.82	3.01	1.96
W	Over the next 7 days, I intend to talk with friends about the health outcomes of full-fat dairy products consumption.	0.85	.056	.81	2.71	.73

Note. Questionnaire is available by request from the first author. Analysis excludes control subjects, to whom the message evaluation scales were not presented. Unst. Coef., unstandardized coefficient; St. Coef., standardized coefficient; SE, standard error of estimate.
[a] Item responses were made on 7-point Likert scales. Negative emotions ranged from 1 (*not at all*) to 7 (*very much*), information-seeking intentions ranged from 1 (*definitely will not*) to 7 (*definitely will*), and all other measures ranged from 1 (*strongly disagree*) to 7 (*strongly agree*).
[b] Not tested for statistical significance. All other unstandardized estimates are statistically significant at $p < .001$.

Table 2.4
Standardized Direct, Indirect, and Total Effects

Outcome	Direct	Indirect	Total
Perceived Contradiction			
Contradictory Messages[a] → Perceived Contradiction	.163**	-	.163**
Perceived Complexity			
Contradictory Messages[a] → Perceived Complexity	-.035	-	-.035
Issue Uncertainty			
Perceived Contradiction → Issue Uncertainty	.156**	-	.156**
Perceived Complexity → Issue Uncertainty	.281***	-	.281***
Contradictory Messages[a] → Issue Uncertainty	-	.016	.016
Decision Uncertainty			
Perceived Contradiction → Decision Uncertainty	-	.104**	.104**
Perceived Complexity → Decision Uncertainty	.062	.188***	.249***
Issue Uncertainty → Decision Uncertainty	.666***	-	.666***
Contradictory Messages[a] → Decision Uncertainty	-	.008	.008
Negative Appraisals			
Perceived Contradiction → Negative Appraisals	-	.054*	.054*
Perceived Complexity → Negative Appraisals	-	.121***	.121***
Issue Uncertainty → Negative Appraisals	.103	.245***	.348***
Decision Uncertainty → Negative Appraisals	.368***	-	.368***
Contradictory Messages[a] → Negative Appraisals	-	.005	.005
Threat Emotions			
Perceived Contradiction → Threat Emotions	-	.031*	.031*
Perceived Complexity → Threat Emotions	-	.070***	.070***
Issue Uncertainty → Threat Emotions	-	.201***	.201***
Decision Uncertainty → Threat Emotions	-	.213***	.213***
Negative Appraisal → Threat Emotions	.578***	-	.578***
Contradictory Messages[a] → Threat Emotions	-	.003	.003
Information-Seeking Intentions			
Perceived Contradiction → Info-Seeking Intentions	-	.011*	.011*
Perceived Complexity → Info-Seeking Intentions	-	.024***	.024***
Issue Uncertainty → Info-Seeking Intentions	-	.070***	.070***
Decision Uncertainty → Info-Seeking Intentions	-	.074***	.074***
Negative Appraisals → Info-Seeking Intentions	-	.202***	.202***
Threat Emotions → Info-Seeking Intentions	.350***	-	.350***
Contradictory Messages[a] → Info-Seeking Intentions	-	.001	.001

Note. [a] Reference group is the Complex Messages condition; Info = Information.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 2.1
Revised Uncertainty Management Theory

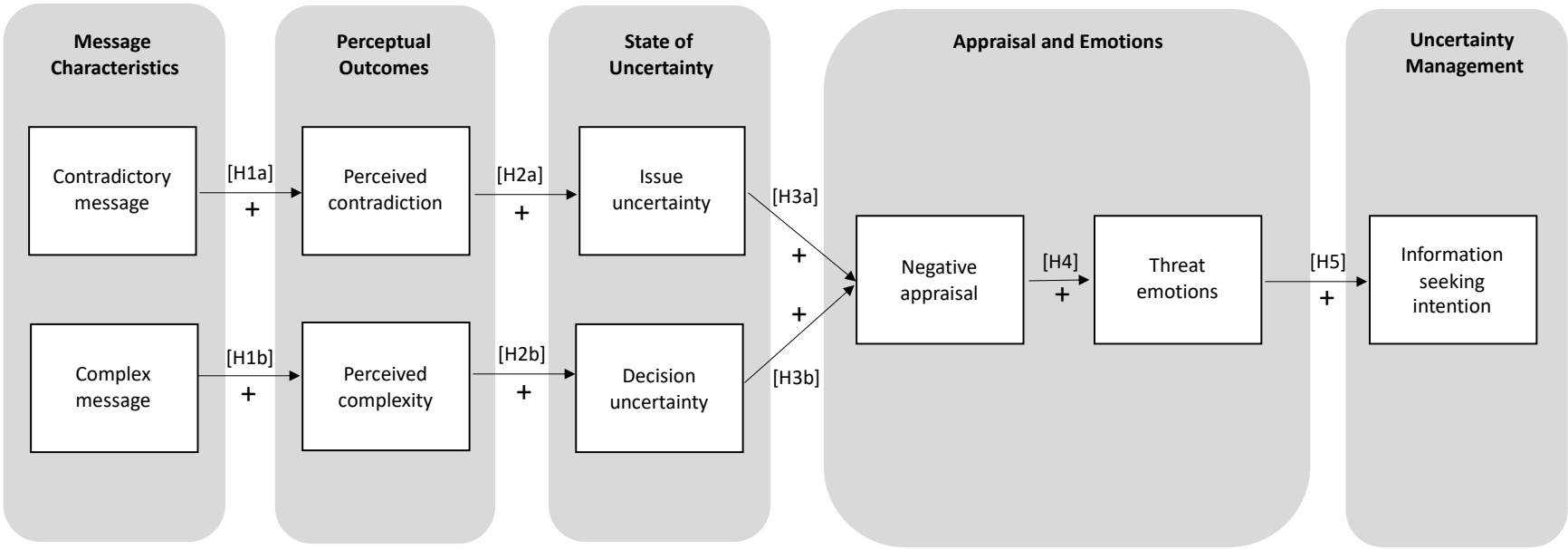


Figure 2.2
Articles Developed for the Complex Messages Experimental Condition

eHealth

LOG IN

Low-fat Dairy Products are Better for Your Heart

Full-fat dairy increases the risk of heart disease.

By Nick Aubrey
Oct. 26, 2018

Dairy products are an important source of saturated fat in the American diet. In recent decades, we have been spooning up more yogurt, overindulging in cheese, and pouring on sauces made of heavy cream.

Decades of research shows an association between saturated fat intake and heart disease. A diet rich in saturated fats increases total dietary cholesterol – especially dangerous LDL cholesterol – which can block arteries in the heart, increasing the risk of heart disease. Heart disease is the leading cause of death in the US.

In a healthy diet, saturated fat consumption should not exceed 13 grams per day. A single cup of full-fat milk contains 5 grams of saturated fat. The US Dietary Guidelines recommendations are to limit the intake of fatty dairy products and to consume 3 cup-equivalents per day of low-fat or fat-free dairy.

It is important to follow these recommendations closely because fatty dairy can hide in many foods, such as baked goods, sauces and prepared meals, and this can add up to a lot of saturated fat in your diet over the course of the day. So, stick to low-fat or fat-free dairy in your diet for improved heart heath.

HealthNews

Full-fat Dairy Foods Actually Help Promote a Healthy Weight

Consuming full-fat dairy can benefit your health

By Kelly White Nov. 14, 2018

A major medical study links whole-fat dairy food consumption to a reduced risk of obesity, leading scientists to recommend that the consumption of full-fat dairy should be encouraged for most people.

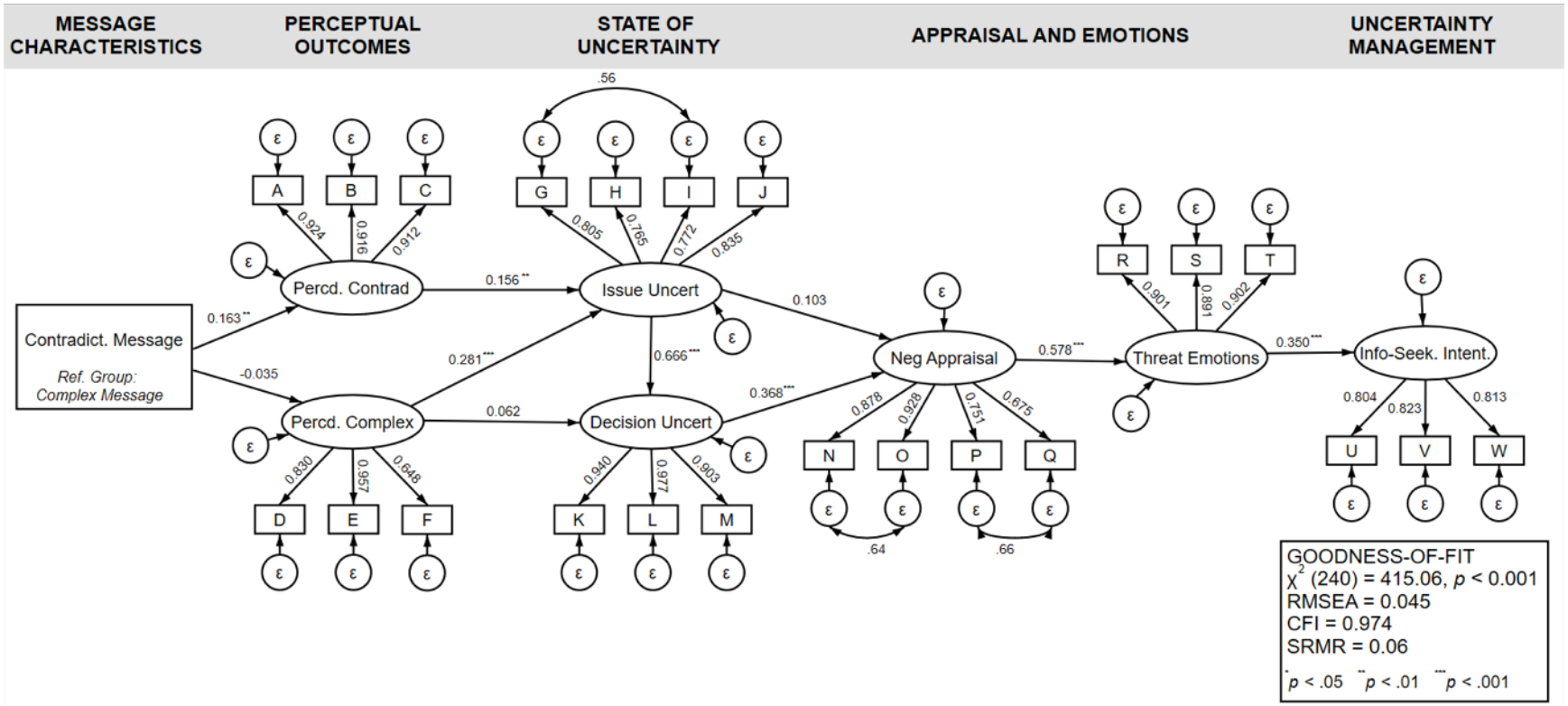
The study was published in the prestigious medical journal, *The Lancet*. It included nearly 130,000 individuals, between the ages of 35-70 years old, who were followed for nine years.

Higher intake of full-fat dairy products was associated with a lower incidence of obesity. The study controlled for numerous factors, such as age, education, smoking, physical activity, and the consumption of fruits, vegetables, and starchy foods.

This new research aligns with other studies showing that saturated fats may promote a healthy weight. Full-fat dairy products make you feel more full than low-fat dairy. There are also elements in the milk fat that alter our metabolism in a way that help us burn body fat for energy, rather than storing it.

The recommendation based on this major study is that people who avoid whole milk, cheese, and other full-fat dairy products may actually be hurting their health. It is recommended, however, that one should talk with their doctor before making significant dietary changes.

Figure 2.3
Test of a Model of the Effects of Uncertainty-Arousing Health Information



Chapter 3. When Media Health Stories Conflict: Test of the Contradictory Health Information Processing (CHIP) Model

Chapter 3. When Media Health Stories Conflict: Test of the Contradictory Health Information Processing (CHIP) Model

Abstract

Guided by Uncertainty Management Theory, UMT (Brashers, 2001), we tested a model that explicates how uncertainty arising from contradictory health information is managed through information seeking. In an online experiment, 763 U.S. adults were randomly assigned to one of three message conditions: contradictory, non-contradictory, or control. Participants in the contradictory and non-contradictory conditions answered questions about their perceptions of contradiction, issue and decision uncertainty, negative appraisals and emotions, and information-seeking intentions. They also completed measures of several moderator variables, including information overload, intolerance for uncertainty, and health self-efficacy. Baseline levels of issue and decision uncertainty were measured in the control condition. Model tenets were confirmed: perceptions of contradiction led to issue uncertainty which, in turn, prompted cognitive appraisals directly, and indirectly through increased decision uncertainty. The effects of issue and decision uncertainty on information-seeking intentions were mediated by negative appraisals and threat emotions. Individuals with high health self-efficacy and positive outcome expectations of information search were more likely to manage uncertainty through information seeking. These results support the use of the CHIP model when perceptions of contradiction and decision uncertainty need to be accounted for, while also validating UMT for its original purposes. Model refinements, and implications are discussed.

When Media Health Stories Conflict:

Test of the Contradictory Health Information Processing (CHIP) Model

Contradictory health messages are pervasive in the media, causing some individuals to feel paralyzed. Should we drink or abstain from wine for a healthier heart? Is it safe or not to adopt a low-carbohydrate/high-fat diet? The prevalence of contradictory health information has been documented in numerous domains, including public information about medications (Carpenter et al., 2014), e-cigarettes (Katz et al., 2018; Tan et al., 2017), cancer screening (Nagler et al., 2019; Shi et al., 2019), and nutrition (Clark et al., 2019; C. J. Lee et al., 2018; Nagler, 2010, 2014). Effects of exposure to contradictory messages include reduced adherence to physician recommendations (Carpenter et al., 2014), increased risk perceptions and worrying (Han et al., 2006), confusion (Clark et al., 2019; Nagler, 2014), uncertainty (Chang, 2015; Jensen & Hurley, 2012), and alterations in information-seeking behaviors (Rains & Tukachinsky, 2015).

Contradictory health messages contain information that is logically inconsistent (Carpenter et al., 2016), which can lead to uncertainty, defined as the subjective perception of one's own lack of knowledge about an aspect of reality (Han et al., 2009). Outcomes of health-related uncertainty remain poorly understood (Hillen et al., 2017; Strout et al., 2018). Especially needed is a better understanding of how uncertainty is managed through information seeking (Brashers, 2001; Brashers & Hogan, 2013).

Uncertainty Management Theory, UMT (Brashers, 2001) describes the communication and psychological processes involved in managing uncertainty arising from contradictory health information (Brashers & Hogan, 2013). Based on UMT, we tested an extended model of the causal paths between contradictory health message exposure, uncertainty, and intentions to seek information.

The Contradictory Health Information Processing (CHIP) Model

Contradiction is often seen as a problematic characteristic of health information that gives rise to uncertainty (Brashers & Hogan, 2013; Han et al., 2011, 2019). When uncertainty is appraised as a potential harm to one's wellbeing, negative emotional reactions emerge, motivating individuals to engage in actions to reduce such discomfort. Information seeking can be a strategy to manage this discomfort (Brashers, 2001; Brashers & Hogan, 2013). Despite being a prominent communication uncertainty framework, empirical research on UMT is still needed to refine our understandings of uncertainty and its outcomes (Quinn et al., 2017; Rains & Tukachinsky, 2015).

The CHIP Model (Figure 3.1) thus builds upon UMT in three ways: by differentiating between objective and perceived message contradiction, by identifying different forms of uncertainty, and by testing potential moderators of mechanisms in the process. CHIP specifies that attention to contradictory health information will result in a perception of contradiction (the degree of perceived information inconsistency), which in turn leads to uncertainty. The effect of this attention is not uniform across people. For example, two seemingly contradictory health messages might simply be reporting on research using different methodologies. Most audiences would perceive contradiction, but people with a keener ability to evaluate scientific research might not (Carpenter et al., 2016; Han et al., 2009). The distinction between the objective existence of contradiction and perceptions of contradiction allows us to explore how individual characteristics might influence such perceptions.

H1: Contradictory health messages will generate greater perceptions of contradiction than non-contradictory messages.

The model also differentiates between uncertainty about an issue (for example, "is coconut oil healthy?) and uncertainty about the decision one should make (for example, "should I consume coconut oil?"). Messages perceived as contradictory do not contain sufficient information to allow an individual to build a proper knowledge structure for the issue (Mishel, 1988, 1990). Therefore, when perceptions of contradiction are high and additional information is limited, people are likely to feel insecure about their state of knowledge on the issue (Brashers, 2001; Chang, 2015; Jensen & Hurley, 2012).

H2: Perceptions of contradiction will lead to issue uncertainty.

Feeling more knowledgeable about the health harms and benefits pertaining to an issue should facilitate accurate risk perceptions and help individuals decide what is best for them (Stacey et al., 2017). Individuals who doubt their own state of knowledge about an issue are thus more prone to indecisiveness (Han et al., 2019).

H3: Issue uncertainty will lead to decision uncertainty.

The effects of uncertainty also include negative appraisals, fear and anxiety, avoidant behaviors, and information seeking (Han et al., 2019). UMT describes a sequential path of these effects: uncertainty prompts appraisals, followed by specific emotions that, in turn, motivate individuals to manage uncertainty through information seeking or avoiding. People generally desire the world to be predictable and controllable (Klein et al., 2015) and, therefore, exposure to contradictory health messages is typically associated with negative evaluations. Negative appraisals, in turn, lead to negative emotional responses (Brashers, 2001; Lazarus & Folkman, 1987; Smith & Lazarus, 1993). Threat emotions of worry, fear, and anxiety are commonly associated with uncertainty on health issues (Rains & Tukachinsky, 2015).

H4: Decision uncertainty will lead to negative appraisals.

H5: Negative appraisals will lead to threat emotions.

Emotions motivate uncertainty management through information seeking (Brashers, 2001). Emotions are associated with states of action readiness (i.e., individual's tendency to engage in or disengage from interaction with an object) (Nabi, 2003). However, the relation between emotion and behaviors is context dependent. For example, fear can cause paralysis in some situations and flight in others (Dillard & Peck, 2001; S. Y. Lee et al., 2008). When experiencing uncertainty, threat emotions usually prompt individuals to protect themselves (Frijda et al., 1989; So et al., 2016) and information seeking is a primary self-protective behavior (Rimal & Real, 2003). Accordingly, threat emotions should motivate individuals to search for additional information in order to reduce uncertainty and its negative outcomes (Brashers, 2001).

H6: Threat emotions will lead to the development of information-seeking intentions.

Moderators in the CHIP Model

CHIP specifies four potential moderators of causal paths not incorporated into UMT.

Information Overload. The relevant moderator in the current study is *diet information overload*, or perception that there is an excessive number of diet recommendations in the information environment. There is a large and increasing amount of contradictory nutrition information (Ramondt & Ramírez, 2019), which demands substantial cognitive resources for message processing (Jensen et al., 2014) and makes individuals confused and overwhelmed (Khaleel et al., 2020). When searching for information about health topics, approximately 35% of Americans feel frustrated, nearly 50% are concerned about the quality of that information, and almost 25% find the information hard to understand (Health Information National Trends Survey, 2017). When the ability to separate relevant from irrelevant information is reduced, individuals can become highly selective and neglectful of new information (Eppler & Mengis,

2008).

H7: Diet information overload will moderate the relation between perceived contradiction and issue uncertainty, such that the strength of this relation will be stronger among individuals with a higher level of diet information overload.

Need for Cognition. Need for cognition (NC) refers to a person's tendency to engage in and enjoy effortful thinking. Individuals with high NC tend to think about and reflect back on information, prefer complex to simple problems, and enjoy to think in depth (Cacioppo et al., 1996). Since processing of contradictory messages requires cognitive effort (Lang, 1995), we predicted that high NC individuals should be more likely to reflect upon the opposing nature of contradictory health information and, as a consequence, experience more issue uncertainty than individuals with low NC (Kardash & Scholes, 1996).

H8: NC will moderate the effect of perceived contradiction on issue uncertainty, such that the strength of this relation will be stronger among individuals with a higher level of NC.

Intolerance for Uncertainty. Intolerance for uncertainty (IU) refers to an individual's cognitive, emotional, and behavioral tendencies to react in a negative manner in the face of uncertainty. Individuals with high IU tend to feel worried, anxious, and even paralyzed by small doubts. Therefore, they should appraise uncertainty as a source of threat (Buhr & Dugas, 2002; Carleton et al., 2007). Importantly, while NC refers to effortful thinking, IU refers to reactions to uncertainty.

H9: IU will moderate the effect of decision uncertainty on negative appraisals, such that the strength of this relation will be stronger among individuals with lower IU.

Health Self-Efficacy. We predicted that the relationship between negative emotions and information seeking would be moderated by health self-efficacy. Health self-efficacy refers to

individuals' beliefs about their capabilities to exercise control over their own health habits (Bandura, 2004). Individuals with stronger health self-efficacy are more likely to initiate and adhere to positive health behaviors, such as health information seeking, even when under emotional distress (Zhao & Cai, 2009). Threat emotions have been found to be especially strong predictors of information seeking when self-efficacy is high (S. Y. Lee et al., 2008).

H10: The effect of threat emotions on information-seeking intentions will be moderated by health self-efficacy, such that threat emotions will be more strongly related to information-seeking intentions when health self-efficacy is higher.

Outcome Expectations. Seeking or avoiding information to manage uncertainty in an individual's desired direction is one of the central principles of UMT (Brashers, 2001; Brashers & Hogan, 2013). This suggests that, in addition to health self-efficacy, expectations for how new information would impact uncertainty (outcome expectation) should also be taken into consideration (S. Y. Lee et al., 2008; Nabi, 1999). Individuals are usually motivated to seek information as a way to reduce uncertainty appraised as negative and the threat emotions that follow. Information-seeking intentions were expected to be stronger for individuals who believed their information search would lead to new information that would create uncertainty-reducing coherence (cognitive outcome expectation) and reduce threat emotions (emotional outcome expectation) (Brashers, 2001; Brashers & Hogan, 2013; Sweeny et al., 2010).

H11: The effect of threat emotions on information-seeking intentions is moderated by cognitive outcome expectation, such that high-threat emotions will be more strongly related to information-seeking intentions when cognitive outcome expectation is higher.

H12: The effect of threat emotions on information-seeking intentions is moderated by emotional outcome expectation, such that high threat emotions will be more strongly related to information-seeking intentions when emotional outcome expectation is higher.

Methods

We identified a topic of potential interest to a wide range of respondents; of little familiarity and thus no strong prior opinions; and for which positive and negative stories existed. Accordingly, we developed experimental messages about a new vegan burger, The Impossible Burger™ (IB). The topic was judged to have high potential interest because there is a growing interest in plant-based diets (Fresán & Sabaté, 2019). The study was carried out at around the time the IB was being introduced in U.S. quick-serve restaurants (June 2020) and, thus, of little familiarity to most respondents.

Message Development

Following the definition of contradictory health messages offered by Carpenter et al. (2016), four messages were developed for the contradictory conditions: two articles with positive and consistent information about the IB (article A: *The Impossible Burger Success Story* and article B: *Cows Everywhere Rejoice! A Meatless Burger Good for You and the Planet*) and two articles with negative and consistent information about the IB (article C: *Impossible Claims about the Impossible Burger* and article D: *The Truth about the Impossible Burger*). The primary point of comparison for the effects of contradictory information was the non-contradictory condition. Note that, in accordance to O'Keefe (2003), perceived contradiction is not a manipulation check, but rather a measure to investigate the CHIP Model's theoretical relations. Further, we needed a control group to measure baseline levels of issue and decision uncertainty about the IB. In the control condition, participants were then exposed to two messages about

William Shakespeare. All messages had between 236 to 243 words and Flesh-Kincaid (F-K) readability grade level scores from 8.6 to 9.9. F-K scores are frequently used to estimate the years of education required to understand online information (Mcinnes & Haglund, 2011), with lower scores indicating higher readability (Flesch, 1948; Kincaid et al., 1975).

Message Testing

We pretested the four experimental messages about the IB (articles A-D) to assure similar levels of credibility and persuasiveness. Participants (N=96) were recruited through MTurk for an online survey. Participants were primarily of male (63.5%), white (70.8%), and of middle age (M=36.6 years, SD=11.14). Ratings for perceptions of the article's credibility (*accurate, believable, factual,* and *trustworthy*) were taken from Appelman & Sundar (2016) (α=.92). Persuasiveness was measured by asking participants how *persuasive* and *compelling* they thought the messages were for a typical person (r=.79). In a repeated one-way ANOVA, we verified no significant differences in the credibility or persuasiveness of the four articles (p<.05 criterion).

Procedures

Experimental procedures were approved by the authors' Institutional Review Board. In June 2020, 1,020 participants were recruited through MTurk. The questionnaire was hosted in Qualtrics. Each respondent was randomly assigned to one of three conditions: contradictory, non-contradictory, and control. Participants assigned to the contradictory or non-contradictory experimental conditions initially completed scales to assess the moderating variables. Next, participants read two articles presented separately, in a randomized order. Table 3.1 describes the message counterbalancing strategy used to assure that messages A through D each appeared an equal number of times in the contradictory and noncontradictory conditions. Thereafter

respondents answered questions about the remaining variables and provided basic demographic information.

Participants in the control condition read two articles about William Shakespeare, also presented separately and in a randomized order, and then completed the measures of issue and decision uncertainty and provided demographic information. The other measures were not relevant because they asked for evaluations of messages about the focal topic.

Measures

Unless otherwise noted, measures were Likert-type scales ranging from 1 (strongly disagree) to 7 (strongly agree). The questionnaire concluded with demographic questions.

Attention Check. Participants were presented with four statements taken from the messages and four faux statements. They then indicated if each statement appeared in the messages they read, or not. We excluded respondents who identified 50% or less of the correct statements shown in the stimuli.

Diet Information Overload. The scale developed by Ramondt & Ramírez (2019) consisted of five items (e.g., *There are so many recommendations about eating a healthy diet, it's hard to know which ones to follow*).

Need for Cognition. The scale developed by Pieniak, Verbeke, Scholderer, Brunsø, & Olsen (2007) had five items (e.g., *I would prefer complex to simple problems*).

Intolerance for Uncertainty. Nine items adapted from Carleton et al. (2007), Greco & Roger (2001), and McLain (2009) were used. The items tapped into cognitive (e.g., *It is important that I have certainty in every aspect of my life*), emotional (e.g., *Uncertainty usually makes me anxious*), and behavioral reactions to uncertainty (e.g., *When it's time to act, uncertainty paralyzes me*).

Health Self-Efficacy. Four items adapted from S. Y. Lee et al. (2008) (e.g., *I have the ability to manage my own health*) were used.

Perceived Contradiction. Respondents rated the extent to which the articles were *contradictory*, *inconsistent*, and *incompatible*. Items were adapted from Chang (2015).

Issue Uncertainty. Four items were adapted from Mishel (1981) (e.g., *I know very little* and *I have a lot of questions without answers*).

Decision Uncertainty. Participants were asked to think about whether they should consume the IB, or not. All three items were developed by O'Connor (1995) (e.g., *This decision is difficult for me to make*).

Negative Appraisals. Individuals' evaluations of potential health outcomes of consuming IB were assessed with three items (e.g., *I am concerned that consuming the IB could cause harm to my health*) adapted from Ahmad (2005).

Threat Emotions. The extent to which participants experienced worry, fear, and anxiety when thinking about the health outcomes of consuming the IB was assessed on scales ranging from 1 (not at all) to 7 (very much) (Folkman & Lazarus, 1985).

Cognitive Outcome Expectation. Participants were asked to reflect on how their knowledge level would change if they were to look for additional information about the IB. Four 7-point bipolar scales were created (e.g., *I would be more knowledgeable*).

Emotional Outcome Expectation. Participants were asked to think about how they would be affected emotionally by what they expected to find if were to look for information about the IB. Four 7-point bipolar scales were created (e.g., *I would be less anxious*).

Information-Seeking Intentions. Four items adapted from Liu et al. (2005) were used (e.g., *I will use the Internet to learn more information about this topic*).

Issue Relevance. Two items adapted from Petty & Cacioppo (1984) (e.g., *How important to you personally is knowing about the health effects of meat alternatives/IB?*).

Data Analysis

Confirmatory factor analysis (CFA) was used to assess the measurement model, using maximum likelihood method (StataCorp, 2017). Structural equation modeling (SEM) was used to test our hypotheses, with the contradictory condition represented as a dummy variable and the non-contradictory condition serving as the reference. The control group was not included in the analysis, as this condition had the sole objective of providing baseline levels of issue and decision uncertainty. Model fit was deemed to be "good" (RMSEA≤.06, CFI≥.95, SRMR≤.08) or "acceptable" (RMSEA≤.08, CFI≥.90, SRMR≤.08) according to Hu & Bentler (1999). (The model χ^2 is no longer considered a valid goodness-of-fit measure due to its sensitivity to sample size (Schermelleh-Engel et al., 2003).) When necessary, modification indices were examined to identify theoretically justifiable parameters that would improve fit if estimated (Acock, 2013). Model comparisons between UMT and the CHIP Model were based on fit indexes, following recommendations by Seaman and Weber (2015) and procedures similar to C. J. Lee et al. (2019), because there is no statistical test to compare non-hierarchical models (Kline, 2016). (The models are not hierarchical because although the UMT model has the same causal paths depicted in the CHIP Model, it does not include the variables perceived contradiction and decision uncertainty.) To test the moderator hypotheses, hierarchical multiple regression analysis was conducted. Moderators were tested in this way because no extant statistical program accommodates multiple moderation tests between latent variables simultaneously.

Results

Preliminary Analyses

Sample Characteristics. Complete data were obtained from 1,026 participants. A total of 128 respondents were excluded because they spent less than the minimum amount of time judged reasonable by the researchers for a fast responder to diligently complete the questionnaire (270 and 420 seconds for the control and experimental conditions, respectively). Next, 135 individuals were excluded because they had scores on the attention test that were at or below the chance level of accuracy. The final sample consisted of 763 participants, with a mean age of 38.7 years (SD=11.56); a majority were male (60.6%) and white (67.6%) (Table 3.2).

Randomization Check. Randomization produced comparable experimental groups, with no significant differences across conditions for the demographic (Table 3.2) and moderator variables (p>.05 for all measures).

Reliabilities. Cronbach alpha reliabilities were very good: need for cognition (α=.83), diet information overload (α=.88), intolerance for uncertainty (α=.95), health self-efficacy (α=.97), cognitive (α=.93) and emotional (α=.94) outcome expectation, perceived contradiction (α=.95), issue uncertainty (α=.91), decision uncertainty (α=.95), negative appraisal (α=.94), threat emotion (α=.95), information-seeking intentions (α=.83). Means and standard deviations are reported in Table 3.3.

Baseline Levels of Uncertainty. A between-subjects ANOVA (Table 3.3) indicated significant differences in issue uncertainty among conditions (F[2, 760]=12.19, p<.001). Tukey tests indicated that issue uncertainty was higher in the contradictory (M=4.78, SD=1.62) than in the non-contradictory (M=4.08, SD=1.72) and control (M=4.24, SD=1.63) conditions. There were also differences in decision uncertainty, F[2, 760]=7.61, p=.001). Decision uncertainty was

higher in the contradictory (*M*=3.94, *SD*=2.02) than in the non-contradictory (*M*=3.28, *SD*=1.91) condition. Decision uncertainty in the control (*M*=3.55, *SD*=1.73) was not significantly different from the contradictory condition (*p*=.055).

Measurement Model

Latent variables were allowed to correlate in the CFA analysis. Data from the two experimental conditions were included (*n*=500). The initial model provided a good fit to the data (RMSEA=.05, CFI=.98, SRMR=.04) (Table 3.4).

Structural Model Fit

The data fit the initial model poorly ($\chi^2(184)=547.38$, $p<.001$, RMSEA=.06, CFI=.96, SRMR=.10). Modification indices identified a theoretically justifiable alteration: the addition of a direct path from issue uncertainty to negative appraisals. After this modification, a good fit was obtained ($\chi^2(183)=465.18$, $p<.001$, RMSEA=.06, CFI=.97, SRMR=.08).

Model Comparisons

The measures of fit CFI, TLI, RMSEA, SRMR, χ^2/df, and AIC were used for model comparison (C. J. Lee et al., 2019). Table 3.5 reports each model's rank position for each of these measures. The arithmetic mean of these ranks indicates the best-fitting model (i.e., the one with lowest overall mean rank) (Eveland et al., 2005; C. J. Lee et al., 2019). UMT also fits the data well; however, among the two models, the CHIP model was best supported by the data. Importantly, the SEM technique "cannot statistically determine the 'best' model from a group of variables, but only whether a given model is reasonably supported by the data" (Seaman & Weber, 2015, p. 210); both models were supported.

Hypothesized Direct Effects

As shown in Table 3.6, H1 was supported, as contradictory health messages generated perceptions of contradiction. In support of H2, perceptions of contradiction were positively related to issue uncertainty. H3 was also supported, as issue uncertainty was positively related to decision uncertainty. In support of H4, decision uncertainty was positively related to negative appraisals. H5 was supported, as appraisals were positively related to threat emotions. In support of H6, emotions were positively related to information-seeking intentions.

Indirect Effects

Perceived contradiction had a positive, indirect effect on decision uncertainty that was mediated by issue uncertainty (Table 3.6). Issue uncertainty had a positive, indirect effect on negative appraisals that was mediated by decision uncertainty. Issue uncertainty also had a positive, indirect effect on threat emotions that was mediated by appraisals. Decision uncertainty had a positive, indirect effect on emotions that was mediated by appraisals. Appraisals had a positive, indirect effect on information-seeking intentions that were mediated by threat emotions.

Hypothesized Moderation Effects

Diet information overload (H7), IU (H9), and emotional outcome expectation (H12) were not significant moderators. NC (H8) accounted for a significant amount of variance in issue uncertainty R^2=.207, F(2, 497)=64.92, p<.001, and the interaction between perceived contradiction and NC accounted for a significant proportion of additional variance in issue uncertainty, but in the contrary direction, ΔR^2=.014, ΔF(1, 496)=8.678, p=.003, b=-.058.

H10 was supported: threat emotions and health self-efficacy accounted for a significant amount of variance in information-seeking intentions R^2=.059, F(2, 497)=16.64, p<.001. Their interaction accounted for a significant proportion of additional variance in information seeking

ΔR^2=.038, ΔF(1, 496)=20.917, p<.001, b=.095. H11 was also supported: threat emotions and cognitive outcome expectation accounted for a significant amount of variance in information-seeking R^2=.215, F(2, 497)=67.87, p<.001. Their interaction accounted for a significant proportion of additional variance in information seeking ΔR^2=.007, ΔF(1, 496)=4.264, p=.039, b=.044.

Discussion

We investigated the relations between contradictory health messages, uncertainty, and information-seeking intentions by testing the CHIP model. Results supported the core tenants of the model by showing that contradictory health messages give rise to perceptions of contradiction, leading to issue uncertainty. Issue uncertainty prompts negative appraisals directly, as well as indirectly by increasing decision uncertainty. Negative appraisals foster fear, worry, and anxiety, which, in turn motivates individuals to engage in information seeking.

The CHIP model pays homage to UMT, while extending it to make three contributions to theorizing about contradictory health information processing. First, it differentiates between objective and perceived message contradiction. This distinction is relevant, for example, when exploring how individual characteristics and message features (health topic, number of sources, temporal inconsistency, etc.) lead to different perceptions of contradiction and, possibly, different psychological and behavioral effects (Carpenter et al., 2016).

Second, it distinguishes between issue and decision uncertainty. Our findings suggest that the distinction is important, for perceptions of contradiction made individuals insecure in their state of knowledge (issue uncertainty) which, in turn, increased indecision about the appropriate behavior to adopt (decision uncertainty). Future research should investigate potential differences in uncertainty management motivated by knowledge acquisition and/or by decision making.

A third feature of the model is the role it gives to individuals' health self-efficacy as a moderator of the effects of negative threat emotions on information seeking. Previous research suggests that individuals with strong health self-efficacy who experience uncertainty and negative emotions are more likely to engage in information-seeking behaviors (S. Y. Lee et al., 2008; Zhao & Cai, 2009). Our results offer additional evidence that this is so. Information seeking is self-protective (Rimal & Real, 2003) and, therefore, individuals who feel threatened, but are confident in their ability to manage their health, are more likely to engage in information search that can help protect their well-being.

We wish to make clear that the CHIP Model does not claim superiority to UMT, but rather provides an extended framework to be used when perception of contradiction and decision uncertainty are of interest. Investigators conducting research in which such issues are not of concern can confidently rely on the more parsimonious UMT, as our study adds to the evidence of its validity.

We also found that individuals with the positive expectation that additional information can help reduce uncertainty are more likely to engage in information seeking when experiencing threat emotions. Presumably, engaging in information seeking is beneficial to reduce one's feeling of uncertainty (Brashers, 2001). Nonetheless, previous research suggests that information seeking motivated by threat emotions is superficial (Rains & Tukachinsky, 2015) and selective, with preference for protection-related information (Nabi, 2003). In order to understand benefits and shortcomings of this information search, future research should investigate how threat emotions and cognitive outcome expectations operate jointly during actual information seeking. Health self-efficacy should also influence this information search, since self-efficacy beliefs influence the outcomes people expect their efforts to produce (Bandura, 2004).

Although the processes depicted in CHIP were largely supported as expected, some surprising results emerged. Need for cognition moderated the relationship between perceived contradiction and issue uncertainty, but counter to the hypothesized direction; the relationship was weaker among individuals with high NC than low NC. Individuals with high NC might have gained a more comprehensive overview of the issue when reading supportive and unsupportive arguments that were presented in the opposing messages, thus increasing their perception of knowledge about the issue. Future research could help confirm or not this explanation.

The remaining moderation hypotheses were not supported. First, diet information overload did not moderate the relation between perceived contradiction and issue uncertainty. We reasoned that diet information overload would limit cognitive processing capabilities, making individuals highly selective and neglectful to new information (Eppler & Mengis, 2008) and, thus, less likely to reconcile any perceived contradiction. In our experiment, we informed participants that they would be tested on their memory, which could have motivated individuals with diet information overload to more mindfully process messages than they normally would.

Second, cognitive appraisal has generally been considered the most proximal direct outcome of uncertainty (Brashers, 2001). We thus predicted that IU should moderate the relation between decision uncertainty and cognitive appraisals. This hypothesis was not supported. It is possible that IU exerts its influence on threat emotions. Thus, although individuals with different IU have similar evaluations of health risks under uncertainty, their emotional reactions to those potential harms could be exacerbated by their IU.

Third, participants' emotional outcome expectation was not a significant moderator of the effect of threat emotions on information-seeking intentions. Given that cognitive outcome expectation moderated this effect, rational expectations of finding information that increases

knowledge and reduces indecisiveness seem more motivating to individuals than expectations of finding any information that could reduce their emotional discomfort. Future research should investigate if this apparent rationality also holds during actual information search.

The present study has important implications for health communication practice. Given the negative effects of uncertainty stemming from exposure to contradictory health information, reducing individuals' *perception* of contradiction should likely be the first step. The identification of individual characteristics related to perceptions of contradiction, such as age, education, and race, can help identify population groups more likely to be affected by the negative effects of contradictory information. Targeted health and scientific literacy interventions can increase these individuals' ability to understand and evaluate research and, as a result, reduce their perceptions of contradiction (Carpenter et al., 2016; Han et al., 2009). Understandings how some individuals are able to reconcile perceived contradictions and increase their self-perception of knowledge (such as individuals with high NC) might also be beneficial.

The way that contradictions are communicated to the public might also be improved. Some strategies, such as the use of weight-of-evidence/expert (Dunwoody & Kohl, 2017; Kohl et al., 2016), hedging (Jensen, 2008), and scientific context (including a paragraph that places the topic in context with a wider body of research) (Corbett & Durfee, 2004) are shown to reduce perceptions of divergence (Clarke, Dixon, et al., 2015; van der Linden, Clarke, & Maibach, 2015) and uncertainty (Clarke, Dixon, et al., 2015; Kohl et al., 2016).

Our study has limitations. Participants were exposed to only one nutrition topic. Results need to be replicated across a broader range of issues and domains. Second, for the sake of experimental control, we presented contradictory information from only two sources. In the real world, people are presented with a wider array of contradictory information on any given topic,

expressed by many voices, sometimes spread across a wider time frame. Third, we used a convenience sample of adults that is not representative of the general population. Finally, we measured information-seeking intentions instead of actual information-seeking behaviors.

Contradictory health information is prevalent in the media. The present program of research furthers our understanding of how individuals perceive this type of information, and how they experience and manage its resulting uncertainty. A clear and accurate explication of the process of contradictory health information processing will provide a foundation upon which practical guidance can be constructed for countering the deleterious effects of such information on people's decisions to become more informed, or not, on important health issues.

References

Acock, A. C. (2013). *Discovering structural equation modeling using Stata*. Stata Press.

Ahmad, M. M. (2005). Psychometric evaluation of the cognitive appraisal of health scale with patients with prostate cancer. *Journal of Advanced Nursing*, *49*(1), 78–86.

Appelman, A., & Sundar, S. S. (2016). Measuring message credibility: Construction and validation of an exclusive scale. *Journalism & Mass Communication Quarterly*, *93*(1), 59–79.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, *31*(2), 143–164.

Brashers, D. E. (2001). Communication and uncertainty management. *Journal of Communication*, *51*(3), 477–497.

Brashers, D. E., & Hogan, T. P. (2013). The appraisal and management of uncertainty: Implications for information-retrieval systems. *Information Processing & Management*, *49*(6), 1241–1249.

Buhr, K., & Dugas, M. J. (2002). The intolerance of uncertainty scale: Psychometric properties of the English version. *Behaviour Research and Therapy*, *40*(8), 931–945.

Cacioppo, J. T., Petty, R. E., Feinstein, J. A., & Jarvis, W. B. G. (1996). Dispositional differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin*, *119*(2), 197–253.

Carleton, R. N., Norton, M. P. J., & Asmundson, G. J. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders*, *21*(1), 105–117.

Carpenter, D. M., Elstad, E. A., Blalock, S. J., & DeVellis, R. F. (2014). Conflicting medication information: Prevalence, sources, and relationship to medication adherence. *Journal of Health Communication*, *19*(1), 67–81.

Carpenter, D. M., Geryk, L. L., Chen, A. T., Nagler, R. H., Dieckmann, N. F., & Han, P. K. J. (2016). Conflicting health information: A critical research need. *Health Expectations*, *19*(6), 1173–1182.

Chang, C. (2015). Motivated processing: How people perceive news covering novel or contradictory health research findings. *Science Communication*, *37*(5), 602–634.

Clark, D., Nagler, R. H., & Niederdeppe, J. (2019). Confusion and nutritional backlash from news media exposure to contradictory information about carbohydrates and dietary fats. *Public Health Nutrition*, *22*(18), 3336–3348.

Corbett, J. B., & Durfee, J. L. (2004). Testing public (un)certainty of science: Media representations of global warming. *Science Communication*, *26*(2), 129–151.

Dillard, J. P., & Peck, E. (2001). Persuasion and the structure of affect. Dual systems and discrete emotions as complementary models. *Human Communication Research*, *27*(1), 38–68.

Dunwoody, S., & Kohl, P. A. (2017). Using weight-of-experts messaging to communicate accurately about contested science. *Science Communication*, *39*(3), 338–357.

Eppler, M. J., & Mengis, J. (2008). The concept of information overload: A review of literature from organization science, accounting, marketing, MIS, and related disciplines (2004). In M. Meckel & B. F. Schmid (Eds.), *Kommunikationsmanagement im Wandel* (pp. 271–305). Gabler.

Eveland, W. P., Hayes, A. F., Shah, D. V., & Kwak, N. (2005). Understanding the relationship between communication and political knowledge: A model comparison approach using panel data. *Political Communication*, *22*(4), 423–446.

Flesch, R. (1948). A new readability yardstick. *Journal of Applied Psychology*, *32*(3), 221–233.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, *48*(1), 150–170.

Fresán, U., & Sabaté, J. (2019). Vegetarian diets: Planetary health and its alignment with human health. *Advances in Nutrition*, *10*(S4), S380–S388.

Frijda, N. H., Kuipers, P., & Ter Schure, E. (1989). Relations among emotion, appraisal, and emotional action readiness. *Journal of Personality and Social Psychology*, *57*(2), 212–228.

Greco, V., & Roger, D. (2001). Coping with uncertainty: The construction and validation of a new measure. *Personality and Individual Differences*, *31*(4), 519–534.

Han, P. K. J., Babrow, A., Hillen, M. A., Gulbrandsen, P., Smets, E. M., & Ofstad, E. H. (2019). Uncertainty in health care: Towards a more systematic program of research. *Patient Education and Counseling*, *102*(10), 1756–1766.

Han, P. K. J., Klein, W. M., & Arora, N. K. (2011). Varieties of uncertainty in health care: A conceptual taxonomy. *Medical Decision Making*, *31*(6), 828–838.

Han, P. K. J., Moser, R. P., & Klein, W. M. (2006). Perceived ambiguity about cancer prevention recommendations: Relationship to perceptions of cancer preventability, risk, and worry. *Journal of Health Communication*, *11*(S1), 51–69.

Han, P. K. J., Moser, R. P., Klein, W. M. P., Beckjord, E. B., Dunlavy, A. C., & Hesse, B. W. (2009). Predictors of perceived ambiguity about cancer prevention recommendations: Sociodemographic factors and mass nedia exposures. *Health Communication*, *24*(8), 764–772.

Health Information National Trends Survey, HINTS (2017). All HINTS Questions. https://hints.cancer.gov/view-questions-topics/all-hints-questions.aspx

Hillen, M. A., Gutheil, C. M., Strout, T. D., Smets, E. M., & Han, P. K. J. (2017). Tolerance of uncertainty: Conceptual analysis, integrative model, and implications for healthcare. *Social Science & Medicine*, *180*(2017), 62–75.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55.

Jensen, J. D. (2008). Scientific uncertainty in news coverage of cancer research: Effects of hedging on scientists' and journalists' credibility. *Human Communication Research*, *34*(3), 347–369.

Jensen, J. D., Carcioppolo, N., King, A. J., Scherr, C. L., Jones, C. L., & Niederdeppe, J. (2014). The cancer information overload (CIO) scale: Establishing predictive and discriminant validity. *Patient Education and Counseling*, *94*(1), 90–96.

Jensen, J. D., & Hurley, R. J. (2012). Conflicting stories about public scientific controversies: Effects of news convergence and divergence on scientists' credibility. *Public Understanding of Science*, *21*(6), 689–704.

Kardash, C. M., & Scholes, R. J. (1996). Effects of preexisiting beliefs, epistemological beliefs, and need for cognition on interpretation of controversial issues. *Journal of Educational Psychology*, *88*(2), 260–271.

Katz, S. J., Erkkinen, M., Lindgren, B., & Hatsukami, D. (2018). Assessing the impact of conflicting health warning information on intentions to use e-cigarettes: An application of the Heuristic-Systematic Model. *Journal of Health Communication*, *23*(10–11), 874–885.

Khaleel, I., Wimmer, B. C., Peterson, G. M., Zaidi, S. T. R., Roehrer, E., Cummings, E., & Lee, K. (2020). Health information overload among health consumers: A scoping review. *Patient Education and Counseling*, *103*(1), 15–32.

Kincaid, J. P., Fishburne Jr, R. P., Rogers, R. L., & Chissom, B. S. (1975). *Derivation of new readability formulas (automated readability index, fog count and flesch reading ease formula) for navy enlisted personnel*. Naval Technical Training Command Millington Research Branch.

Klein, W. M. P., Hamilton, J. G., Harris, P. R., & Han, P. K. J. (2015). Health messaging to individuals who perceive ambiguity in health communications: The promise of self-affirmation. *Journal of Health Communication*, *20*(5), 566–572.

Kline, R. B. (2016). *Principles and practice of structural equation modeling*. The Guilford Press.

Kohl, P. A., Kim, S. Y., Peng, Y., Akin, H., Koh, E. J., Howell, A., & Dunwoody, S. (2016). The influence of weight-of-evidence strategies on audience perceptions of (un)certainty when media cover contested science. *Public Understanding of Science*, *25*(8), 976–991.

Lang, A. (1995). Defining audio/video redundancy from a limited- capacity information processing perspective. *Communication Research*, *22*(1), 86–115.

Lazarus, R. S., & Folkman, S. (1987). Transactional theory and research on emotions and coping. *European Journal of Personality*, *1*(3), 141–169.

Lee, C. J., Kim, K., & Kang, B.-A. (2019). A moderated mediation model of the relationship between media, social capital, and cancer knowledge. *Health Communication*, *34*(6), 577–588.

Lee, C. J., Nagler, R. H., & Wang, N. (2018). Source-specific exposure to contradictory nutrition information: Documenting prevalence and effects on adverse cognitive and behavioral outcomes. *Health Communication*, *33*(4), 453–461.

Lee, S. Y., Hwang, H., Hawkins, R., & Pingree, S. (2008). Interplay of negative emotion and health self-efficacy on the use of health information and its outcomes. *Communication Research*, *35*(3), 358–381.

Liu, Y., Doucette, W. R., Farris, K. B., & Nayakankuppam, D. (2005). Drug information–seeking intention and behavior after exposure to direct-to-consumer advertisement of prescription drugs. *Research in Social and Administrative Pharmacy*, *1*(2), 251–269.

Mcinnes, N., & Haglund, B. J. (2011). Readability of online health information: Implications for health literacy. *Informatics for Health and Social Care*, *36*(4), 173–189.

McLain, D. L. (2009). Evidence of the properties of an ambiguity tolerance measure: The multiple stimulus types ambiguity tolerance scale–II (MSTAT–II). *Psychological Reports*, *105*(3), 975–988.

Mishel, M. H. (1981). The measurement of uncertainty in illness. *Nursing Research*, *30*(5), 258–263.

Mishel, M. H. (1988). Uncertainty in illness. *Journal of Nursing Scholarship*, *20*(4), 225–232.

Mishel, M. H. (1990). Reconceptualization of the uncertainty in illness theory. *Journal of Nursing Scholarship*, *22*(4), 256–262.

Nabi, R. L. (1999). A cognitive-functional model for the effects of discrete negative emotions on information processing, attitude change, and recall. *Communication Theory*, *9*(3), 292–320.

Nabi, R. L. (2003). Exploring the framing effects of emotion: Do discrete emotions differentially influence information accessibility, information seeking, and policy preference? *Communication Research*, *30*(2), 224–247.

Nagler, R. H. (2010). *Steady diet of confusion: Contradictory nutrition messages in the public information environment*. Philadelphia, PA: (Unpublished doctoral dissertation). Annenberg School for Communication, University of Pennsylvania.

Nagler, R. H. (2014). Adverse outcomes associated with media exposure to contradictory nutrition messages. *Journal of Health Communication*, *19*(1), 24–40.

Nagler, R. H., Yzer, M. C., & Rothman, A. J. (2019). Effects of media exposure to conflicting information about mammography: Results from a population-based survey experiment. *Annals of Behavioral Medicine*, *53*(10), 896–908.

O'Connor, A. M. (1995). Validation of a decisional conflict scale. *Medical Decision Making*, *15*(1), 25–30.

O'Keefe, D. J. (2003). Message properties, mediating states, and manipulation checks: Claims, evidence, and data analysis in experimental persuasive message effects research. *Communication Theory*, *13*(3), 251–274.

Petty, R. E., & Cacioppo, J. T. (1984). Source factors and the Elaboration Likelihood Model of persuasion. *ACR North American Advances*, *NA-11*. https://www.acrwebsite.org/volumes/6328/volumes/v11/NA-11/full

Pieniak, Z., Verbeke, W., Scholderer, J., Brunsø, K., & Olsen, S. O. (2007). European consumers' use of and trust in information sources about fish. *Food Quality and Preference*, *18*(8), 1050–1063.

Quinn, S., Bond, R., & Nugent, C. (2017). Quantifying health literacy and eHealth literacy using existing instruments and browser-based software for tracking online health information seeking behavior. *Computers in Human Behavior*, *69*, 256–267.

Rains, S. A., & Tukachinsky, R. (2015). An examination of the relationships among uncertainty, appraisal, and information-seeking behavior proposed in uncertainty management theory. *Health Communication*, *30*(4), 339–349.

Ramondt, S., & Ramírez, A. S. (2019). Assessing the impact of the public nutrition information environment: Adapting the cancer information overload scale to measure diet information overload. *Patient Education and Counseling*, *102*(1), 37–42.

Rimal, R. N., & Real, K. (2003). Perceived risk and efficacy beliefs as motivators of change: Use of the risk perception attitude (RPA) framework to understand health behaviors. *Human Communication Research*, *29*(3), 370–399.

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of fit measures. *Methods of Psychological Research*, *8*(2), 23–74.

Seaman, C. S., & Weber, R. (2015). Undisclosed flexibility in computing and reporting structural equation models in communication science. *Communication Methods and Measures*, *9*(4), 208–232.

Shi, W., Nagler, R. H., Fowler, E. F., & Gollust, S. E. (2019). Predictors of women's awareness of the benefits and harms of mammography screening and associations with confusion, ambivalence, and information seeking. *Health Communication*, *36*(3)1–12.

Smith, C. A., & Lazarus, R. S. (1993). Appraisal components, core relational themes, and the emotions. *Cognition & Emotion*, *7*(3–4), 233–269.

So, J., Kuang, K., & Cho, H. (2016). Reexamining fear appeal models from cognitive appraisal theory and functional emotion theory perspectives. *Communication Monographs*, *83*(1), 120–144.

Stacey, D., Légaré, F., Lewis, K., Barry, M. J., Bennett, C. L., Eden, K. B., Holmes-Rovner, M., Llewellyn-Thomas, H., Lyddiatt, A., Thomson, R., & Trevena, L. (2017). Decision aids for people facing health treatment or screening decisions. *Cochrane Database of Systematic Reviews*, *4*(4), 1–294.

StataCorp. (2017). *Stata statistical software: Release 15* (Version 15) [Computer software].

Strout, T. D., Hillen, M., Gutheil, C., Anderson, E., Hutchinson, R., Ward, H., Kay, H., Mills, G. J., & Han, P. K. J. (2018). Tolerance of uncertainty: A systematic review of health and healthcare-related outcomes. *Patient Education and Counseling*, *101*(9), 1518–1537.

Sweeny, K., Melnyk, D., Miller, W., & Shepperd, J. A. (2010). Information avoidance: Who, what, when, and why. *Review of General Psychology*, *14*(4), 340–353.

Tan, A. S., Lee, C. J., Nagler, R. H., & Bigman, C. A. (2017). To vape or not to vape? Effects of exposure to conflicting news headlines on beliefs about harms and benefits of electronic

cigarette use: Results from a randomized controlled experiment. *Preventive Medicine*, *105*, 97–103.

Zhao, X., & Cai, X. (2009). The role of risk, efficacy, and anxiety in smokers' cancer information seeking. *Health Communication*, *24*(3), 259–269.

Table 3.1
Experimental Design

	Messages Presented					
	Impossible Burger Positive Articles		Impossible Burger Negative Articles		Shakespeare Biography Articles	
Conditions	A	B	C	D	E	F
Contradictory						
Group 1	✔		✔			
Group 2	✔			✔		
Group 3		✔	✔			
Group 4		✔		✔		
Non-contradictory						
Group 5	✔	✔				
Group 6			✔	✔		
Control						
Group 7					✔	✔

Notes. Data from the four contradictory groups were combined to create a single group. Data from the two non-contradictory groups were also combined to create a single group. Article A: "The Impossible Burger Success Story", article B: "Cows Everywhere Rejoice! A Meatless Burger Good for You and the Planet", article C: "Impossible Claims about the Impossible Burger", article D: "The Truth about the Impossible Burger", article E: "Who was William Shakespeare?", article F: "William Shakespeare: Playwriter Precisely Captured Human Condition".

Table 3.2
Sample Characteristics (*N*=763)

Characteristic	Frequency	Percent
Male	462	60.6
White race	516	67.6
Age, mean (*SD*)	38.7 (11.57)	-
Married or living as married	439	57.5
Education		
No H.S. diploma	3	.4
H.S. diploma or GED	128	16.8
Associate's degree	83	10.9
Bachelor's degree	386	50.6
Professional or graduate degree	163	21.4
Household income		
<$20,000	61	8
$20,000-$39,999	154	20.2
$40,000-$59,999	195	25.6
$60,000-79,999	145	19
$80,000-$99,999	84	11
≥$100,000	114	14.9
Declined to answer	10	1.3

Table 3.3
Means and Standard Deviations by Experimental Condition

	Contradictory Messages (*n*=250)		Non-contradictory Messages (*n*=250)		Control Messages (*n*=263)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Processing Variables						
Perceived Contradiction	5.25[a]	1.59	2.89[a]	1.79	-	-
Issue Uncertainty	4.78[ab]	1.62	4.08[a]	1.72	4.24[b]	1.63
Decision Uncertainty	3.94[a]	2.02	3.28[a]	1.91	3.55	1.73
Negative Appraisals	4.06[a]	1.81	3.59[a]	1.90	-	-
Threat Emotions	3.05	1.77	2.75	1.84	-	-
Information-Seeking Intentions	4.18	1.58	4.24	1.59	-	-
Moderator Variables						
Need for Cognition	4.47	1.53	4.53	1.46	-	-
Diet Information Overload	3.92	1.61	3.64	1.59	-	-
Intolerance for Uncertainty	4.18	1.67	4.04	1.56	-	-
Health Self-Efficacy	5.39	1.67	5.34	1.70	-	-
Cognitive Outcome Expectation	5.31	1.56	5.21	1.50	-	-
Emotional Outcome Expectation	4.54	1.58	4.51	1.60	-	-

Notes. Means within rows with the same superscript are significantly different ($p \leq .05$ criterion).

Table 3.4
Maximum Likelihood Estimates for a 6-Factor Solution for Model Variables (*N*=500)

Measure/Items	Unst. Coef.	SE	Stand. Coef.	M	SD
PERCEIVED CONTRADICTION[a]					
The information in the articles … was contradictory.	1.0[b]	-	.95	4.09	2.17
The information in the articles… was inconsistent.	0.98	.026	.91	4.05	2.20
There were incompatible claims about the health outcomes…	0.95	.025	.92	4.07	2.13
ISSUE UNCERTAINTY[a]					
When it comes to the health outcomes of eating the IB…					
I know very little.	1.0 [b]	-	.82	4.28	1.86
I have a lot of questions without answers.	1.08	.048	.86	4.42	1.92
It is unclear to me how harmful eating it would be.	1.13	.048	.89	4.41	1.94
I am not very confident that I know all of the most important health effects.	1.06	.049	.83	4.61	1.94
DECISION UNCERTAINTY[a]					
Think about whether you should consume the IB or not…					
This decision is difficult for me to make.	1.0 [b]	-	.95	3.55	2.10
I am unsure what to do.	0.99	.023	.94	3.57	2.07
It is not clear what choice is best for me.	0.97	.024	.93	3.70	2.06
NEGATIVE APPRAISAL[a]					
When it comes to the health outcomes of consuming the IB...					
I am concerned that consuming the Impossible Burger could cause harm to	1.0 [b]	-	.89	4.14	2.07
I have a lot to lose if I eat this product.	0.94	.029	.92	3.56	1.89
My health would be put at risk if I add this new product to my diet.	1.01	.029	.95	3.77	1.96

Measure/Items	Unst. Coef.	SE	Stand. Coef.	M	SD
THREAT EMOTIONS[a]					
When you think about the health outcomes of consuming the IB, to what extent do you experience the following emotions?					
Worry	1.0 [b]	-	.93	3.05	1.93
Fear	0.95	.026	.92	2.73	1.86
Anxiety	1.0	.025	.94	2.91	1.90
INFORMATION-SEEKING INTENTIONS[a]					
I will use the Internet to learn more information about this topic.	1.0 [b]	-	.65	5.01	1.88
I will talk with my doctor or another healthcare provider to learn more about this topic.	1.27	.103	.75	3.64	2.07
I will talk with family or friends to learn more about this topic.	1.19	.092	.74	4.04	1.94
I will turn to books, articles or another printed materials to learn more about this topic.	1.29	.090	.81	4.15	1.93

Notes. Analysis excludes control subjects, to whom the message evaluation scales were not presented. Unst. Coef., unstandardized coefficient; St. Coef., standardized coefficient; SE, standard error of estimate.

[a] Item responses were made on 7-point Likert scales. Negative emotions ranged from 1 (*not at all*) to 7 (*very much*) and all other measures ranged from 1 (*strongly disagree*) to 7 (*strongly agree*).

[b] Not tested for statistical significance. All other unstandardized estimates are statistically significant at $p \leq .001$.

Table 3.5
Fit Measures for the CHIP Model and the UMT Model (rank in parentheses)

Models	CFI	TLI	RMSEA (90% C.I.)	SRMR	χ^2 /df	AIC	Mean Rank**
CHIP Model	0.970 (1)	0.965 (1)	0.056(.049, .062) (1)	0.077 (2)	2.542 (1)	33851.364 (2)	1.33
UMT Model	0.968 (2)	0.962 (2)	0.064(.055, .073) (2)	0.063 (1)	3.037 (2)	24478.739 (1)	1.67
Best Model*	CHIP	CHIP	CHIP	UMT	CHIP	UMT	CHIP

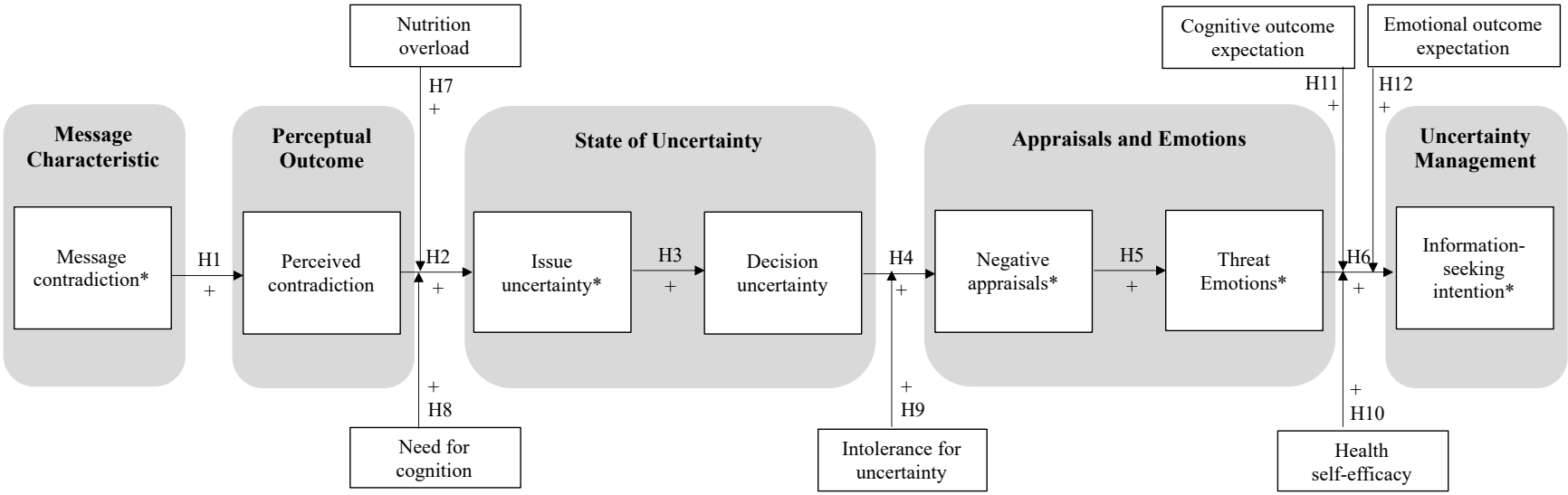
Notes. UMT Model=Message contradiction → issue uncertainty → negative appraisals → threat emotions → information-seeking intention.
CFI=Comparative Fit Index; TLI=Tucker-Lewis Index; RMSEA=Root Mean Square Error of Approximation; SRMR=Standardized Root Mean Square Residual; χ^2/df=Chi-square per degrees of freedom; AIC=Akaike Information Criterion. Model χ^2 and degrees of freedom are: CHIP: $\chi^2(183)=465.18$, $p<.001$; UMT: $\chi^2(87)=264.24$, $p<.001$.
*Best fitting model for the column fit measure.
**Arithmetic mean of the ranks in parentheses.

Table 3.6
Standardized Direct, Indirect, and Total Effects

Outcome	Direct	Indirect	Total
Perceived Contradiction			
Contradictory Messages[a] → Perceived Contradiction	.586***	-	.586***
Issue Uncertainty			
Perceived Contradiction → Issue Uncertainty	.503***	-	.503***
Contradictory Messages[a] → Issue Uncertainty	-	.295***	.295***
Decision Uncertainty			
Issue Uncertainty → Decision Uncertainty	.661***	-	.661***
Perceived Contradiction → Decision Uncertainty	-	.332***	.332***
Contradictory Messages[a] → Decision Uncertainty	-	.195***	.195***
Negative Appraisals			
Decision Uncertainty → Negative Appraisals	.230***	-	.230***
Issue Uncertainty → Negative Appraisals	.490***	.152***	.642***
Perceived Contradiction → Negative Appraisals	-	.323***	.323***
Contradictory Messages[a] → Negative Appraisals	-	.190***	.190***
Threat Emotions			
Negative Appraisals → Threat Emotions	.564***	-	.564***
Decision Uncertainty → Threat Emotions	-	.130***	.130***
Issue Uncertainty → Threat Emotions	-	.362***	.362***
Perceived Contradiction → Threat Emotions	-	.182***	.182***
Contradictory Messages[a] → Threat Emotions	-	.107***	.107***
Information-Seeking Intentions			
Threat Emotions → Info-Seeking Intentions	.190***	-	.190***
Negative Appraisals → Info-Seeking Intentions	-	.107***	.107***
Decision Uncertainty → Info-Seeking Intentions	-	.025**	.025**
Issue Uncertainty → Info-Seeking Intentions	-	.070***	.070***
Perceived Contradiction → Info-Seeking Intentions	-	.035***	.035***
Contradictory Messages[a] → Info-Seeking Intentions	-	.020***	.020***

Notes. [a] Reference group is the non-contradictory condition; Info=Information.
* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

Figure 3.1
Contradictory Health Information Processing (CHIP) Model



Chapter 4. Effects of Contradictory Health Information on Information Processing and Information Seeking

Chapter 4. Effects of Contradictory Health Information on Information Processing and Information Seeking

Abstract

Guided by the Contradictory Health Information Processing (CHIP) Model (Zimbres et al., in press), we explore individuals' processing of contradictory health information and subsequent management of uncertainty via information seeking. U.S. women (*N*=478) were randomly assigned to one of three conditions: experimental conditions consisting of two messages about the safety of a consumer health product that were (1) contradictory or (2) non-contradictory, or a (3) control condition with two messages unrelated to that consumer product. Participants in the two experimental conditions provided ratings of the CHIP model constructs, including perceived message contradiction, issue uncertainty, decision uncertainty, negative appraisals, threat emotions, and information-seeking intentions. Control participants provided baseline ratings of issue and decision uncertainty. Findings showed that participants who read contradictory messages felt as uninformed and undecided as did control participants. However, those in the non-contradictory condition had lower levels of issue and decision uncertainty than did those in the contradictory and control conditions. Perceptions of contradiction gave rise to issue uncertainty which prompted negative appraisals and decision uncertainty. Consistent with the CHIP model, the effects of issue uncertainty on information-seeking intentions were mediated by negative appraisals and threat emotions. Decision uncertainty did not affect information-seeking intentions, which evidences the complexity of uncertainty management strategies. Model refinements and practical implications are discussed.

Effects of Contradictory Health Information on Information Processing and Information Seeking

Do healthy individuals need annual physical exams, or not? Should we drink coffee and wine for better heart health, or do these beverages present risks to cardiovascular health? Contradictory health messages such as these are abundant in the media, making individuals insecure about many daily health decisions (Zimbres et al., in press). The effects of these messages are not fully understood, however. As a result, strategies to help the public process contradictory health information are needed (Carpenter et al., 2016).

Contradictory health messages contain logically inconsistent propositions. These messages can stem from single or multiple sources and be presented concurrently or at separate times. Individuals' reactions to such contradictions vary (Carpenter et al., 2016), but the effects are typically adverse, such as loss of confidence in health recommendations, confusion (Clark et al., 2019; Nagler, 2014), and heightened uncertainty (Chang, 2015; Jensen & Hurley, 2012).

Uncertainty refers to the perception of one's own lack of knowledge about an aspect of reality (Han et al., 2009). Communications that present contradictory health messages can be a source of such uncertainty (Babrow et al., 1998) insofar as such messages render individuals insecure about their state of knowledge or their personal decisions on an issue (Brashers, 2001, 2007; Zimbres et al., in press). Nonetheless, communications can also play an important role in the management of uncertainty, as individuals have the option to seek (or avoid) information that could address their uncertainty (Brashers, 2001, 2007).

In the present study, we tested the Contradictory Health Information Processing Model, CHIP, an extension of Uncertainty Management Theory, UMT (Brashers, 2001, 2007; Zimbres et al., in press). The CHIP model differentiates between the objective presence of contradiction

and individuals' perceptions of contradiction, tests the concept and role of decision uncertainty, and assesses the influence of two theory-driven moderators. The model was originally developed and tested in the context of nutrition. The present study extends the model's propositions in a new domain– contradictory claims about the safety of a consumer health product.

The CHIP Model

Information that is contradictory, insufficient, complex, or probabilistic gives rise to uncertainty (Brashers, 2001, 2007; Han et al., 2019). Contradiction is the focus of the CHIP model (Figure 4.1) and is defined as "two or more health-related propositions that are logically inconsistent with one another (…) such that a person could not simultaneously engage in or believe both propositions at once" (Carpenter et al., 2016, p. 1175). An example is a message stating that the use of antiperspirants with aluminum increases the risk of breast cancer in women, followed by a message proclaiming these products are safe.

The objective contradictory information about a health issue can result from conflicting scientific evidence (from studies using different methodologies), temporal inconsistency (synchronous or asynchronous), and/or a single or multiple sources (Carpenter et al., 2016). Nonetheless, individuals' *perceptions* of contradiction (i.e., the degree of perceived information inconsistency) can vary depending on different combinations of these dimensions. Such personal perceptions rather than objective contradiction dimensions are better predictors of the effects of contradictory messages (Carpenter et al., 2016). The distinction between the objective presence of contradiction and the perception of contradiction further enables the identification of individual characteristics that could explain why people exposed to the same contradictory messages have different reactions. Importantly, in accordance with O'Keefe (2003), the primary role of perceived contradiction within the CHIP model is not a manipulation check, but rather a

mediator of the hypothesized relation between objective contradiction and uncertainty. This discussion leads to our first hypothesis.

H1: Contradictory health messages will generate perceptions of contradiction.

The CHIP model further depicts perceptions of contradiction as the proximal antecedent of issue uncertainty (Zimbres et al., in press). In contrast to UMT (Brashers, 2001, 2007), the CHIP model differentiates between *issue uncertainty* (e.g., "I know very little about the health outcomes of using antiperspirants with aluminum") and *decision uncertainty* (e.g., "I am unsure whether I should keep using antiperspirant with aluminum, or not"). When individuals perceive messages as having inadequate information for building proper knowledge structures about an issue (Mishel, 1988, 1990), they feel insecure about their state of knowledge about that issue, hence, experiencing issue uncertainty (Brashers, 2001, 2007; Chang, 2015; Jensen & Hurley, 2012).

The distinction between issue and decision uncertainty was initially suggested by O'Connor (1995, 1998), who identified a perceived lack of knowledge about a health-related issue as an important factor contributing to health-related decisional conflict (i.e., decision uncertainty). The conceptual distinction between issue and decision uncertainty, as well as their causal order, has been validated in previous empirical testing of the CHIP model within the context of nutrition messages (Zimbres et al., in press); this finding was expected to hold true in the new domain investigated in the present study.

H2: Perceptions of contradiction will lead to issue uncertainty.

H3: Issue uncertainty will lead to decision uncertainty.

The CHIP model's predictions pertaining to uncertainty and appraisals were derived from UMT (Brashers, 2001, 2007) and grounded on appraisal theories of emotions (Folkman &

Lazarus, 1985). According to these theories, individuals are constantly evaluating the implications of life events to their personal well-being. These cognitive appraisals trigger emotions (Lazarus & Folkman, 1987; Moors et al., 2013) that serve an adaptive function of fostering behaviors that promote or prevent important outcomes (Lee et al., 2008). Thus, emotions are not random responses, but rather distinctive expressions of an individual's appraisals of harm or benefit that motivate coping activities (Smith & Lazarus, 1990). Although UMT proposed that responses to uncertainty are shaped by positive or negative appraisals and emotions (Brashers, 2001, 2007), appraisals to health-related uncertainty are typically negative and accompanied by the threat emotions of fear, worry, and anxiety (Han et al., 2019). Negative appraisals and threat emotions have been found to mediate issue uncertainty outcomes across a variety of health contexts, such as stem cell transplantation (Hamilton et al., 2013), skin cancer (Rains & Tukachinsky, 2015), and nutrition (Zimbres et al., in press). In previous testing of the CHIP model, issue uncertainty led to negative appraisals both directly, and indirectly through decision uncertainty (Zimbres et al., in press).

H4: (a) Issue uncertainty and (b) decision uncertainty will lead to negative appraisals.

H5: Negative appraisals will lead to the arousal of threat emotions.

The last prediction in the CHIP model concerns the relation between threat emotions and information seeking. Several communication frameworks have investigated determinants of information seeking since this behavior is related to positive health outcomes (Yang & Kahlor, 2013). Relations between emotions and actions are context dependent, however (Lee et al., 2008). When confronting uncertainty about health outcomes, threat emotions typically motivate individuals to protect themselves from the prospective threat (Frijda et al., 1989; So et al., 2016). Information seeking is considered a self-protective behavior that prevents negative outcomes to

one's well-being (Rimal & Real, 2003). Accordingly, UMT posits that individuals engage in information seeking in order to reduce uncertainty and to cope with its accompanying negative emotions (Brashers, 2001, 2007).

A meta-analysis of the antecedents of health information seeking found that negative emotions are positively associated with the pursuit of information (Wang et al., 2020). More specifically, efforts to manage fear, worry, and anxiety about the unpredictable nature of health issues can motivate information seeking (S. Y. Lee et al., 2008; Lu et al., 2021; Yang & Kahlor, 2013). Understanding the management of uncertainty via information search is of practical importance in helping individuals develop constructive uncertainty management skills, and in guiding professionals to optimize the design of information that serves the public's needs (Chasiotis et al., 2020; Zhuang & Guan, 2021).

H6: Threat emotions will motivate information-seeking intentions.

Moderators in the CHIP Model

The CHIP model also extends UMT (Brashers, 2001, 2007) as it identifies two relevant moderators of the relationship between threat emotions and information-seeking intentions: health self-efficacy and outcome expectations (Zimbres et al., in press).

Health Self-Efficacy. As noted in Figure 4.1, the CHIP model proposes that the relation between negative emotions and information-seeking intentions is moderated by individuals' belief about the ability to control their own health behaviors or outcomes, or health self-efficacy (Bandura, 2004). A meta-analysis found that self-efficacy, worry, and anxiety are predictors of health information seeking (Wang et al., 2020). Specifically, when health self-efficacy is high,

threat emotions are expected to be stronger predictors of information seeking (S. Y. Lee et al., 2008; Zimbres et al., in press).

H7: The effect of threat emotions on information-seeking intentions will be moderated by health self-efficacy, such that threat emotions will be more strongly related to information-seeking intentions when health self-efficacy is higher.

Outcome expectations. Seeking information serves to manage uncertainty in one's desired direction (Brashers, 2001, 2007; Brashers & Hogan, 2013) and, therefore, expectations of how new information could help reduce that uncertainty and help individuals cope with threat emotions should also influence information search (S. Y. Lee et al., 2008; Nabi, 1999). Individuals who expect that information search can lead to new information that creates uncertainty-reducing coherence (i.e., outcome expectation) should be more likely to engage in information seeking (Brashers, 2001, 2007; Brashers & Hogan, 2013; Zimbres et al., in press). Studies also show that negative affect and favorable attitudes toward information seeking lead to greater search intentions (Yang & Kahlor, 2013).

H8: The effect of threat emotions on information-seeking intentions is moderated by outcome expectations, such that high-threat emotions will be more strongly related to information-seeking intentions when outcome expectations are higher.

Methods

The use of antiperspirants with aluminum was the topic selected for this study because of its high relevance; approximately 90% of Americans use deodorants and/or antiperspirants (Statistica, 2020). Aluminum is commonly used as an active ingredient in antiperspirants because of its ability to reduce sweating. Some media messages have suggested that antiperspirants with aluminum might be associated with Alzheimer's disease and breast cancer, even though over-

the-counter antiperspirants with aluminum are generally recognized as safe (National Cancer Institute, 2016). Since breast cancer is much more common among women (Centers for Disease Control and Prevention, 2020), the current study only focused on women. Study procedures were approved by the authors' Institutional Review Board.

Message Development

Four contradictory messages were created using information from the internet. Two messages were about the proven safety of antiperspirants with aluminum (article A: *Relax! Aluminum in Underarm Antiperspirants is Safe* and article B: *The Reassuring Truth about Antiperspirants and Your Health*), and two messages were about potential negative health effects of antiperspirants with aluminum (article C: *Ditch Those Deadly Antiperspirant Products* and article D: *A Dire Warning about the Dangers of Antiperspirants*). Two control messages were also created about a topic unrelated to antiperspirants (article E: *Who was William Shakespeare?* And article F: *William Shakespeare: Playwriter Precisely Captured Human Condition*). All messages had about 240 words and a Flesh-Kincaid Grade Level of 10-11.

Message Pretesting

We pretested the four experimental messages (articles A, B, C, and D) to ensure similar levels of perceived credibility and perceived persuasiveness. In February 2021, $N=98$ women (75% white, and M=44.33 years, SD=13.19) recruited through Amazon Mechanical Turk (MTurk) provided complete responses to the four messages via an online questionnaire hosted in Qualtrics. Perceived message credibility rating scales (*accurate, believable, factual,* and *trustworthy*) were adapted from Appelman & Sundar (2016) (α=.81). Participants also indicated how *persuasive* and *compelling* they thought the messages were for a typical person (r=.89). Ratings were made on 7-point bipolar scales. In a repeated measures one-way ANOVA, no

significant differences were found in perceptions of credibility and persuasiveness across the four messages ($p<.05$ criterion).

Procedures

In April 2021, women recruited through MTurk were randomly assigned to one of three message conditions in an online experiment hosted in Qualtrics: contradictory messages, non-contradictory messages, or control condition. We created the contradictory and non-contradictory conditions by pairing the four experimental messages; we did so to ensure that each article appeared the same number of times in the contradictory (AC / AD / BC / BD) and in the non-contradictory (AB / CD) conditions. The control condition was created with the two control messages about William Shakespeare (EF). In all three conditions, the order of the two messages was randomized. The message counterbalancing strategy is outlined in Table 4.1.

Participants in the contradictory and non-contradictory conditions first completed measures of health self-efficacy. Next, they read two articles presented separately, in a randomized order, and answered questions to measure the remaining study variables. Participants in the control condition read two articles about William Shakespeare presented separately, in a randomized order. Next, they completed measures of issue and decision uncertainty to provide the baseline levels for both variables in that sample (other study variables were not measured in the control condition because they assessed evaluations of the messages about antiperspirants to which these participants were not exposed). Participants from all conditions concluded the questionnaire by providing standard demographic information.

Measures

Measures were Likert-type scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), unless otherwise noted. Table 4.1 contains descriptive statistics for each measure.

Attention Check. From a list of eight statements related to the articles, participants indicated which statements were true or false. The purpose of this measure was to exclude disingenuous participants who identified 50% or less of the correct statements.

Health Self-Efficacy. Four items were adapted from Lee et al. (2008) (e.g., *I feel that I am in control of my health*).

Perceived Contradiction. Participants indicated the extent to which the articles were *contradictory*, *inconsistent*, and *incompatible*, using a scale adapted from Chang (2015).

Issue Uncertainty. Four items adapted from Mishel (1981) were used to measure participants' perceived lack of knowledge about the health effects of antiperspirants with aluminum (e.g., *I have a lot of questions without answers*).

Decision Uncertainty. Respondents were asked to reflect on whether they should use antiperspirants with aluminum, or not (e.g., *I am unsure what to do*) with three items taken from O'Connor (1995).

Negative Appraisals. Participants evaluated the potential health outcomes of using antiperspirants with aluminum (e.g., *I am concerned that using this product could cause harm to my overall health*). The three items were adapted from Ahmad (2005).

Threat Emotions. The extent to which participants experienced *worry*, *fear*, and *anxiety* when thinking about the health outcomes of using antiperspirants with aluminum was measured on scales ranging from 1 (not at all) to 7 (very much). These three items were taken from Folkman & Lazarus (1985).

Outcome Expectations. Respondents reflected on how their knowledge would change if they searched for more information about antiperspirants with aluminum (e.g., *I would be more knowledgeable*) using four 7-point bipolar scales taken from (Zimbres et al., in press).

Information-Seeking Intentions. Intentions to search for additional information about antiperspirants with aluminum were assessed with four items adapted from Liu et al. (2005). (e.g., *I will use the Internet to learn more information about this topic*).

Data Analysis

Confirmatory factor analysis (CFA) was used to assess the measurement model (StataCorp, 2017) and structural equation modeling (SEM) was used for hypotheses testing. The reference group for the effects of contradictory information was the non-contradictory condition (the control condition only provided baseline levels of issue and decision uncertainty and, therefore, was not included in the analysis). Following Hu and Bentler (1999) criteria, model fit was considered "good" (RMSEA≤.06, CFI≥.95, SRMR≤.08) or "acceptable" (RMSEA≤.08, CFI≥.90, SRMR≤.08). χ^2 was not considered given its sample size sensitivity (Schermelleh-Engel et al., 2003). In a subsidiary analysis, we compared the relative fit of the CHIP model and UMT from which was derived. The models were compared qualitatively based on fit measures (C. J. Lee et al., 2019) because there is no test of statistical significance to compare non-hierarchical models (Kline, 2016; Seaman & Weber, 2015). Moderator hypotheses were tested using hierarchical multiple regression because these hypotheses concerned only the interactions on the relation between two variables and no statistical program can currently handle simultaneous interactions between multiple latent variables in SEM.

Results

Preliminary Analyses

Sample Characteristics. Complete data from 551 participants were obtained. Ten participants in the control and 37 participants in the experimental conditions were excluded for finishing the questionnaire in less than 235 and 335 seconds, respectively; pilot testing indicated

these are the minimum amount of time needed for a fast reader to attentively complete the questionnaire). Next, 26 participants who scored ≤50% in the attention test were excluded from the survey. The final sample consisted of 478 women, primarily white (78%), with a mean age of 45.6 years (*SD*=13.38) (Table 4.2).

Randomization Check. There were no differences across the experimental and control conditions for the demographic and moderator variables ($p>.05$ for all), indicating that randomization produced equivalent groups.

Reliabilities. Cronbach's alphas indicated high internal consistencies for the study variables: perceived contradiction ($\alpha=.99$), issue uncertainty ($\alpha=.90$), decision uncertainty ($\alpha=.95$), negative appraisal ($\alpha=.95$), threat emotion ($\alpha=.97$), information-seeking intentions ($\alpha=.85$), health self-efficacy ($\alpha=.97$), cognitive outcome expectation ($\alpha=.93$). Means and standard deviations are reported in Table 4.3.

Levels of uncertainty. As shown in Table 4.3, and consistent with expectations, both issue and decision uncertainty were highest for respondents who read contradictory articles about aluminum in deodorants or who were given no information at all (the control respondents). In contrast, participants who read two consistent articles on the topic reported levels of issue and decision uncertainty that were significantly lower than those in the contradictory and control message conditions.

Model Fit

All latent variables were allowed to correlate in the CFA analysis. Recall that data from only the two experimental conditions were included ($n=311$) because control group participants were assessed only on the two uncertainty measures. The initial model provided a good fit to the

data: RMSEA=.05, CFI=.98, SRMR=.04. Scale items and results are reported in Table 4.4. The data fit the structural model well: $\chi^2(183)=346.78$, $p<.001$, RMSEA=.05, CFI=.98, SRMR=.06.

Model Comparison

As reported in Table 4.5, the fit measures CFI, TLI, RMSEA, SRMR, χ^2/df, and AIC were used for model comparison. For each of these measures, each model's rank position is indicated. The model with the lowest overall mean rank is the best-fitting model (Eveland et al., 2005; C. J. Lee et al., 2019). UMT also fits the data well but, among the two models, CHIP was best supported by the data. The SEM technique "cannot statistically determine the 'best' model from a group of variables, but only whether a given model is reasonably supported by the data" (Seaman & Weber, 2015, p. 210). Both models received validation.

Hypothesized Direct Effects

Table 4.6 reports the analysis of direct and indirect effects for the structural model. H1 was supported, as contradictory health messages generated perceptions of contradiction. In support of H2, perceptions of contradiction were positively related to issue uncertainty. H3 was also supported, as issue uncertainty was positively related to decision uncertainty. Issue uncertainty was also positively related to negative appraisals, in support of H4a. H4b was not supported, however, as decision uncertainty was not significantly related to negative appraisals. H5 was supported, as appraisals were positively related to threat emotions. In support of H6, threat emotions were positively related to information-seeking intentions.

Indirect Effects

Message contradiction had a positive, indirect effect on issue uncertainty that was mediated by perceived contradiction (Table 4.6). Perceived contradiction had positive, indirect effects on decision uncertainty and on negative appraisals that were mediated by issue

uncertainty. Issue uncertainty also had a positive, indirect effect on threat emotions that was mediated by negative appraisals. Negative appraisals had a positive, indirect effect on information-seeking intentions that were mediated by threat emotions.

Hypothesized Moderation Effects

H8 was not supported. Threat emotions and health self-efficacy accounted for a significant amount of variance in information-seeking intentions R^2=.25, F(2, 308)=50.73, p<.001. Their interaction, however, did not account for a significant proportion of additional variance in information seeking intentions ΔR^2=.002, ΔF(1, 307)=.620, p=.432, b=-.021.

H9 was not supported. Threat emotions and outcome expectations accounted for a significant amount of variance in information-seeking intentions R^2=.27, F(2, 308)=57.48, p<.001. Their interaction, however, did not account for a significant proportion of additional variance in information seeking intentions ΔR^2=.003, ΔF(1, 307)=1.244, p=.266, b=-.032.

Discussion

The purpose of this study was to investigate how individuals process contradictory information about a consumer health product, and their intentions to manage the resulting uncertainty through information seeking, in a domain not previously examined – consumer health product claims. As with one earlier test that was conducted in the nutrition realm (Zimbres et al., in press), results suggest that perception of contradiction mediates the effect of objective message contradiction on issue uncertainty. Issue uncertainty, in turn, prompts negative appraisals and decision uncertainty. Further, issue uncertainty fosters information-seeking intentions through the mediation of negative appraisals and threat emotions. In the present study, however, decision uncertainty did not affect information-seeking intentions, which evidences the complexity of uncertainty management strategies might vary across different health issues.

The present study supports the importance of distinguishing between the objective presence of contradiction in messages and the perception of contradiction by showing the significant mediation effect of contradiction perception (Zimbres et al., in press). The distinction allows for the empirical test of the effects of conceptual typologies of contradictory health information that have not been systematically validated. For example, in the present study, we tested a specific type of contradictory message deduced from the typology advanced by Carpenter et al. (2016): two synchronous and seemingly believable sources of information presenting logically inconsistent health propositions. This form of contradiction is perhaps the most blatant exemplar of contradictory health information and is thus likely to lead to strong perceptions of contradiction. It is not, however, the only type present in the media environment. Other types of contradiction need to be investigated because different forms of message contradiction are likely to have different cognitive, emotional, and behavioral implications (Hamilton et al., 2013).

In support of the CHIP Model predictions, issue uncertainty and decision uncertainty were once again shown to be distinct constructs (Zimbres et al., in press), with issue uncertainty being the precursor to decision uncertainty (O'Connor, 1995; O'Connor et al., 1998; Zimbres et al., in press). The present study suggests, however, that issue uncertainty and decision uncertainty can lead to distinct outcomes. Previously, in the nutrition realm, both issue and decision uncertainty prompted negative appraisals and emotions, which in turn fostered information-seeking intentions (Zimbres et al., in press). In the present study, however, only issue uncertainty led to these effects.

A potential explanation for these distinct findings might be related to the different health issues considered in these studies. In the present study, the safety of antiperspirants could be a

topic unfamiliar to most people, leading research participants to focus more on controversies surrounding the issue than on their personal consumer behavior. Furthermore, antiperspirants are essential hygiene products that few Americans feel they could go without. Thus, it seems plausible that before deciding if they should discontinue their use of these products (i.e., reducing decision uncertainty), individuals sought to become more knowledgeable about the issue (i.e., reducing issue uncertainty). Future studies should explicate how topic familiarity and other issue characteristics affect the relative impact of issue and decision uncertainty on information seeking motivations. Such studies could inform health communication practitioners' decisions regarding the type of information to provide in order to assist people in their management of uncertainty and reduction of fear, worry, and anxiety (S. Y. Lee & Hawkins, 2016; Lu et al., 2021; Yang & Kahlor, 2013). Our results provide preliminary evidence that for low-familiar topics, public health messages that educate on the topic may be more beneficial and needed before providing decision aids.

As with our earlier testing of the CHIP model in the nutrition realm, the CHIP model proved superior to UMT on most measures of model fit. We thus provide additional evidence that the CHIP model is a valid extended framework of UMT, being especially useful when perceptions of contradiction and/or decision uncertainty are of interest. That said, both models fit the data well, allowing researchers to select the model that best aligns with their research purposes.

Unexpectedly, neither health self-efficacy nor outcome expectations moderated the relationship of threat emotions with information-seeking intentions. These results are at odds with previous CHIP Model research, in which both variables were found to be significant moderators (Zimbres et al., in press). Given that the main difference between Study 2 and Study

3 pertained to the health issues studied, we attribute these findings to differences in topic familiarity. As explained above, the safety of antiperspirants is likely a topic unfamiliar to most people. Further, assuming the majority of users would not quickly change their purchase choices upon reading the messages, the influence of one's self-efficacy on such choices may be small in this context.

In regard to the lack of moderation of outcome expectations, the measurement used assessed expectations of how new information could help reduce both issue uncertainty and decision uncertainty. If individuals did focus more on the contradictions surrounding the issue than on their own antiperspirant use, the importance of expectations about reducing decision uncertainty through new information might have been minimized. Future studies should consider disentangling the role of expectations regarding issue uncertainty from decision uncertainty reduction.

Our findings have limitations that can serve as an opportunity for future research. First, the model was tested with a single health issue, and only for women. Second, we used a convenience sample of participants who selected themselves into the study based on some information about what the experiment would focus upon. Third, we did not investigate actual information-seeking behavior and its results in reducing uncertainty and negative emotions. Finally, we only tested a specific type of contradictory message (two synchronous and seemingly believable sources of contradictory information).

Overall, this study provides a additional verification of the core predictions of the CHIP Model: perceptions of contradiction give rise to issue uncertainty, which in turn prompts negative appraisals and threat emotions that motivate information seeking to manage that uncertainty (Zimbres et al., in press). This study also showed that participants exposed to

contradictory messages on a health issue felt as ignorant and undecided as individuals uninformed about that issue. This suggests that receiving more information with contradictory claims does not benefit people's knowledge or decision-making. It is possible that for other more familiar health topics, contradictory messages may even further damage perceived knowledge and decision efficacy. That said, the processing and effects of contradictory health information remain an understudied topic of critical importance.

References

Ahmad, M. M. (2005). Psychometric evaluation of the cognitive appraisal of health scale with patients with prostate cancer. *Journal of Advanced Nursing*, *49*(1), 78–86.

Appelman, A., & Sundar, S. S. (2016). Measuring message credibility: Construction and validation of an exclusive scale. *Journalism & Mass Communication Quarterly*, *93*(1), 59–79.

Babrow, A. S., Kasch, C. R., & Ford, L. A. (1998). The many meanings of uncertainty in illness: Toward a systematic accounting. *Health Communication*, *10*(1), 1–23.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, *31*(2), 143–164.

Brashers, D. E. (2001). Communication and uncertainty management. *Journal of Communication*, *51*(3), 477–497.

Brashers, D. E. (2007). A theory of communication and uncertainty management. In B. B. Whaley & W. Samter (Eds.), *Explaining communication: Contemporary theories and exemplars* (pp. 223–242).

Brashers, D. E., & Hogan, T. P. (2013). The appraisal and management of uncertainty: Implications for information-retrieval systems. *Information Processing & Management*, *49*(6), 1241–1249.

Carpenter, D. M., Geryk, L. L., Chen, A. T., Nagler, R. H., Dieckmann, N. F., & Han, P. K. J. (2016). Conflicting health information: A critical research need. *Health Expectations*, *19*(6), 1173–1182.

Centers for Disease Control and Prevention. (2020, June 8). *Breast cancer statists*. Breast. https://www.cdc.gov/cancer/breast/statistics/index.htm

Chang, C. (2015). Motivated processing: How people perceive news covering novel or contradictory health research findings. *Science Communication*, *37*(5), 602–634.

Chasiotis, A., Wedderhoff, O., Rosman, T., & Mayer, A.-K. (2020). Why do we want health information? The goals associated with health information seeking (GAINS) questionnaire. *Psychology & Health*, *35*(3), 255–274.

Clark, D., Nagler, R. H., & Niederdeppe, J. (2019). Confusion and nutritional backlash from news media exposure to contradictory information about carbohydrates and dietary fats. *Public Health Nutrition*, *22*(18), 3336–3348.

Eveland, W. P., Hayes, A. F., Shah, D. V., & Kwak, N. (2005). Understanding the relationship between communication and political knowledge: A model comparison approach using panel data. *Political Communication*, *22*(4), 423–446.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, *48*(1), 150–170.

Frijda, N. H., Kuipers, P., & Ter Schure, E. (1989). Relations among emotion, appraisal, and emotional action readiness. *Journal of Personality and Social Psychology*, *57*(2), 212–228.

Hamilton, J. G., Hutson, S. P., Moser, R. P., Kobrin, S. C., Frohnmayer, A. E., Alter, B. P., & Han, P. K. J. (2013). Sources of uncertainty and their association with medical decision making: Exploring mechanisms in Fanconi anemia. *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine*, *46*(2), 204–216.

Han, P. K. J., Babrow, A., Hillen, M. A., Gulbrandsen, P., Smets, E. M., & Ofstad, E. H. (2019). Uncertainty in health care: Towards a more systematic program of research. *Patient Education and Counseling*, *102*(10), 1756–1766.

Han, P. K. J., Moser, R. P., Klein, W. M. P., Beckjord, E. B., Dunlavy, A. C., & Hesse, B. W. (2009). Predictors of perceived ambiguity about cancer prevention recommendations: Sociodemographic factors and mass nedia exposures. *Health Communication*, *24*(8), 764–772.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55.

Jensen, J. D., & Hurley, R. J. (2012). Conflicting stories about public scientific controversies: Effects of news convergence and divergence on scientists' credibility. *Public Understanding of Science*, *21*(6), 689–704.

Kline, R. B. (2016). *Principles and practice of structural equation modeling*. The Guilford Press.

Lazarus, R. S., & Folkman, S. (1987). Transactional theory and research on emotions and coping. *European Journal of Personality*, *1*(3), 141–169.

Lee, C. J., Kim, K., & Kang, B.-A. (2019). A moderated mediation model of the relationship between media, social capital, and cancer knowledge. *Health Communication*, *34*(6), 577–588.

Lee, S. Y., & Hawkins, R. P. (2016). Worry as an uncertainty-associated emotion: Exploring the role of worry in health information seeking. *Health Communication*, *31*(8), 926–933.

Lee, S. Y., Hwang, H., Hawkins, R., & Pingree, S. (2008). Interplay of negative emotion and health self-efficacy on the use of health information and its outcomes. *Communication Research*, *35*(3), 358–381.

Liu, Y., Doucette, W. R., Farris, K. B., & Nayakankuppam, D. (2005). Drug information–seeking intention and behavior after exposure to direct-to-consumer advertisement of prescription drugs. *Research in Social and Administrative Pharmacy*, *1*(2), 251–269.

Lu, L., Liu, J., & Yuan, Y. C. (2021). Cultural differences in cancer information acquisition: Cancer risk perceptions, fatalistic beliefs, and worry as predictors of cancer information seeking and avoidance in the US and China. *Health Communication*, 1–10.

Mishel, M. H. (1981). The measurement of uncertainty in illness. *Nursing Research*, *30*(5), 258–263.

Mishel, M. H. (1988). Uncertainty in illness. *Journal of Nursing Scholarship*, *20*(4), 225–232.

Mishel, M. H. (1990). Reconceptualization of the uncertainty in illness theory. *Journal of Nursing Scholarship*, *22*(4), 256–262.

Moors, A., Ellsworth, P. C., Scherer, K. R., & Frijda, N. H. (2013). Appraisal theories of emotion: State of the art and future development. *Emotion Review*, *5*(2), 119–124.

Nabi, R. L. (1999). A cognitive-functional model for the effects of discrete negative emotions on information processing, attitude change, and recall. *Communication Theory*, *9*(3), 292–320.

Nagler, R. H. (2014). Adverse outcomes associated with media exposure to contradictory nutrition messages. *Journal of Health Communication*, *19*(1), 24–40.

National Cancer Institute. (2016, August 9). *Antiperspirants/deodorants and breast cancer*.

O'Connor, A. M. (1995). Validation of a decisional conflict scale. *Medical Decision Making*, *15*(1), 25–30.

O'Connor, A. M., Tugwell, P., Wells, G. A., Elmslie, T., Jolly, E., Hollingworth, G., McPherson, R., Bunn, H., Graham, I., & Drake, E. (1998). A decision aid for women considering hormone therapy after menopause: Decision support framework and evaluation. *Patient Education and Counseling*, *33*(3), 267–279.

O'Keefe, D. J. (2003). Message properties, mediating states, and manipulation checks: Claims, evidence, and data analysis in experimental persuasive message effects research. *Communication Theory*, *13*(3), 251–274.

Rains, S. A., & Tukachinsky, R. (2015). An examination of the relationships among uncertainty, appraisal, and information-seeking behavior proposed in uncertainty management theory. *Health Communication*, *30*(4), 339–349.

Rimal, R. N., & Real, K. (2003). Perceived risk and efficacy beliefs as motivators of change: Use of the risk perception attitude (RPA) framework to understand health behaviors. *Human Communication Research*, *29*(3), 370–399.

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of fit measures. *Methods of Psychological Research*, *8*(2), 23–74.

Seaman, C. S., & Weber, R. (2015). Undisclosed flexibility in computing and reporting structural equation models in communication science. *Communication Methods and Measures*, *9*(4), 208–232.

Smith, C. A., & Lazarus, R. S. (1990). Emotion and adaptation. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research* (pp. 609–637).

So, J., Kuang, K., & Cho, H. (2016). Reexamining fear appeal models from cognitive appraisal theory and functional emotion theory perspectives. *Communication Monographs*, *83*(1), 120–144.

StataCorp. (2017). *Stata statistical software: Release 15* (Version 15) [Computer software].

Statistica. (2020, November 13). *U.S. population: Usage of deodorants/anti-perspirants from 2011 to 2024*. https://www.statista.com/statistics/285880/usage-of-deodorants-anti-perspirants-in-the-us-trend/

Wang, X., Shi, J., & Kong, H. (2020). Online health information seeking: A review and meta-analysis. *Health Communication*, 1–13.

Yang, Z. J., & Kahlor, L. (2013). What, me worry? The role of affect in information seeking and avoidance. *Science Communication*, *35*(2), 189–212.

Zhuang, J., & Guan, M. (2021). Modeling the Mediating and Moderating Roles of Risk Perceptions, Efficacy, Desired Uncertainty, and Worry in Information Seeking-Cancer Screening Relationship Using HINTS 2017 Data. *Health Communication*, 1–12.

Zimbres, T. M., Bell, R. A., Jingwen, Z., & Miller, L. M. S. (in press). When media health stories conflict: Test of the Contradictory Health Information Processing (CHIP) Model. *Journal of Health Communication*.

Table 4.1
Experimental Design

	Messages Presented					
	Antiperspirants with Aluminum Positive Articles		Antiperspirants with Aluminum Negative Articles		William Shakespeare Biography Articles	
Conditions	A	B	C	D	E	F
Contradictory						
Group 1	✔		✔			
Group 2	✔			✔		
Group 3		✔	✔			
Group 4		✔		✔		
Non-contradictory						
Group 5	✔	✔				
Group 6			✔	✔		
Control						
Group 7					✔	✔

Notes. Data from the four contradictory groups were combined to create a single group. Data from the two non-contradictory groups were also combined to create a single group. Article A: "Relax! Aluminum in Underarm Antiperspirant is Safe", article B: "The Reassuring Truth about Antiperspirant and your Health", article C: "Ditch Those Deadly Antiperspirant Products", article D: "A Dire Warning about the Dangers of Antiperspirants", article E: "Who was William Shakespeare?", article F: "William Shakespeare: Playwriter Precisely Captured Human Condition".

Table 4.2
Sample Characteristics (N=478 women)

Characteristics	Frequency	Percent
White race	373	78
Age, mean (SD)	45.6 (13.4)	-
Married or living as married	274	57.3
Education		
No H.S. diploma	3	.6
H.S. diploma or GED	117	24.5
Associate's degree	86	18
Bachelor's degree	193	40.4
Professional or graduate degree	79	16.5
Household income		
<$20,000	39	8.2
$20,000 - $39,999	93	19.5
$40,000 - $59,999	111	23.3
$60,000 – 79,999	82	17.2
$80,000 - $99,999	63	13.2
≥$100,000	82	17.2
Declined to answer	8	1.7

Table 4.3
Means and Standard Deviations by Experimental Condition

	Contradictory Messages (*n*=159)		Non-contradictory Messages (*n*=152)		Control Messages (*n*=167)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
Processing Variables						
Perceived Contradiction	6.34[a]	1.06	1.88[a]	1.28	-	-
Issue Uncertainty	5.00[a]	1.64	3.52[a]	1.55	4.98[b]	1.42
Decision Uncertainty	4.43[a]	1.99	2.85[a]	1.80	4.19[b]	1.86
Negative Appraisals	4.56[a]	1.64	4.0[a]	2.17	-	-
Threat Emotions	3.61[a]	1.80	3.19[a]	1.98	-	-
Information-Seeking Intentions	4.18	1.66	4.16	1.73	-	-
Moderator Variables						
Health Self-Efficacy	5.43	1.64	5.62	1.51	-	-
Cognitive Outcome	5.33	1.31	5.62	1.35	-	-

Notes. Means within rows with the same superscript are significantly different, according to post hoc comparisons using Tukey HSD test ($p \leq .05$ criterion).

Table 4.4
Maximum Likelihood Estimates for a 6-Factor Solution for Model Variables (N=311)

Measure/Items	Unst. Coef.	SE	Stand. Coef.	M	SD
PERCEIVED CONTRADICTION[a]					
The information about the health outcomes of AA was contradictory…	1.0[b]	-	.99	4.16	2.60
The information about the health outcomes of AA was inconsistent...	0.98	.014	.99	4.11	2.55
There were incompatible claims about the health outcomes of AA…	0.95	.017	.97	4.20	2.52
ISSUE UNCERTAINTY[a]					
When it comes to the health outcomes of using AA…					
I know very little.	1.0 [b]	-	.85	4.28	1.87
I have a lot of questions without answers.	1.06	.056	.85	4.22	1.99
It is unclear to me how harmful using it would be.	1.17	.057	.90	4.05	2.10
I am not very confident that I know all of the most important health effects.	.98	.056	.80	4.53	1.94
DECISION UNCERTAINTY[a]					
Think about whether you should use AA, or not…					
This decision is difficult for me to make.	1.0 [b]	-	.95	3.58	2.10
I am unsure what to do.	1.02	.027	.96	3.65	2.12
It is not clear what choice is best for me.	1.0	.033	.91	3.75	2.19
NEGATIVE APPRAISAL[a]					
When it comes to the health outcomes of using AA...					
I am concerned that using this product could cause harm to my overall health.	1.0 [b]	-	.90	4.51	2.08
I have a lot to lose if I use this product.	0.99	.035	.94	4.14	1.97

Measure/Items	Unst. Coef.	SE	Stand. Coef.	M	SD
Use of AA would put my breast health at risk.	1.03	.035	.96	4.21	2.01
THREAT EMOTIONS[a]					
When you think about the health outcomes of using AA, to what extent do you experience the following emotions?					
Worry	1.0 [b]	-	.94	3.55	2.00
Fear	1.01	.026	.97	3.27	1.95
Anxiety	.98	.028	.95	3.40	1.94
INFORMATION-SEEKING INTENTIONS[a]					
I will use the Internet to learn more information about this topic.	1.0 [b]	-	.72	5.01	1.94
I will talk with my doctor or another healthcare provider to learn more…	1.23	.097	.80	4.15	2.14
I will talk with family or friends to learn more about this topic.	1.15	.096	.77	3.62	2.08
I will turn to books, articles, or another printed material to learn more…	1.09	.090	.76	3.89	1.99

Notes. Analysis excludes control subjects, to whom the message evaluation scales were not presented. AA, antiperspirants with aluminum; Unst. Coef., unstandardized coefficient; St. Coef., standardized coefficient; SE, standard error of estimate.

[a] Item responses were made on 7-point Likert scales. Negative emotions ranged from 1 (*not at all*) to 7 (*very much*) and all other measures ranged from 1 (*strongly disagree*) to 7 (*strongly agree*).

[b] Not tested for statistical significance. All other unstandardized estimates are statistically significant at $p \leq .001$.

Table 4.5
Fit Measures for the CHIP Model and the UMT Model (rank in parentheses)

Models	CFI	TLI	RMSEA (90% C.I.)	SRMR	χ^2 /df	AIC	Mean Rank**
CHIP Model	.978 (1)	.975 (1)	.054(.045, .062) (1)	.061 (2)	1.895 (1)	20062.046 (2)	1.33
UMT Model	.973 (2)	.967 (2)	.064(.052, .076) (2)	.059 (1)	2.257 (2)	15011.444 (1)	1.67
Best Model*	CHIP	CHIP	CHIP	UMT	CHIP	UMT	CHIP

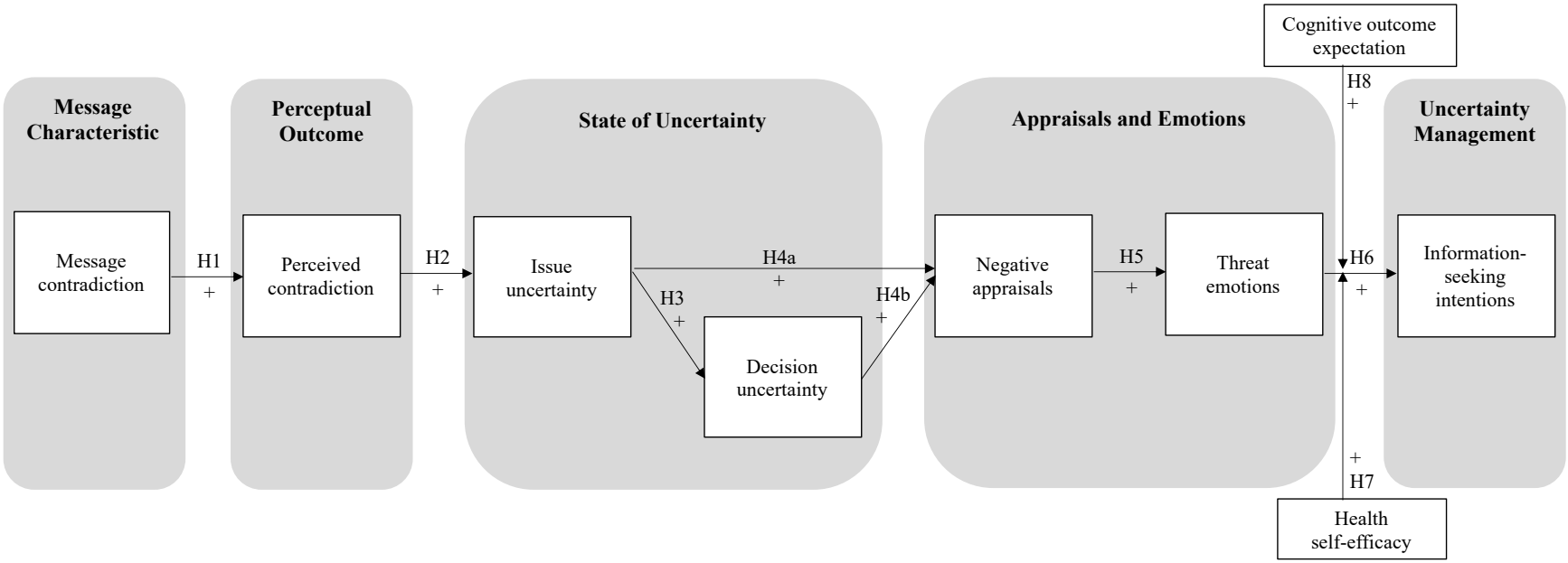
Notes. UMT Model=Message contradiction → issue uncertainty → negative appraisals → threat emotions → information-seeking intention.
CFI=Comparative Fit Index; TLI=Tucker-Lewis Index; RMSEA=Root Mean Square Error of Approximation; SRMR=Standardized Root Mean Square Residual; χ^2/df=Chi-square per degrees of freedom; AIC=Akaike Information Criterion. Model χ^2 and degrees of freedom are: CHIP: $\chi^2(183)=346.781$, $p<.001$; UMT: $\chi^2(87)=196.394$, $p<.001$.
*Best fitting model for the column fit measure.
**Arithmetic mean of the ranks in parentheses.

Table 4.6
Standardized Direct, Indirect, and Total Effects

Outcome	Direct	Indirect	Total
Perceived Contradiction			
Contradictory Messages[a] → Perceived Contradiction	.896***	-	.896***
Issue Uncertainty			
Perceived Contradiction → Issue Uncertainty	.531***	-	.531***
Contradictory Messages[a] → Issue Uncertainty	-	.476***	.476***
Decision Uncertainty			
Issue Uncertainty → Decision Uncertainty	.739***	-	.739***
Perceived Contradiction → Decision Uncertainty	-	.393***	.393***
Contradictory Messages[a] → Decision Uncertainty	-	.352***	.352***
Negative Appraisals			
Decision Uncertainty → Negative Appraisals	.07	-	.07
Issue Uncertainty → Negative Appraisals	.428***	.051	.479***
Perceived Contradiction → Negative Appraisals	-	.255***	.255***
Contradictory Messages[a] → Negative Appraisals	-	.228***	.228***
Threat Emotions			
Negative Appraisals → Threat Emotions	.687***	-	.687***
Decision Uncertainty → Threat Emotions	-	.048	.048
Issue Uncertainty → Threat Emotions	-	.329***	.329***
Perceived Contradiction → Threat Emotions	-	.175***	.175***
Contradictory Messages[a] → Threat Emotions	-	.157***	.157***
Information-Seeking Intentions			
Threat Emotions → Info-Seeking Intentions	.537***	-	.537***
Negative Appraisals → Info-Seeking Intentions	-	.369***	.369***
Decision Uncertainty → Info-Seeking Intentions	-	.026	.026
Issue Uncertainty → Info-Seeking Intentions	-	.177***	.177***
Perceived Contradiction → Info-Seeking Intentions	-	.094***	.094***
Contradictory Messages[a] → Info-Seeking Intentions	-	.084***	.084***

Notes. [a]Reference group is the non-contradictory condition; Info=Information.
* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

Figure 4.1
Contradictory Health Information Processing (CHIP) Model



Source: Zimbres et al. (in press).

Chapter 5. General Discussion

Chapter 5

General Discussion

The objective of this dissertation research was to investigate the nature of individuals' processing of contradictory health information and the effects of this process on their uncertainty levels. The primary outcome of uncertainty examined in this research program was information-seeking intentions. To accomplish this objective, the *Contradictory Health Information Processing (CHIP) Model* was developed and tested across three experiments. The first two experiments were conducted in the domain of contradictory nutrition information about milk and a newly marketed vegan burger. The topic for the third study pertained to the safety of a health consumer product, antiperspirants with aluminum.

Results supported the core predictions of the CHIP Model: perception of contradiction mediates the effect of objective message contradiction on issue uncertainty. Issue uncertainty, in turn, prompts negative appraisals and decision uncertainty. Further, issue uncertainty fosters information-seeking intentions through the mediation of negative appraisals and threat emotions. In addition, the results consistently supported the proposition that issue uncertainty and decision uncertainty are distinct constructs, with issue uncertainty being the precursor to decision uncertainty. Furthermore, this research suggests that the proposed effect of decision uncertainty on information-seeking intentions applies primarily to high-familiarity issues. Several moderators of the model's relationships were tested, but no consistent findings were found, suggesting that their significance may also vary across different health issues.

In this final chapter of this dissertation, these general findings will be discussed for the purpose of outlining an agenda for future research that will build upon this dissertation. A primary goal for future investigation is a more refined explication of the causal propositions that

compose the CHIP model, followed by the creation and testing of strategies to help people process contradictory health information and guide the design of public health information.

This final chapter is organized into three parts. First, a general discussion of the main findings is provided. Second, the main limitations of the dissertation are discussed. Third, a program of research for the future is outlined.

Main Findings

Objective Contradiction and Perceived Contradiction. The initial point of investigation for this dissertation involved the conceptual and operational definition of contradictory health information. Carpenter et al. (2016) formally proposed the first working definition and typology of contradictory health information to guide research in this area. Contradictory health information was defined as "two or more health-related propositions that are logically inconsistent with one another (…) the propositions are discrepant such that a person could not simultaneously engage in or believe both propositions at once" (Carpenter et al., 2016, p. 1175).

This conceptual definition and typology focused on the *objective* existence of contradiction, but the authors highlighted that *perceptions* of contradiction (i.e., the degree of perceived information inconsistency) are better predictors of individuals' responses to contradictory health information (Carpenter et al., 2016; Yoon et al., 2017). Indeed, the three empirical studies comprising this dissertation established that perception of contradiction mediates the effects of objective, experimentally manipulated levels of message contradiction on people's responses to contradictory health information. Furthermore, Study 1 showed that even messages without the objective existence of contradiction – complex messages – can be

perceived as contradictory and, for this reason, can generate similar responses to the ones observed for contradictory health information.

This finding highlights the importance of carefully designing public health information to minimize the risk of perceived contradiction in even unintentional ways – for example, by reducing the complexity of information provided as much as possible. From a theoretical perspective, this program of research also extends the original tenets of Uncertainty Management Theory, UMT (Brashers, 2001, 2007). UMT was the main theory guiding the predictions of the CHIP model, but it does not account for perceptions of contradiction.

Issue Uncertainty and Decision Uncertainty. Messages perceived as contradictory do not contain adequate information for individuals to build proper knowledge structures (Mishel, 1988, 1990). Therefore, when perceptions of contradiction are high and additional information is limited, people are likely to feel uncertain about their state of knowledge (Chang, 2015; Jensen & Hurley, 2012). The CHIP model builds upon past research by differentiating between *issue uncertainty*, which is uncertainty about the health outcomes of a behavior, and *decision uncertainty*, which is uncertainty about what course of action to take. The initial conceptualization of the CHIP model considered these constructs to be independent. However, the results from all three studies indicated that these concepts are related and, more specifically, that issue uncertainty is an important precursor to decision uncertainty, as initially suggested by O'Connor (1995, 1998).

Unique to this dissertation is the finding in Study 3 that issue and decision uncertainty can differentially affect information-seeking intentions, a result attributed to potential differences in topic familiarity and to higher levels of intolerance for uncertainty among women. Study 1 and Study 2 were conducted in the context of nutrition, an area commonly perceived by individuals

as a source of contradiction (Clark et al., 2019). The problem area for Study 3, however, was antiperspirants safety, an issue unlikely to be familiar to most individuals. These initial findings suggest that when topic familiarity is low, participants may focus more on controversies surrounding the issue than on their personal consumer behavior. This may explain why issue uncertainty yielded negative appraisals, while decision uncertainty did not. In addition, although not consistent, some studies find that women tend to score higher on intolerance for issue uncertainty (Strout et al., 2018) and, thus, more focused on the controversies about that issue.

These explanations require further investigation, but if replicated it suggests that for low-familiar issues, public health messages that educate on the topic in question may be more beneficial than messages that seek to shape decisions, especially for women's health issues. From a theoretical perspective, this finding highlights a limitation in the original tenets of UMT (Brashers, 2001, 2007), which did not distinguish between issue uncertainty and decision uncertainty.

Negative Appraisals and Threat Emotions. All three studies consistently indicated that negative appraisals and threat emotions are effects that flow from the experience of uncertainty. Fear, worry, and anxiety were expressions of individuals' appraisals of harm. Negative appraisals and threat emotions were also mediators of the effects of issue uncertainty and decision uncertainty (for high-familiarity topics) on information-seeking intentions. These findings, which are in accordance with both the predictions of UMT (Brashers, 2001, 2007) and appraisal theories of emotions (Folkman & Lazarus, 1985), underscore the importance of distinguishing between cognitive appraisals and emotions. This distinction is particularly important given that across all three studies, threat emotions were the direct motivator of information-seeking intentions.

Information-Seeking Intentions. A core prediction of UMT (Brashers, 2001, 2007) is that individuals engage in information seeking in order to reduce negative uncertainty and alleviate its accompanying threat emotions. All three studies confirmed that information seeking is an uncertainty management strategy that has to potential to bring about positive health outcomes (Yang & Kahlor, 2013). Understanding the management of uncertainty via information search is also of practical importance in helping individuals develop constructive uncertainty management skills that lead to positive health outcomes, and in guiding professionals to optimize the design of information that serves the public's needs (Chasiotis et al., 2020; Zhuang & Guan, 2021).

Moderators on Contradictory Health Information Processing. Based on an extensive literature review, six different moderators of the relations in the CHIP model were tested in Study 2: information overload, need for cognition, intolerance for uncertainty, health self-efficacy, cognitive outcome expectations, and emotional outcome expectations. Because self-efficacy and cognitive outcome expectations were the only significant moderators of the relationship between threat emotions and information-seeking intentions, these two moderators alone were explored in Study 3. However, in the third investigation, health self-efficacy and cognitive outcome expectations did not significantly moderate the relationship between threat emotions and information-seeking intentions.

Given that the main difference between Study 2 and Study 3 pertained to the health issues studied, these findings were also attributed to differences in topic familiarity. The safety of antiperspirants is likely a topic unfamiliar to most people, leading research participants to focus more on the contradictions surrounding the issue than their personal consumer behavior decisions. This focus on the controversies presented would have reduced the relevance of

individuals' beliefs about their health self-efficacy. Similarly, the importance of expectations about reducing decision uncertainty through new information might have been minimized.

The role of these moderators should be further investigated. It is expected that the main predictions of the CHIP model will be confirmed in future studies across other health contexts. Nonetheless, it is important that moderators of the CHIP relations be identified in order to allow for a better understanding of potential nuances in the replication of the model.

Limitations

The studies comprising this dissertation have limitations. First, the three studies used a convenience sample, which limits the generalizability of the findings. Second, in every study, only the simplest type of contradictory health information was investigated (two synchronous and seemingly believable sources of contradiction). Doing so enhanced the internal validity of studies, but may have limited ecological validity. Third, each of the three experiments was limited to the study of one type of health issue. Fourth, actual information-seeking behavior was not investigated. In light of these limitations, future research ideas are discussed next.

A Research Agenda

Characteristics of Contradictory Health Information. Carpenter et al. (2016) offered the first working typology of contradictory health information that classified these messages according to four fundamental dimensions: the specific health issue under conflict, the number of different contradictory sources, the degree of scientific evidence heterogeneity, and the degree of temporal inconsistency (synchronous or asynchronous). To date, there has been no systematic investigation of the public perception of different combinations of these dimensions. Such investigation was also not the purpose of this dissertation.

Across all three studies in this dissertation, only the effects of two synchronous and seemingly believable sources of contradictions were explored. Future research should replicate the validity of the CHIP model across a broader range of health issues, through multiples sources of contradiction, and spread across time (i.e., presenting participants with one single message and a few weeks later presenting another single message that directly contradicts the first one).

As in the three present studies, it is hypothesized that the core predictions of the CHIP model will hold for different combinations of these dimensions. As seen in Study 3, however, there might be nuances in some cognitive responses to different types of contradictory health information, such as the role of issue uncertainty and decision uncertainty. The idea that different sources of uncertainty likely yield different cognitive, emotional, and behavioral outcomes has already been considered theoretically (Carpenter et al., 2016; Han et al., 2011, 2019). Hamilton et al., (2013) showed that different sources of uncertainty have distinct effects on treatment decisions, and that contradictory expert opinions were associated with greater decision-making difficulty. This dissertation offers additional evidence of these distinct outcomes and highlights research that is needed in the topics below.

Health issues. In accordance with the theoretical expectations that contradiction about different health issues can yield different outcomes (Carpenter et al., 2016), a recent meta-analysis reviewed how the focal health topic can influence the type and strength of various predictors of information seeking (Wang et al., 2020). The defining characteristics of those health issues were not investigated, however. One such characteristic is message recipients' familiarity with a topic.

Building upon Study 3, an experiment could clarify how topic familiarity influences the differential effects of issue and decision uncertainty on information seeking. For example,

individuals could be randomized to read contradictory messages about a high-familiar topic *or* a low-familiar topic, and then assess CHIP model variables. A novel issue, or even a totally made-up issue, could assure low-familiarity (and no strong prior opinions), allowing for greater internal control for the purpose of model testing. Alternatively, one could simply recruit individuals with different levels of familiarity about a single health issue, and explore differences in response between those with high vs low familiarity. Doing so, however, would require efforts to control for differences between the individuals in the two familiarity groups.

As a final question in the study, instead of offering participants the choice of voluntarily reading additional articles, participants would be required to choose if they wished to read an article with additional information or receive a decision-aid. Presumably, participants in the low familiarity condition will show stronger preferences for informative materials. After reading the informative material, levels of issue and decision uncertainty would be measured again to check the effectiveness of that uncertainty management strategy.

Number of sources. Negative reactions are thought to increase as the number of contradictory sources increase (Carpenter et al., 2016). This assumption is aligned with persuasive studies on source magnification, which indicate that individuals are more likely to be persuaded after exposure to unique arguments from multiple sources (perceived as independent from one another) rather than from a single source, especially for strong arguments (Moore et al., 1994; Moore & Reardon, 1987). Thus, an experiment similar to Study 2 can verify this assumption by adding another experimental condition with more pairs of contradictory messages about the Impossible Burger (from different sources). Presumably, the condition with a higher number of contradictory sources should generate greater levels for all variables, including greater information-seeking intentions. In all three studies, information-seeking intentions were not

significantly different across conditions but increasing the number of sources could lead to relevant differences in those intentions, allowing for a better understanding of the instances in which individuals might seek information.

Other Message Factors. The future studies outlined above take into consideration the dimensions of the typology of contradictory health messages advanced by Carpenter et al. (2016). Other areas of research might also offer new and important insights to the effects of these messages and to the validity of the CHIP model, especially persuasion studies. Persuasion research on emotional message appeals is especially pertinent. The contradictory health messages used in the three empirical studies of this dissertation were written in a more objective and neutral tone to avoid introducing potential confounds into the study designs. Future research should investigate the effects of contradictory health messages with such appeals to test the generalizeability of the CHIP model. For example, researchers might investigate the extent to which the predictions of the model hold true under high uncertainty and exacerbated threat emotions that might follow from exposure to fear-arousing contradictory health messages. In this context, the Extended Parallel Process Model, EPPM (Witte, 1994) – frequently used in persuasive studies – might offer insights to the predictions regarding protective uncertainty management strategies (such as information seeking) versus defensive uncertainty management strategies (such as information avoidance). One might also consider the possibility that fear arousal itself (and other distractions) can alter information-processing style, or even deter information processing altogether (see Nabi, 1999) and, thus, result in reduced perceptions of contradiction and/or low uncertainty.

In addition, the CHIP model was developed and tested with the intention to understand the effects of objective health contradiction, mostly the ones originated from contradictory

scientific findings. The model, however, might also explicate the processing and effects of other types of contradictory messages, such as misinformation. Misinformation refers to false or inaccurate propositions, created with the intention to deceive (Carpenter & Han, 2020). Although a single false proposition cannot be classified as contradictory (Carpenter & Han, 2020), two or more false (or inaccurate) propositions that directly contradict one another do contain objective contradiction. The CHIP model thus offers a new framework for advancing these relatively new areas of research.

Individuals Characteristics. In addition to health self-efficacy and cognitive outcome expectations, other individual characteristics should be explored, such as prior attitudes toward the health issue under study. A major factor influencing the health issues selected in this dissertation was the lack of strong prior attitudes toward the topics investigated. When this happens, nuances in the processing of contradictory health information are likely observed, such as heighten threat emotions and biased information-seeking that reinforces the initial attitudes (Fischer, 2011).

Dysfunctional methods of uncertainty management can lead to poor health decisions, such as information avoiding (Brashers & Hogan, 2013) or selectively crediting and dismissing information to confirm one's prior beliefs, often leading to polarization (Nan & Daily, 2015). Dismissal of the belief-inconsistent information usually occurs through the evaluation of the belief-inconsistent information as having lower quality and lower source credibility, when compared to belief-consistent information of the same quality. Dismissing belief-inconsistent information thus leads to biased assimilation, usually more pronounced when there is stronger emotions toward the issue (Greitemeyer, Fischer, Frey, & Schulz-Hardt, 2009; Lord, Ross, & Lepper, 1979). For example, Nan and Daily (2015) found that individuals who believe that

vaccines are ineffective reduced their perceptions of vaccine efficacy even more after reading contradictory messages about HPV immunization, reinforcing their prior beliefs, and suggesting dismissal of the belief-inconsistent information.

A similar experiment to Study 2 can be conducted in the context of COVID-19 vaccination, comparing the reactions from individuals who oppose the vaccination versus individuals who favor vaccination. Further, instead of offering participants the choice of reading additional articles, only the headlines of news messages would be presented, and participants could be required to select the headline of the news article that they were more likely to read. Presumably, participants will be more likely to select belief-consistent headlines. An attitude measurement would follow from this question, likely indicating reinforcement of the initial attitude.

Additional characteristics of health issues that should be further explored are personal experience with the issue and topic relevancy. These characteristics can be easily measured at the end of questionnaires, and their influence in CHIP model relationships could be tested in an exploratory fashion.

Actual Information Seeking

Information generally helps individuals to make sense of an issue and, by purposefully looking for additional information, and attenuate uncertainty and its negative emotions (Carcioppolo, Yang, & Yang, 2016; Fung, Griffin, & Dunwoody, 2018; Lipshitz & Strauss, 1997; Rains & Tukachinsky, 2015). Thus, the investigation of information-seeking behaviors allows to confirm the central tenet that information-seeking intention is motivated by uncertainty and threat emotions' reduction (Brashers, 2001, 2007). By measuring levels of issue uncertainty,

decision uncertainty, and threat emotions after an actual information search, researchers can empirically confirm this tenet.

Less clear, however, is the pattern of this information search and the type of information preferred. In study 2, cognitive outcome (but not emotional outcome) expectation moderated this effect, suggesting that rational expectations of finding information that increases knowledge and reduces indecisiveness seemed more motivating to individuals than expectations of finding information that could reduce their emotional discomfort. Somewhat contrary to this explanation, Rains & Tukachinsky (2015) suggested that this information search is likely superficial, in order to locate any information that could reduce threat emotions. Future research should thus investigate if this apparent rationality persists during actual information search.

An alternative to the previous study that was described, consists of a test of the CHIP model using survey data on COVID-19 vaccinations. The survey study would allow a real-world test of the model, with past (actual) information-seeking behaviors being the outcome assessed. The sample could be recruited from an online panel, such as that provided by Centiment (https://www.centiment.co/), who are parents of children under the age of 12, for whom a vaccine will likely be approved in several months. To create heterogeneity in prior attitudes toward childhood vaccination for COVID-19, 50% of the sample could be recruited from among panel participants who self-describe as conservatives and the remaining 50% could consist of self-described liberals; conservatives have been consistently more opposed to COVID-19 vaccination (Cowan et al., 2021). Since self-described conservatives are more likely to rely upon conservative news outlets as their primary news source (Stecula & Pickup, 2021), they are also more likely to encounter information that contradicts official vaccination guidance. Self-described conservatives are thus more likely to report greater perceived contradiction, issue

uncertainty, leading to decision uncertainty. Just as their past information-seeking behaviors likely rely on conservative sources, so will be their future information-seeking intentions.

Conclusion

The CHIP model accurately explicates individuals' processing of contradictory health information, the effects of such information on their experience of uncertainty, and their subsequent management of that uncertainty via information seeking. The model tests conducted for this dissertation show that the effects of contradictory health information originate from an individual's unique perceptions of contradiction of that information, yielding to a state of uncertainty: individuals feel unsure about their knowledge and the health decision that is best for them. Subsequent fear, worry, and anxiety that originate from uncertainty motivate the search for additional information. This information search is usually motivated to reduce issue uncertainty and, for certain health issues, to reduce decision uncertainty.

These findings pave the way for further study that will guide the creation of strategies that can help people process contradictory health information as well as the design of public health information. What are the characteristics of these messages that are highly perceived as contradictory? What are the demographic and psychosocial factors that make certain groups more likely to experience uncertainty? What skills do these groups need to manage uncertainty properly? What is the best way to design messages that challenge established knowledge and beliefs? These are questions that require theory-based answers. The CHIP model offers one potential framework for such queries.

References

Brashers, D. E. (2001). Communication and uncertainty management. *Journal of Communication*, *51*(3), 477–497.

Brashers, D. E. (2007). A theory of communication and uncertainty management. In B. B. Whaley & W. Samter (Eds.), *Explaining communication: Contemporary theories and exemplars* (pp. 223–242).

Brashers, D. E., & Hogan, T. P. (2013). The appraisal and management of uncertainty: Implications for information-retrieval systems. *Information Processing & Management*, *49*(6), 1241–1249.

Carpenter, D. M., Geryk, L. L., Chen, A. T., Nagler, R. H., Dieckmann, N. F., & Han, P. K. J. (2016). Conflicting health information: A critical research need. *Health Expectations*, *19*(6), 1173–1182.

Carpenter, D. M., & Han, P. K. (2020). Conflicting health information. *The Wiley Encyclopedia of Health Psychology*, 47–53.

Chang, C. (2015). Motivated processing: How people perceive news covering novel or contradictory health research findings. *Science Communication*, *37*(5), 602–634.

Chasiotis, A., Wedderhoff, O., Rosman, T., & Mayer, A.-K. (2020). Why do we want health information? The goals associated with health information seeking (GAINS) questionnaire. *Psychology & Health*, *35*(3), 255–274.

Clark, D., Nagler, R. H., & Niederdeppe, J. (2019). Confusion and nutritional backlash from news media exposure to contradictory information about carbohydrates and dietary fats. *Public Health Nutrition*, *22*(18), 3336–3348.

Cowan, S. K., Mark, N., & Reich, J. A. (2021). COVID-19 Vaccine hesitancy is the new terrain for political division among Americans. *Socius*, *7*, 1–3.

Fischer, P. (2011). Selective exposure, decision uncertainty, and cognitive economy: A new theoretical perspective on confirmatory information search. *Social and Personality Psychology Compass*, *5*(10), 751–762.

Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, *48*(1), 150–170.

Hamilton, J. G., Hutson, S. P., Moser, R. P., Kobrin, S. C., Frohnmayer, A. E., Alter, B. P., & Han, P. K. J. (2013). Sources of uncertainty and their association with medical decision making: Exploring mechanisms in Fanconi anemia. *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine*, *46*(2), 204–216.

Han, P. K. J., Babrow, A., Hillen, M. A., Gulbrandsen, P., Smets, E. M., & Ofstad, E. H. (2019). Uncertainty in health care: Towards a more systematic program of research. *Patient Education and Counseling*, *102*(10), 1756–1766.

Han, P. K. J., Klein, W. M., & Arora, N. K. (2011). Varieties of uncertainty in health care: A conceptual taxonomy. *Medical Decision Making*, *31*(6), 828–838.

Jensen, J. D., & Hurley, R. J. (2012). Conflicting stories about public scientific controversies: Effects of news convergence and divergence on scientists' credibility. *Public Understanding of Science*, *21*(6), 689–704.

Mishel, M. H. (1988). Uncertainty in illness. *Journal of Nursing Scholarship*, *20*(4), 225–232.

Mishel, M. H. (1990). Reconceptualization of the uncertainty in illness theory. *Journal of Nursing Scholarship*, *22*(4), 256–262.

Moore, D. J., Mowen, J. C., & Reardon, R. (1994). Multiple sources in advertising appeals: When product endorsers are paid by the advertising sponsor. *Journal of the Academy of Marketing Science*, *22*(3), 234–243.

Moore, D. J., & Reardon, R. (1987). Source Magnification: The Role of Multiple Sources in the Processing of Advertising Appeals. *Journal of Marketing Research*, *24*(4), 412–417.

Nabi, R. L. (1999). A cognitive-functional model for the effects of discrete negative emotions on information processing, attitude change, and recall. *Communication Theory*, *9*(3), 292–320.

Nan, X., & Daily, K. (2015). Biased assimilation and need for closure: Examining the effects of mixed blogs on vaccine-related beliefs. *Journal of Health Communication*, *20*(4), 462–471.

O'Connor, A. M. (1995). Validation of a decisional conflict scale. *Medical Decision Making*, *15*(1), 25–30.

O'Connor, A. M., Tugwell, P., Wells, G. A., Elmslie, T., Jolly, E., Hollingworth, G., McPherson, R., Bunn, H., Graham, I., & Drake, E. (1998). A decision aid for women considering hormone therapy after menopause: Decision support framework and evaluation. *Patient Education and Counseling*, *33*(3), 267–279.

Stecula, D. A., & Pickup, M. (2021). How populism and conservative media fuel conspiracy beliefs about COVID-19 and what it means for COVID-19 behaviors. *Research & Politics*, *8*(1), 1–9.

Strout, T. D., Hillen, M., Gutheil, C., Anderson, E., Hutchinson, R., Ward, H., Kay, H., Mills, G. J., & Han, P. K. J. (2018). Tolerance of uncertainty: A systematic review of health and healthcare-related outcomes. *Patient Education and Counseling*, *101*(9), 1518–1537.

Wang, X., Shi, J., & Kong, H. (2020). Online health information seeking: A review and meta-analysis. *Health Communication*, 1–13.

Witte, K. (1994). Fear control and danger control: A test of the extended parallel process model (EPPM). *Communications Monographs*, *61*(2), 113–134.

Yang, Z. J., & Kahlor, L. (2013). What, me worry? The role of affect in information seeking and avoidance. *Science Communication*, *35*(2), 189–212.

Yoon, H., Sohn, M., Choi, M., & Jung, M. (2017). Conflicting online health information and rational decision making: Implication for cancer survivors. *The Health Care Manager*, *36*(2), 184–191.

Zhuang, J., & Guan, M. (2021). Modeling the mediating and moderating roles of risk perceptions, efficacy, desired uncertainty, and worry in information seeking-cancer screening relationship using HINTS 2017 data. *Health Communication*, 1–12.