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An Examination of the Relationships Among Uncertainty, Appraisal, and Information-Seeking Behavior Proposed in Uncertainty Management Theory

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Uncertainty management theory (UMT; Brashers, 2001, 2007) is rooted in the assumption that, as opposed to being inherently negative, health-related uncertainty is appraised for its meaning. Appraisals influence subsequent behaviors intended to manage uncertainty, such as information seeking. This study explores the connections among uncertainty, appraisal, and information-seeking behavior proposed in UMT. A laboratory study was conducted in which participants ($N = 157$) were primed to feel and desire more or less uncertainty about skin cancer and were given the opportunity to search for skin cancer information using the World Wide Web. The results show that desired uncertainty level predicted appraisal intensity, and appraisal intensity predicted information-seeking depth—although the latter relationship was in the opposite direction of what was expected.

Uncertainty has been widely recognized as an important construct in health and health communication (Babrow, Kasch, & Ford, 1998; Brashers, 2001; Mishel, 1988). Uncertainty management theory (UMT) is one framework that has been offered to explain the process through which individuals encounter, appraise, and cope with health-related uncertainty (Brashers, 2001, 2007; Brashers et al., 2000). UMT is rooted in the assumption that uncertainty is not inherently positive or negative. Individuals appraise uncertainty for meaning, and such appraisals can motivate attempts to manage uncertainty (Brashers, 2001, 2007; Brashers & Hogan, 2013). Although uncertainty management may take many forms (e.g., information avoidance; Barbour, Rintamaki, Ramsey, & Brashers, 2012), one widely documented strategy is information seeking (Hogan & Brashers, 2009). The purpose of the present study is to explore the connections proposed in UMT among uncertainty, appraisal, and information-seeking

behavior. The results of this project offer insights about the uncertainty-appraisal process and, more generally, the relationships among uncertainty, appraisal, and information seeking in UMT.

LITERATURE REVIEW

UMT (Brashers, 2001, 2007), which is informed by Mishel's (1988) theorizing regarding uncertainty, outlines possible sources and appraisals of as well as responses to health-related uncertainty. Uncertainty occurs "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). A distinction is implied in UMT between the level of uncertainty one currently feels (i.e., actual uncertainty) and the level of uncertainty one would prefer or like to feel (i.e., desired uncertainty). Uncertainty involves the recognition of a discrepancy between one's preferred and actual

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information state (Brashers, 2007). A key principle of UMT is that uncertainty may take several different forms and stem from different sources (Brashers & Hogan, 2013; Brashers et al., 2003; Bylund et al., 2012). This project focuses on medical forms of uncertainty involving elements of a condition itself such as the etiology, symptoms, and treatments.

Uncertainty and Appraisal in UMT

UMT is distinguished from related theories such as uncertainty reduction theory (Berger & Calabrese, 1975) in that uncertainty is conceptualized as not being inherently positive or negative. A key assumption of UMT, which is rooted in prior theorizing about stress and appraisal (Lazarus, 1991; Lazarus & Folkman, 1989), is that individuals appraise uncertainty for its meaning. Brashers and colleagues (Brashers et al., 2000, p. 77) note that, "Individuals appraise uncertainty for potential harm or benefit. These appraisals are associated with emotional responses. . . . Appraisals and emotional responses motivate behavioral and psychological actions intended to manage uncertainty."

Although appraisals can take different forms, two distinct appraisals discussed in prior research on UMT include uncertainty as hope or danger (Brashers, 2007; Brashers & Hogan, 2013). In appraising uncertainty as offering hope, individuals may feel optimistic or perceive a positive outcome potentially resulting from uncertainty. Individuals with HIV, for example, may feel encouraged by uncertainty about an experimental drug and its therapeutic benefits (Brashers et al., 2000). In appraising uncertainty as danger, individuals may feel fear or anxiety about the potential outcome of uncertainty. For instance, parents in Dillard and Carson's (2005) study reported worry and anxiety about beginning the testing process for determining whether or not their newborn had cystic fibrosis.

An important factor that determines the nature of an appraisal is the degree to which the event is congruent or incongruent with one's goals (Lazarus, 1991). In the context of health-related uncertainty and UMT, one's goal could be thought of as one's desired level of uncertainty about a particular topic, issue, or situation. Knowing an individual's desired level of uncertainty makes it possible to predict how one will likely appraise experienced uncertainty. For individuals who desire a high level of uncertainty, encountering uncertainty would be goal congruent and should result in a positive appraisal of uncertainty as hope or opportunity. In her discussion of the appraisal process, Mishel (1988) notes that a relatively high level of uncertainty effectively makes possible an opportunity appraisal. She contends that the "vague and amorphous nature of an uncertain situation allows it be reformed by persons into a positive situation" (p. 230). A high level of desired uncertainty should be associated with the appraisal of uncertainty as opportunity. Conversely, desiring a relatively low level of uncertainty in a particular situation generally should be associated with a

negative appraisal of uncertainty as danger. Preferring a low level of uncertainty should signal a concern with the negative consequences of remaining uncertain (Brashers, 2007). Experiencing a high level of uncertainty would be goal incongruent among individuals who desire a low level of uncertainty. This incongruence should result in a negative appraisal experienced as emotions such as fear and anxiety.

Given the preceding argument, it is hypothesized that desired level of uncertainty is associated with uncertainty appraisal intensity. One's desired level of uncertainty reflects one's goal related to uncertainty. Knowing an individual's goal makes it possible to predict how one will appraise uncertainty in a given situation. Individuals who prefer greater levels of uncertainty should view uncertainty as more of an opportunity and report a relatively stronger positive emotional response when they encounter uncertainty. In contrast, individuals who prefer lower levels of uncertainty should appraise uncertainty as more of a danger and report a relatively stronger negative emotional response when they encounter uncertainty. The following hypothesis is proposed to examine the connection between desired uncertainty and uncertainty appraisal:

Hypothesis 1a: One's amount of desired uncertainty predicts the intensity of one's uncertainty appraisal. Greater desired uncertainty is associated with a stronger opportunity appraisal and weaker danger appraisal.

Appraisal and Information Seeking in UMT

Appraisal–information seeking connection. Uncertainty appraisals and their commensurate emotional responses motivate uncertainty management efforts (Brashers & Hogan, 2013). One such response documented in previous research is information seeking (Brashers et al., 2000; DeLorme & Huh, 2009; Dillard & Carson, 2005; Donovan-Kicken & Bute, 2008). Information seeking is defined in this project as intentionally and actively attempting to acquire information about a specific topic or issue (Hogan & Brashers, 2009).

Prior research has argued and shown a connection between the nature of one's appraisal and behavior related to information seeking. When uncertainty is appraised as danger, several scholars studying UMT have argued (Brashers, 2007) and reported evidence (Brashers et al., 2000; DeLorme & Huh, 2009) that individuals are likely to purposively look for information in an attempt to decrease their actual level of uncertainty and to ameliorate negative emotional responses related to the danger appraisal. Information can help one make sense of an event or issue (Brashers, 2007; Mishel, 1988). DeLorme and Huh (2009), for example, reported that the older adults in their sample who were distressed by uncertainty associated with direct-to-consumer pharmaceutical advertisements sought information to help verify the content of the advertisements. Research on related theories

offers further evidence for the notion that a danger appraisal can motivate information-seeking behavior. In the theory of motivated information management (TMIM; Afifi & Weiner, 2006), anxiety is thought to provoke individuals to evaluate their options for taking action in regard to uncertainty.

When uncertainty is appraised as opportunity, information seeking is also a possibility (Brashers et al., 2000). Yet maintaining or not reducing uncertainty is often a goal for individuals who appraise uncertainty as opportunity, and information avoidance is an important strategy for achieving this end (Barbour et al., 2012). Avoidance makes it possible to maintain hope and optimism by not confronting any disconfirming information. Beyond UMT, avoidance has been discussed by several scholars as a critical information-management strategy. Case and colleagues (Case, Andrews, Johnson, & Allard, 2005) note that avoidance is a widely accepted response to information that may cause distress. Moreover, Miller's (1980, 1987) notion of blunting as an information-seeking style consists of avoiding threatening information.

To summarize, the preceding discussion suggests that the nature of one's uncertainty appraisal motivates different types of behavior related to information seeking. Individuals who appraise uncertainty as more of a danger typically are motivated to find information to mitigate the danger or at least assuage the aversive emotions associated with the danger appraisal (Brashers, 2007). In contrast, individuals who appraise uncertainty as more of an opportunity generally are motivated to not encounter contradictory or disconfirming information that could undermine their opportunity appraisal (Brashers & Hogan, 2013; Brashers et al., 2000). Yet the nuances of the relationship between appraisal and information-seeking behavior warrant greater consideration. It is critical to go beyond the basic dichotomy of seeking and avoiding information and to better understand how individuals go about acquiring information in response to different types of appraisals. To this end, information-seeking depth is explored in the present study.

Web use and information-seeking depth.   The Web offers a useful context in which to examine information-seeking behavior and UMT. One key principle of UMT is that many sources and forms of information exist (Brashers & Hogan, 2013; Hogan & Brashers, 2009). The Web is a noteworthy information resource because it provides access to a diverse array of sources and forms of health information—ranging from individuals coping with illness in online support groups (Wright, Johnson, Averbeck, & Bernard, 2011) and blogs (Rains & Keating, 2011) to more formal information outlets such as websites operated by the National Library of Medicine and the Centers for Disease Control and Prevention (Junghans, Sevin, Ionin, & Seifried, 2004). Moreover, the Web is a widely used resource for health information. It has been estimated that 59% of all American adults used the Web specifically to search for health information during 2010 (Fox, 2011).

In UMT (Brashers, 2001, 2007), information seeking is typically discussed in terms of interactive, active, and passive strategies for acquiring information that were originally identified in research related to uncertainty reduction in personal relationships (Berger & Kellermann, 1994). Yet these strategies are generally limited to the context of interpersonal interaction and are typically discussed in theorizing about UMT in terms of strategies for reducing uncertainty. In investigating information-seeking behavior using the Web, this study focuses on information-seeking depth—referring to the degree to which a search is relatively focused (i.e., scrutinizing a small number of webpages) or broad (i.e., shallowly surveying a large number of webpages).

Uncertainty appraisal is examined as a motivating factor influencing information-seeking depth. Building from prior research arguing (Brashers, 2007; Brashers & Hogan, 2013) and demonstrating (Barbour et al., 2012; Brashers et al., 2000; DeLorme & Huh, 2009) that greater danger appraisal motivates information seeking to mitigate the threat and greater opportunity appraisal motivates information behavior intended to not encounter disconfirming information (i.e., information that undermines one's opportunity appraisal), we hypothesize an association between uncertainty appraisal intensity and information-seeking depth. Individuals who make a more negative appraisal of uncertainty as danger are predicted to conduct a deeper search in an effort to minimize the threat posed by uncertainty. These individuals should select fewer webpages, but scrutinize them thoroughly, thus spending more time on each page. Individuals who make a more positive opportunity appraisal are expected to conduct a shallower search in order to maintain their positive experience of uncertainty. These individuals should view a larger number of webpages, but spend less time per page. The following hypothesis is forwarded to test the connection between uncertainty appraisal intensity and information-seeking depth.

Hypothesis 1b: The intensity of one's uncertainty appraisal predicts the depth of one's information search. A weaker danger appraisal and stronger opportunity appraisal is associated with less information-seeking depth.

Taken together, the first two hypotheses suggest that desired level of uncertainty predicts the intensity of uncertainty appraisal, which in turn predicts information-seeking behavior. Implicit in these hypotheses—and in the discussion of uncertainty, appraisal, and information seeking in UMT (Brashers, 2001, 2007)—is the notion that there should be an indirect effect from desired uncertainty to information-seeking behavior through uncertainty appraisal. Through its relationship with appraisal intensity, desired level of uncertainty should be indirectly associated with information-seeking behavior. To formally test this notion, the following hypothesis is proposed.

Hypothesis 2: There is a significant indirect effect of desired uncertainty on information-seeking depth through appraisal.

Actual Uncertainty as a Moderator

In examining the role of desired uncertainty in the appraisal process, it is also important to consider one's actual amount or existing state of uncertainty. Although this is not explicitly addressed in UMT, other research examining uncertainty suggests that responses to uncertainty may be jointly influenced by the amount of uncertainty one feels and the amount one desires. For example, the construct tolerance for uncertainty (Kellermann & Reynolds, 1990) involves the notion that there is an amount of uncertainty with which one feels comfortable. In a high-uncertainty situation (i.e., initial interpersonal interaction), Kellermann and Reynolds (1990) showed that tolerance for uncertainty was inversely associated with information seeking. Moreover, the TMIM (Afifi & Weiner, 2006) is founded on the assumption that individuals may desire to increase or decrease their existing level of uncertainty. It is the discrepancy between one's desired and actual levels of uncertainty in the TMIM that is proposed to initiate uncertainty-management processes—including the process of appraisal.

In the context of UMT, the relationship between desired amount of uncertainty and appraisal intensity may be moderated by one's actual amount of uncertainty. Although desired uncertainty was predicted to be associated with a weaker danger appraisal and stronger opportunity appraisal, these relationships may be contingent upon one's actual level of experienced uncertainty. The relationship between desired uncertainty and appraisal intensity should be stronger when actual uncertainty is relatively low than when actual uncertainty is relatively high. As argued in prior research examining tolerance for uncertainty (Kellermann & Reynolds, 1990) and uncertainty discrepancy in the TMIM (Afifi & Weiner, 2006), responses to uncertainty should be stronger as the discrepancy between one's preferred and actual levels of uncertainty increases. The association between desired uncertainty and a stronger opportunity appraisal and weaker danger appraisal should be larger when actual uncertainty is lower than when it is higher. The difference between one's actual and desired state of uncertainty should serve to intensify one's appraisal of uncertainty. The following hypothesis is proposed to test this idea.

Hypothesis 3a: One's actual amount of uncertainty moderates the relationship between amount of desired uncertainty and intensity of uncertainty appraisal. The association between desired uncertainty and appraisal intensity is stronger when actual uncertainty is relatively low than when actual uncertainty is relatively high.

Finally, the connection proposed in UMT (Brashers 2001, 2007) among uncertainty, appraisal, and information seeking suggests that there may also be an indirect effect

of the interaction between desired and actual uncertainty on information-seeking depth through appraisal. Through impacting the nature of appraisal, the interaction between desired and actual uncertainty may indirectly influence the depth of one's information-seeking efforts. To test this possibility, the following hypothesis is forwarded.

Hypothesis 3b: There is a significant indirect effect of the interaction between desired and actual uncertainty on information-seeking depth through uncertainty appraisal.

Summary of Predictions and Models

The predictions made in this study can be combined to form a set of two nested models. In the base model, desired uncertainty level serves as an exogenous variable predicting uncertainty appraisal intensity (Hypothesis 1a), and appraisal predicts information-seeking depth (Hypothesis1b). The base model also makes it possible to test the indirect effect proposed in Hypothesis 2. Actual uncertainty level is included as an exogenous variable predicting appraisal in the base model; including actual uncertainty makes it possible to effectively control for this factor and to examine the effect of desired uncertainty over and beyond the possible influence of actual uncertainty. In the second model, the interaction between actual and desired uncertainty is added to the base model as an exogenous variable predicting appraisal. This model makes it possible to test Hypotheses 3a and 3b. The hypotheses are illustrated in Figure 1.

METHOD

Study Context

The hypotheses were tested in the context of young adults' use of the Web to acquire information about skin cancer. Skin cancer is the most common cancer in the United States, with an estimated 2 million new cases during 2012 (National Cancer Institute, 2013a). Some forms of skin cancer can be quite serious. Approximately 9,500 deaths related to melanoma were reported in the United States during 2012 (National Cancer Institute, 2013b). As such, it is not surprising that the topic of skin cancer has been examined in several studies investigating health-related information processing (e.g., Block & Keller, 1995; Prentice-Dunn, Jones, & Floyd, 1997).

Skin cancer is particularly relevant to young adults. Relative to other groups, young adults are especially likely to engage in behaviors such as tanning that increase their lifetime risk of skin cancer (McMath & Prentice-Dunn, 2005). Despite the fact that skin cancer is a preventable condition, young adults are also likely to experience confusion about preventative behaviors such as sunscreen use (Ostewalder & Hertzog, 2009). Moreover, the Web appears to be a widely used resource for health information among young adults. More than three-quarters of Internet users in the United
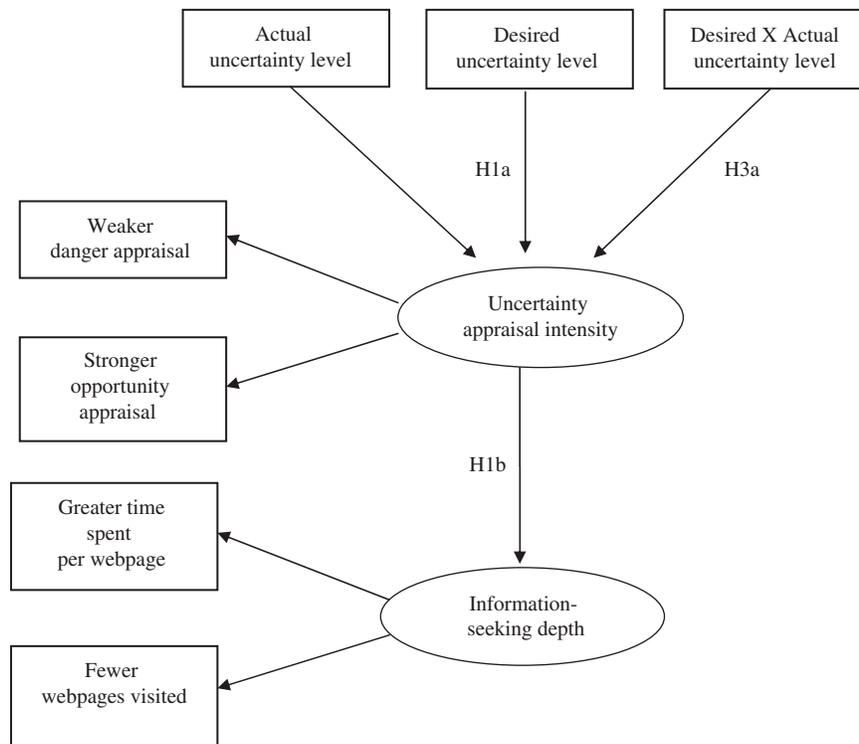
FIGURE 1 Models depicting the study hypotheses. H2 involves the indirect effect from desired uncertainty to information-seeking depth through uncertainty appraisal intensity; H3b involves the indirect effect from the interaction term to information-seeking depth through uncertainty appraisal intensity.

States between the ages of 18 and 34 years have searched for health information online (Fox, 2011). Although not limited to young adults, 40% of all American adults have used the Internet for the specific purpose of acquiring cancer-related information (National Cancer Institute, 2005). Taken as a whole, use of the Web by young adults to acquire skin cancer information represents an opportune setting in which to examine uncertainty management processes.

Sample

Undergraduate students at a university in the southwestern United States were invited to participate in an hour-long study about Internet use and health. In total, 157 (67.5% female) students who had not previously been diagnosed with skin cancer completed the study and had their information-seeking behavior coded. Participants' ages ranged from 18 to 33 years with a mean of 19.96 years ($SD = 1.46$).

Procedure and Materials

Upon arriving at the lab, participants first completed a priming task (which is detailed in the following paragraph). The purpose of the priming task was to increase the variance in perceptions of skin cancer uncertainty among study participants. Participants then reported their actual and desired levels of skin cancer uncertainty and uncertainty appraisal. After completing these self-report measures, participants were allowed to search the Web for information about skin cancer. Participants' search behavior was recorded using monitoring software and evaluated by human coders. Conducting a lab study made it possible to ensure sufficient variability in participants' perceptions of skin cancer uncertainty and to objectively measure their information-seeking behavior.

Heightened (un)certainty prime. The (un)certainty prime consisted of two components designed to heighten participants' desired and actual levels of skin cancer (un)certainty. All participants first completed a quiz examining their knowledge about skin cancer causes, symptoms, prevention, and detection. Regardless of their responses to the quiz questions, participants were randomly assigned to receive feedback that made either their relative certainty or uncertainty about skin cancer salient. It should be noted that the quiz was set up such that all of the response options contained medically accurate information (i.e., no medically inaccurate information about skin cancer was presented to participants in the quiz). Moreover, participants were informed at the conclusion of the study that the feedback they received regarding the quiz (i.e., the degree to which their performance reflects [un]certainty) was bogus and

were provided with information about skin cancer from the National Cancer Institute and National Library of Medicine.

In the heightened uncertainty condition, participants were informed that they lacked knowledge about skin cancer. Consistent with Brashers's (2001) definition of uncertainty, they were further informed that "Skin cancer is a complex, ambiguous, and unpredictable condition. A lot of the information available about skin cancer is inconsistent. In fact, many college students feel insecure in their state of knowledge about skin cancer." Participants in the heightened certainty condition were informed that they were knowledgeable about skin cancer, which was described as "a simple, concrete, and predictable condition." They were further informed that "There is a lot of consistent information available about skin cancer. In fact, many college students feel secure in their state of knowledge about skin cancer." This first component of the prime was included to influence participants' expectations regarding the attainability of complete certainty regarding skin cancer and thereby to either promote or temper their desired level of uncertainty.

The second component of the prime involved asking participants to list their thoughts about skin cancer symptoms, prevention, and detection. Participants in the heightened certainty condition were specifically directed to think about and list things they felt *certain* about, whereas participants in the heightened uncertainty condition were instructed to think about and list things about which they were *uncertain*. The objective of the second component of the prime was to influence participants' actual level of uncertainty. Instructing participants to reflect on things about which they felt relatively certain or uncertain was designed to make salient participants' actual level of (un)certainty about skin cancer.

Web search. Following the prime and completion of the uncertainty and appraisal measures, participants were encouraged to search for information about skin cancer using the Web. They were instructed to "use any search methods and search terms, conduct as many searches, and open as many websites and webpages within each site [as you like]. Please search as you normally would when you are searching for information over the Internet." SpectorPro software was used to record the websites and webpages participants visited and the amount of time spent on their search. While they were seeking information, participants were unaware that their Web-use activity was being recorded. However, participants were fully debriefed and asked for their permission to use their data at the conclusion of the study.

Measures

Actual skin cancer uncertainty. Participants' actual amount of uncertainty was measured using four items rated on a 7-point scale with the anchors *feel completely certain* and *feel completely uncertain*. Participants were asked to report how certain they currently feel about the causes,

symptoms, detection, and prevention of skin cancer. Larger scores indicate greater levels of actual uncertainty about skin cancer ($M = 3.91$, $SD = 1.84$, Cronbach's $\alpha = .85$).

Desired skin cancer uncertainty. The measure of desired amount of skin cancer uncertainty mirrored the measure of actual uncertainty. The same four items were used, but participants were asked to rate how much uncertainty they *want* to feel about skin cancer causes, symptoms, detection, and prevention. Ratings were made on a 7-point scale with the anchors *want to feel completely certain* and *want to feel completely uncertain.* Larger scores indicate greater levels of desired uncertainty about skin cancer ($M = 1.60$, $SD = 1.03$, Cronbach's $\alpha = .94$).

Uncertainty appraisal intensity. Following prior research on uncertainty appraisal by Mishel and colleagues (Mishel & Sonorson, 1991; Padilla, Mishel, & Grant, 1992), the measures of danger and opportunity appraisal intensity were derived from Folkman and Lazarus's (1985) measure of appraisal. After being exposed to the priming procedure, participants were asked to rate the degree to which they feel a series of emotions "when they think about skin cancer." The measure of *danger appraisal strength* included three items: fear, anxiety, and worry ($M = 3.91$, $SD = 1.47$, Cronbach's $\alpha = .87$). The measure of *opportunity appraisal strength* also included three items: relieved, pleased, and confident ($M = 1.39$, $SD = 1.07$, Cronbach's $\alpha = .75$). All ratings were made on a 7-point scale, with greater scores indicating a more intense danger/opportunity appraisal.

Information-seeking depth. Search depth was operationalized as time spent per webpage and the number of webpages visited; viewing fewer pages and spending more time per page indicates that one is conducting a relatively deeper search. The Web-use data recorded by the monitoring software were coded by two trained research assistants. Ten percent of the data were evaluated by both coders, and intercoder reliability was computed using Krippendorff's alpha (Krippendorff, 2004). To identify the total number of webpages visited, the coders counted the number of URLs visited by each participant. Webpages listing the results of a search engine query (e.g., the webpage displaying the results from a Google search) were excluded from the count. For each participant, the total number of URLs visited was computed (Krippendorff's $\alpha = .99$). Participants accessed a mean of just over seven webpages ($M = 7.39$, $SD = 4.20$). To identify the amount of time spent per webpage by participants, the coders first identified the amount of time that each participant spent on each accessed webpage using data recorded by the monitoring software (Krippendorff's $\alpha = 1.0$). The mean amount of time spent per webpage was then computed by dividing the total amount of time spent on all pages by the number of pages visited. Participants spent a mean of almost $1\frac{1}{2}$ minutes per webpage visited during their searches ($M = 89.37$ seconds, $SD = 73.45$).

RESULTS

Preliminary Analyses

Screening the data revealed that two of the variables evaluated in this study were not normally distributed. To address this issue, time spent per webpage was log transformed and number of webpages visited was square root transformed. The zero-order correlations among all study variables are reported in Table 1.

Although the purpose of the heightened (un)certainty prime was solely to create variance in participants' perceptions of skin cancer uncertainty, a manipulation check was conducted to determine the effectiveness of the prime. Participants in the heightened uncertainty condition ($M =$ 4.51, $SD = 1.09$) reported greater levels of actual uncertainty about skin cancer following the prime than participants in the heightened certainty condition ($M = 3.39$, $SD = 1.01$), $t(155) = 6.60$, $p < .01$, $\eta^2 = .22$. The prime also impacted participants' desired level of uncertainty about skin cancer. Participants in the heightened uncertainty condition ($M =$ 1.82, $SD = 1.21$) reported greater levels of desired uncertainty following the prime than participants in the heightened certainty condition ($M = 1.40$, $SD = .81$), $t(155) = 2.55$, $p < .01$, $\eta^2 = .04$.

The Relationships Among Uncertainty, Appraisal, and Information-Seeking Behavior

Hypothesis 1a predicted an association between desired amount of uncertainty and appraisal intensity, and Hypothesis 1b predicted an association between appraisal intensity and information-seeking behavior. Hypothesis 2 predicted an indirect effect from desired uncertainty to information-seeking behavior through appraisal. These hypotheses were tested simultaneously using a path model.

Desired amount of uncertainty was specified as an exogenous variable predicting appraisal intensity, which was modeled as a latent construct consisting of danger and opportunity appraisal strength. As expected, the measures of danger and opportunity appraisal strength were negatively correlated ($r = -.13$). To facilitate interpretation of the latent appraisal construct, the danger appraisal measure was reverse scored prior to testing the model. Larger scores on the appraisal construct indicate a more intense opportunity and less intense danger appraisal. As previously noted, actual amount of uncertainty was also included in the model to control for the influence of this variable; actual uncertainty was modeled as an exogenous variable predicting uncertainty appraisal. Appraisal intensity was modeled as predicting information-seeking depth, which was specified as a latent construct consisting of time spent per webpage and number of webpages visited. Given that these two indicators are measured on different scales, both variables were standardized to make them equivalent. Time spent per page and number of pages visited were negatively correlated ($r = -.35$). Accordingly, number of pages visited was reverse scored to facilitate the interpretation of the latent information-seeking depth construct. Greater scores for information-seeking depth indicate that respondents spent more time per webpage and visited fewer webpages. AMOS 16 was used to test the model. A bootstrapping, bias-corrected percentile method was employed to compute the standard errors used in testing the path coefficients and constructing the confidence intervals for the tests of the indirect effects (Hayes, 2009).

Figure 2 presents the model with standardized path coefficients. Overall, the model fit was acceptable, $\chi^2(7,$ $N = 157) = 8.11$, $p = .32$, CFI $= .98$, NFI $= .90$, RMSEA $= .03$. The chi-squared test was not significant, and the alternate fit indices are consistent with Hu and Bentler's (1999) criteria for acceptable model fit. Consistent with Hypothesis 1a, desired uncertainty predicted uncertainty appraisal. A greater amount of desired uncertainty was associated with a more intense appraisal of uncertainty as opportunity and less intense appraisal of uncertainty as danger. The results are partially consistent with Hypothesis

TABLE 1
Zero-Order Pearson Correlation Matrix for All Observed Variables

1 Actual Uncertainty Level	2 Desired Uncertainty Level	3 Actual × Desired Uncertainty	4 Stronger Opportunity Appraisal	5 Weaker Danger Appraisal	6 Fewer Webpages Visited	7 Greater Time Spent Per Webpage
1	.32**	.08	−.10	.11	−.07	.02
2		.58**	.08	.18*	.14^	.08
3			−.09	.13	.04	.08
4				.13	.19*	.19*
5					.04	.11
6						.45**
7						

Note. Actual × desired uncertainty = the interaction between actual uncertainty and desired uncertainty. Actual uncertainty and desired uncertainty were mean-centered. Danger appraisal was reverse coded such that higher scores indicate a weaker danger appraisal. Number of webpages visited was log transformed, standardized, and reversed scored; higher scores for this variable indicate fewer pages visited. Time spent per webpage was square root transformed and standardized.
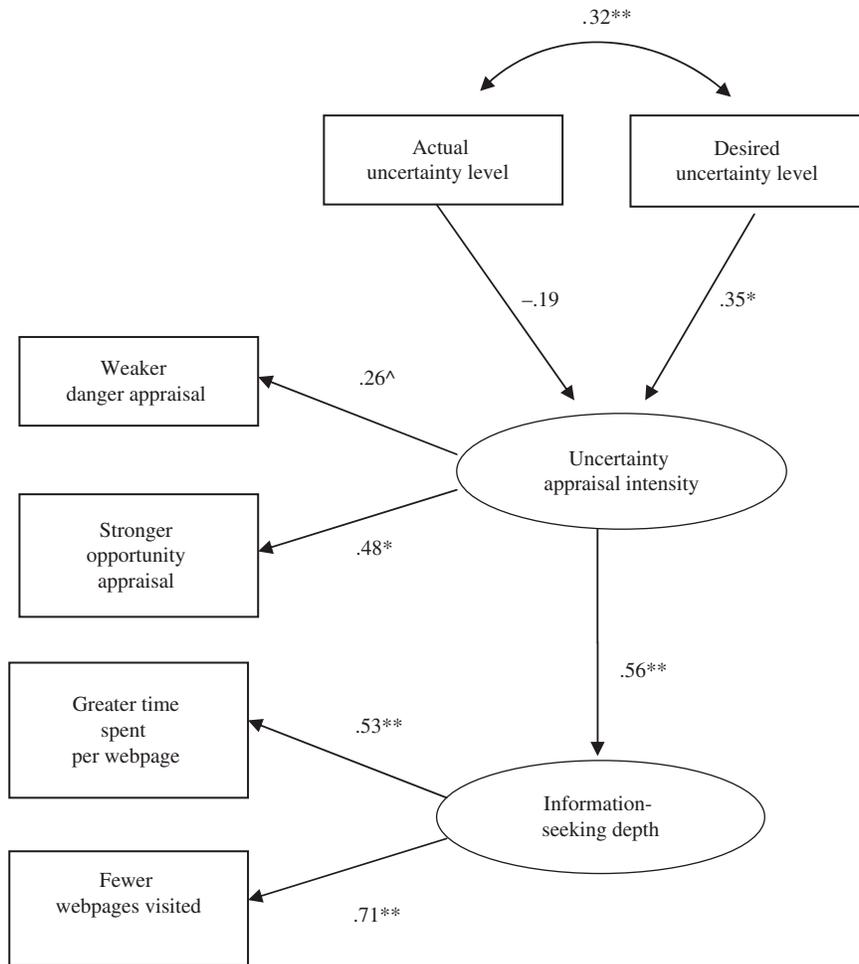
**$p < .01$. *$p < .05$. ^$p < .10$.

FIGURE 2 Results of the model testing hypotheses 1 and 2. Signficance indicated by $^{**}p < .01$, $^{*}p < .05$, $^{\wedge}p = .06$. All path coefficients are standardized. Danger appraisal was reverse coded such that higher scores indicate a weaker danger appraisal. Number of webpages visited was log transformed, standardized, and reverse scored; higher scores for this variable indicate fewer pages visited. Time spent per webpage was square root transformed and standardized.

1b. Although the path from appraisal to information-seeking depth was significant, the valence of this relationship was opposite of what was expected. Appraisal intensity, which was coded such that greater values indicate a stronger opportunity appraisal and weaker danger appraisal, was positively associated with greater information-seeking depth (i.e., spending more time on each page, but visiting fewer pages). This finding is further considered in the discussion section. Finally, the bootstrapped confidence interval for the unstandardized estimate of the indirect effect of desired uncertainty on information-seeking depth through appraisal did not include zero (.13, 95% CI [.001, .34]). The results support Hypothesis 2.

Actual Uncertainty as a Moderator

Hypothesis 3a predicted that actual amount of uncertainty would moderate the relationship between desired amount

of uncertainty and appraisal intensity, and Hypothesis 3b predicted a significant indirect effect from the interaction term to information-seeking depth through appraisal. As was discussed in summarizing the study predictions, these two hypotheses were tested by adding the interaction between desired and actual uncertainty to the previously tested model as an exogenous variable predicting appraisal intensity. Desired uncertainty and actual uncertainty were mean-centered and then multiplied to create the interaction term (Aiken & West, 1991).

The model adequately fit the sample data, $\chi^2(10, N=157) = 13.20$, $p = .21$, CFI $= .98$, NFI $= .91$, RMSEA $= .05$. However, adding the interaction term did not significantly improve overall model fit compared with the original model depicted in Figure 2, $\Delta\chi^2(3) = 5.09$, $p > .10$. The path from the interaction term to appraisal was not significant, $\beta = .30$, $p = .23$. Additionally, the bootstrapped confidence interval for the unstandardized estimate of the indirect effect of the interaction on information seeking through appraisal

included zero (–.07, 95% CI [–.25, .05]). These results indicate that actual level of uncertainty did not moderate the relationship between desired level of uncertainty and appraisal intensity, and the indirect effect of the interaction term on information-seeking depth through appraisal was not significant. No support was found for Hypotheses 3a or 3b.

DISCUSSION

The purpose of this project was to examine the uncertainty–appraisal–information seeking connection proposed in UMT. The results show associations between uncertainty and appraisal as well as between appraisal and information-seeking depth—though the direction of the latter relationship was unexpected. Additionally, the indirect effect of desired uncertainty on information-seeking depth through appraisal was significant. The findings and their implications for research on UMT are considered in the following paragraphs.

Uncertainty, Appraisal, and Information Seeking in UMT

The results of this study underscore the important role of information seeking in UMT and highlight the relationships among uncertainty, appraisal, and information-seeking behavior. First, desired uncertainty was associated with uncertainty appraisal intensity. Respondents who reported desiring higher levels of uncertainty also reported appraising uncertainty as more of an opportunity and less of a danger, while those who reported desiring lower levels of uncertainty appraised it less as an opportunity and more as a danger. The connection between desired uncertainty and appraisal intensity demonstrated in this study is important for several reasons. A critical assumption of UMT is that uncertainty is not inherently meaningful, but appraised for its meaning (Brashers, 2001, 2007). Yet relatively little empirical research has been conducted to examine the appraisal process in UMT. The findings from this study contribute to theorizing about UMT by demonstrating the connection between appraisal and uncertainty. The results are consistent with the argument made in this project that, drawing from Lazarus's (1991) ideas about appraisal, desired uncertainty represents one's goal in regard to uncertainty. As such, knowing one's desired level of uncertainty makes it possible to determine how one is likely to appraise uncertainty in a given context.

Second, there was a significant relationship between appraisal intensity and information-seeking depth. However, the nature of this relationship was opposite of what was expected. A more positive appraisal of uncertainty as opportunity and less negative appraisal of uncertainty as danger was associated with greater information-seeking depth in the form of spending more time per webpage and viewing fewer

webpages. One explanation for this finding can be traced to participants' motivation for seeking information. It was argued that, based on previous research (Brashers et al., 2000; DeLorme & Huh, 2009), individuals who appraise uncertainty more negatively as danger should have greater motivation to find information that mitigates the threat posed by uncertainty. The results suggest that they may do so by searching as widely and shallowly as possible. Such a search pattern may make it possible to locate any information that could disconfirm their existing knowledge and thereby help assuage the negative emotions such as fear and anxiety that occur with a danger appraisal. Individuals who appraise uncertainty more positively as opportunity, in contrast, may seek very specific information that will not disturb their equilibrium. The results indicate that these individuals search for information more selectively and deeply, accessing fewer pages but spending more time on each page. It seems plausible that individuals who appraise uncertainty more positively are spending more time carefully attempting to identify information that confirms what they already know and enables them to maintain their opportunity appraisal.

These results resonate with research related to message processing and mood in the context of persuasion (e.g., Mackie & Worth, 1989). There is some evidence that although individuals in positive affective states will avoid systematic processing of messages (i.e., careful scrutiny of the message content) that might disrupt their positive feelings, people readily systematically process messages that are congruent with their positive state (Hullett, 2005). It may be that, in the context of the present study, an appraisal of uncertainty as more of an opportunity in and of itself does not result in shallower search behavior. Instead, the appraisal of uncertainty as opportunity calls for a deeper approach that enables individuals to detect self-serving information that reinforces their existing knowledge and allows them to maintain or strengthen their appraisal of uncertainty as opportunity.

A third key finding from this study is that the connection between uncertainty and information seeking was substantiated. The indirect effect of desired uncertainty on information-seeking depth through appraisal was significant. This finding is particularly important because it offers empirical evidence to support a key tenet of UMT. Central to UMT is the notion that uncertainty is appraised for meaning and such appraisal can motivate uncertainty management efforts (Brashers, 2001, 2007). Through being associated with participants' uncertainty appraisal, desired uncertainty was indirectly associated with the nature of participants' information-seeking efforts.

It is also important to consider the hypotheses that were not supported. Actual level of uncertainty did not moderate the relationship between desired level of uncertainty and appraisal intensity, and the indirect effect from the interaction between actual and desired uncertainty on information-seeking depth through appraisal was not significant. Taken

together, these two findings are important for several reasons. At a very basic level, they offer evidence consistent with the notion that actual uncertainty and desired uncertainty are distinct constructs with unique implications for uncertainty management. Although the distinction between these two features of uncertainty is mostly implicit in UMT (Brashers, 2001, 2007), it is made explicit in related theories of uncertainty such as the TMIM (Afifi & Weiner, 2006). Participants' actual and desired levels of uncertainty had different implications for appraisal. The association between participants' desired level of uncertainty and appraisal intensity was not contingent upon participants' actual level of uncertainty. One's desire for uncertainty appears to be principally responsible for one's uncertainty appraisal in UMT.

These nonsignificant findings also raise questions about the utility of incorporating actual or experienced level of uncertainty in constructs like uncertainty discrepancy in the TMIM (Afifi & Weiner, 2006). In the TMIM, it is the discrepancy between one's actual and desired level of uncertainty that is proposed to produce anxiety. Yet the test of the interaction in this study, which might be considered an alternate means of examining uncertainty discrepancy, was not significant. These results suggest that although distinguishing between actual and desired levels of uncertainty is meaningful, it may be that only desired level of uncertainty is critical to the appraisal process. Future research further examining the outcomes of actual and desired uncertainty is essential to more fully understand the unique properties of these two dimensions of uncertainty.

Limitations and Directions for Future Research

In discussing the findings, the study limitations should also be addressed. One potential limitation involves the fact that it is not possible to draw causal inferences about the relationships among uncertainty, appraisal, and information-seeking behavior. However, it should be noted that the information-seeking task was preceded by the uncertainty prime and assessments of both uncertainty and appraisal. A second limitation is that the lab study was somewhat contrived. Yet this limitation should be considered in light of the broader purpose of the project and the specific details of the study parameters. The information-seeking activity was designed to be as naturalistic as possible in a laboratory setting. Participants were not exposed to any predetermined websites, but were allowed to search freely as they might when conducting a search at their home. Moreover, the lab setting made it possible to track participants' actual search behavior and to overcome some of the biases and limitations possible in self-report data about information seeking.

In addition to the limitations, several possible directions for future research warrant consideration. First, given the link between appraisal intensity and information-seeking depth demonstrated in the study results, it would be worthwhile to explore the connection between certain appraisals and specific types of information content. It seems plausible that information seekers who appraise uncertainty as more of an opportunity search for different types of content than those who appraise uncertainty as more of a danger. Because a stronger opportunity appraisal was associated with greater information-seeking depth, it may be that individuals who appraise uncertainty as an opportunity may be more strategic in their information seeking, looking for information to support what they already know and believe. To explore this issue, future studies might assess individuals' prior knowledge and beliefs and compare that with the actual content they access during an information search. Understanding the possible relationships between appraisal and specific types of content sought would help advance our understanding of UMT. Second, it would be valuable to examine the outcomes of the uncertainty–appraisal–information seeking process. It may be that different types of appraisal and/or information-seeking behaviors result in different health outcomes related to uncertainty management. Individuals who prefer a high level of uncertainty, appraise uncertainty as more of an opportunity, and are able to find uncertainty-increasing information may feel a high level of self-efficacy about their ability to manage uncertainty and, ultimately, their health condition. Examining the potential outcomes of information seeking would be a useful direction for future research efforts.

CONCLUSION

Given the central role occupied by uncertainty in illness and health more generally, it is critical to continue advancing our theoretical understanding of this construct. This project examined the uncertainty–appraisal–information seeking connection proposed in UMT. The results offer insights about the interrelationships among these constructs by demonstrating associations between desired uncertainty and appraisal intensity as well as between appraisal intensity and information-seeking depth. Yet the results of this study also underscore the need for future research on UMT in order to continue refining and developing our understanding of uncertainty and this important theory of health communication.

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