



A Little Uncertainty Goes a Long Way: State and Trait Differences in Uncertainty Interact to Increase Information Seeking but Also Increase Worry

Natalie O. Rosen & Bärbel Knäuper

To cite this article: Natalie O. Rosen & Bärbel Knäuper (2009) A Little Uncertainty Goes a Long Way: State and Trait Differences in Uncertainty Interact to Increase Information Seeking but Also Increase Worry, *Health Communication*, 24:3, 228-238, DOI: [10.1080/10410230902804125](https://doi.org/10.1080/10410230902804125)

To link to this article: <https://doi.org/10.1080/10410230902804125>



Published online: 04 May 2009.



Submit your article to this journal [↗](#)



Article views: 674



Citing articles: 63 [View citing articles](#) [↗](#)

A Little Uncertainty Goes a Long Way: State and Trait Differences in Uncertainty Interact to Increase Information Seeking but Also Increase Worry

Natalie O. Rosen and Bärbel Knäuper

*Department of Psychology
McGill University, Montreal, Quebec, Canada*

This study examines the effect of an interaction between intolerance of uncertainty (IU) and situational uncertainty (SU) on worry due to uncertainty and on information seeking. Health providers may benefit from knowing when communicating uncertain information is beneficial. The study was a 2 (IU condition: high vs. low) \times 2 (SU condition: high vs. low) experimental design resulting in four conditions to which university students ($N = 153$) were randomly assigned. IU was manipulated through a linguistic manipulation of responses to an IU questionnaire coupled with written false feedback. SU was manipulated by modifying the information participants read about a fictitious infection. Individuals in the high IU and high SU condition sought the most information and worried most due to uncertainty compared to people in the low IU and low SU condition, who sought the least information and worried least. Findings suggest that high IU may increase positive health behaviors such as screening intentions when individuals are faced with an uncertain health threat, but that it also increases worries due to that uncertainty. Providing opportunities for discussing one's emotional response to uncertainty and providing instrumental support for managing uncertainty (e.g., booking the follow-up appointment) is essential when communicating uncertain information.

Several areas of psychological research have emphasized the role of uncertainty in affecting individuals' cognitive, emotional, and behavioral responses to a given situation. For example, clinicians have investigated the role of uncertainty in the development and maintenance of anxiety disorders (e.g., Dugas & Ladouceur, 2000), and health researchers have examined how communicating an uncertain test result may lead to heightened psychological distress (e.g., Maissi, Marteau, Hankins, Moss, Legood, & Gray, 2004). Situational uncertainty (SU) occurs when a particular event cannot be adequately structured or categorized because it is marked by unpredictability, ambiguity, and a lack of information (Brashers et al., 2000). For example, a woman may feel uncertain about whether or not she has the human papillomavirus (HPV) after she learns that each woman has an 80% chance of contracting an HPV infection in her lifetime. Situational uncertainty about a health threat may refer to

any aspect of the health condition, including the seriousness of the condition, one's vulnerability or risk, treatment efficacy, and prognosis (Mishel, 1981). Previous research suggests that SU may lead to psychological distress such as increased worry, particularly when that uncertainty remains unresolved. For example, not knowing whether a positive HPV result will or will not lead to negative health consequences (e.g., cervical lesions) was found to be associated with higher anxiety in women (Maissi et al., 2004).

In addition to the effect of SU, some people may be more or less affected by the unknown outcome of a health threat. A high intolerance of uncertainty (IU) refers to "a predisposition to react negatively to an uncertain event or situation, independent of its probability of occurrence and its associated consequences" (Ladouceur, Gosselin, & Dugas, 2000). A person with a high IU views uncertain situations as unacceptable and highly aversive, in contrast to a person with low IU, who does not feel distraught in these same situations (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). IU differs from SU because it refers to a trait of the individual rather than a characteristic of the situation. An

Correspondence should be addressed to Natalie O. Rosen, Department of Psychology, McGill University, 1205 Dr. Penfield Avenue, Montreal, QC, Canada H3A 1B1. E-mail: natalie.rosen@mcgill.ca

evaluation of one's IU can be differentiated from the similar but distinct construct of uncertainty orientation (Sorrentino & Short, 1986). IU focuses on the psychological effects of given uncertainties (like health threats) on the individual (e.g., the activation of coping efforts such as information seeking), whereas uncertainty orientation focuses on individual differences in the desire to approach or avoid uncertainty (Rosen, Knäuper, & Sammut, 2007).

UNCERTAINTY AND INFORMATION SEEKING

Information can be defined as "stimuli from a person's environment that contributes to his or her knowledge or beliefs" (Brashers, Goldsmith, & Hsieh, 2002). Seeking information is one possible response to uncertainty about one's health and may be motivated by wanting to understand one's diagnosis and risk, to make treatment decisions, or to predict prognosis. Seeking information can lead to decreases and/or increases in uncertainty, depending on the content of the information but also on a person's appraisal and interpretation of that information. Similarly, the uncertainty itself can be interpreted as a source of distress or it can lead to feelings of reassurance and optimism (Mishel, 1990). On the one hand, the information that HPV is a very prevalent infection (approximately 80% of women will contract HPV at some time in their lives) may increase uncertainty about one's HPV status and lead to higher worries about one's cancer risk. On the other hand, this same information could be interpreted as reassuring given that the infection is so common yet only a very small portion of women who test positive for HPV will develop cervical cancer. Thus, the presence of conflicting goals or motivations for seeking information (e.g., reducing uncertainty and related anxiety or worries vs. maintaining one's health) also affects these behaviors and how one interprets information (Brashers et al., 2002).

Prior research has focused on the impact of uncertainty on psychological functioning (e.g., Maissi et al., 2004), yet uncertainty may also directly affect health behaviors like information seeking. First, research suggests that SU may lead to higher information seeking and better adherence to screening recommendations (e.g., Funke & Nicholson, 1993; Rosen et al., 2007). Funke and Nicholson (1993) investigated factors affecting compliance to medical recommendations from their health care providers among women receiving an abnormal Pap test. They found that women who agreed with the statement "the uncertainty about my Pap test makes me nervous" were four times more likely to comply with health providers' recommendations than were women who disagreed with the statement (Funke & Nicholson, 1993). These results suggest that nervousness associated with uncertainty over the potential consequences of a positive test result may lead to adaptive behaviors. However, this study confounds the direct effect (i.e., uncertainty) and

the indirect effect (i.e., wanting to reduce nervousness) in predicting health behaviors. Thus, it remains unclear whether SU itself increases information seeking.

Second, Rosen et al. (2007) recently tested the hypothesis that an intolerance of uncertainty increases information seeking. The researchers tested the theoretical proposition by Krohne (1993) that some individuals whom he called "vigilant" have an inability to tolerate uncertainty, which leads to an extensive and continual search for threat signals (Krohne, 1993). However, Krohne (1993) did not provide empirical evidence that an intolerance of uncertainty leads to higher information seeking. In support of this proposition, Rosen et al. (2007) found that experimentally inducing high IU led to greater intentions to seek information (e.g., perform an Internet search, get tested for a sexually transmitted infection [STI]), as well as increased requests for information and a higher likelihood of actually taking the information sheet provided in the study home with them.

Last, previous research has not addressed an interaction between IU and SU on information seeking. Brouwers and Sorrentino (1993) examined this interaction using uncertainty orientation and its effect on health compliance, which is one feature of information seeking. They found that uncertainty-oriented individuals (those who deal directly with uncertainty, are motivated to reduce it, and are capable of resolving it) were more likely to seek out health information compared to certainty-oriented individuals (those who feel threatened by information that contains uncertainty and therefore avoid it; Brouwers & Sorrentino, 1993).

In addition, uncertainty orientation theory was developed under the assumption that motivation and information-processing styles are contingent on a match between a person's uncertainty orientation and the amount of SU (Hodson & Sorrentino, 1999). This study tests the hypothesis that, as in uncertainty orientation theory, a Person \times Situation interaction exists between SU and IU. Given that previous research finds that higher IU leads to higher information seeking when faced with an uncertain health threat (i.e., high SU), it follows that lower IU may lead to lower information seeking for situations with lower SU. Health providers may benefit from knowing when communicating uncertain information (e.g., that HPV may be an undetected infection) is beneficial to encourage information seeking.

Previous research also indicated that higher IU (Dugas & Ladouceur, 2000) and higher SU (Schwartz, Lerman, Miller, Daly, & Masny, 1995, respectively) cause more worry compared to lower IU or SU. Given these findings, we expect that the interaction between IU and SU will also lead to greater worries due to uncertainty. To make informed recommendations to health providers regarding the impact of communicating uncertain information, it is essential to examine not only the potential positive effects (i.e., greater information seeking) but also the potential negative effects (i.e., higher worries). The hypotheses of this study are as follows:

- H1: SU will moderate the relationship between IU and information seeking. Specifically, individuals in the high IU and high SU condition will seek the most information, whereas people in the low IU and low SU condition will seek the least.
- H2: SU will also moderate the relationship between IU and worry due to uncertainty. Individuals in the high IU and high SU condition will worry most, whereas people in the low IU and low SU condition will worry least.

CASE STUDY FOR UNCERTAINTY: HPV

DNA from the STI, HPV has been found in up to 99.7% of cervical cancer cases worldwide, leading researchers to conclude that certain strains of HPV cause cervical cancer (Walboomers et al., 1999). Recently, Rosen et al. (manuscript in preparation) identified five sources of uncertainty regarding women's own HPV status or uncertainty about possibly having a cervical lesion. These sources included the high prevalence of HPV, the fact that an HPV infection can sometimes go undetected (i.e., be dormant), the lack of means for preventing transmission, the fact that HPV is transmitted by sexual contact, and that there are different types of HPV with various consequences (some cause genital warts and others cause cervical cancer). HPV is ideal for studying the effects of uncertainty on information seeking because it is affected by many sources of uncertainty and the potential health risks can be reduced through cervical cancer screening, which is one aspect of information seeking.

To investigate our hypotheses, our study used a fictitious STI, bacillosis virus (BV), designed to have similar uncertain properties (in the high SU condition) to those of HPV. Specifically, the STI information read by participants in the high SU condition included four of the five sources of uncertainty inherent in HPV identified in the research by Rosen et al. We did not include information indicating that there are different types of the STI with various consequences because at the time of designing the study materials, data collection for the Rosen et al. study was still under way. We modeled our fictitious STI after these HPV characteristics to allow generalizations of our research findings to health providers who communicate HPV test results and to populations coping with HPV test results.

METHOD

Participants

Participants were recruited either through the McGill University Psychology subject pool (these participants received course credit for their participation) or through an

advertisement on the McGill University Web site (these participants received financial compensation). Eligible participants had to be sexually active (having contact with another person's genitals) in the past or present to ensure they would feel at risk for the STI introduced in the study. Forty-four men (mean age = 22.89 years, $SD = 7.04$) and 176 women (mean age = 20.75 years, $SD = 2.12$) participated.

Procedure

We sought to demonstrate causality through rigorous experimental design that consisted of (a) experimental manipulation of our independent variables (high/low IU and high/low SU), (b) random assignment to experimental conditions to balance out extraneous effects (e.g., *a priori* characteristics of the individuals), and (c) controlling for potential confounding variables. Manipulating IU and SU is the most direct way to clarify the causal relationships between IU, SU, worry, and information seeking, therefore aiding in understanding the role of particular causes (IU and SU) in the acquisition and maintenance of diverse problems (worry) and behaviors (information seeking; Garber & Hollon, 1991). Participants completed an online consent form and a set of baseline questionnaires including the measure of IU (described in the Measures section) on a secure Web site approximately 1 week prior to the laboratory session.

Manipulation of IU. It is now commonly accepted in modern personality psychology that stable within-person variability exists in the extent to which a person expresses his or her personality across time, situations, or social roles (e.g., Fleeson, 2001; Moskowitz & Zuroff, 2004). Strong empirical evidence for trait variability has been provided by numerous experience-sampling and event-contingent recording studies. Such studies allow researchers to measure real-time changes in self-reported traits as assessed by fluctuations in trait-relevant behaviors throughout the day and week (e.g., Fleeson, 2001; Moskowitz & Zuroff, 2004). The research assumes that behaviors express trait-relevant content (e.g., being argumentative reflects the trait of quarrelsomeness) and that variability in trait-relevant behaviors reflect intraindividual variability in traits. For example, Moskowitz and Zuroff (2004) used event-contingent recording to assess intraindividual variability in interpersonal behaviors reflecting the following four traits: submissiveness, dominance, agreeableness, and quarrelsomeness. They found stable variation around the individual's mean score for all four traits. Thus, on average a person may be more or less submissive, but over the course of a day that person may engage in both more and less submissive behaviors. In sum, this research firmly establishes that variation exists in the manifestation of traits and that individuals regularly demonstrate higher and lower levels of traits in their behaviors. As such, our study experimentally manipulated IU to

capitalize on this variation. Specifically, we induced individuals to be either higher or lower in IU within the context of our study. We acknowledge that this shifting in IU is most likely only temporary, for the course of the study. However, both Fleeson (2001) and Moskowitz and Zuroff (2004) provided evidence that trait fluctuations within an individual at one period in time are likely to replicate at another point in time within a given context. This conclusion suggests that inducing a higher IU and higher SU may lead to higher information seeking when such conditions are fostered again in a similar context (e.g., in delivering an uncertain test result).

Previously, three studies have manipulated IU to examine the relationship between IU and worry (Dugas & Ladouceur, 2000; Grenier & Ladouceur, 2004; Ladouceur et al., 2000). In one study, the researchers designed a computerized roulette game in which IU was increased or decreased by manipulating whether the uncertainty of winning the game was acceptable or unacceptable to the individual. In another study, IU was manipulated by having participants imagine ingesting a medication and then read out loud a paragraph consisting of statements meant to either increase (e.g., “c’est difficile de ne pas savoir ce qui va arriver” [it is difficult not to know what will happen]) or decrease (e.g., “je dois vivre avec les différentes possibilités” [I have to live with the different possibilities]) IU. The results of both studies showed that participants in the high IU condition worried more than those in the low IU condition (Grenier & Ladouceur, 2004; Ladouceur et al., 2000). The second study also demonstrated that it was possible to increase and decrease IU in the same participant within a 1-week period. Thus, this example, demonstrating variability in the manifestation of IU through an experimental manipulation, is consistent with the personality research on intra-personal variability in traits.

This study employs a linguistic manipulation developed by Salancik and Conway (1975) coupled with written false feedback based on responses to the IU questionnaire. This procedure has been shown to successfully manipulate self-perceptions such as the perception of self-control in dieting (Polivy & Herman, 1991) and perception of oneself as a “close, intimate partner” in a relationship (Broemer & Blumle, 2003).

Salancik and Conway (1975) proposed that when a person responds positively or negatively to a statement describing an attitude or behavior, he or she will generate cognitions, particularly by using information made most salient to the person at that time, consistent with the endorsement. The researchers inferred that one can manipulate these cognitions by changing the probability of the person endorsing a statement.¹ For our study, questionnaire items in the high IU

condition were combined with the qualifier “occasionally” and items in the low IU condition were paired with the qualifier “almost always.” Participants in the high IU condition were expected to endorse a higher number of statements compared to participants in the low IU condition and as a consequence to perceive themselves as more intolerant of uncertainty.

The second part of our manipulation provided false feedback on how well an individual tolerates uncertainty based on the number of statements endorsed in the manipulated IU scale. Numerous studies have shown that providing false feedback can successfully manipulate self-perception, for example, in state self-esteem (Rector & Roger, 1997) and perceived intelligence (Fein & Spencer, 1997). The cutoff points for receiving the feedback were manipulated for each condition to increase the probability of receiving the correct feedback for the condition. Participants in the high IU condition had to endorse only five or more statements to receive the high IU feedback.² In the low IU condition, participants had to endorse 24 or fewer statements to receive the opposite feedback.

Manipulation of SU. Following the IU manipulation, participants were introduced to the fictitious STI, bacillosis virus (BV). We used a fictitious STI, first, to control for the amount of exposure and existing knowledge about the STI, and, second, to avoid the ethical concern that information about a real STI could lead to anxiety and worry over carrying or contracting the infection. The SU manipulation consisted of modifying the information participants read about BV. Participants in the high SU condition read an information sheet intended to provoke strong feelings of uncertainty (based on properties of HPV) regarding whether or not they have BV. Participants in the low SU condition read an information sheet intended to reduce feelings of uncertainty about whether or not they have the virus. A table reporting the four sources of uncertainty that were manipulated and the corresponding information for the high vs. low SU conditions can be found at <http://ego.psych.mcgill.ca/perpg/fac/knaeuper/supplementalmaterial.htm>.

Participants then completed questionnaires described in the measures section. The State-Trait Anxiety Scale (STAI) and Penn State Worry Questionnaire (PSWQ) were included at baseline and after the manipulation to control for changes in anxiety and worry—that is, to make sure the IU manipulation was indeed manipulating IU and not just peoples’ level of anxiety and worry. Last, participants reported to what extent they believed that the STI, BV, was real and to what extent they felt that the IU feedback they received was characteristic of them.

¹A more detailed explanation of the rationale behind the IU manipulation can be found in Rosen et al. (2007); refer to Salancik and Conway (1975) for a general overview of the manipulation.

²High IU feedback (based on the definition of IU by Freeston et al., 1994): “You do not tolerate uncertainty well. You find uncertainty stressful and upsetting and avoid uncertain events at all costs. You feel that being uncertain is unfair and can lead to the inability to take action.”

Measures

Intolerance of Uncertainty Scale (IUS) and Need for Closure Scale (NFCS). The IUS (Buhr & Dugas, 2002) includes 27 items that assess emotional, cognitive and behavioral reactions to ambiguous situations, implications of being uncertain and attempts to control the future. Participants endorsed items by responding “true” or “false.” A higher number of true statements reflected higher IU. Sample items include “uncertainty stops me from having a strong opinion” and “uncertainty makes life intolerable.” The IUS has good test–retest reliability over a 5-week period ($r = .74$; $p < .001$) and convergent validity with measures of worry and divergent validity with measures of anxiety and depression (Buhr & Dugas, 2002; Freeston et al., 1994). A recent criticism of the IUS suggests that it evaluates the consequences of being uncertain and does not adequately assess the individual’s tendency to consider uncertainty unacceptable (Gosselin, Ladouceur, Evers, & Laverdiere, 2005). We therefore added 8 items to the IUS scale from the predictability of future contexts subscale of the Need for Closure Scale (NFCS; Webster & Kruglanski, 1994) that directly address that uncertainty is unacceptable. A sample item includes “I don’t like to go into a situation without knowing what I can expect from it.” Results reported from this point forth that refer to the “IUS” also include the NFCS items. Cronbach’s alpha for the IUS/NFCS scale was .92 premanipulation and .86 postmanipulation.

Penn State Worry Questionnaire. The PSWQ (Meyer, Miller, Metzger, & Borkovec, 1990) is a 16-item questionnaire that assesses the trait tendency to worry. Participants rate items as characteristic of themselves on a scale from 1 (*not at all typical*) to 5 (*very typical*). Examples include “My worries overwhelm me” and “When I am under pressure I worry a lot.” The PSWQ has shown good discriminative validity with measures of anxiety and depression (Brown, Antony, & Barlow, 1992). Cronbach’s alpha was .93 premanipulation and .94 postmanipulation.

State-Trait Anxiety Scale. The STAI (Spielberger, 1983) is a 40-item measure of state and trait anxiety. The “state” factor is a measure of present or short-term anxiety. Examples include “I feel calm” and “I am tense.” The “trait” factor is a measure of long-term or stable anxiety. Examples include “I feel nervous and restless” and “I feel pleasant.” All item responses range from 1 (*not at all*) to 4 (*very much so*). The STAI has good convergent validity and test–retest reliability (Stanley, Beck, & Zebb, 1996). Cronbach’s alpha was .93 and .92, respectively, for the state and trait subscales premanipulation, and .91 and .92, respectively, postmanipulation.

Mishel Uncertainty in Illness Scale (MUIS). The MUIS (Mishel, 1981) consists of 30 items that assess (a) ambiguity in illness (e.g., “I don’t know what is wrong with

me”) and (b) unpredictability in illness (e.g., “It is clear to me when I am getting better or worse”). Participants rate the items on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), and higher scores reflect higher certainty. Both factors of the MUIS have good internal consistency ($\alpha = .91$ and $\alpha = .64$, for ambiguity and unpredictability, respectively) and good construct and convergent validity (Mishel, 1981). For our study, we adapted 10 MUIS items as a manipulation check for the SU condition. Examples of questions include “I have a lot of questions about BV and don’t have answers” and “It’s vague to me how I can prevent contracting BV.” Cronbach’s alpha was .70.

Behavioral intentions of information seeking. Information seeking intentions were measured with 9 items on a scale ranging from 1 (*extremely unlikely*) to 7 (*extremely likely*). Examples include “How likely are you to talk with others about BV?” and “If your partner has not been tested for BV, how likely are you to ask him/her to get tested?” Scores on these items were summed to create a behavioral information-seeking score ranging from 9 to 63. One item was deleted both pre- and postmanipulation because it substantially reduced the internal consistency of the scale. Cronbach’s alpha after deletion of the item was .83.

Behavioral measures of information seeking. We aimed to improve the reliability and validity of our conclusions by including direct behavioral measures of information seeking. Participants were given the opportunity to take the information sheet about BV and to request an information package about BV; whether or not they took the sheet or made this request were recorded as separate measures of information seeking.

Information-seeking index. We did not have specific hypotheses on how the individual information-seeking variables would differ and therefore we created an information-seeking index. Standardized z scores were calculated for each of the information-seeking variables and then summed: (a) behavioral information-seeking intentions, (b) whether or not the participant took the information sheet on BV, and (c) whether or not the participant requested an information package on BV. Higher scores reflect higher information seeking.

Motivation to reduce uncertainty. Previous research (Rosen et al., 2007) indicates that the motivation to reduce uncertainty is an important covariate of information seeking; therefore participants completed a measure of this motivation so that it could be controlled for in the analyses. Participants were presented with the statement “I want to get more information about BV to find out for sure whether or not I have the virus.” Participants indicated the extent to which they agreed with the statement on a scale of 0 (*not at all*) to 4 (*very much*).

Worry due to uncertainty. To assess worry due to uncertainty, participants were asked “To what extent do you feel worried because you feel uncertain about whether or not you have BV?” and then indicated their response on a scale of 1 (*not at all worried*) to 7 (*very worried*).

Manipulation check questions. Owing to the feedback component of the IU manipulation, we were not able to obtain a direct manipulation check (“how well do you tolerate uncertainty?”) because it would not yield valid results given that participants would be likely to simply repeat what they were just told in the feedback. In addition, this question might arouse suspicion of our manipulation. In line with previous studies (e.g., Broemer & Blumle, 2003; Ladouceur et al., 2000; Polivy & Herman, 1991; Rosen et al., 2007), we therefore assessed the success of the manipulation by the mean differences in the number of endorsed statements. After completing all study materials, participants were asked to respond to the question “to what extent did you feel that the intolerance of uncertainty feedback that you received was characteristic of you?” on a scale ranging from 1 (*not at all*) to 7 (*very much*). Responses to this question represented a second measure of the success of the IU manipulation. The manipulation check for SU consisted of total scores on the 10 adapted items from the MUIS.

RESULTS

Participants

To be included in the analyses participants had to (a) receive the correct feedback for the condition to which they were assigned and (b) indicate a response of 3 to 7 on a scale ranging from 1 (*not at all*) to 7 (*very much*) to the question “to what extent did you feel that the intolerance of uncertainty feedback that you received was characteristic of you?” Five participants met neither criterion and were excluded. An additional 36 participants failed to meet criterion a because they endorsed too many or too few items to receive the correct feedback for the condition to which they were assigned (e.g., a participant in the low IU condition endorsed many statements as true and therefore received the high IU feedback). Twenty-six participants were excluded based on criterion b because it was important that participants felt the feedback was characteristic of them because this belief represented the success of the IU manipulation. There were no significant differences in age, gender, or SU scores between the excluded and included participants. The final sample included 28 men (mean age = 23.61 years, $SD = 8.28$) and 125 women (mean age = 20.80 years, $SD = 2.11$).

For 40 participants with particularly high baseline IU scores ($M = 100.97$, $SD = 19.03$ compared to $M = 82.45$, $SD = 19.26$ for participants who received the correct

feedback) the manipulation was not successful in lowering their IU. These participants who were assigned to the low IU condition still endorsed many statements (and thus received the feedback that they were high in IU) even though the statements were worded with “almost always” (e.g., “Uncertainty *almost always* stops me from having a strong opinion”). Thus, they were excluded from the data analysis as indicated previously in criterion a. The number of participants who received the “wrong” feedback was lower for the high IU condition—only one participant had to be excluded because he/she received the unintended low IU feedback. This discrepancy indicates that it is easier to increase rather than decrease a person’s IU. Due to the higher number of participants excluded from the low IU condition, purportedly because it was difficult to lower their initial relatively high IU, there was now a significant difference by experimental condition in baseline IU for the remaining participants: participants assigned to the high IU condition ($M = 0.23$, $SD = 1.12$) had higher scores on the baseline IUS compared to participants in the low IU condition, $M = -0.13$, $SD = 0.85$, $t(148) = 2.37$, $p = .02$.

To account for this difference, we used analysis of covariance (ANCOVA). The ANCOVA calculates adjusted means for the dependent variable as if the groups had not differed on the covariate. The ANCOVA tests whether the adjusted means differ significantly, using an error term from which the variance attributed to the covariate has already been partialled out (by linear regression). As applied to our study, the ANCOVA tests for differences in the means of high vs. low IU condition on information seeking and worry after the variation due to baseline IUS scores has been removed. Interpretation of the results remains the same as for an analysis of variance (ANOVA) because participants were still randomly assigned to conditions and the covariate was measured before the manipulation (Howell, 2002).

Manipulation and Deception Checks

All of the data analyses including the manipulation check questions were conducted after participants were removed based on the exclusion criteria. Responses to the IU measure at baseline and postmanipulation were indicated on different response scales due to the manipulation methodology. Thus, we calculated z -standardized scores on the two scales and used paired-sample t tests to examine differences from baseline to postmanipulation. In the high IU condition, there was a significant increase in IU scores from baseline ($M = 0.23$, $SD = 1.12$) to postmanipulation, $M = 0.58$, $SD = 0.84$, $t(56) = 2.52$, $p = .02$. In the low IU condition, there was a significant decrease in IU scores from baseline ($M = -0.13$, $SD = 0.85$) to postmanipulation, $M = -0.70$, $SD = 0.75$, $t(87) = -5.34$, $p < .01$. Results suggest that our manipulation successfully increased and decreased participants’ IU.

An ANOVA showed that participants in the high IU condition ($M = 17.95$, $SD = 5.72$) endorsed a significantly higher number of true statements on the IUS compared to those in the low IU condition, $M = 9.28$, $SD = 5.10$, $F(1, 144) = 95.77$, $p < .01$. There was no main effect of SU condition on IUS scores. However, there was an unexpected significant interaction between the IU and SU conditions on IUS scores, $F(1, 144) = 4.20$, $p = .04$. The IU versus SU effects can not be completely separated due to this interaction. However, the size of the interaction is relatively small compared to the main effect of IU condition: the main effect of IU condition ($\eta^2 = 0.4$) was 13 times greater than the main effect of the interaction ($\eta^2 = 0.03$). The difference in effect sizes supports the contention that although the effects cannot be totally separated, they can be separated to a degree and examined in their main influences.

An ANOVA showed that participants in the high SU condition ($M = 3.40$, $SD = 0.51$) were significantly less certain about whether or not they had BV, as indicated by lower scores on the adapted MUIS compared to those in the low SU condition, $M = 4.10$, $SD = 0.61$, $F(1, 149) = 56.54$, $p < .01$. There was no main effect of IU condition on MUIS scores nor was there an interaction between IU and SU condition on MUIS scores.

To check for the believability of our cover story, participants indicated to what extent they believed that the STI, BV, was real on a scale of 1 (*not at all*) to 7 (*very much*). There were no significant differences between conditions, IU condition: $M = 4.62$, $SD = 2.15$, SU condition: $M = 4.58$, $SD = 2.06$, $F(3, 139) = 1.13$, *ns*.

An important limitation to previous studies that experimentally manipulated IU is that the authors could not be certain that only IU was induced by the manipulation and not additional variables known to be related to IU such as worry ($r = .63$) and anxiety ($r = .57$; Freeston et al., 1994). This study makes a contribution to the literature by employing a methodology that allows us to test whether our manipulations unintentionally also affected levels of anxiety and worry, and by statistically controlling for these variables in our analyses.

To test whether our manipulations unintentionally affected levels of anxiety and worry, we conducted three separate univariate ANOVAs on the dependent variables (a) state anxiety (STAI-state), (b) trait anxiety (STAI-trait), and (c) worry (PSWQ). After entering premanipulation scores on the STAI (state and trait) and the PSWQ as covariates in their respective analyses, there were no significant differences between IU or SU conditions postmanipulation on measures of state anxiety ($M = 1.86$, $SD = 0.53$), trait anxiety ($M = 2.03$, $SD = 0.57$), or worry ($M = 3.07$, $SD = 0.86$), indicating that our manipulation indeed, manipulated only IU. Previous research has shown moderate correlations between IU, anxiety, and worry. Therefore, standardized premanipulation scores on the STAI, the PSWQ, and the IUS were entered as covariates in all of the following analyses

to control for baseline levels prior to the manipulation. In addition to these variables, we also controlled for participant's motivation to reduce uncertainty because it has been found in previous studies (Rosen et al., 2007) to be an important covariate in the prediction of information seeking.

Effect of Interaction Between IU and SU on Information Seeking

Means, standard deviations, and sample sizes for the variables comprising the information-seeking index are reported by condition in Table 1. The correlations among the variables comprising the information-seeking index are reported in Table 2. Means, standard deviations, and sample sizes for both dependent measures (information-seeking index, worry

TABLE 1
Means, Standard Deviations, and Sample Size for Individual Information-Seeking Variables Included in the Information-Seeking Index by Condition

Variable	Condition	<i>M</i>	<i>SD</i>	<i>n</i>
Behavioral information-seeking intentions ^a	High IU			
	High SU	3.43	1.47	30
	Low SU	2.67	1.40	29
	Low IU			
	High SU	2.89	1.15	53
BV sheet ^b	Low SU	2.78	1.59	41
	High IU			
	High SU	15 (50%)	–	30
	Low SU	8 (27.6%)	–	29
	Low IU			
Information request ^b	High SU	23 (43.4%)	–	53
	Low SU	17 (41%)	–	41
	High IU			
	High SU	12 (40%)	–	30
	Low SU	5 (17.2%)	–	29
	Low IU			
	High SU	9 (17%)	–	53
	Low SU	3 (7.3%)	–	41

Note. BV = bacillosis virus; IU = intolerance of uncertainty; SU = situational uncertainty.

^aStandardized scores ranging from 1 to 7. ^bEntries are in number of participants who took a BV sheet or requested additional information (% participants).

TABLE 2
Correlations Among Variables Comprising the Information-Seeking Index

Variable	Information-Seeking Intentions	BV Sheet
BV sheet	0.32*	—
Information request	0.34*	0.27*

Note. BV = bacillosis virus.

* $p < .01$.

TABLE 3
Means, Standard Deviations, and Sample Size for Information-Seeking and Worry by Condition

Variable	Condition	<i>M</i>	<i>SD</i>	<i>n</i>
Information-Seeking Index	High IU			
	High SU	1.08	2.54	30
	Low SU	-0.62	2.24	28
	Low IU			
	High SU	0.08	2.99	51
	Low SU	-0.60	1.76	40
Worry due to Uncertainty	High IU			
	High SU	0.53	1.22	30
	Low SU	-0.18	0.96	29
	Low IU			
	High SU	0.10	0.92	53
	Low SU	-0.43	0.53	41

Note. Means and standard deviations are *z* standardized. IU = intolerance of uncertainty; SU = situational uncertainty.

due to uncertainty) are reported by condition in Table 3. H1—which predicted an interaction between IU and SU, that is, that individuals will seek the most information when there is high SU and they are induced to have a high IU, and will seek the least information when there is low SU and they are induced to have a low IU—was assessed using multivariate ANCOVA followed by planned contrasts. The model is 2 (IU condition: high vs. low) \times 2 (SU condition: high vs. low). The dependent variable was score on the information-seeking index. The main effects of IU condition and SU condition were not significant. As predicted, the interaction between IU and SU was significant, $F(1, 139) = 5.04, p = .02$. Planned contrasts support our hypothesis: Individuals in the high IU and high SU condition ($M = 1.08, SD = 2.54$) sought the most information, whereas people in the low IU and low SU condition ($M = -0.61, SD = 1.74$) sought the least, $t(149) = 3.31, p < .01$.

Effect of Interaction Between IU and SU on Worry

H2 predicted an interaction between IU and SU such that individuals will worry most because of the uncertainty over whether or not they have BV when there is high SU and they are induced to have a high IU and will worry least when there is low SU and they are induced to have a low IU. This hypothesis was also assessed using multivariate ANCOVA followed by planned contrasts. The model is 2 (IU condition: high vs. low) \times 2 (SU condition: high vs. low). The dependent variable was *z*-standardized response to the question “To what extent do you feel worried because you feel uncertain about whether or not you have BV?” as indicated on a scale of 1 (*not at all worried*) to 7 (*very worried*). The main effect of IU condition was not significant. There was a main effect of SU condition whereby people in the high SU condition ($M = 2.30, SD = 1.40$) worried

more due to uncertainty than did those in the low SU condition $M = 1.54, SD = 1.00, F(1, 139) = 5.22, p = .02$. As predicted, the interaction between IU and SU was significant, $F(1, 139) = 4.00, p = .04$. Planned contrasts support our hypothesis: Individuals in the high IU and high SU condition ($M = 0.53, SD = 1.22$) worried due to uncertainty most, whereas people in the low IU and low SU condition ($M = -0.43, SD = 0.53$) worried least, $t(149) = 4.37, p < .01$.

The results remain the same when only women ($n = 125$) were included in the analyses. The results did not hold for the sample of men only ($n = 28$). The small sample size of men precludes drawing any conclusions about gender differences at this point but would be an avenue for future research.

DISCUSSION

The hypotheses were supported, showing that individuals sought the most information and worried due to uncertainty (over whether or not they had BV) most when there was high SU and they were induced to have a high IU, and that they sought the least information and worried least when there was low SU and they were induced to have a low IU. Previous research has shown separately that experimentally induced IU leads to higher information seeking (Rosen et al., 2007) and heightened worry (Dugas & Ladouceur, 2000) and that high SU is associated with higher information seeking (Funke & Nicholson, 1993) and greater psychological distress (Maissi et al., 2004). This study is the first to demonstrate the effect of an interaction between individual differences in IU and SU on information seeking and worry due to uncertainty.

Uncertainty orientation, a similar but distinct construct to that of IU, makes explicit in its underlying theory that motivation and information processing styles change according to individual differences (uncertainty orientation) and the amount of SU present. The results of this study suggest that research on IU should take into account the amount of SU in order to specify the conditions under which high/low IU will lead to adaptive (higher information seeking) or maladaptive behaviors (lower information seeking) and higher or lower worries.

Certain limitations must be taken into account when interpreting the findings. First, the study used a fictitious STI. However, we modeled this STI after the characteristics of a real STI, HPV, to increase the external validity of our findings. Future research should focus on actual infections such as HPV to ensure that the study results are generalizable to real health situations. Second, the results are based on a university sample. Although the results are highly applicable to this age group because students are at high risk for STI infection (Aral, 2001), the findings are limited in generalizability to other populations. Third, although we attempted to ensure that the sexual health threat was salient

to the population by requiring participants to be sexually active, there may have been variability in the personal salience of the STI threat. We addressed this issue by assessing individuals' consistency of condom use, number of sexual partners, and number of STI tests conducted. None of these variables were correlated with IU or SU, and therefore they were not controlled for in the analyses. Fourth, a methodological concern is that one of our outcome variables, worry due to uncertainty, was a single-item measure. This limitation warrants caution when drawing conclusions from the results. However, single-item measures of constructs such as cancer risk, cancer worry, and perceived cancer preventability have been shown to predict behavioral outcomes, including cancer screening (e.g., Lipkus, Iden, Terrenoire, & Feaganes, 1999). Last, there was no direct manipulation check for the IU manipulation ('how well do you tolerate uncertainty?') because it would not yield valid results, as participants would be likely to simply repeat what they were just told in the feedback portion of the manipulation. In addition, this question might arouse suspicion of our manipulation.

The findings suggest some important implications to health providers who communicate uncertain test results. First, the impact of individual differences in IU on people's ability to choose appropriate coping mechanisms changes according to the perceived level of SU. Individuals with high IU who are faced with high SU may in fact engage in more adaptive health behaviors, such as getting tested, whereas individuals with a low IU have a lower tendency to seek information. It would be advantageous for health providers to be aware of these differences to determine when it may be appropriate to foster a higher IU and higher SU to encourage information seeking. These findings indicate that it may be easier to increase rather than decrease IU. Further, prior research concluded that trait fluctuations within an individual at one time are likely to replicate at another point in time within a given context (Fleeson, 2001; Moskowitz & Zuroff, 2004). This conclusion supports the practical implications and the generalizability of this study: Inducing a higher IU and higher SU may lead to higher information seeking when such conditions are fostered again in a similar context. Future research should address how to implement these findings into health-care settings. For example, in the case of HPV, health providers should communicate the high prevalence of HPV (approximately 80%) to increase feelings of SU. In addition, the definition of IU includes the perception that uncertainty is unacceptable to the individual. One idea for fostering a higher IU is to engender the feeling that the SU (i.e., one's HPV status) is indeed unacceptable. Thus, the association between the presence of high risk (cancer-causing) HPV types and cervical cancer could be emphasized in communications.

Second, it should be noted that adaptive information-seeking behaviors may be accompanied by higher levels of psychological distress such as worry, as indicated by these

results. Indeed, individuals worried more under conditions of high SU compared than under low SU conditions. Multiple studies have demonstrated that as IU increases, worry also increases (e.g., Dugas & Ladouceur, 2000). However, the unique contribution of our worry variable is that it assesses the specific worry that is due to uncertainty rather than other types of worries (e.g., worries about symptoms, telling one's partner that they have an STI, etc.). Thus, our results specify the conditions under which worries may develop (high IU and high SU) and also the nature of the worries (due to uncertainty about whether or not one has BV) that lead to higher information seeking.

The results suggest a dilemma for health providers: is it more important to increase adherence to health recommendations by emphasizing uncertainty even if one might simultaneously induce higher levels of worry? Health providers must be cognizant of the fact that oftentimes uncertainty may go factually unresolved (e.g., a woman may receive a positive HPV test result, but this does not mean she will develop cervical cancer for certain). The challenge is to establish a balance in communicating uncertain information, such as a positive HPV test result, in a way that optimizes adaptive health behaviors and minimizes worry.

Communication studies that deal with uncertainty management provide some insights for health providers communicating this information. When uncertainty about, for example, the progression of disease, the presence of symptoms, or the prevention of transmission, is chronic, a necessary shift occurs from a goal of uncertainty reduction to a goal of uncertainty management (Brashers, Neidig, & Goldsmith, 2004; Mishel, 1990). The health provider can aid in uncertainty management via providing social support to the individual. This support affects uncertainty by encouraging reappraisals of the uncertainty as positive or by increasing perceptions of control through, for example, instrumental support, skill development (e.g., how to search for more information), and discussing one's emotional responses to the information (Brashers et al., 2004). For example, when communicating a positive HPV test result, the health provider can offer instrumental support to the individual by planning the exact date of the next follow-up appointment, which will increase perceptions of control over the potential risk of developing precancerous cervical lesions. Similarly, when health educators disseminate HPV information that may induce high SU about whether or not a person has HPV, the educators should accompany this information with clear guidelines for cervical cancer screening so an individual can develop a screening routine for managing the uncertainty.

These findings illustrate that high SU does not affect all individuals in the same way. Recent research has established the reliability and validity of a short-form (12 items) of the IUS (IUS-12; Carleton, Norton, & Asmundson, 2007). Use of this tool in a clinical setting would allow for a

quick (less than 5 min) assessment of IU so that a health provider can tailor his or her recommendations accordingly. Given the knowledge from this study that individuals high in IU are particularly prone to worry due to this uncertainty, providing opportunities for discussing one's emotional response and providing detailed instructions for managing their distress (tangible support) is essential. Research suggests that having someone to talk to about one's uncertainty can reduce stress and enable a more objective view of the situation (Brashers et al., 2004). Due to constraints on the amount of time a health provider can spend with an individual patient, we suggest that individuals high in IU be encouraged to bring a supportive friend to appointments in which they will receive test results that imply uncertainty in one's future health.

ACKNOWLEDGMENTS

The reported research was funded by a fellowship from the Fonds Québécois de Recherche sur la Société et la Culture and from the Psychosocial Oncology Research Training program to Natalie O. Rosen, as well as a New Opportunities Fund from the Canadian Foundation for Innovation and a grant by the Social Sciences & Humanities Research Council of Canada to Bärbel Knäuper. We thank Gabrielle Pagé and Warren Lewin for help with data collection and Mahtab Firuz for help with data entry.

REFERENCES

- Aral, S. O. (2001). Sexually transmitted diseases: Magnitude, determinants and consequences. *International Journal of STDs and AIDS, 12*, 211–215.
- Brashers, D. E., Goldsmith, D. J., & Hsieh, E. (2002). Information seeking and avoiding in health contexts. *Human Communication Research, 28*, 258–271.
- Brashers, D. E., Neidig, J. L., & Goldsmith, D. J. (2004). Social support and the managements of uncertainty for people living with HIV or AIDS. *Health Communication, 16*, 305–331.
- 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. *Communication Monographs, 67*, 63–84.
- Broemer, P., & Blumle, M. (2003). Self-views in close relationships: The influence of attachment styles. *British Journal of Social Psychology, 42*, 445–463.
- Brouwers, M. C., & Sorrentino, R. M. (1993). Uncertainty orientation and protection motivation theory: The role of individual differences in health compliance. *Personality and Individual Differences, 65*, 102–112.
- Brown, T. A., Antony, M. M., & Barlow, D. H. (1992). Psychometric properties of the Penn State Worry Questionnaire in a clinical disorder sample. *Behavior Research and Therapy, 30*, 33–37.
- Buhr, K., & Dugas, M. J. (2002). The Intolerance of Uncertainty Scale: Psychometric properties of the English version. *Behavior Research and Therapy, 40*, 931–945.
- Carleton, R. N., Norton, P. J., & Asmundson, G. J. G. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders, 21*, 105–117.
- Dugas, M. J., & Ladouceur, R. (2000). Treatment of GAD: Targeting intolerance of uncertainty in two types of worry. *Behavior Modification, 24*, 635–657.
- Fein, S., & Spencer, S. J. (1997). Prejudice as self-image maintenance: Affirming the self through negative evaluations of others. *Journal of Personality and Social Psychology, 73*, 31–44.
- Fleeson, W. (2001). Toward a structure- and process-integrated view of personality: Traits as density distributions of states. *Journal of Personality and Social Psychology, 80*, 1011–1027.
- Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry? *Personality and Individual Differences, 17*, 791–802.
- Funke, B. L., & Nicholson, M. E. (1993). Factors affecting patient compliance among women with abnormal pap smears. *Patient Education and Counseling, 20*, 5–15.
- Garber, J., & Hollon, S. D. (1991). What can specificity designs say about causality in psychopathology research? *Psychological Bulletin, 110*, 129–136.
- Gosselin, P., Ladouceur, R., Evers, A., & Laverdiere, A. (2005). Evaluation of intolerance of uncertainty: Development of a new measure. Poster presented at the annual conference of the Canadian Psychological Association, Montreal, Québec.
- Grenier, S., & Ladouceur, R. (2004). Manipulation de l'intolérance à l'incertitude et inquiétudes. *Revue Canadienne des Sciences du Comportement, 36*, 56–65.
- Hodson, G., & Sorrentino, R. M. (1999). Uncertainty-orientation and the big five personality structure. *Journal of Research in Personality, 33*, 253–261.
- Howell, D. C. (2002). *Statistical methods for psychology* (5th ed.). Pacific Grove, CA: Duxbury.
- Krohne, H. W. (1993). Vigilance and cognitive avoidance as concepts in coping research. In H. W. Krohne (Ed.), *Attention and avoidance*. Seattle, WA: Hogrefe & Huber.
- Ladouceur, R., Gosselin, P., & Dugas, M. J. (2000). Experimental manipulation of intolerance of uncertainty: A study of a theoretical model of worry. *Behaviour Research and Therapy, 38*, 933–941.
- Lipkus, I. M., Iden, D., Terrenoire, J., & Feaganes, J. R. (1999). Relationships among breast cancer concern, risk perceptions, and interest in genetic testing for breast cancer susceptibility among African-American women with and without a family history of breast cancer. *Cancer, Epidemiology, Biomarkers and Prevention, 8*, 533–539.
- Maissi, E., Marteau, T. M., Hankins, M., Moss, S., Legood, R., & Gray, A. (2004). Psychological impact of human papillomavirus testing in women with borderline or mildly dyskaryotic cervical cancer smear results: Cross sectional questionnaire study. *British Medical Journal, 328*, 1–6.
- Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour and Research Therapy, 28*, 487–496.
- Mishel, M. H. (1981). The measurement of uncertainty in illness. *Nursing Research, 30*, 258–263.
- Mishel, M. H. (1990). Reconceptualization of the uncertainty in illness theory. *Image: Journal of Nursing Scholarship, 22*, 256–262.
- Moskowitz, D. S., & Zuroff, D. C. (2004). Flux, pulse, and spin: Dynamic additions to the personality lexicon. *Journal of Personality and Social Psychology, 86*, 880–893.
- Polivy, J., & Herman, C. P. (1991). Good and bad dieters—Self-perception and reaction to a dietary challenge. *International Journal of Eating Disorders, 10*, 91–99.
- Rector, N. A., & Roger, D. (1997). The stress buffering effects of self-esteem. *Personality and Individual Differences, 23*, 799–808.
- Rosen, N. O., Knäuper, B., Pagé, G., Di Dio, P., Morrison, E., Mayrand, M. H., et al. (manuscript in preparation). Sources of uncertainty and reassurance about being infected with HPV: Women's qualitative responses in a pilot study.
- Rosen, N. O., Knäuper, B., & Sammut, J. (2007). Do individual differences in intolerance of uncertainty affect health monitoring? *Psychology & Health, 22*, 413–430.

- Salancik, G. R., & Conway, M. (1975). Attitude inferences from salient and relevant cognitive content and behavior. *Journal of Personality and Social Psychology*, *32*, 829–840.
- Schwartz, M. D., Lerman, C., Miller, S. M., Daly, M., & Masny, A. (1995). Coping disposition, perceived risk, and psychological distress among women at increased risk for ovarian cancer. *Health Psychology*, *14*, 232–235.
- Sorrentino, R. M., & Short, J. C. (1986). Uncertainty orientation, motivation and cognition. In R. M. Sorrentino & E. T. Higgins (Eds.), *The handbook of motivation and cognition: Foundations of social behaviour*. New York: Guilford.
- Spielberger, C. D. (1983). *State-Trait Anxiety Inventory for Adults*. Palo Alto, CA: Mind Garden.
- Stanley, M. A., Beck, J. G., & Zebb, B. J. (1996). Psychometric properties of four anxiety measures in older adults. *Behavior Research and Therapy*, *34*, 827–838.
- Walboomers, J. M., Jacobs, M. V., Manos, M. M., Bosch, F. X., Kummer, J. A., Shah, K. V., et al. (1999). Human papillomavirus is a necessary cause of invasive cervical cancer worldwide. *Journal of Pathology*, *189*, 12–19.
- Webster, D. M., & Kruglanski, A. W. (1994). Individual differences in need for cognitive closure. *Journal of Personality and Social Psychology*, *67*, 1049–1062.