THE PSYCHOSOCIAL IMPACT OF TRAIT AND STATE DIFFERENCES IN UNCERTAINTY: THE CASE OF HPV

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DEDICATION

To Matthew

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CONTRIBUTION OF AUTHORS

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ABSTRACT

A crucial element affecting individuals' responses to a health threat is how certain or uncertain they feel about whether that health threat will occur. Moreover, individuals differ in the degree to which they are affected by uncertainty. I propose that state and trait differences in uncertainty interact to predict psychosocial responses. The first manuscript shows that a higher intolerance of uncertainty (IU) leads to greater information-seeking about a health threat. The second manuscript shows that this relationship is moderated by perceived situational uncertainty (SU) and also affects worry. Specifically, individuals with higher IU seek the most information and worry most when they perceive the SU surrounding a health threat to be higher rather than lower. Next I used the real health threat of the human papillomavirus (HPV) to further examine my questions. Some characteristics of HPV infections may induce uncertainty in women (e.g., the infection can stay undetected [latent] for years; the fact that a Pap test could be normal when an HPV infection is present). Manuscript 3 describes 11 facts about HPV that women reported made them feel uncertain of their HPV status. Given that informational needs and level of worry/anxiety differ according to IU and SU, and that women do perceive some facts about HPV as uncertainty-inducing, the last manuscript examines in a randomized controlled design the impact of an IU on anxiety after receiving an informational intervention about HPV. The results demonstrate that meeting the informational needs of women with higher IU (i.e. giving them a lot of information about HPV) increases their anxiety compared to giving them less information. I propose that

this heightened anxiety arises because HPV is an example of a health threat whereby uncertainty cannot be resolved through more information. Thus, this subset of individuals may be at risk for greater distress when they seek out or receive uncertainty-inducing information. The results inform health providers regarding the potential positive (i.e., greater information-seeking) and negative (i.e., higher worries and anxiety) effects of uncertainty-inducing information. Additional theoretical and applied implications as well as avenues for future research are discussed.

RÉSUMÉ

La réaction qu'une personne a face à une menace de santé peut être grandement affectée par ses sentiments de certitude ou d'incertitude que la menace se produira. De plus, les personnes sont affectées différemment par l'incertitude. Je propose que les différences situationnelles et du trait de l'incertitude interagissent pour prédire les réponses psychologiques. Le premier manuscrit démontre qu'une intolérance d'incertitude (I-I) élevée mène à une recherche d'information sur la menace de santé. Le deuxième manuscrit démontre que cette relation est modérée par la perception d'incertitude situationnelle (I-S) et que cette relation affecte l'inquiétude. Spécifiquement, les individus avec un haut degré d'I-I recherchent plus d'information et sont les plus inquiets lorsqu'ils perçoivent l'I-S entourant la menace de santé comme étant élevée plutôt que basse. J'ai par la suite utilisé une menace de santé réelle, le virus du papillome humain (VPH), afin d'examiner davantage mes questions. Certains aspects d'une infection du VPH peuvent engendrer de l'incertitude chez les femmes (par exemple une infection peut rester non détectée pour des années, ou le fait qu'un test de Pap peut se révéler normal lorsqu'en réalité il y a infection du VPH). Le troisième manuscrit décrit 11 faits sur le VPH que les femmes ont reporté être la cause d'incertitude concernant leur état de VPH. Considérant les besoins d'information, que le niveau d'inquiétude-d'anxiété varie selon l'I-I et l'I-S, et que les femmes perçoivent certains aspects du VPH comme étant une source d'incertitude, le dernier manuscrit examine avec une étude contrôlée randomisée l'impacte du I-I sur l'anxiété après avoir reçu une intervention informationnelle

sur le VPH. Les résultats démontrent que, pour les femmes avec une I-I élevée, satisfaire leur besoin d'information (c'est-à-dire leurs donner beaucoup d'information sur le VPH) accroît leur niveau d'anxiété comparé à si elles sont données moins d'information. Je propose que cette anxiété intensifiée surgie puisque le VPH est un exemple de menace de santé où l'incertitude ne peut être résolu par le biais d'une accumulation d'information. Donc, ce sous-groupe de femmes risquent d'accroîtrent leur niveau de détresse lorsqu'elles sont à la recherche ou reçoivent de l'information qui peut induire l'incertitude. Ces résultats informent les travailleurs dans le domaine de la santé des effets positifs (c'est-à-dire la recherche d'information) et négatifs (c'est-à-dire une augmentation d'inquiétude et d'anxiété) dont l'information qui peut induire l'inquiétude peut avoir. Un nombre d'implications théoriques et appliquées ainsi que des idées pour la recherche à venir sont examinées.

GENERAL INTRODUCTION

The main theoretical question of the current research program is: What is the affective and behavioural impact of state and trait differences in uncertainty when being faced with a health threat? My thesis therefore distinguishes between two domains of research on uncertainty. First, perceived situational uncertainty (SU) refers to the perceived characteristics of a situation, and second, intolerance of uncertainty (IU) refers to a trait of the individual.

The majority of research on uncertainty in health has explored the effect of SU on psychological functioning (e.g., anxiety, worry) and behaviour (e.g., information-seeking, adherence to medical recommendations). Researchers have used various definitions of SU in their studies and likewise my understanding of the concept has evolved and is reflected over the course of my research. The most precise definition of SU that I retained by the end of my dissertation refers to the doubt that exists about whether or not a particular outcome will occur (Keren & Gerritson, 1999), such as the uncertainty produced when an individual finds out that he or she possesses a certain gene that might or might not lead to cancer (e.g., Gwyn, Vernon, & Conoley, 2003). Past researchers have found that anxiety is higher when uncertainty remains unresolved. For example, one study found that among women who tested positive for the human papillomavirus (HPV), not knowing whether or not the result will lead to negative health consequences (i.e. cervical lesions) was associated with increased anxiety (Maissi, Marteau, Hankins, Moss, Legood, & Gray, 2004).

Much of the research on SU in health contexts has been conducted using the Mishel Uncertainty in Illness Scale (MUIS; Mishel, 1981). The MUIS measures uncertainty in the lives of patients facing acute illness, treatment, and hospitalization, but also the uncertainties of those living with chronic illnesses. The MUIS assesses the patients' ability to extract meaning from the illness-related experience (Mishel, 1988). This meaning is not merely a consequence of having adequate information (i.e. it is not equal to knowledge); rather it is derived from beliefs about the event, predictions about event outcomes, and through assigning value to the event (as positive, negative, or neutral). Early research using the MUIS identified different levels of uncertainty among patients being diagnosed with an illness, patients undergoing treatment, and surgical patients (Mishel, 1981). Researchers have since established that greater uncertainty is associated with poorer decision-making, poorer psychosocial adjustment and lower quality of life (Christman, McConnell, Pfeiffer, Webster, Schmitt, & Ries, 1988; Mishel, 1999; Wong & Bramwell, 1992). The MUIS does not intend to assess the impact of the uncertainty itself, in other words, how stressful or distressing the patients perceive uncertainty to be.

Individual differences in coping with uncertainty

However, individuals do differ in the degree to which they are affected by uncertainty. The individual difference concepts described in the following sections differ from perceived situational uncertainty in that they refer to a trait of the individual rather than a perceived characteristic of the situation. The vast majority of research examining individual differences in dealing with uncertainty

has been with respect to psychological functioning (e.g., anxiety disorders) and social psychological phenomena (e.g., persuasion, stereotyping, impression formation). For example, researchers have shown that an intolerance of uncertainty plays a key role in the development and maintenance of both Generalized Anxiety Disorder and Obsessive Compulsive Disorder (e.g., Dugas, Buhr, & Ladouceur, 2004; Dugas, Ladouceur, Léger, Freeston, Langlois, Provencher, et al., 2003; Holaway, Heimberg & Coles, 2006; Steketee, Frost, & Cohen, 1998). Others have shown that individuals who have a greater desire for definite knowledge on an issue, i.e. a greater need for certainty (referred to as a high need for closure) are more motivated to use information-processing heuristics (Mayseless & Kruglanski, 1987), rely on stereotypes (Kruglanski & Freund, 1983) and show stronger in-group favouritism (Maass & Arcuri, 1992) compared to those with a low need for closure (see more examples in Kruglanski & Webster, 1996).

Although perceived situational uncertainty (SU) has been extensively documented as a critical component to the illness experience, there are few researchers who have taken individual differences in coping with uncertainty into account in health research. One notable exception is Krohne's (1993) theory of coping with health threats. Krohne (1993) proposed 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 (IU) leads to higher information-seeking when faced with a health

threat; an assertion that was tested in manuscript one (Rosen, Knäuper & Sammut, 2007) of this thesis. A second more recent exception is a study that examined the interaction between IU and perceived risk on distress following an uninformative test result for mutations on the BRCA 1 or BRCA 2 genes (O'Neill, Demarco, Peshkin, Rogers, Rispoli, Brown et al., 2006). Mutations on these genes increase former cancer patients' susceptibility to developing breast or ovarian cancer again. If no mutation in the BRCA 1 or BRCA 2 genes is detected, then test results are considered uninformative because there is still the possibility of a mutation in a different cancer susceptibility gene or that the mutation went undetected. The researchers found that for women receiving uninformative results, those with higher IU and higher perceived risk experienced higher levels of cancer-related and genetic-testing distress six months later, suggesting that these women may be at risk for long-term distress.

In sum, there is a considerable gap in knowledge of how trait differences in tolerating uncertainty impact individuals' affective (e.g., worry, anxiety) and behavioural (e.g., information-seeking) responses to health threats. Research examining the impact of these individual differences has important implications. Identifying individual differences that may increase people's vulnerability to psychological distress and affect adherence to screening recommendations is important information for health care providers who communicate test results. Specifically, the results would allow making informed recommendations to health providers regarding both the potential positive effects (i.e., greater information-seeking) but also the potential negative effects (i.e., higher worries and anxiety) of

communicating uncertainty-inducing information. We believe it is possible to prospectively identify individuals with higher IU through the use of a reliable and valid screening tool such as the short-form of the IUS (12 items, IUS-12; Carleton, Norton, & Asmundson, 2007). Use of this tool in a clinical setting would allow for a quick (less than 5 minutes) assessment of IU. Alternatively, health providers could be trained to ask and interpret a few informal screening questions (based on the IUS) to assess an individuals' IU. However, the reliability and validity of this informal assessment would need to be established. 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 adaptive health behaviours, and when it may be necessary to provide additional social support to those who have difficulty managing uncertainty.

Comparing Intolerance of Uncertainty to Related Constructs

A number of researchers have conceptualized individual differences in responding to uncertainty (e.g., Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994; Frenkel-Brunswik, 1949; Kruglanski & Webster, 1996; Sorrentino & Short, 1986). The definitions and measures used to assess these various concepts are related and past research has even, mistakenly, used them interchangeably (e.g., Furnham & Ribchester, 1995; Majid & Pragasam, 1997; Myers, Henderson-King, & Henderson-King, 1997). It is important to distinguish between similar but distinct concepts to establish whether conclusions drawn from past findings need to be re-evaluated because the concepts were confounded in them. Furthermore, the improved construct explication would – through more precise measurement of

the respective constructs – increase the power to select the appropriate construct for one's research question and therefore make correct predictions in research.

The following section differentiates the concept of an intolerance of uncertainty (IU) from three other related but distinct individual differences (intolerance of ambiguity, uncertainty-orientation, and need for cognitive closure) with the aim of clarifying why our research questions can best be addressed using the construct of IU. For each concept I will outline (1) the definition (2) the primary or most common means of assessment and (3) the similarities and differences with IU. I will then provide a brief description of the clinical case example used in my research program, which is the sexually transmitted infection called the human papillomavirus (HPV). Finally, I will provide the objectives of this dissertation and introduce the manuscripts that are included.

Intolerance of Uncertainty

An intolerance of uncertainty (IU) refers to a set of cognitive, emotional, and behavioural reactions to perceived uncertainty (Freeston et al., 1994). More specifically, a high 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, p. 934). IU is considered to be a *filter* through which the environment is viewed and uncertainty is regarded as unacceptable (Buhr & Dugas, 2002). Thus, a person with high IU views uncertain situations as stressful and upsetting, highly aversive, and believes that being uncertain about the future is unfair. In contrast, persons with low IU do not feel disturbed by these same situations nor do they hold these maladaptive

beliefs (Dugas, Hedayati, Karavidas, Buhr, Francis, & Phillips, 2005). Most recently, Dugas et al. (2005) specified that IU represents an emotional state oriented toward the future rather than the present.

The self-report measure used to assess IU is the Intolerance of Uncertainty Scale (IUS) (Buhr & Dugas, 2002). The IUS includes 27 items that assess emotional, cognitive and behavioural reactions to ambiguous situations, implications of being uncertain and attempts to control the future. The scale items are composed of four factors: (1) uncertainty leads to the inability to act (e.g., "uncertainty stops me from having a strong opinion"); (2) uncertainty is stressful and upsetting (e.g., "uncertainty makes life intolerable"); (3) unexpected events are negative and should be avoided (e.g., "I can't stand being taken by surprise") and (4) being uncertain is unfair (e.g., "I can't stand being undecided about my future"). The IUS has excellent internal consistency, $\alpha = .91$, (Freeston et al., 1994) and good test-retest reliability over a five-week period, $r = .78$; $p < .001$, (Dugas, Freeston, & Ladouceur, 1997). The IUS has also demonstrated convergent validity with measures of worry ($r = .63$) and divergent validity with measures of anxiety ($r = .57$) and depression ($r = .52$) (Buhr & Dugas, 2002; Freeston et al., 1994). Although the correlations are moderate to high, there is still unique variance attributed to IU that cannot be captured by these other variables.

Intolerance of Ambiguity

Ambiguity was first defined by Budner (1962, p. 30) as a situation that "cannot be adequately structured or categorized because of the lack of sufficient cues." An ambiguous situation involves novelty, complexity, insolubility,

unpredictability and uncertainty (Budner, 1962). More specifically, high ambiguity exists when there is more than one possible interpretation of an event and each possibility carries a varying degree of uncertainty (Cioffi, 1991). In this way, ambiguity can be viewed as leading to uncertainty.

IU is a relatively new concept, whereas the concept of intolerance of ambiguity (IA) was first introduced by Frenkel-Brunswik in 1948. Since then, researchers have studied IA across various disciplines such as clinical psychology (e.g., Furnham & Ribchester, 1995; Kirton, 1981; McLain, 1993; Myers et al., 1997) and industrial and organizational psychology (Furnham & Ribchester, 1995) and to investigate variables including personality style, religious beliefs, attitudes and career choices (Budner, 1962; Furnham, 1994). Researchers concur that IA refers to an individual's tendency to interpret ambiguous situations as a source of threat or discomfort (Budner, 1962; Grenier, Barrette, & Ladouceur, 2005; Kirton, 1981; MacDonald, 1970; McLain, 1993). This interpretation leads to three specific reactions that are characteristic of people with high IA. First, their cognitive reactions include the tendency to view ambiguous situations rigidly in black or white. Second, their emotional reactions involve uneasiness, discomfort, dislike, anger and anxiety. And third, they exhibit predictable behavioural reactions, such as the rejection or avoidance of ambiguous situations (Bhushan & Amal, 1986). A person with low IA views ambiguous stimuli as challenging, desirable, and interesting (Furnham & Ribchester, 1995).

It is not surprising given that the concept of IA has been studied for over 50 years that researchers have developed a myriad of self-report measures to

assess it (Budner, 1962; Bushan & Amal, 1986; MacDonald, 1970; McClain, 1993; Norton, 1975; O'Conner, 1952; Rydell & Rosen, 1966). A review of the literature indicates that the Budner (1962) scale, called the Scale of Tolerance-Intolerance of Ambiguity (TIA) appears to be the most commonly used questionnaire for assessing IA. The TIA consists of 16-items (half positive, half negative) that assess the tendency to perceive ambiguous situations as threatening. Each item refers to one of three types of ambiguous situations: novelty (e.g., "I would like to live in a foreign country for a while"), complexity (e.g., "A good teacher is one who makes you wonder about your way of looking at things"), and insolubility (e.g., "Most of our decisions are based on insufficient information"). The TIA has shown good test-retest reliability over a two-month period ($r = 0.85$, $p < .001$) but only moderate internal consistency ($\alpha = 0.49$-0.59; Budner, 1962; Furnham, 1994). However the authors maintain that the TIA has shown adequate evidence of validity through its correlations with other measures of IA (ranging from $r = 0.44$-0.57; Furnham, 1994) and with measures of conventionality and authoritarianism (Budner, 1962).

Both IU and IA can be understood as filters through which individuals perceive their environment as a source of discomfort and anxiety (Buhr & Dugas, 2002; Grenier et al., 2005). IU and IA provoke cognitive (e.g., heightened perception that uncertainty/ambiguity is unacceptable), emotional (e.g., heightened anxiety, worry), and behavioral (e.g., rejection or avoidance of threat related information) reactions in individuals in response to threatening situations (Grenier et al., 2005). Thus, it is logical that IU, as assessed by the IUS (Buhr &

Dugas, 2002) and IA, as assessed by the TIA (Budner, 1962) have a moderate positive correlation of $r = .42, p < .01$ (Buhr & Dugas, 2006). This correlation suggests that both scales assess the general tendency to prefer certainty and predictability (Buhr & Dugas, 2006). Yet, the moderate correlation indicates that the scales assess distinct constructs.

One important conceptual difference was recently proposed in the literature. Grenier et al. (2005) suggest that those who are intolerant of ambiguity cannot tolerate the ambiguous features of a situation in the "here and now," which translates into feeling threatened by the current situation. In contrast, people who are intolerant of uncertainty find that uncertainty over a potential negative event is unacceptable and therefore feel threatened by a future situation (Dugas, Gosselin, & Ladouceur, 2001). In both cases, a person with a high IA or a high IU will experience distress however the impetus for IA is in the present and for IU it is the future (Grenier et al., 2005).

The distinction between IU and IA was recently examined empirically (Miller, Rosen & Knäuper, 2007). The researchers examined the correlations between the IUS and the TIA with measures of future and present time perspective as assessed by the Zimbardo Time Perspective Inventory-Short Form (Keough, Zimbardo, & Boyd, 1999). Miller et al. hypothesized that IU (but not IA) would be positively correlated with the future subscale, whereas IA (but not IU) would be positively correlated with the present subscale. The authors did not find support for the hypothesis, although they observed some trends in the hypothesized direction for the relationship between IU and future-orientation. The

authors proposed two explanations for the lack of significant findings. First, some of the measures had low internal consistency including the measure of IA (α = .55) and of present-orientation (α = .42). Second, it is possible that the trait features of IU and IA may only manifest themselves under conditions of high perceived SU and perceived situational ambiguity. A future study should use more reliable measures and manipulate perceived situational uncertainty and ambiguity to establish empirically whether the theoretical proposition made by Grenier et al. (2005) is supported.

Need for Cognitive Closure

Like an intolerance of ambiguity, the need for cognitive closure (NCC) has been researched extensively, mainly by social psychologists, over the past decades (see Kruglanski & Webster, 1996, for a review). For example, researchers have established relationships between NCC and various psychological phenomena including impression formation (Heaton & Kruglanski, 1991), stereotyping (Dijksterhuis, Knippenberg, Kruglanski, & Schaper, 1996), and persuasion (e.g., Kruglanski, Webster, & Klem, 1993). Kruglanski and Webster (1996, p.264) define NCC along a motivational continuum as "an individual's desire for a firm answer to a question and an aversion toward ambiguity". Individuals with a high NCC tend to be impulsive in decision-making due to their impatience to find an answer and tend to be rigid in their thinking (i.e. reluctant to see other points of view). In contrast, individuals low in NCC tend to avoid closure and are reluctant to give a definite opinion (Kruglanski & Webster, 1996).

The self-report measure used to assess NCC is the *Need for Closure Scale* (NFCS) (Webster & Kruglanski, 1994). The 47 items (including a 5-item lie scale) consist of five subscales: (1) desire for predictability (e.g., "I dislike unpredictable situations"), (2) discomfort with ambiguity (e.g., "I don't like situations that are uncertain"), (3) preference for order and structure (e.g., "I like to have a plan for everything and a place for everything"), (4) decisiveness (e.g., "I usually make important decisions quickly and confidently"), and (5) close-mindedness (e.g., "I always see many possible solutions to problems I face"). Past research has shown that the NFCS has excellent convergent and discriminant validity (e.g., with measures of authoritarianism, impulsivity, need for cognition), good test-retest reliability over 12-13 weeks ($\alpha = .86$) and good internal consistency ($\alpha = .84$) (Webster & Kruglanski, 1994).

There are two theoretical differences between IU and NCC. The first is that need for closure occurs along a *motivational* continuum where one end of the continuum reflects a strong need for closure and the other end reflects a strong need to avoid closure. In contrast, IU focuses on the psychological effects of uncertainty (e.g., anxiety, worry) on the individual rather than the motivation to approach or avoid uncertainty. Second, NCC theory posits that the motivation to approach or avoid closure, although a stable individual difference, can reverse according to the perceived benefits and costs of the situation. Thus, a person with high NCC may actually approach or prefer uncertainty if he or she perceives the benefits of uncertainty and costs of certainty to outweigh the benefits of certainty and the costs of uncertainty (Kruglanski & Webster, 1996). Although the

psychosocial impact of IU may change (increase or decrease) under conditions of higher and lower uncertainty (see manuscript 2), the conceptualization of IU is unilateral in that individuals demonstrate more or less of the tendency to react negatively to uncertainty.

The relationship between IU and NCC was recently examined (Berenbaum, Bredemeier, & Thompson, 2008) based on the observation that certain items on the self-report measures were similar (e.g., IUS: "I must get away from all uncertain situations," NFCS: "I don't like situations that are uncertain") and that the constructs have shown similar correlates, for example, with intolerance of ambiguity (Buhr & Dugas, 2006; Webster & Kruglanski, 1994). Berenbaum et al. (2008) conducted an independent factor analysis of the IUS and examined correlations between these factors and the NFCS subscales. The researchers labelled the four factors of the IUS to be: (1) desire for predictability, (2) uncertainty paralysis, (3) uncertainty distress and (4) inflexible uncertainty beliefs. They found that the desire for predictability subscale of the IUS was most strongly correlated with the predictability ($r = .47$), ambiguity ($r = .55$), and order ($r = .32$) subscales of the NFCS (all $p < .01$). The order subscale of the NFCS did not correlate with any of the other subscales of the IUS and the decisiveness subscale was negatively correlated with all the IUS subscales (i.e. the more decisive [reflects higher NCC] the less intolerant of uncertainty [reflects lower IU]). The correlations between the close-mindedness subscale of the NFCS and the IUS subscales were all positive but low (less than .35) suggesting some relationship but no significant overlap. These correlational results suggest that the

predictability, ambiguity and order subscales of the NFCS are most closely aligned with the IU construct, and the desire for predictability subscale of the IUS in particular (Berenbaum et al. 2008). However, the moderate correlations as well as the other dimensions of NCC that are negatively related or unrelated to the IUS subscales demonstrate that IU and NCC each capture additional variance not accounted for by the other.

Uncertainty-Orientation

Sorrentino and Short (1986) developed their measure of uncertainty-orientation to assess individual differences in how people approach or avoid uncertain situations. The authors contend that every situation involves an informational component, that is, the extent to which the situation provides information that will resolve uncertainty about the self, the environment, or potential outcomes of the situation. The construct of uncertainty-orientation combines the work of Kagan (1972) and Rokeach (1960). Kagan (1972) suggested that uncertainty reduction is a primary motivation that occurs when people are presented with uncertainty about the self or the environment. Rokeach (1960) distinguished between people who do not feel threatened by uncertainty and are able to resolve it and those people who do feel threatened by uncertainty.

Sorrentino and Short (1986) combined aspects of the work of both these researchers to develop their own construct called uncertainty-orientation. Here, individuals are classified as either "uncertainty-oriented" (those who deal directly with uncertainty, are motivated to reduce it, and are capable of resolving it) or "certainty-oriented" (those who feel threatened by information that contains

uncertainty and are motivated to maintain clarity and avoid uncertainty). Thus, uncertainty-oriented individuals are motivated when there is uncertainty to be resolved about the self or the environment, leading them to orient toward new or unfamiliar environments. In contrast, certainty-oriented individuals are motivated when there is no uncertainty to be resolved, leading them to orient toward environments that are familiar and consistent.

The assessment of one's uncertainty-orientation is made up of two theoretically and empirically independent measures: (1) a projective test used to assess the tendency to approach uncertainty (Sorrentino, Roney, & Hanna, 1992) and (2) a 22-item self-report questionnaire of acquiescence-free authoritarianism (Cherry & Byrne, 1977) used to assess the tendency to approach or maintain certainty. The projective test uses four sentence leads and the stories written by participants based on the leads are coded and scored for uncertainty-resolving imagery. Standardized scores on the authoritarianism measure are subtracted from standardized scores on the uncertainty measure to calculate one's uncertainty-orientation. Previous research has found excellent inter-rater reliability for the uncertainty measure (e.g., $r = .90$ or better with another expert scorer, Frederick & Sorrentino, 1977) and good test-retest reliability ($r = .90$, Sorrentino, 1977) for the measure of authoritarianism. Previous research has also demonstrated the validity of the uncertainty-orientation measure through predicting future behaviours (e.g., Driscoll, Hamilton, & Sorrentino, 1991; Sorrentino, Bobocel, Gitta, Olson, & Hewitt, 1988).

The relationship between IU and uncertainty-orientation has yet to be examined empirically, but there are some important theoretical differences. First, like NCC, Sorrentino and Short (1986) conceptualize "uncertainty-orientation" in terms of the degree to which individuals are *motivated* to resolve uncertainty and how this motivation will affect information-processing. As previously stated in the comparison between IU and NCC, this conceptualization is different from an evaluation of one's *intolerance* of uncertainty. 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 resolve or avoid uncertainty (Rosen et al. 2007). Second, uncertainty-oriented individuals find uncertain situations to be desirable and challenging and therefore approach these situations. In contrast, individuals with low IU, although not particularly bothered by uncertainty, do not feel invigorated by it or motivated to seek it out. Thus, uncertainty-orientation specifies not only which individuals find uncertainty threatening, but also whether they will avoid or seek situations that contain uncertainty. In contrast, IU identifies those who find uncertainty threatening and therefore avoid it. It would be interesting to test the theoretically proposed differences between IU and uncertainty-orientation. One might expect a low negative correlation between IU and uncertainty-orientation based on the theoretical similarities and differences, but the extensive training and scoring of the projective measure (approximately 40 hours of training, A. C. H. Szeto, personal communication, September 21, 2006) may have precluded prior attempts

to compare the constructs. In sum, the arguments that differentiate IU from uncertainty-orientation are similar to those that distinguish IU from NCC because both are motivational rather than clinical constructs.

Intolerance of Uncertainty and Health

Researchers have primarily studied IU within the context of anxiety disorders (e.g., Dugas, Gagnon, Ladouceur, & Freeston, 1998; Freeston et al., 1994; Ladouceur et al., 2000) whereas IA, NCC and uncertainty-orientation has rarely been studied in this context (for exceptions see Anderson & Schwartz, 1992; Myers et al., 1997). Grenier et al. (2005) argue that IU is more appropriate than IA to use in studies of anxiety disorders because these disorders most often revolve around the anticipation of future negative consequences. The uncertainty about a potential health threat may refer to any aspect of the health condition such as the seriousness of the condition, one's vulnerability or risk, treatment efficacy and prognosis (Mishel, 1981). All of these aspects share the common feature of inducing uncertainty regarding future negative consequences to one's health. I sought to understand the affective and behavioural impact of both state and trait uncertainty when individuals are faced with a health threat. Given that IU is a trait oriented toward future negative consequences and given that our research questions concern the psychological rather than motivational effects of uncertainty when faced with a potential health threat, IU appeared to be the best suited construct for addressing the present research questions.

Clinical Context for Uncertainty: Human Papillomavirus (HPV)

The clinical case example used to answer my research questions is the sexually transmitted infection called the human papillomavirus (HPV). DNA from the sexually transmitted infection (STI), HPV has been found in up to 99.7% of cervical cancer cases worldwide leading researchers to conclude that certain strains of HPV (high risk or oncogenic types) *cause* cervical cancer (Walboomers, Jacobs, Manos, Bosch, Kummer, Shah, et al. 1999). Some characteristics of the natural history of HPV infections may be perceived as reassuring (e.g., low chances of developing cervical cancer in the 3 years following a negative result), while others may cause uncertainty (e.g., the infection can stay undetected [latent] for years; the fact that a Pap test could be normal when an HPV infection is present). HPV is ideal for studying the affective and behavioural impact of uncertainty for a number of reasons: (1) there are many facts about HPV that may induce uncertainty about one's HPV status and the future health implications of a positive HPV test result, (2) the potential health risks can be reduced through cervical cancer screening, and (3) the introduction of HPV testing and the HPV vaccine means that HPV information is more accessible through the media and Internet but there is little known about the psychosocial impact of receiving this potentially uncertainty-inducing information on women.

Thesis Objectives

The objectives of this dissertation are divided into two parts. The first part answers the question whether trait and state differences in uncertainty impact behavioural and affective responses to a health threat. The first manuscript in the

thesis (Rosen et al., 2007) investigates the causal relationship between trait differences in intolerance of uncertainty (IU) and information-seeking. The second manuscript examines how this relationship is moderated by state situational uncertainty (SU) and how the IU by SU interaction also affects worry (Rosen & Knäuper, in press).

The second part of the dissertation examines these questions with a community sample of women and within the real health context of the human papillomavirus (HPV) and HPV DNA testing as a screen for cervical cancer. Researchers have provided some indirect empirical evidence (i.e., indirect because they did not directly ask women but rather inferred it from interviews with women about HPV) for information about HPV that induced uncertainty in women (Anhang et al., 1999) and information that women found to be reassuring (Waller, McCaffery, Nazroo, & Wardle, 2005). However, they did not specify comprehensively what specific facts induce uncertainty and what reassures women upon receiving written HPV information. The third manuscript identifies in a descriptive design what specific facts about HPV make women feel uncertain about their HPV status and the potential health implications of an HPV DNA test result and what facts reassure them (Rosen, Knäuper, Pagé, Di Dio, Morrison, Mayrand, et al., 2008). Given that HPV information induces uncertainty, the last manuscript in this thesis examines in a randomized controlled design the impact of an intolerance of uncertainty on anxiety after receiving an informational intervention about HPV (Rosen, Knäuper, DiDio, Morrison, Tabing, Feldstain, et al., 2008).

MANUSCRIPT 1: DO INDIVIDUAL DIFFERENCES IN INTOLERANCE OF UNCERTAINTY AFFECT HEALTH MONITORING?

Rosen, N. O., Knäuper, B., & Sammut, J. (2007). Do individual differences in intolerance of uncertainty affect health monitoring? *Psychology & Health, 22,* 413-430.

Abstract

Researchers have postulated that individual differences in intolerance of uncertainty (IU) may affect people's health behaviours. Study 1 ($N = 147$ university students) supports this proposition showing that higher IU is associated with higher monitoring (seeking threat-relevant information). Study 2 ($N = 117$ university students) experimentally manipulated IU to ensure that the association is not due to other related constructs such as anxiety or worry. Results show that inducing high IU led to increased monitoring as reflected by higher scores on an index of monitoring measures. Wanting information about the health threat in order to reduce their uncertainty was an independent predictor of monitoring and did not mediate the relationship between IU and monitoring. Findings suggest that high IU induces people to increase their monitoring; an adaptive strategy when the health threat can be reduced through this behaviour.

Introduction

When people are faced with a potential health threat, a key element affecting their subsequent behaviour is how certain or uncertain they feel that the threat will actually ensue. For example, a woman faced with the certain health threat of a positive breast cancer diagnosis is likely to comply with the physician recommended treatments. In contrast, it is more difficult to predict whether a woman who is faced with the uncertain health threat of a family history of breast cancer will go for regular mammograms or not. Uncertainty refers to the circumstance whereby a particular event or situation cannot be structured or categorized because of insufficient information (Budner, 1962). Thus, uncertainty may result from a lack of information or may arise when there is no possible information to adequately resolve the uncertainty. In the above example, there is no test that could provide certain information about whether or not a woman with a family history of breast cancer will develop breast cancer. Uncertainty about a health threat may refer to any or all aspects of the health condition. For example, there may be uncertainty with respect to the seriousness of the condition, one's vulnerability or risk, treatment efficacy and prognosis (Mishel, 1981). The focus of the present research is on uncertainty whereby there is no possible information that could provide permanent certainty, for example testing positive for the Human Papillomavirus (HPV) does not mean that one will develop cervical cancer for certain; however the potential health consequences may be prevented by following screening recommendations.

STUDY 1

Past research exploring the role of uncertainty in health can be divided into two domains. First, research has examined the role of uncertainty caused by particular situations, for example, the uncertainty produced when people find out that they possess a certain gene that might, or might not result in a disease (e.g., Gwyn, Vernon, & Conoley, 2003). Situational uncertainty of this kind can lead to psychological distress, such as increased anxiety, particularly when that uncertainty remains unresolved (Maissi, Marteau, Hankins, Moss, Legood, & Gray, 2004). In fact, one study found that women at increased risk for ovarian cancer experienced high levels of psychological distress equivalent to that experienced by breast cancer patients (Schwartz, Lerman, Miller, Daly, & Masny, 1995). Although these women were only *at risk* for cancer, that is, whether or not they would develop cancer was uncertain, they experienced distress analogous to women with cancer.

A second domain of research examining uncertainty has looked at individual differences in intolerance of uncertainty (IU) (e.g., Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). In addition to the effect of situational uncertainty, people may be more or less affected by the unknown outcome of a health threat and these differences could explain additional variance in behaviours such as information seeking and adherence to screening appointments. Intolerance of uncertainty refers to cognitive, emotional, and behavioural reactions to uncertainty (Freeston et al., 1994). It differs from situational uncertainty in that it refers to a trait of the individual rather than a characteristic of the situation. More

specifically, high intolerance of uncertainty 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, p. 934). Thus, a person with a high intolerance of uncertainty would view uncertain situations as unacceptable and highly aversive in contrast to a person with low intolerance of uncertainty who would not feel disturbed by these same situations (Freeston et al., 1994).

It may be helpful in understanding the construct of IU to differentiate it from related but distinct other constructs. First, neuroticism refers to a broad and stable personality trait characterized by chronic negative emotions (e.g., sadness, anxiety, guilt) and characteristics such as low self-esteem and preoccupation (Smith, Pope, Rhodewald, & Poulton, 1989). One study found that neuroticism had a causal effect on the development of intolerance of uncertainty, which in turn had a causal effect on worry (Sexton, Norton, Walker, & Norton, 2003). The authors suggested that neuroticism represents a higher-order factor common to many people and disorders whereas intolerance of uncertainty is a more specific factor with its own effects such as the development of worries. Indeed, research by Dugas and colleagues (e.g., Dugas & Ladouceur, 2000; Ladouceur et al., 2000) supports the causal role of IU in the development and maintenance of worry.

Thus, the second important distinction is between worry and IU. Buhr and Dugas (2002) distinguish between IU and worry by defining worry to be a *mental act* whereby a person thinks repeatedly about a situation and the possible negative outcomes. In contrast, IU is considered to be a *filter* through which the

environment is viewed and uncertainty is regarded as unacceptable. In fact, Dugas, Freeston, and Ladouceur (1997) demonstrated differential patterns of correlations for worry and IU on performance in specific behavioural tasks varying in ambiguity. Their findings showed that IU was negatively correlated with performance on moderately ambiguous tasks whereas worry showed no correlation. Additionally, research demonstrates that worry is closely related to other mood states so it is not surprising to find high correlations between intolerance of uncertainty and worry (r = .63), anxiety (r = .57), and depression (r = .52) (Freeston et al., 1994). Although the correlations are moderate to high, there is still unique variance attributed to IU that cannot be captured by these other variables.

IU and monitoring

Although prior research has focused on the impact of uncertainty on psychological functioning, uncertainty may also affect health behaviours. Previously, two researchers have postulated a role for individual differences in intolerance of uncertainty either explicitly (Krohne, 1993) or by implication (Miller, Summerton, & Brody, 1988) in explaining peoples' health seeking behaviours when faced with a threatening situation. First, Miller (1980) identified "monitors" as a group of individuals who scan for threat-relevant information when faced with a health threat. For example, high monitors may request additional information about a test result compared to low monitors who do not actively seek out threat-relevant information and may distract themselves rather than think further about a test result.

Several studies demonstrate an association between high monitoring and increased psychological distress when faced with a health threat (e.g., Miller, Roussi, Caputo & Kruus, 1995; Miller et al, 1988). Research suggests that high monitors tend to overestimate the potential severity, likelihood, and unpredictability of threatening events compared to low monitors (e.g., Miller, Summerton & Brody, 1988; Schwartz et al., 1995). Similarly, high monitors are more likely to process ambiguous information as highly threatening and to ruminate on this information leading to exaggerated risk perceptions compared to low monitors (Miller et al., 1995). Taken together, this research suggests that the trait tendency to monitor may lead to an exaggeration of the seriousness of a situation resulting in more psychological distress.

If high monitoring is associated with distress, why then are people motivated to do it? Miller et al. (1988) proposed that high monitors may not be interested in information purely for its instrumental value. In fact, their study of primary care patients found that high monitors wanted more tests, information, and counseling than their lower scoring counterparts, yet they desired a more passive role in their health care, that is, they preferred their physician to make the decisions regarding their medical treatment. In addition, high monitors scanned for information even when the health threat was uncontrollable. The authors interpreted these findings to mean that monitors may be motivated to seek information because of a desire to reduce uncertainty rather than out of a desire for control (Miller et al., 1988). However, they could not support this assertion

with empirical evidence because they did not directly ask patients why they monitored.

Second, Krohne (1993) proposed a similar construct to monitoring that he called "vigilance." Individuals characterized by "vigilance" cope by constantly seeking out and processing threat-related information in order to reduce the uncertainty that is inherent in most threatening situations. In contrast to Miller, Krohne makes explicit the point that vigilance is carried out *in order to reduce uncertainty*. A study by Hock, Krohne and Kaiser (1996) found that highly vigilant individuals show biases in both their attention (showing shorter response latencies to ambiguous compared to unambiguous stimuli) and interpretation (by rating ambiguous situations as more unpleasant than unambiguous situations) of ambiguous information as threatening compared to low vigilant individuals. However, the authors did not provide empirical evidence to support Krohne's assertion that vigilants processed or searched for information in order to reduce their uncertainty.

Thus, both researchers have in effect suggested that searching for threat-related information may be driven by the desire to reduce uncertainty. Despite the fact that this theoretical explanation makes intuitive sense, it has not been empirically tested. Furthermore, although the two domains of situational and individual differences in intolerance of uncertainty may be examined separately; it is also necessary to examine their effects simultaneously to provide a richer understanding of how differences in uncertainty predict health behaviours.

One study has examined a similar construct to IU, called uncertainty-orientation (Sorrentino & Short, 1986), and its effect on health compliance, which is one feature of monitoring (Brouwers & Sorrentino, 1993). The researchers classified individuals as either "uncertainty-oriented" (those who deal directly with uncertainty, are motivated to reduce it, and are capable of resolving it) or "certainty-oriented" (those who feel threatened by information that contains uncertainty or is inconsistent and therefore avoid it). They found that uncertainty-oriented individuals were more likely to seek out health information compared to certainty-oriented individuals (Brouwers & Sorrentino, 1993). Their findings suggest that individual differences in information seeking may be motivated by individual differences in whether people will approach or avoid uncertainty. This conceptualization is different than an evaluation of one's *intolerance* of uncertainty (IU) because 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 resolve or avoid uncertainty.

Case study for uncertainty: HPV

The sexually transmitted infection (STI), Human Papillomavirus (HPV) is ideal for studying the effects of uncertainty on monitoring because it is affected by many sources of uncertainty and the potential health risks can be reduced through cervical cancer screening (monitoring). HPV-DNA 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, Jacobs, Manos, Bosch, Kummer, Shah, et al., 1999).

The first source of uncertainty concerning HPV is that women may not know that they carry the virus because it can stay hidden for years after it was first acquired and the immune system is equipped to clear the infection on its own (Ho, Bierman, Beardsley, Chang, & Burk, 1998). Second, it remains unknown as to what extent HPV can be prevented by using condoms and what the probabilities are that HPV can be transmitted through skin-to-skin contact with infected areas and through other forms of contact such as touching infected towels (Manhart & Koutsky, 2002). Third, given that there is no clear means of full protection, there is a high level of uncertainty as to how to proceed in one's sexual activities to prevent transmission.

Some research suggests that the heightened negative affect experienced by women after receiving a positive HPV result may be related to uncertainty. Indeed, not knowing whether a positive HPV result will or will not lead to negative health consequences (i.e. cervical lesions) has been associated with higher levels of anxiety in women (Maissi et al., 2004). In addition to causing distress, the uncertainty inherent in HPV may affect monitoring behaviours. Although this hypothesis has yet to be tested, Funke and Nicholson (1993) found that women receiving an abnormal Pap test 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 women who disagreed with the statement. These results suggest nervousness associated with uncertainty over

the potential health consequences of a positive test result may in fact lead to adaptive rather than maladaptive behaviour.

Individual differences such as intolerance of uncertainty (IU) may elucidate why some people are more likely to monitor than others. Identifying individual differences that may increase people's vulnerability to psychological distress and affect adherence to screening recommendations is important information for health care providers who communicate test results. The goal of the current two studies is to clarify the relationship between IU and monitoring so as to better understand what motivates these behaviors.

Study 1 examined in a descriptive design whether individual differences in intolerance of uncertainty (IU) are associated with differences in monitoring. Research on IU has focused largely on its relationship with anxiety disorders (e.g., Dugas & Ladouceur, 2000). Thus, there is a paucity of research examining the effect of IU on health behaviour. In the current study, we expect that higher IU will be associated with higher monitoring. This hypothesis was examined as part of a larger study examining HPV knowledge in university women.

Method

Participants and Procedure

Participants were recruited through the McGill University Psychology subject pool and received course credit for their participation, or they were recruited as volunteers from McGill undergraduate classes. Our research questions were added to a larger study examining cervical cancer and HPV knowledge, thus our sample consisted of 147 (mean age = 20.74, SD = 1.72)

women. Participants were asked to complete a 7-page questionnaire including the Intolerance of Uncertainty Scale (short form) and behavioural monitoring questions. Participants reported demographic information such as frequency of condom use to establish STI risk that may affect monitoring. Finally, participants were debriefed and provided with an information sheet answering frequently asked questions about HPV.

Measures

The Intolerance of Uncertainty Scale – Short Form (IUS-S; Buhr, Dugas, Dorval, & Simard, unpublished data, 2004).The Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002) includes 27 items that assess emotional, cognitive and behavioural reactions to ambiguous situations, implications of being uncertain and attempts to control the future. High scores reflect high IU. A principle components analysis revealed a four-factor structure: (1) uncertainty leads to the inability to act (e.g. "uncertainty stops me from having a strong opinion"); (2) uncertainty is stressful and upsetting (e.g. "uncertainty makes life intolerable"); (3) unexpected events are negative and should be avoided (e.g. "I can't stand being taken by surprise") and (4) being uncertain is unfair (e.g. "I can't stand being undecided about my future"). All factors were highly correlated with the overall IUS score with correlations ranging from .82 to .94 (all $p < .001$). Participants rate the items on a 5-point scale from 1 (*not at all characteristic of me*) to 5 (*entirely characteristic of me*). The IUS has excellent internal consistency ($\alpha = .94$), good test-retest reliability over a five-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).

The IUS-S includes 13 of the original items and was developed as a brief instrument to be used in health research. The IUS-S has excellent internal consistency ($\alpha = .96$, $p < .001$) and item-total correlations ranged from .65 to .88. Factor analysis revealed a one-factor solution. Test-retest reliability at 12 months was low in this validation study ($r = .48$, $p < .001$) (Buhr et al., unpublished data, 2004). However, less than 50% of the original respondents who participated in the study were re-tested (M. Dugas, personal communication, March 6, 2006). Given that the test-retest reliability was acceptable for the original IUS, that the short-version has excellent psychometric qualities aside from test-retest reliability (which may not have been adequately assessed because only a small portion of the original sample was retested) and given that our measures were added to an already lengthy battery of questionnaires, we elected to use the short version of the IUS.

Behavioural Measures of Monitoring. Monitoring behaviours were assessed in terms of information seeking and behavioural intentions measured on a scale ranging from 1 (*extremely unlikely* or *strongly disagree*) to 7 (*extremely likely* or *strongly agree*). Examples include: "How likely is it that you will talk with others about HPV?" and "How likely is it that you will ask your partner to get tested for HPV?" Participants were asked an open-ended question separately for a positive HPV result and for a negative HPV result: "How much time should a physician/nurse devote to discussing the results of your HPV test with you?"

Wanting their health provider to spend more time discussing their result was assumed to reflect higher monitoring.

Results

Reliability

The internal consistency measured by Cronbach's alpha for the IUS-S was $\alpha = .93$. A monitoring score was calculated for the six behavioural monitoring questions. One item was subsequently excluded based on low inter-item correlations with the other items and because the reliability of the scale increased when the item was deleted. The internal consistency measured by Cronbach's alpha of the final behavioural monitoring measure was $\alpha = .65$.

Relationship between IU and Monitoring

The hypothesis that higher IU is associated with higher monitoring was assessed by correlations (Table 1). For behavioural monitoring, the higher people scored on the IUS-S the higher their total monitoring score. Similarly, correlations between IUS scores and the amount of time participants thought physicians/nurses should spend discussing their HPV result were significant for both a positive and a negative result. The higher people's IU, the more time they thought physicians/nurses should spend discussing their positive or negative HPV result.

Discussion

The goal of Study 1 was to demonstrate an association between individual differences in intolerance of uncertainty (IU) and monitoring. Previous research has shown that situational uncertainty can lead to psychological distress such as nervousness, which may in turn lead to increased compliance with medical

recommendations (e.g., Funke & Nicholson, 1993). However, this study is the first to examine the association between IU and monitoring. Consistent with the initial hypothesis, women with a higher IU were more likely to monitor.

STUDY 2

The purpose of Study 2 is threefold: (1) to assess perceived situational uncertainty, (2) to test Krohne's hypothesis that people with high IU monitor in order to reduce their uncertainty, and (3) to test whether high IU causes monitoring. Manipulating low/high intolerance of uncertainty is the most direct way to clarify the causal relationship between IU and monitoring and attempt causal inferences.

Previously, two studies have manipulated IU to examine the relationship between IU and worry (Grenier & Ladouceur, 2004; Ladouceur, et al., 2000). For example, in one study, the researchers designed a computerized roulette game where IU was increased or decreased by manipulating whether the uncertainty of winning the game was acceptable or unacceptable to the individual. The results showed that participants in the high IU condition worried more than those in the low IU condition (Ladouceur et al., 2000). Thus, these studies demonstrate successful attempts at experimentally manipulating IU.

The current study employs a different methodology for manipulating IU: a linguistic manipulation developed by Salancik and Conway (1975) coupled with written false feedback based on responses to the questionnaire. The linguistic manipulation has previously been shown to manipulate cognitive constructs such as religious attitudes (Salancik & Conway, 1975). In addition, the procedure has

been shown to successfully manipulate self-perceptions such as the perception of self-control in dieting (Polivy & Herman, 1991), perception of oneself as a "close, intimate partner" in a relationship (Broemer & Blumle, 2003), and in academic performance (Ehrlinger & Dunning, 2003).

The linguistic manipulation of IU is based on Bem's self-perception theory that states that individuals will infer their attitudes based on information derived from their behavior (Bem, 1972). Salancik and Conway (1975) further proposed that individuals will infer their attitudes by generating and reviewing relevant information from the past and present, particularly by using information made most salient to them at that time. Accordingly, when a person responds positively or negatively to a statement describing an attitude or behaviour, he or she will generate cognitions consistent with their endorsement. Salancik and Conway (1975) inferred that one can manipulate these cognitions by changing the probability by which a person will endorse a statement.

The manipulation assumes that people are more likely to endorse that something is *occasionally* rather than *frequently* true of themselves. In the original study examining religious attitudes, participants in the "pro-religious" condition who were given items paired with the word "occasionally" (e.g., "I occasionally attend a church or synagogue") responded positively to more items compared to participants in the "anti-religious" condition who were given items paired with the word "frequently" (e.g., "I frequently attend a church or synagogue"). Importantly, to further assess the efficacy of their manipulation, the authors correlated participants' self-perceptions about how religious they were ("To what

extent are you religious?") with their endorsement of religious behaviours. The pattern of correlations indicated that endorsing pro-religious statements was positively correlated with self-perceptions of religiosity and endorsing anti-religious statements was negatively correlated. Thus, the results showed that participants could be lead to *perceive themselves* as more or less religious based on how they were asked about their previous religious behaviours (Salancik & Conway, 1975).

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 IUS. Numerous studies have shown that providing false feedback can successfully manipulate self-perception, for example in state self-esteem (Rector & Roger, 1997), self-efficacy (Sana, 1992) and perceived intelligence (Fein & Spencer, 1997). For example, Fein and Spencer (1997) randomly gave participants either positive or negative feedback about their performance on an intelligence test. Their manipulation check revealed that participants believed the feedback and that it significantly affected their state self-esteem.

We predict that inducing high IU will cause increased monitoring and inducing low IU will reduce monitoring. We also predict that participants who are induced to be more intolerant of uncertainty will be more likely to endorse the reason why they monitor as a desire to reduce uncertainty compared to participants with lower IU.

Method

Participants

Participants were recruited through the McGill University Psychology subject pool and received course credit for their participation, or through an advertisement on the McGill University website and 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 sexually transmitted infection (STI) introduced in the study. Sixty-three men (mean age = 22.30 years, *SD* = 4.05) and 101 women (mean age = 20.94 years, *SD* = 3.31) participated in the study.

Procedure

Participants completed an online consent form and the *Miller Behavioral Styles Scale* (MBSS; Miller, 1980) on a secure website approximately one week prior to the laboratory session. Scores on the MBSS served as a baseline and were later used as a control for MBSS scores after the experimental manipulation. Participants were randomly assigned to either a high or low intolerance of uncertainty (IU) condition. The manipulation consisted of two parts: (1) a linguistic manipulation of the IUS scale and (2) false feedback about one's IUS score.

First, in the high IU condition questionnaire items were combined with the qualifier "occasionally". In the low IU condition, items were paired with the qualifier "almost always". Thus, participants in the high IU condition were expected to endorse a high number of statements compared to those in the low IU condition.

Second, participants summed the number of statements they endorsed as "true" on the IUS and read their corresponding feedback. The cutoff points for receiving the feedback were manipulated in accordance with each condition to increase the probability of receiving the correct feedback for the condition. Thus, participants in the high IU condition only had to endorse five or more statements in order to receive the following 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." In the low IU condition participants had to endorse 15 or less statements in order to receive the opposite feedback.

Following the manipulation, participants were subsequently introduced to a fictitious STI, Bacillosis Virus (BV) designed to have similar uncertain properties to HPV. Participants were asked as a manipulation check for situational uncertainty, "how certain do you feel right now that you do not have BV?" on a scale of 1 (*not at all certain*) to 7 (*extremely certain*). We used a fictitious STI in order to, first, control for the amount of exposure and existing knowledge about the STI, and second, to avoid the ethical problem that information about a real STI could lead to anxiety and worry over carrying or contracting the infection.

Participants completed behavioural measures of monitoring, the MBSS, and provided demographic information. Upon completion, participants were directed to a separate room for debriefing and were given the opportunity to pick up health information sheets including a sheet about BV. The experimenter

recorded whether or not participants took a BV sheet as a final measure of monitoring. Participants were then informed that the STI, BV, is fictitious and that the uncertainty feedback was a manipulation. Finally, participants reported to what extent they believed that the STI, BV, was real in order to check the believability of the cover story.

Measures

The Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002). The properties of this scale were described in Study 1. Participants endorsed items by responding "true" or "false." A higher number of true statements reflected higher intolerance of uncertainty.

The Miller Behavioral Style Scale (MBSS; Miller, 1980). The MBSS is composed of four scenarios that present a threatening situation (e.g., undergoing a dental procedure) followed by statements representing methods of coping, four of which reflect monitoring (e.g., "I would ask the dentist exactly what to do"). Participants check as many statements as they like. A monitoring score was calculated by summing the number of monitoring statements endorsed, ranging from 0-16. The MBSS has shown good internal consistency (e.g., $\alpha = .80$ in Shiloh, Ben-Sinai, & Keinan, 1999) and good discriminative validity (e.g., Miller, 1987).

Behavioural Measures of Monitoring. Monitoring behaviours were assessed in terms of intentions and whether or not participants took an information sheet on BV. Intentions were measured with 7 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 behavioural monitoring score ranging from 1-49. Participants were also given the opportunity to take information sheets on different STIs, including one on BV, and on general health issues (e.g., stress). Whether or not they took a BV sheet was recorded as a separate measure of behavioural monitoring.

Process Variable. To assess Krohne's hypothesis that people monitor in order to reduce their uncertainty, participants were asked "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*).

Results

Participants

Eight participants were excluded because they completed a version of the questionnaire package that was missing the manipulation check. An additional 15 participants were excluded 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). Finally, 24 participants reported that they felt "extremely certain" that they did not have BV and were excluded under the assumption that individual differences in IU must be activated by situational uncertainty. There were no significant differences in age, gender, or IUS scores

between the excluded and included participants. The final sample included 48 men (mean age = 22.65 years, *SD* = 4.42) and 69 women (mean age = 21.13 years, *SD* = 3.68).

Manipulation and Deception Checks

An independent samples t-test showed that participants in the high IU condition (*M* = 15.66, *SD* = 5.30) endorsed a significantly higher number of true statements compared to those in the low IU condition *(M* = 6.13, *SD* = 4.15), $t(140) = 11.86$, $p < .001$. Due to the feedback component of the manipulation, we were not able to obtain a direct manipulation check ("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. In addition, this question might arouse suspicion of our manipulation. In line with previous studies (e.g., Broemer & Blumle, 2003; Polivy & Herman, 1991) we therefore assessed the success of the manipulation by the mean differences in the number of endorsed statements, as reported above.

The study aimed to place everyone under conditions of uncertainty and to only manipulate individuals' intolerance of uncertainty. Thus, we did not expect or find differences between conditions on the extent to which participants felt uncertain about whether or not they had BV (*M* = 4.65, *SD* = 1.90). There were also no significant differences between conditions on the extent to which participants believed that the STI, BV, was real (*M* = 4.45, *SD* = 2.10).

Reliability

For all analyses, IU was measured using scores from the Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002) where higher scores reflect higher intolerance of uncertainty. The internal consistency measured by Cronbach's alpha for the IUS was $\alpha = .90$. To assess individual differences in monitoring, the Miller Behavioral Styles Scale (MBSS) was administered to participants before the experiment (MBSS pre-manipulation) and following the manipulation (MBSS post-manipulation). High scores indicate more monitoring. The internal consistency measured by Cronbach's alpha for the MBSS pre-manipulation was $\alpha = .70$ and for the MBSS post-manipulation, $\alpha = .69$. These alpha levels are consistent with other research that found alpha levels of $\alpha = .70$ and .76 for the monitoring subscale (e.g., Miller, Rodoletz, Schroeder, Mangan, & Sedlacek, 1996). A total monitoring score was calculated based on responses to the behavioural monitoring questions described in the methods section. The internal consistency of the behavioural monitoring measure was $\alpha = .86$.

Effect of IU on Monitoring

The hypotheses that higher IU leads to higher monitoring and that participants in the high IU condition would be more likely to seek information because they want to reduce their uncertainty were assessed using linear regression analyses (Table 2). We elected to use regression analyses in order to simultaneously examine the contribution of a dichotomous (IU condition) and a continuous (seeking information to reduce one's uncertainty) variable to monitoring. Because we did not have specific hypotheses on how the individual monitoring variables would differ, the hypothesis was tested by creating a

monitoring index score. This index is statistically more reliable than running analyses with the separate monitoring variables. Standardized scores were calculated and summed for the three monitoring dependent variables: (1) MBSS (consisting of scores on the MBSS post-manipulation), (2) total behavioural monitoring scores (consisting of 7 questions), and (3) whether or not the participant took an information sheet on BV. Standardized MBSS pre-manipulation scores were entered into the first step of the regression analysis to control for baseline monitoring prior to the manipulation. The hypothesis was supported such that people in the high IU condition monitored more (β = -.66, p < .01) and the more people wanted information to reduce their uncertainty, the more they monitored (β = .97, p < .01), $F = 45.17$, $p < .01$. Thus, the results indeed show that higher IU leads to higher monitoring and that people with a higher IU are more likely to seek information in order to reduce their uncertainty compared with people with lower IU.

The mediational hypothesis proposed by Krohne (1993) and Miller et al. (1988) that people with a high IU seek information in order to reduce their uncertainty was examined using the monitoring index as the dependent variable. The mediational hypothesis was not supported by the current data. According to Baron and Kenny (1986), for mediation to exist it is necessary that the predictor (IU condition) is correlated with the proposed mediator (desire to seek information to reduce one's uncertainty). No correlation between the predictor and the proposed mediator was found in the data ($p = .29$) and thus no further investigation of the mediation model was warranted. It can therefore be

concluded that the desire to seek information to reduce one's uncertainty does not mediate the relationship between IU and monitoring. Rather, these two variables appear to be independent predictors of monitoring.

Discussion

The first hypothesis was supported such that participants in the high IU condition scored higher on an index of monitoring compared to participants in the low IU condition. Krohne (1993) and Miller et al.'s (1988) proposition that people monitor in order to reduce their uncertainty was not supported. Rather, individual differences in IU and seeking information in order to reduce one's uncertainty were found to be independent predictors of monitoring.

One possible explanation for their independence is that IU is an individual difference assumed to remain relatively stable across situations. In contrast, the motivational factor of wanting to reduce one's uncertainty may be situation-dependent and therefore apply regardless of individual differences in IU, hence the lack of correlation between the two variables. For example, a woman with a low IU may be less likely to request additional information about a test result; however she may report that *if* she were to request additional information, it would be to reduce her uncertainty. Another woman, high in IU, may be more likely to request information, but may be motivated by a desire to reduce her distress. Thus, there are several reasons why high IUs monitor and the desire to reduce uncertainty may not always be one of them. The opposite can also be true; there are various determinants for wanting information to reduce one's uncertainty and IU does not have to be one of them.

The finding that experimentally induced higher IU leads to higher monitoring is a contribution to the literature. Few researchers have attempted to experimentally manipulate this construct in the past and as discussed previously, the literature examining individual differences in IU has focused on their effect on psychological distress (e.g. Dugas & Ladouceur, 2000).

The finding that the motivation to seek information to reduce one's uncertainty predicts higher monitoring is consistent with prior research (e.g., Gwyn et al., 2003; Hurley, Miller, Costalas, Gillespie, & Daly, 2001). For example, one study found that reduction of uncertainty was the factor most strongly associated with interest in prophylactic oophorectomy (the surgical removal of the ovaries) in women with a family history of ovarian cancer (Hurley et al., 2001). This research suggests that the desire to reduce uncertainty increases monitoring.

GENERAL DISCUSSION

The goal of the present research was to examine the relationship between intolerance of uncertainty and monitoring in both a cross-sectional and experimental design in order to better understand what motivates monitoring behaviour. Study 1 showed that higher IU is associated with higher monitoring. However, this study did not assess perceived situational uncertainty; some people may have felt more uncertain about whether or not they have HPV and this may have influenced their tendency to monitor, in addition to their respective IU. In addition, this initial study did not evaluate Krohne's hypothesis regarding why people with high IU monitor, i.e. that they monitor in order to reduce their

uncertainty. Finally, due to the correlational study design, we could not assess the causal effects of IU on monitoring. Study 2 however, used an experimental design to address the aforementioned questions. Its results showed that experimentally induced IU causes higher monitoring and that wanting information about the health threat in order to reduce one's uncertainty was an independent predictor of monitoring and did not mediate the relationship between IU and monitoring.

Certain limitations to the design of Study 2 merit further consideration and caution when interpreting the findings. First, although the results suggest that the manipulation of IU was successful, we can not be certain that it was only IU that was induced by our manipulation and not additional variables such as worry or anxiety. This limitation is akin to that found in previous studies that manipulated IU (e.g., Grenier & Ladouceur, 2004; Ladouceur et al., 2000) and illustrates the difficulty of manipulating an individual difference factor that is highly related to other cognitive constructs. Future research however, should incorporate measures such as anxiety and worry pre- and post- manipulation to better control for these factors. Second, the study used a fictitious STI to control for previous knowledge and possible effects such as anxiety over learning one may have an STI. In addition, we used behavioural intentions to reflect monitoring. Future research should focus on actual infections such as HPV and assess actual behaviours to ensure that the study results are generalizable to real health situations. And third, the results are based on studies with university samples. 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.

Implications

The findings suggest that individual differences in IU may affect people's ability to choose appropriate coping mechanisms when faced with an uncertain health threat. The results indicate that high IU may in fact lead to more adaptive health behaviours, such as getting tested, compared to individuals with a low IU who have a lower tendency to monitor. 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 to encourage monitoring of a health threat. However, it should be noted that the adaptive monitoring behaviours may be accompanied by higher levels of psychological distress such as anxiety. Thus, the future challenge will be to establish a balance in communicating uncertain information in a way that optimizes adaptive health behaviours and minimizes distress. Information that can aid health providers who communicate test results is essential to meeting the psychosocial needs of both patients and caregivers who are confronting a health threat.

Future Research

The two studies presented here have revealed some meaningful results however, continued research is necessary to better clarify the relationship between IU, situational uncertainty, and monitoring. First, future studies should manipulate situational uncertainty in addition to IU to examine the interaction between situational and trait differences in uncertainty and its effect on monitoring.

Second, future research should address how to implement these findings into health care settings. For example, a study could simulate patient-doctor communication where the amount of information provided to the patient is tailored to their IU to examine its effect on monitoring. Similarly, future studies could investigate *how* to foster a high IU to encourage monitoring and whether this will affect patient behaviour and psychological functioning. Although it may be premature to make applied recommendations based on these preliminary findings, our results underscore the importance of addressing individual differences such as IU in health research to aid in increasing adherence to prevention, treatment and effective coping among people facing an uncertain future.

Table 1: Correlations between intolerance of uncertainty (IU) and monitoring (N = 147). From Rosen, Knäuper, & Sammut (2007). Copyright Taylor & Francis. Reprinted with permission.

	IU score	Behavioural monitoring	Time spent discussing positive HPV result
Behavioural monitoring	.19*		
Time spent discussing positive HPV result	.23**	.20*	
Time spent discussing negative HPV result	.23**	.26**	.62**

** $p < .01$, * $p < .05$

Table 2: Regression analysis for effect of IU and desire to reduce one's uncertainty on monitoring. From Rosen, Knäuper, & Sammut (2007). Copyright Taylor & Francis. Reprinted with permission.

Variable	β	SE_β	F	p
Criterion: Monitoring Index			45.17	< .01
Predictors:				
IU condition	-.66**	.26		
Desire to reduce uncertainty	.77**	.12		

** $p \leq .01$

TRANSITION TO MANUSCRIPT 2

Manuscript 1 (Rosen, Knäuper, & Sammut, 2007) demonstrated a positive association between an intolerance of uncertainty (IU) and information-seeking. I found that inducing higher IU caused more information-seeking compared to inducing lower IU when individuals were faced with an uncertain health threat. I also found that Krohne's (1993) proposition that people seek information in order to reduce their uncertainty was not supported. Rather, individual differences in IU and seeking information in order to reduce one's uncertainty were independent predictors of information-seeking.

Given the finding that higher IU leads to higher information-seeking when faced with an uncertain health threat (i.e. high situational uncertainty [SU]) it follows that this relationship may reverse for situations with lower SU. In other words, I predicted that a person by situation interaction exists between IU and SU and I examined this possibility in Manuscript 2 (Rosen & Knäuper, in press). In Manuscript 1, SU was defined as the circumstance whereby "a particular event or situation cannot be structured or categorized because of insufficient information" (Budner, 1962, p. 30). In Manuscript 2, I further specified the definition of SU as a particular event that cannot be adequately structured or categorized because it is marked by unpredictability, ambiguity, and a lack of information (Brashers, Neidig, Haas, Dobbs, Cardillo, & Russell, 2000). This more precise definition clarifies that uncertainty is not simply caused by a lack of knowledge (i.e. insufficient information).

In order to make informed recommendations to health providers regarding the impact of communicating uncertain information about a health threat, 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). Thus, in Manuscript 2, I also sought to examine the impact of an IU by SU interaction on worry.

In Manuscript 1 I used the term "health monitoring", borrowed from Miller's theory of coping styles (i.e. monitoring vs. blunting), to refer to seeking out health threat-relevant information. I later realized that this terminology might be confusing to those familiar with Miller's theory because I am referring to the health behaviour of seeking information rather than a trait of the individual as Miller intended the term to refer to. Thus, I replaced "health monitoring" with "information-seeking", which is a more accurate reflection of the health behaviours I measure.

MANUSCRIPT 2: A LITTLE UNCERTAINTY GOES A LONG WAY: STATE AND TRAIT DIFFERENCES IN UNCERTAINTY INTERACT TO INCREASE INFORMATION-SEEKING, BUT ALSO INCREASE WORRY

Rosen, N. O., & Knäuper, B. (in press). A little uncertainty goes a long way: Do situational uncertainty and individual differences in intolerance of uncertainty interact to increase information-seeking, but also worry? *Health Communication.*

Abstract

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) by 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 due to uncertainty most 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 behaviours such as screening intentions when individuals are faced with an uncertain health threat; but 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.

Introduction

Several areas of psychological research have emphasized the role of uncertainty in affecting individuals' cognitive, emotional and behavioural 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, 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, Neidig, Haas, Dobbs, Cardillo, & Russell, 2000). For example, a woman may feel uncertain about whether or not she has the human papillomavirus (HPV) after she learns that every 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 such as 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 (i.e. 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 by 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 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 life) 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 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 behaviours 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 affect health behaviours directly, like information-seeking. First, research suggests that SU might lead to higher information-seeking and better adherence to screening recommendations (e.g., Funke & Nicholson, 1993; Rosen et al., 2007). For example, 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 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 behaviours. However, this study

confounds the direct effect (i.e., uncertainty) and the indirect effect (i.e., wanting to reduce nervousness) in predicting health behaviours. 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 lead to greater intentions to seek information (e.g., perform an internet search, get tested for an 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.

Finally, 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 was developed under the assumption that motivation and information-processing styles are contingent upon a *match* between a person's uncertainty-orientation and the amount of SU (Hodson & Sorrentino, 1999). The current study tests the hypothesis that, like in uncertainty-orientation theory, a person by 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 this relationship may reverse 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 indicates that IU and SU (separately) cause more worry (Dugas & Ladouceur, 2000; Schwartz, Lerman, Miller, Daly, & Masny, 1995, respectively). Given these findings, we expect that the interaction between IU and SU will also lead to greater worries due to uncertainty. In order 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:

(1) 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 compared to people in the low IU and low SU condition who will seek the least.

(2) 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 compared to people in the low IU and low SU condition who will worry least.

Case Study for Uncertainty: HPV

DNA from the sexually transmitted infection (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, Jacobs, Manos, Bosch, Kummer, Shah, 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) as HPV. Specifically, the STI information read by participants in the high SU condition included 4 out of 5 of the sources of uncertainty inherent in HPV identified in the research by Rosen et al. We did not include information 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 underway. We modeled our fictitious STI after these HPV characteristics in order 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 either recruited through the McGill University Psychology subject pool and received course credit for their participation, or through an advertisement on the McGill University website and 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 (1) experimental manipulation of our independent variables (high/low IU and high/low SU), (2) random assignment to experimental conditions in order to balance out extraneous effects (e.g., a priori characteristics of the individuals) and (3) 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 behaviours (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 website approximately one week prior to the laboratory session.

Manipulation of intolerance of uncertainty (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 behaviours throughout the day and week (e.g., Fleeson, 2001; Moskowitz & Zuroff, 2004). The research assumes that behaviours express trait-relevant content (e.g., being argumentative reflects the trait of quarrelsomeness) and that variability in trait-relevant behaviours reflect intra-individual variability in traits. For example, Moskowitz and Zuroff (2004) used event-contingent recording to assess intra-individual variability in interpersonal behaviours 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 behaviours. 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 behaviours. As such, our study experimentally manipulated IU in order 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 where 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 possibilitiés" [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 one-week period. Thus, this example, demonstrating variability in the manifestation of IU through an experimental manipulation, is consistent with the personality research on intrapersonal variability in traits.

The current 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 behaviour, he or she will generate cognitions, particularly by using information made most salient to them at that time, consistent with their endorsement. They inferred that one can manipulate these cognitions by changing the probability by which a person will endorse 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 those in the low IU condition and as a consequence to perceive themselves as more intolerant of uncertainty.

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

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 only had to endorse five or more statements in order to receive the high IU feedback[2]. In the low IU condition participants had to endorse 24 or less statements in order to receive the opposite feedback.

Manipulation of situational uncertainty (SU). Following the IU manipulation, participants were introduced to the fictitious STI, Bacillosis Virus (BV). We used a fictitious STI in order to, first, control for the amount of exposure and existing knowledge about the STI, and second, to avoid the ethical problem 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

[2] High 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."

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 STAI and 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. Finally, 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.

Measures

Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002) and *Need for Closure Scale* (NFCS; Webster & Kruglanski, 1994). The IUS includes 27 items that assess emotional, cognitive and behavioural 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 five-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 eight items to the IUS scale from the predictability of future contexts subscale of the Need for Closure Scale (NFCS) 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 pre-manipulation and .86 post-manipulation.

Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990). The PSWQ 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 pre-manipulation and .94 post-manipulation.

State-Trait Anxiety Scale (STAI; Spielberger, 1983). The STAI 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 for the state and trait subscales pre-manipulation and .91 and .92 post-manipulation.

Mishel Uncertainty in Illness Scale (MUIS; Mishel, 1981). The MUIS consists of 30 items that assess: (1) ambiguity in illness (e.g., "I don't know what is wrong with me") and (2) 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 $\alpha = .64$, 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.

Behavioural 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 behavioural information-seeking score ranging from 9 to 63. One item was deleted both pre- and post-manipulation because it substantially reduced the internal consistency of the scale. Cronbach's alpha after deletion of the item was .83.

Behavioural measures of information-seeking. We aimed to improve the reliability and validity of our conclusions by including direct behavioural measures of information-seeking. Participants were given the opportunity to take

the information sheet about BV and to request an information package about BV and whether or not they took the sheet or made this request was 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: (1) behavioural information-seeking intentions, (2) whether or not the participant took the information sheet on BV, and (3) 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 and therefore participants completed a measure of this motivation to be controlled for in the analyses. Participants were asked "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 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 as 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*). Reponses 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 (1) receive the correct feedback for the condition to which they were assigned and (2) indicate a response of 3-7 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 (1) 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 (2) as 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 above in criterion (1). 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 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 post-manipulation 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 post-manipulation. In the high IU condition, there was a significant increase in IU scores from baseline (M = 0.23, SD = 1.12) to post-manipulation (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 post-manipulation (M = -0.70, SD = 0.75), $t(87)$ = -5.34, $p < .01$. Results suggest that our manipulation successfully increased and decreased participant's IU.

An analysis of variance 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 can not be totally separated, they can be separated to a degree and examined in their main influences.

An analysis of variance 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). The current 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 analyses of variance on the dependent variables (1) state anxiety (STAI-state), (2) trait anxiety (STAI-trait), and (3) worry (PSWQ). After entering pre-manipulation scores on the STAI (state and trait) and the PSWQ as covariates in their respective analyses, there were no significant differences between IU nor SU conditions post-manipulation 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, only manipulated IU. Previous research has shown moderate correlations between IU, anxiety and worry. Therefore, standardized pre-manipulation scores on the STAI, the PSWQ and the IUS were entered as covariates in all analyses reported below in order to control for baseline levels prior to the manipulation. In addition to these variables, we also control for participant's motivation to reduce

uncertainty in the analyses 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 due to uncertainty) are reported by condition in Table 3. The first hypothesis predicting an interaction between IU and SU, i.e. that individuals will seek the most information when there is high SU and they are induced to have a high IU and seek the least information when there is low SU and they are induced to have a low IU was assessed using multivariate analysis of covariance followed by planned contrasts. The model is 2 (IU condition: high vs. low) by 2 (SU condition: high vs. low). The dependent variable is scores 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 compared to people in the low IU and low SU condition ($M = -0.61$, $SD = 1.74$) who sought the least, $t(149) = 3.31$, $p < .01$.

Effect of interaction between IU and SU on worry

The second hypothesis 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 worry least when there is low SU and they are induced to have a low IU. This hypothesis was also assessed using multivariate analysis of covariance followed by planned contrasts. The model is 2 (IU condition: high vs. low) by 2 (SU condition: high vs. low). The dependent variable is z standardized responses 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 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 compared to people in the low IU and low SU condition ($M = -0.43$, $SD = 0.53$) who 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 have BV) most when there was high SU and they were induced to have a high IU and 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 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 from 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 (lower information-seeking) behaviours 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, in order 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 were therefore 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 behavioural outcomes including cancer screening (e.g., Lipkus, Iden, Terrenoire, & Feaganes, 1999). Finally, 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 behaviours, such as getting tested, compared to individuals with a low IU who 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. The current 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 the present 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 behaviours may be accompanied by higher levels of psychological distress such as worry, as

indicated by the current results. Indeed, individuals worried more under conditions of high SU compared to low SU. Multiple studies demonstrate 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 behaviours 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, 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 cervical precancerous 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.

The present 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 of the IUS (12 items, IUS-12; Carleton, Norton, & Asmundson, 2007). Use of this tool in a clinical setting would allow for a quick (less than 5 minutes) assessment of IU so that a health provider can tailor his or her recommendations accordingly. Given the knowledge from the current 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.

Table 3: Means, standard deviations and sample size for individual information-seeking variables included in the information seeking index by condition. From Rosen & Knäuper, (in press). Copyright Taylor & Francis. Reprinted with permission.

Variable	Condition	*M*	*SD*	*N*
Behavioural 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
	Low SU	2.78	1.59	41
BV sheet[b]	High IU			
	High SU	15 (50%)	-	30
	Low SU	8 (27.6%)	-	29
	Low IU			
	High SU	23 (43.4%)	-	53
	Low SU	17 (41%)	-	41
Information request[b]	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

[a]Standardized scores ranging from 1-7.

[b]Entries are in number of participants who took a BV sheet or requested additional information (% participants).

Note. IU = intolerance of uncertainty; SU = situational uncertainty; BV = Bacillosis Virus.

Table 4: Correlations among variables comprising the information-seeking index. From Rosen & Knäuper, (in press). Copyright Taylor & Francis. Reprinted with permission.

Variable	Information-seeking intentions	BV Sheet
BV sheet	0.32*	
Information request	0.34*	0.27*

* $p < .01$.

Note. BV = Bacillosis Virus.

Table 5: Means, standard deviations and sample size for information-seeking index by condition. From Rosen & Knäuper, (in press). Copyright Taylor & Francis. Reprinted with permission.

Variable	Condition	*M*	*SD*	*N*
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.

TRANSITION TO MANUSCRIPT 3

Manuscript 2 (Rosen & Knäuper, in press) showed that individuals sought the most information and worried due to uncertainty (over whether or not they have the fictitious sexually transmitted infection [STI] introduced in the study) most when there was high SU and they were induced to have a high IU. They sought the least information and worried least when there was low SU and they were induced to have a low IU. The research reported thus far in my thesis used a fictitious STI, called Bacillosis Virus (BV), designed to have similar uncertain properties (in the high SU condition) as the human papillomavirus (HPV). I modeled the fictitious STI after HPV in order to allow generalizations of the research findings to health providers who communicate HPV test results and to populations coping with HPV test results.

In the first manuscript (Rosen, Knäuper, & Sammut, 2007), the fictitious STI was modeled after HPV because I identified HPV as an ideal health context for examining the relationship between uncertainty and information-seeking. HPV is affected by a lot of uncertainty and the potential health risks can be reduced through cervical cancer screening, which is one aspect of seeking information. I proposed several facts about HPV that may induce uncertainty in women regarding their HPV status and the potential health implications of an HPV DNA test result. However, it is essential to directly ask women what induces uncertainty upon receiving written information about HPV in order to specify comprehensively *whether* they feel uncertain and *what* specific facts makes them feel uncertain. I therefore conducted the study reported in Manuscript 3 to identify

uncertainty-inducing HPV facts (Rosen, Knäuper, Pagé, Di Dio, Morrison, Mayrand, et al., under review). This identification is a necessary step toward generalizing research findings from Manuscripts 1 and 2 (that used a fictitious STI, modeled after HPV) to the real context of HPV.

In Manuscript 3 my definition of situational uncertainty (SU) evolved once again to be more specific to the context of HPV. In addition, I was concerned that my previous definition of SU was confounded with the concept of ambiguity. As discussed in the general introduction to my thesis, I believe that a more precise definition and measurement of uncertainty as a distinct construct from ambiguity will increase the ability to make correct predictions in my research. I was particularly interested in identifying what facts made women feel uncertain about their current HPV status or about the potential implications of an HPV test result. Thus, SU was defined in this study as the doubt that exists about whether or not a particular outcome will occur (Cioffi, 1991), the outcome being whether or not a person has HPV.

Manuscript 3 (Rosen et al., in press) also sought to identify what facts about HPV were perceived as reassuring for women who previously tested HPV-negative in order to identify specific information that health providers can use to help women feel reassured of their low cancer risk following a negative test result.

MANUSCRIPT 3: UNCERTAINTY-INDUCING AND REASSURING FACTS ABOUT HPV: A DESCRIPTIVE STUDY OF FRENCH-CANADIAN WOMEN

Rosen, N.O., Knäuper, B., Pagé, G., Di Dio, P., Morrison, E., Mayrand, MH., Franco, E. L., & Rosberger, Z (in press). Uncertainty-inducing and reassuring facts about HPV: A descriptive study of French-Canadian women. *Health Care for Women International.*

Abstract

We sought to describe information that makes women feel (1) uncertain and (2) reassured about their human papillomavirus (HPV) status and the potential health implications of an HPV DNA test result and (3) to examine information seeking after receiving their result. Thirty women (previously tested HPV negative) read factual information on HPV and cervical cancer and were asked which facts were uncertainty-inducing and which were reassuring. Twenty-four facts reassured women of their HPV negative status, 11 facts made women feel uncertain and 10 facts made them feel both. The most common reason for seeking information in the future was receiving a positive test result. The authors outline what specific facts about HPV health providers can emphasize to alleviate anxiety and encourage women to feel reassured of their low cancer risk following a negative test result.

Introduction

Human papillomaviruses (HPV) are the most common sexually transmitted infectious (STI) agents. Some HPV types can lead to genital warts or cause no clinically evident lesions (low risk or non-oncogenic types) whereas others have been linked to cervical cancer (high risk or oncogenic types) (Arbyn, Sasieni, Meijer, Clavel, Koliopoulos, & Diliner, 2006). Cervical cancer remains the second most frequently diagnosed cancer in women worldwide, with approximately 80% of deaths due to cervical cancer occurring in the developing world (Parkin, Bray, Ferlay, & Pisani, 2002). The identification of oncogenic HPVs as the cause of cervical cancer has brought the hope of improving primary (e.g., vaccine development) and secondary (e.g., HPV DNA testing as a screening tool) prevention strategies. HPV DNA testing is a more sensitive screening test to detect cervical precancerous lesions compared to the less sensitive (i.e., high rates of false negatives) Pap test (Arbyn et al., 2006; Mayrand, Duarte-Franco, Rodrigues, Walter, Hanley, Ferenczy et al., 2007). The greater sensitivity of HPV DNA testing may be particularly important for women who have limited or infrequent access to screening (i.e., in developing countries) because it would allow for greater intervals between screening. In addition, the greater sensitivity of HPV testing may make it more cost-effective, which is also of importance in the developing world, by reducing the number of referrals to colposcopy compared to Pap testing (Mayrand et al., 2007). Incorporating HPV testing into cervical cancer screening regimens necessitates both global campaigns of patient education about HPV and HPV testing, as well as the development of written

information that can be provided alongside test results. Before implementing routine HPV DNA testing, it is essential to evaluate the potential psychological (e.g., increased uncertainty) and behavioural (e.g., information seeking) impact of providing women with information about HPV and HPV testing.

The rapidly evolving field of HPV research has lead to numerous attempts at developing clear and satisfying information about HPV that could be used to increase women's knowledge (American Society for Colposcopy and Cervical Pathology [ASCCP], 2003; Gilbert, Alexander, Grosshans, & Jolley, 2003). However, recent research indicates that the only variable consistently associated with greater HPV knowledge is having tested positive for HPV (Tiro, Meissner, Kobrin, & Chollette, 2007; Waller, McCaffery, Forrest, Szarewshi, Cadman, & Wardle, 2003). In addition, women who receive an abnormal Pap or a positive HPV test result are more likely to seek additional information compared to women receiving a negative test result (McCaffery & Irwig, 2005). Yet, the majority of women will receive negative HPV DNA results. Based on these results, we believe that women who receive HPV negative results may thus receive and/or seek less HPV-related information. This lack of knowledge may render them insensitive to the possibility of future infection when their risk profile changes (i.e., new sexual partner) and place them at greater risk for lower adherence to screening recommendations. Moreover, researchers have shown that it is more difficult to process information at the time of a positive diagnosis due to heightened anxiety (Hinds, Streater, & Mood, 1995). Receiving clear and accurate information *prior* to receiving a positive test result may help alleviate anxieties,

enabling the person to ask relevant questions to the health care provider at the time of diagnosis and lowering the need to seek information from other, potentially confusing sources (e.g., the Internet) in the future (McCaffery & Irwig, 2005). In sum, educational messages aimed at HPV negative women are essential in order to prevent misinformation, minimize confusion and equip them for making decisions about screening and for interpreting their test results (Tiro et al., 2007).

Some characteristics of the natural history of HPV infections may be perceived as reassuring for HPV negative women (e.g., low chances of developing cervical cancer in the 3 years following a negative result), while others may cause uncertainty (e.g., the infection can stay undetected [dormant] for years; the fact that a Pap test could be normal when an HPV infection is present). Researchers have examined women's psychological responses to positive HPV DNA test results (e.g., Maissi, Marteau, Hankins, Moss, Legood, & Gray, 2004) as well as informational needs of untested women (Anhang, Wright, Smock & Goldie, 1999) and of women who received positive or negative test results (Waller, McCaffery, Nazroo, & Wardle, 2005). The researchers in the aforementioned studies provided some indirect empirical evidence (i.e., they did not directly ask women) for information about HPV that induced uncertainty in women (Anhang et al., 1999), and information that women found to be reassuring (Waller et al., 2005). But the researchers did not specify comprehensively what specific facts induce reassurance and what induces uncertainty upon receiving written information, and particularly among HPV negative women. Thus, our

methodology, which asked women to read HPV information and physically highlight (with a marker) the facts that are uncertainty-inducing and reassuring, allows us to identify specific information that health providers can use to help women to feel reassured of their low cancer risk following a negative test result. Our first and second objectives are to examine what information makes women, who previously tested HPV negative, feel (1) uncertain and (2) reassured about their HPV status and the potential health implications of a result.

Few researchers have examined the impact of receiving a negative test result on information seeking. Information seeking is one desirable behavioural outcome following a negative test result (future screening being another) for many reasons. For example, information aids in making appropriate decisions about screening (e.g., through assessing one's risk), but also because it better equips women for dealing with a positive result, if they ever get one (given that seeking and processing information after receiving a positive result may be hindered by anxiety, Hinds, Streater, & Mood, 1995). The results of one study with untested women led the authors to conclude that uncertainty about one's HPV status may lead to more information seeking (Rosen & Knäuper, in press). The third objective is therefore to examine whether or not women who previously tested negative (but may have still felt uncertain about their future status, due to changing risk profiles, for example) sought additional information after receiving their test result and the reasons why they did or did not seek information. We hypothesized uncertainty reduction and reassurance to be some, but not the only reasons why HPV negative women seek information. These objectives were

addressed within the framework of the Psychosocial Impact of Cervical Cancer Screening (PICCS) study.

Method

Participants

Thirty women were recruited in February-May 2006, as a subset of participants enrolled in the Canadian Cervical Cancer Screening Trial (CCCaST), a randomized controlled trial comparing the efficacy of Pap versus HPV tests in screening for cervical cancer (Mayrand, Duarte-Franco, Coutleé, Rodrigues, Walter, Ratnam, et al., 2006). CCCaST participants were women aged 30-69 years, from Montreal and surrounding municipalities (province of Quebec) and from St. John's (Newfoundland). They were enrolled from 30 medical practices in 2002-2004, and each had two screening tests at recruitment: an HPV and a Pap test. Further details on the CCCaST methodology and participant information can be found in Mayrand et al., 2006. Only women who had negative results on both screening tests were eligible for the present study. The primary objective was to describe uncertain and reassuring facts identified by women who had previously tested negative because the majority of women will receive negative test results. For logistic reasons we contacted only those participants living in the Montreal area. Participant characteristics are reported in Table 1.

Procedure

Ethics approval was obtained from both the McGill University and the Jewish General Hospital review boards in Montreal, Quebec. Morse (2000) suggests that a sample size of 20-40 participants should be sought when exploring

a new research area. A random sample of 125 out of 9370 eligible participants was selected using a random number generator. They were sent a letter of invitation and called to schedule a 60-minute one-on-one interview. It was necessary to contact a second and third random sample of 125 women each (375 total) through the same procedure until our goal of 30 French-Canadian women was reached. Written informed consent was obtained from all participants. The first author (N.R.) reviewed the responses by the first 25 and last 5 participants and found that no new ideas were raised in the last 5 interviews, indicating that information saturation had been achieved (Krueger & Casey, 2000).

Collaboration between the American Society for Colposcopy and Cervical Pathology (ASCCP), the American Cancer Society and the National Cancer Institute resulted in a patient education pamphlet entitled "What Women Should Know about HPV and Cervical Health" (ASCCP, 2003). We received written permission to model our information pamphlets on this information to ensure that it was up-to-date and valid. We included additional information in response to frequently asked questions about HPV as suggested by previous research (Gilbert et al., 2003). Three pamphlet versions were designed for the PICCS study, containing 40, 26, or 17 facts about HPV, in order to examine the psychosocial impact of providing varying amounts of information about HPV to women. The pamphlets can be found at http://ego.psych.mcgill.ca/perpg/fac/knaeuper/supplementalmaterial.htm. The reading grade level of the pamphlets was assessed using the Flesch–Kincaid readability scale (grade-level range, 0 to 12), which has been demonstrated to be

reliable and valid (Kincaid, Fishburne, Rogers, & Chissom, 1975). The reading grade level score for all three pamphlets was between grades 9-10.

These pamphlets were used in the current study in order to simultaneously pilot test the pamphlets for clarity purposes for the PICCS study. The 30 women were randomly assigned to read one of these three versions. Column 2 of Table 2 identifies how many women received a specific HPV fact. After reading the pamphlet, women were asked questions about the clarity of the information they read (for the PICCS) and about HPV facts that induced uncertainty and reassurance and about information-seeking (for the current research questions).

Measures

Questions about uncertainty-inducing and reassuring facts. We examined the highlighted information that women indicated following these instructions: "Please read the brochure and highlight (with a marker) and label (in the margin) any information that makes you feel (1) uncertain about whether or not you have HPV or (2) reassured about your HPV status or your chances of getting cervical cancer." Respondents were told verbally to highlight any information that made them feel uncertain about the potential health consequences, i.e. the meaning, of a positive HPV test result. Respondents were also told verbally to highlight information that might make other women feel uncertain or reassured. Two coders (N.R. and G.P.) independently counted the highlighted information and came to the same result (i.e., achieved perfect inter-rater reliability) about the number of highlighted facts in each of the 30 participants. The results were calculated by counting the number of women who highlighted the HPV fact. We interpreted the

results descriptively, with the number of women who received each specific HPV fact in mind, in order to identify specific facts that health providers can use in their conversations with HPV negative women.

Questions about information-seeking. Questions about information-seeking included: "Did you seek more information about HPV after your first HPV test?" If yes, "why did you seek more information?" If no, "why did you not seek more information?" and "what could potentially make you seek more information in the future?" Responses were recorded verbatim by the interviewer. Two coders (N.R. and G.P.) independently reviewed the recorded responses to the questions. Like responses were counted and labeled according to their content. All participants were asked the same set of questions and thus the results for this section were also calculated in percentages.

Results

Uncertainty-inducing vs. reassuring facts about HPV

Overall, 24 facts about HPV reassured women of their HPV negative status, 11 facts made women feel uncertain about their own (or possibly other women's) HPV status or the potential health consequences of a positive result and 10 facts made them feel both reassured and uncertain. The facts are listed in Table 2. Twenty women did not highlight any facts that made them (or would make other women) feel uncertain about their HPV status or the potential health implications of the result. Of the 10 women who did highlight information, 5 highlighted only one fact (HPV prevalence is 75%) whereas the remaining 5 women highlighted 2 or more. All of these women also highlighted facts that made them feel reassured.

Twenty-four women highlighted at least one fact about HPV as reassuring in terms of their (or other women's) current HPV status (negative) and their future chances of getting cervical cancer.

Seeking information about HPV

None of the women reported seeking more information after their first HPV test. The most common reason for *not* seeking information, given by over one third of the women (11 women, 37%), was that they received a negative test result. Other reasons for not seeking information were that they relied on their health care provider for information (5 women, 17%), they did not feel at risk (4 women, 13%), they did not feel a need for more information (4 women, 13%), and they did not know what HPV was (4 women, 13%). Similarly, the most common reason for seeking information in the future was if they received a positive Pap or HPV test result or if someone close to them received a positive result (22 women, 73%). Women also felt motivated to seek information if they saw pamphlets or advertisements about HPV (4 women, 13%) and if their doctor encouraged them to do so (3 women, 10%).

Discussion and Conclusion

Discussion

We found that for HPV negative women, more than double the number of facts about HPV were perceived as reassuring compared to uncertainty-inducing. The most commonly highlighted reassuring facts included that cervical cancer is preventable and rare, and that HPV infections are very prevalent and usually cleared by the immune system.

Of the 11 facts that were perceived as uncertainty-inducing, 10 were also highlighted by at least one woman as reassuring. The high (75%) lifetime prevalence of HPV was frequently highlighted as both uncertainty-inducing (12 women) *and* reassuring (8 women). On the one hand, this fact may induce uncertainty about one's current or future HPV status given the high probability of infection at least once in a lifetime. On the other hand, women may feel reassured in knowing that they are not alone in contracting HPV. The fact that more women felt uncertain (rather than reassured) about their HPV status due to this fact suggests it should be accompanied by additional reassuring information, as identified by the current research.

A fact about HPV that was, surprisingly, not highlighted as uncertainty-inducing by any of the women was the fact that condoms do not reliably protect against HPV. Our result might reflect the fact that the majority (24 women, 80%) of the participants were older, had few partners and did not report using condoms, therefore making the information on lack of protection personally irrelevant. This potential source of uncertainty could be explored further perhaps with younger women (< 30 years) who are not in committed relationships and use condoms more regularly.

The majority (20 women, 67%) of the HPV negative women in our study did not highlight any facts as uncertainty-inducing in terms of their HPV status or the potential implications of a positive result and did not think other women should feel uncertain if they test negative. This finding is encouraging because some characteristics of HPV's natural history raise concern that after receiving

these facts about HPV, women may feel uncertain about their HPV status even after receiving a negative test result and this uncertainty could lead to higher levels of worry or anxiety. Most information was perceived as reassuring, as indicated by the many reassuring facts that were highlighted. Feeling reassured is an appropriate response given that their last test result was negative and thus there is an extremely low possibility that they will be diagnosed with cervical cancer in the next three years (Smith, Cokkinides, & Eyre, 2006). It is possible that what information women find uncertainty-inducing and reassuring may vary according to their personal risk profile (e.g., age, number of partners, etc.). Future research with diverse populations would elucidate potential moderators of the current results.

Women in our study did not seek any further information after their first test, purportedly because they felt they received all the information they needed about HPV. The most common reason for not seeking information was that they received a negative screening test. Similarly, the most common future motivator for seeking information would be receiving a positive test result or having someone close to them receive a positive result. Women also felt they would be motivated to seek information if they saw pamphlets or advertisements about HPV. Although the women in our sample did not seek further information, it is possible that they would still be interested should they be provided with information. Further, messages aimed at women who receive a negative test result are necessary because it allows them to take preventative measures and because these women may be better able to understand and process the information they

are given as they may be less distracted by anxiety over a positive result (Hinds, Streater, & Mood, 1995).

The rapidly evolving field of HPV research sometimes makes it difficult to provide patients with clear and consistent information on HPV. Thus, cervical cancer program planners are fearful that women will not have the information they need to feel reassured about their HPV status and their cervical cancer risk. However, we think, and the current results support, that this type of information will be readily available to women if HPV DNA testing were to become a standard practice for cervical cancer screening. And it seems that women, who previously tested HPV negative, mostly perceive this information as reassuring.

Although we found it very encouraging that most information about HPV was perceived as reassuring by most of the HPV negative women, women should also be counseled about the possibility of a changing risk profile. Indeed, if older women were to have an undetected (dormant) HPV infection or contract an infection in the future, then they would be in a higher risk group for cervical pathology. Women who receive an HPV positive test result may report more and/or different facts about HPV as uncertainty-inducing or reassuring. Previous researchers have begun to identify what information may reassure (Waller et al., 2005) or induce uncertainty (Maissi et al., 2004) in women after undergoing HPV testing and the current results add to this growing literature. It would be worthwhile to replicate the results with HPV positive women in order to specify comprehensively what facts about HPV lead to different affect depending on the HPV test result.

The small sample size, older age and high educational status of our sample warrants caution in generalizing from the results. We recognize the possibility of a participation bias based on the older age and high educational level of our sample. We assessed the reading grade level of our materials to be moderate (grade 9-10) and appropriate given the educational status of the sample, but the results might differ in a younger and less educated group of women. Researchers should replicate the results with a more heterogeneous sample. Previously, however, researchers, have shown that HPV knowledge, including confusion about HPV transmission and whether condoms or oral contraceptives protect against HPV infection is poor, even among well educated samples (Waller et al., 2003). Indeed, although the women in our sample had already participated in CCCaST and thus had prior experience with HPV DNA testing, 4 women reported not having heard of HPV. Those women who had heard of HPV correctly answered only a little more than one third of the questions on an HPV knowledge test correctly (the knowledge test was given for purposes related to the PICCS study). This level of knowledge is comparable with what is usually found in general population samples of women (Tiro et al., 2007; Waller et al., 2003).

Conclusion

We found that there are many facts about HPV that HPV negative women perceive to be reassuring in terms of their current negative status and future risk of cervical cancer. Most women did not identify any facts that made them feel uncertain about their HPV status. Among those who did highlight uncertainty-inducing facts, all the women also highlighted facts that made them feel

reassured. The high level of reassuring information may have counterbalanced the impact of the uncertainty-inducing information. Our results begin to inform health care providers and educators in delivering negative test results in a manner that accurately describes the characteristics of an HPV infection (potentially inducing uncertainty) while also emphasizing information that can reassure women of their low short term cancer risk. In the event that women continue to feel uncertain or anxious about their HPV status, we have described what specific facts about HPV may be perceived as reassuring. Health care providers and educators can emphasize these facts in order to alleviate anxiety and encourage women to feel reassured of their low cancer risk following a negative test result.

Table 6: Demographic characteristics of participants. From Rosen et al. (2008). Manuscript submitted for publication.

Characteristic	*N* (%)
Age (median, range)	53.50 (34-67)
Marital status	
Single	7 (23.3)
Married/living with a partner	13 (43.3)
Divorced/separated/ widowed	10 (33.3)
Education	
Elementary school	1 (3.3)
Incomplete high school	1 (3.3)
Complete high school	5 (16.7)
College	6 (20.0)
University	17 (56.7)
Birth control method	
None	17 (56.7)
Condom	6 (20.0)
Hormonal	2 (6.7)
Surgical: vasectomy/tubal ligation	4 (13.3)
Lifetime number of sexual partners (median, inter-quartile range)	5.00 (3.00)
Number of sexual partners in the year preceding recruitment in the CCCaST	1.00 (0-6)

study (median, range)

Table 7: Information about HPV highlighted as uncertain vs. reassuring. From Rosen et al. (2008). Manuscript submitted for publication.

Information	*N*	*N* Uncertain	*N* Reassuring
Cervical cancer can be prevented	30	0	17
HPV prevalence is 75%	30	12	8
Cervical cancer is rare	30	2	11
Most infections cleared by immune system	30	0	9
Possibility of undetected "dormant" infections	30	7	2
Impossible to determine when and from whom HPV was transmitted	30	4	2
Details of Pap test procedure	30	0	4
HPV is sexually transmitted	30	3	2
Consequences of HPV can be treated	30	1	3
HPV test detects all types linked to cancer	30	0	2
Details of HPV test procedure	30	2	0
1350 Canadians diagnosed with cervical cancer/year	30	0	1
HPV test can complement the Pap	20	0	4
Removal of abnormal cells is a simple	20	0	4

outpatient procedure			
Prevention by monogamy/abstinence	20	0	3
Attend follow-up appointments after abnormal results	20	0	3
Condoms do not reliably protect	20	0	2
More sexual partners increases risk	20	0	2
Over 100 HPV types	20	1	1
Smoking increases risk of cell abnormalities	20		1
Different HPV types have different consequences	10	3	1
Some HPVs cause genital warts (non-cancerous)	10	2	1
If both tests normal, low risk of changes in next 3 years	10	0	2
2 abnormal HPV tests does not mean cancer; it does mean more evaluation	10	1	1
Total number of facts: 24	n/a	11	24

Notes. HPV = Human Papillomavirus. Three women highlighted the fact "the virus is so common that having only a single lifetime partner does not assure protection" as reassuring. The authors feel that it is likely that these women, in reading and processing a large amount of information, may have read this sentence as "DOES assure protection" and thus felt reassured.

TRANSITION TO MANUSCRIPT 4

Manuscript 3 identified in a descriptive study 11 specific facts about HPV that made women who had previously tested negative feel uncertain about their current HPV status and/or the potential health implications of an HPV DNA test result. The study also indicated that more than double the number of facts about HPV was perceived as reassuring than as uncertainty-inducing. However, the participants in Manuscript 3 had all tested HPV-negative previously. It is likely that women who have previously tested positive for HPV might identify more or different facts as uncertainty-inducing upon receiving HPV information. HPV is an example of a health context whereby uncertainty cannot be permanently resolved through more information because of the specific characteristics of the infection (e.g., the fact that an HPV infection can be latent and therefore go undetected). Thus, uncertainty about one's HPV status and the health implications of one's result might persist after receiving either a positive or a negative test result. Moreover, uncertainty might arise at a later time due to a changing risk profile (e.g., new sexual partner), or because one receives new information (e.g., sees an advertisement for HPV testing), making the uncertainty salient again.

Given the results from Manuscripts 1 and 2 showing that informational needs and level of distress (i.e. worry/anxiety) differ according to perceived situational uncertainty (SU) as well as individual differences in IU, and given the results from Manuscript 3 that women do perceive some facts about HPV as uncertainty-inducing, the final steps in my research program are: (1) to investigate if the results from Manuscripts 1 and 2 can be replicated in a community

population of women and for the real health threat context of HPV and (2) to investigate whether meeting the informational needs of women with higher IU (i.e. giving them a lot of information) will alleviate their anxiety. The definition of SU used in Manuscript 3 was maintained for this study as the doubt that exists about whether or not a particular outcome will occur (Cioffi, 1991), the outcome being whether or not one has HPV.

MANUSCRIPT 4: THE IMPACT OF AN INTOLERANCE OF UNCERTAINTY ON ANXIETY AFTER RECEIVING AN INFORMATIONAL INTERVENTION ABOUT HPV: A RANDOMIZED CONTROLLED STUDY

Rosen, N.O., Knäuper, B., Di Dio, P., Morrison, E., Tabing, R., Feldstain, F., Amsel, R., Mayrand, MH., Franco, E. L., & Rosberger, Z. The impact of an intolerance of uncertainty on anxiety after receiving an informational intervention about HPV: A randomized controlled study. *Psychology & Health.*

Abstract

This study examined the impact of an intolerance of uncertainty (IU) and an informational intervention about the human papillomavirus (HPV) on information-seeking intentions, perceived uncertainty about one's HPV status (referred to as "HPV uncertainty") and anxiety. IU, HPV uncertainty, information-seeking intentions and other baseline measures were assessed through mailed questionnaires. Participants were then randomly assigned to receive either a long ($N = 175$) or short ($N = 190$) pamphlet about HPV or a long ($N = 178$) or short ($N = 158$) control pamphlet about cancer prevention. Participants subsequently completed measures of HPV uncertainty and anxiety. Women with a higher IU had higher information-seeking intentions at baseline when they also perceived higher rather than lower HPV uncertainty. Providing HPV information increased HPV uncertainty compared to providing cancer prevention information and this uncertainty increased the more information the women received. Among women with higher IU, those who received the long HPV or the short control pamphlet were more anxious than those who received the short HPV or the long control pamphlet. Women with higher IU are more likely to seek HPV information but they may also be at risk for experiencing higher anxiety because factual uncertainties about HPV cannot be resolved through more information.

Introduction

Human papillomaviruses (HPV) are the most common sexually transmitted infectious (STI) agents (Ho, Bierman, Beardsley, Chang, & Burk, 1998). HPV types can be low risk (non-oncogenic) types that lead to genital warts or cause no clinically evident lesions, or can be high risk (oncogenic) types that are causally linked to cervical cancer (Arbyn, Sasieni, Meijer, Clavel, Koliopoulos, & Dillner, 2006). Recent evidence shows that HPV DNA testing is a more sensitive screening test compared to the standard screening test (the Pap cytology) for detecting cervical precancerous lesions (Arbyn et al., 2006). Before implementing HPV DNA testing, it is essential to evaluate the potential psychological (e.g., increased uncertainty, anxiety) consequences of providing women with information about HPV and HPV testing.

Some characteristics of the natural history of HPV infections and HPV testing may be perceived as reassuring (e.g., low chances of developing cervical cancer in the 3 years following a negative result), while others may be perceived as uncertainty-inducing (e.g., the infection can stay undetected [latent] for years and a Pap test could be normal when an HPV infection is present). Perceived situational uncertainty occurs when a particular event (or particular information) induces doubt about whether or not an outcome will occur (Keren & Gerritsen, 1999). The above examples of HPV facts may increase perceived situational uncertainty about one's HPV status (referred to henceforth as "HPV uncertainty").

Researchers have provided some empirical evidence for information about HPV that induced HPV uncertainty in women who had not been tested (Anhang, Wright, Smock, Goldie, 1999) and women who had previously tested negative (Rosen, Knäuper, Pagé, Di Dio, Morrison, Mayrand, et al., under review). Rosen et al. (in press) identified in a descriptive study ($N = 30$) specific facts about HPV that made women feel uncertain about their current HPV status and/or the potential health implications of an HPV DNA test result. Facts that were highlighted by two or more women as uncertainty-inducing included: (i) lifetime HPV prevalence is 75%, (ii) the possibility of undetected "latent" infections, (iii) it is impossible to determine when and from whom HPV was transmitted, (iv) HPV is sexually transmitted, (v) different HPV types have different consequences, (vi) the details of an HPV test procedure, and (vii) the fact that some HPVs cause genital warts (non-cancerous). It is likely that women who have tested HPV positive might identify more or different facts as uncertainty-inducing, though researchers have yet to test this hypothesis. In sum, uncertainty about one's HPV status and associated health implications might persist after receiving test results due to the characteristics of the infection. Moreover, HPV uncertainty might arise at a later time due to a changing risk profile (e.g., new sexual partner), or because one receives new information (e.g., sees an advertisement for HPV testing) making the uncertainty salient again.

Researchers have proposed that there are individual differences in the degree to which individuals are affected by uncertainty. 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). An individual with a high IU views uncertain situations as unacceptable and aversive in contrast to an individual with a low IU, who does not feel distraught by these same situations (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). IU differs from situational uncertainty because it refers to a trait of the individual rather than the perceived characteristics of the situation.

Impact of Perceived Situational Uncertainty and IU on Information-seeking

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 changes in uncertainty depending on the content of the information but also on a person's interpretation of that information as either a source of distress or a source of reassurance (Mishel, 1990). On the one hand, the information that HPV is a very prevalent infection (most sexually-active women will contract HPV in their lifetime) may increase uncertainty about one's HPV status and lead to higher anxiety 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, conflicting goals or motivations for seeking information (e.g., reducing uncertainty and related anxiety vs. maintaining one's health) also affects these behaviors and how one interprets information (Brashers, Goldsmith, & Hsieh, 2002).

Rosen et al. (2007) tested the hypothesis that a higher IU increases information-seeking. They found that experimentally inducing higher IU led to a greater desire for threat-relevant information, higher intentions to seek information (e.g., performing an internet search), greater requests for information, and a higher likelihood of taking home the information sheet provided in the study. A second study extended these results to show that individuals sought the most information when there was high perceived situational uncertainty *and* they were induced to have a higher IU (Rosen & Knäuper, in press). Together, these results suggest that informational needs differ according to perceived situational uncertainty as well as individual differences in IU.

The results of Rosen et al.'s (2007) research must be interpreted with caution due to some limitations. The study used a fictitious STI modeled after the characteristics of HPV and the results are based on a university sample. This study design enabled the researchers to examine the effects of situational uncertainty and IU under very controlled conditions in the laboratory. However, the findings need to be replicated within the real health context of HPV and with other populations to ensure generalizability. The first objective of the current research is thus to investigate whether the results from Rosen and Knäuper (in press) can be replicated in a community population of women and within the real health context of HPV.

Impact of Providing Information on Anxiety

Rosen and Knäuper (in press) found that a higher IU led not only to a desire for more information, but also to higher anxiety when faced with a health

threat. Researchers have found that some of the anxiety experienced by women receiving abnormal pap smears for example, may be avoided or reduced by providing clear, relevant information (Marteau, Kidd, Cuddeford, & Walker, 1996). It remains to be seen whether meeting the information needs of individuals with higher IU (i.e. by giving them a lot of information) will alleviate their anxiety. The second objective of this research is to examine the interaction between IU and amount of information (more versus less) on anxiety.

A growing literature on the effectiveness of tailoring print health messages (e.g., pamphlets/brochures) to recipients based on individual characteristics suggests that this technique can induce behavioural change, such as increased mammography and pap screening uptake (Paul, Redman, & Sanson-Fisher, 2004; Williams-Piehota, Pizarro, Schneider, Mowad & Salovey, 2005, see also Noar, Benac, & Harris, 2007). Tailored messages purportedly work by making the information more personally relevant and therefore drawing the recipients' attention to the information (Kreuter, Oswald, Bull, & Clark, 2000). Research lends support to this proposition showing that health messages that are perceived to be a better "fit" by recipients have a greater impact on behavioural change (Kreuter et al., 2000). There is a paucity of research examining the psychological impact of tailored messages, as we intend to do. The limited evidence suggests tailored messages reduce negative psychological outcomes such as negative affect (Williams-Piehota et al., 2005). Previous researchers have established this "fit" between health messages and the individual by tailoring the content of the

information: We believe a fit can also be achieved by tailoring the *amount* of information, which is the focus of this study.

Given this evidence, one should expect that providing higher IU-women with more information compared to less will result in lower anxiety. We expect to show this relationship for the control conditions (who receive either a long or a short pamphlet about cancer prevention). This expectation assumes that individuals with higher IU use the greater amount of information to cope with their anxiety and to resolve uncertainties. However in the case of HPV, uncertainty cannot be permanently resolved through information because of the specific characteristics of the infection. For example, the fact that an HPV infection can be undetected (latent) means that there is ongoing uncertainty about one's HPV status. Thus, for the specific case of HPV (as an example of a health context where additional information does not reduce uncertainty) we expect that providing women with information will *increase* uncertainty because the uncertain characteristics of HPV will become more salient through the additional information. This increase in uncertainty will be more pronounced the more information the women receive. Because receiving more information cannot resolve their uncertainty, we expect that women with a higher IU who receive a lot of HPV-specific information will report higher anxiety compared to those who receive less HPV-specific information.

Hypotheses

The hypotheses were addressed within the framework of the Psychosocial Impact of Cervical Cancer Screening (PICCS) study and are as follows: (i) At

baseline, a higher IU will be associated with a stronger positive relationship between HPV uncertainty and information seeking intentions, (ii) Providing an HPV information pamphlet will increase HPV uncertainty compared to providing a cancer prevention pamphlet and this uncertainty will be higher the more information the women receive (i.e. higher for the long versus the short HPV pamphlet), (iii) After receiving the intervention, anxiety will be higher among women with higher IU who receive the long HPV pamphlet compared to those who receive the short pamphlet. In contrast, anxiety will be higher among women with higher IU who receive the short control pamphlet compared to those who receive the long control pamphlet.

Method

Participants

Participants enrolled in the Canadian Cervical Cancer Screening Trial (CCCaST), a randomized controlled trial comparing the efficacy of Pap versus HPV tests in screening for cervical cancer (Mayrand, Duarte-Franco, Coutleé, Rodrigues, Walter, Ratnam, et al., 2006) were recruited for the PICCS study from September 2006 to August 2007. CCCaST participants were women aged 30-69 years, from Montreal and surrounding municipalities (province of Quebec) and from St. John's (Newfoundland). They were enrolled from 30 medical practices in 2002-2004, and each had two screening tests at recruitment: an HPV and a Pap test. Women were excluded from CCCaST if they (i) were attending a colposcopy clinic for evaluation, treatment or follow-up of cervical lesions, (ii) did not have a cervix, (iii) were pregnant, or (iv) had a history of cervical cancer. Further details

on the CCCaST methodology and participant information can be found in Mayrand et al., 2006. We contacted only those participants living in the Montreal and surrounding municipalities. Thus, 4194 participants were deemed eligible through CCCaST.

Previously, we found the correlation between the IU by situational uncertainty interaction and information-seeking to be $r = .27$ ($R^2 = .07$). Based on 80% power to detect a significant difference ($p = .05$, two sided), with three potential predictors (two independent variables, and their interaction), we required 158 women per group (Cohen, 1988). We therefore aimed to recruit a sample of approximately 1280 women, based on an expected response rate of 50% to obtain complete data from 640 women (160 women per condition).

We recruited approximately 150-225 per month. Of the 1255 women who were randomly selected from CCCaST and contacted for participation, 723/1255 (58%) completed the baseline questionnaires and were randomly assigned an intervention pamphlet that was received with the second set of questionnaires. Figure 1 displays a flow diagram of participants through enrollment, randomization, attrition and analysis for the study.

Procedure

Ethics approval was obtained from both the McGill University and the Jewish General Hospital review boards in Montreal, Quebec. Validated, French translated versions of questionnaires were used when available (i.e. for the *Intolerance of Uncertainty Scale*, *State-Trait Anxiety Inventory*). The remaining questionnaires and individual items were translated into French by a research

assistant and verified independently by two additional research assistants, all of whom speak French as a first language. Randomly selected eligible participants were sent a letter that explained the collaboration with CCCaST and requested that participants contact us if they were *not* interested in participating. Approximately two weeks later, the first questionnaire consisting of baseline measures was mailed. To minimize attrition, a research assistant called one week later to confirm its receipt and to answer questions. A second reminder phone call was made one week later. A final reminder phone call was made two weeks after the second call.

A research assistant randomly assigned the participant to pamphlet condition using a random number generator. The intervention pamphlet and a second questionnaire to be completed after reading the pamphlet was mailed to participants within three weeks of receiving their completed first questionnaire. The same protocol of reminder phone calls was followed. Upon receiving the completed second questionnaire, participants were sent a $20 gift certificate and the long HPV pamphlet, which served as a debriefing.

Pamphlet Development

Collaboration between the American Society for Colposcopy and Cervical Pathology (ASCCP), the American Cancer Society, and the National Cancer Institute resulted in a patient education pamphlet entitled "What Women Should Know about HPV and Cervical Health" (ASCCP, 2003). We received written permission to model our pamphlets on this information to ensure that our materials were up-to-date and scientifically valid. We included additional

information in response to frequently asked questions about HPV as suggested by previous research (Gilbert, Alexander, Grosshans, & Jolley, 2003).

Two experimental and two control pamphlet versions were designed for the PICCS study. In order to test our hypothesis regarding the impact of providing varying amounts of information to women with higher or lower IU, it was essential that the two experimental pamphlets differed in the amount of *new* information that was provided to avoid redundancy. The longer, 4-page version contained answers to the following 9 questions: What are HPVs? How common are HPVs? What is the Pap vs HPV test? How did I get HPV? What is the meaning of the different test results? Can HPV infections be prevented or treated? Will HPV affect a pregnancy or baby? What are the implications for my partner? If I test positive for HPV, how should I respond? In contrast, the shorter, 1-page version contained answers to the first 4 of these questions. In total, the longer booklet contained 40 facts compared to 17 facts in the shorter pamphlet.

Two of the authors (M-H.M. & E.L.F.) are experienced HPV and cervical cancer researchers. They reviewed the text pamphlets to confirm that the contents were accurate. The reading grade level of the pamphlets was assessed to be between grades 9-10, using the Flesch–Kincaid readability scale (grade-level range, 0 to 12), which has been demonstrated to be reliable and valid (Kincaid, Fishburne, Rogers, & Chissom, 1975). The control pamphlets were matched in length to the experimental pamphlets and contained general cancer prevention tips. The pamphlets can be found at http://ego.psych.mcgill.ca/perpg/fac/knaeuper/supplementalmaterial.htm. All

pamphlets were translated from English into French by an experienced translator specializing in translating medical research documents, and were verified independently by two research assistants who speak French as a first language. A pilot study ($N = 30$ women; Rosen et al., in press) was conducted to determine that the information in the pamphlets was comprehensible and, if necessary, revisions were made.

Measures

Baseline and covariate measures

Perceived risk. Past research has shown that perceived risk is an important predictor of higher anxiety among women undergoing HPV testing (Maissi, Marteau, Hankins, Moss, Legood, & Gray, 2004). To assess perceived risk for developing cervical cancer and for contracting HPV, participants responded to the statement "In comparison to other women your age, what do you think your chances are of ever developing cervical cancer?" and "In comparison to other women your age, what do you think your chances are of contracting HPV?" on a scale ranging from 1 (*much lower chances*) to 7 (*much higher chances*).

Mishel Uncertainty in Illness Scale (MUIS; Mishel, 1981). Research has shown that perceived ambiguity, defined as situations or information that "cannot be adequately structured or categorized because of a lack of sufficient cues" (Budner, 1962, p .30), is a related but distinct concept from perceived situational uncertainty (i.e., situations where the potential outcomes are unknown) (Cioffi, 1991). The MUIS consists of 30 items that assess two factors: ambiguity and unpredictability in illness. Both factors have good construct and convergent

validity (Mishel, 1981). To assess perceived ambiguity about HPV information, participants responded to 9 MUIS items that were adapted to be content-specific to HPV. Participants rated the items on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) and higher scores reflected higher perceived ambiguity. Examples of adapted questions are "The information that has been given to me concerning HPV and its relationship to cervical cancer could have many meanings" and "I only have a vague idea about how I can prevent contracting HPV." Cronbach's alpha was .70.

Negative subscale of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The negative affect subscale of the PANAS consists of 10 items that assess general subjective distress including a variety of aversive mood states such as anger, contempt, disgust, guilt, fear and nervousness. Examples include "ashamed" and "distressed". Because anxiety is one of the mood states encompassed within negative affect, we excluded the three items that assess anxiety in the PANAS to avoid content (or item) overlap. It is essential to include negative affect as a covariate (for hypothesis 3) in order to assess the unique contribution of our predictors to anxiety. Participants indicate how they are currently feeling on a scale of 1 (*very slightly or not at all*) to 5 (*extremely*) and higher scores reflect greater negative affect. The PANAS has demonstrated good test-retest reliability, and convergent and divergent validity with measures of depression and anxiety (Watson et al., 1988). Cronbach's alpha was .83.

Predictor variables

Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002) and *Need for Closure Scale* (NFCS; Webster & Kruglanski, 1994). The IUS includes 27 items that assess emotional, cognitive and behavioural reactions to ambiguous situations, implications of being uncertain and attempts to control the future. Participants responded on a scale of 1 (*not at all characteristic of me*) to 5 (*very characteristic of me*). Higher scores reflect 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 five-week period (r = .74; $p < .001$) and good convergent and divergent validity (Buhr & Dugas, 2002; Freeston et al., 1994). A recent criticism of the IUS is that it does not adequately assess the individual's tendency to consider uncertainty unacceptable (Gosselin, Ladouceur, Evers, & Laverdiere, 2005). We therefore added eight items from the predictability of future contexts subscale of the NFCS 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 .94.

Uncertainty about HPV status (HPV uncertainty). To assess perceived situational uncertainty as reflected by uncertainty about one's HPV status, participants responded at baseline and post-intervention to the statement "How certain do you feel right now that you do **not** have HPV?" on a scale of 1 (*not at all certain*) to 7 (*very certain*). Responses were reverse coded so that higher scores reflected higher HPV uncertainty.

Primary outcome variables

Information seeking intention. To assess information seeking intentions, participants responded to the statement "I will make an appointment with a physician to find out more information about HPV and its relationship to cervical cancer" on a scale ranging from 1 (*not at all likely*) to 7 (*very likely*).

State-Trait Anxiety Scale (STAI; Spielberger, 1983). The "state" factor of the STAI is a 20-item measure of present or short term anxiety. Examples include "I feel calm" and "I am tense". All item responses range from 1 (*not at all*) to 4 (*very much so*). The STAI has good convergent and discriminant validity and test-retest reliability (Spielberger, 1983). Cronbach's alpha was .93 (baseline) and .94 (post-intervention) for the state subscale.

Manipulation check questions. We asked participants to indicate their agreement with the following question on a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*): "The information pamphlet provided details beyond the basic facts about HPV and its relationship to cervical cancer". And for the control conditions: "The information pamphlet provided details beyond the basic facts about cancer prevention".

Statistical Analyses

All statistical tests were two-tailed except for tests of planned contrasts that were tested one-tailed, in the direction of our hypotheses. First, we examined the demographic characteristics of participants. Second, we conducted analyses of variance to check for differences between pamphlet conditions at baseline in terms of demographic variables, and our independent and dependent variables.

We used correlational analyses to confirm the relationships of theoretically chosen covariates to the dependent variables and to test for relationships of the dependent variables to other potential covariates.

To test hypothesis one, IU and HPV uncertainty were entered in the first step of a hierarchical regression analysis and the IU by HPV uncertainty interaction was entered in the second step. To avoid multicollinearity among predictors and their interaction, IU and HPV uncertainty scores were centered around zero before computing the interaction term. To determine whether the effect supported our hypothesis, simple regression lines were drawn at two levels of IU: one standard deviation above the mean (high IU) and one standard deviation below the mean (low IU), and the statistical significance of the simple slopes was calculated (Aiken & West, 1991). The second hypothesis was tested with a univariate analysis of covariance followed by planned contrasts.

The third hypothesis was assessed using hierarchical regression analysis. Scores on state anxiety were significantly positively skewed and therefore log-transformed and reverse-transformed before plotting interactions. Centered baseline scores and other covariates were entered in the first step. IU and pamphlet condition (contrast coded) were entered in the second step. One contrast was constructed to test our hypothesis: the long HPV and short control pamphlets vs. the short HPV and long control pamphlets (1 = long HPV pamphlet, -1 = short HPV pamphlet, -1 = long control pamphlet, 1 = short control pamphlet). Two additional contrasts were constructed separately for the experimental and control conditions: (1) to contrast the two experimental conditions (1 = long HPV

pamphlet, -1 = short HPV pamphlet, 0 = long control pamphlet, 0 = short control pamphlet) and (2) to contrast the two control conditions (0 = long HPV pamphlet, 0 = short HPV pamphlet, 1 = long control pamphlet, -1 = short control pamphlet). The contrasts were each multiplied with centered IUS scores to compute a separate interaction term that was entered in the third step of the analyses. A significant interaction was again probed by calculating the significance of the simple slopes of the regression lines.

Results

Participants

Table 1 presents the demographic characteristics of the participants by intervention group. The mean age of participants was 50.01 years (SD = 9.64, range = 33 – 75). The majority of the women were French-Canadian (88%), married or living with a partner (64%) and had completed college or university schooling (75%). Finally, 26% of the women had previously received a positive HPV test result during their participation in CCCaST, either at the time of enrollment in CCCaST or at follow-up. A non-significant chi-square test shows that women who previously received a positive result were evenly distributed across conditions, $\chi^2(3) = 0.19$, *ns*.

There were no significant differences between women in the experimental and control conditions on any of the demographic characteristics. There were also no baseline differences between the pamphlet conditions in HPV uncertainty, state anxiety or information-seeking intentions. However, women who received the shorter HPV pamphlet (M = 79.88, SD = 1.82) scored significantly higher on

the measure of IU compared to women who received the longer HPV pamphlet ($M = 74.85$, $SD = 1.83$) and compared to women who received the shorter control pamphlet ($M = 74.59$, $SD = 1.94$), $F(3, 584) = 1.85$, $p = .14$, but $p = .05$ for pairwise comparisons). When we controlled for baseline state anxiety (women did not differ between conditions on this variable) the difference in IU scores was no longer significant. To examine the unique effect of IU and pamphlet condition on state anxiety (post-intervention) it is essential to include baseline anxiety as a covariate in our analyses. Thus, the baseline differences in IU are resolved. We used correlational analyses to confirm the expected covariates of information-seeking, HPV uncertainty, and anxiety. Variables whose correlation with the dependent variable was greater than .20 and significant at $p < .001$ were retained as covariates (Table 2).

Pamphlet Evaluation

As expected, participants reported that the longer HPV pamphlet provided details beyond the basic facts about HPV and cervical cancer ($M = 5.39$, $SD = 0.14$) more so than did shorter HPV pamphlet ($M = 4.89$, $SD = 0.14$), $F(1, 330) = 7.27$, $p = .01$. Participants did not report any differences in the amount of detail between the long and short control pamphlets.

Information-seeking intentions at baseline

The hypothesis that a higher IU increases the positive relationship between uncertainty about one's HPV status (HPV uncertainty) and information seeking was tested using hierarchical regression analyses. The results are presented in Table 3. Higher IU and higher HPV uncertainty each significantly predicted

higher information-seeking. As expected, the IU by HPV uncertainty interaction term was significant (Figure 2). A test of the slope significance showed that women with higher IU had higher information-seeking intentions when they also reported higher HPV uncertainty rather than lower HPV uncertainty, $t(622) = 2.87$, $p = .004$. For women with lower IU the association between information-seeking and uncertainty was not significant.

Uncertainty after receiving information

The second hypothesis that providing an HPV pamphlet will increase HPV uncertainty compared to providing a cancer prevention pamphlet and that this uncertainty will be higher the more information the women receive was assessed with analysis of covariance. The dependent variable is responses to the statement "How certain do you feel right now that you do **not** have HPV?" on a scale of 1 (*not at all certain*) to 7 (*very certain*). Scores were reverse coded so that higher scores reflected higher uncertainty. We controlled for the following significant covariates: Higher HPV uncertainty at baseline, higher perceived risk of contracting HPV, and higher ambiguity about HPV information, which were all associated with higher HPV uncertainty ($p < .001$). As predicted, there was a main effect of pamphlet condition, $F(3, 617) = 2.87$, $p = .04$. Planned contrasts confirm our hypothesis: providing HPV-specific information (long or short pamphlet) ($M = 3.39$, $SD = 2.18$) increased HPV uncertainty compared to providing cancer prevention information ($M = 3.10$, $SD = 2.22$), $F(1, 618) = 3.59$, $p = .04$. Further, providing a long HPV pamphlet ($M = 3.62$, $SD = 2.22$) increased HPV uncertainty

compared to providing a short HPV pamphlet ($M = 3.15$, $SD = 2.14$), $F(1, 618) = 5.85$, $p = .01$.

Anxiety after receiving information

Scores on the measure of anxiety were within the expected normal (i.e. non-clinical) range for 286/328 (87%) of women aged 19-49 years (raw score < 47) and 255/315 (81%) of women aged 50-69 years (raw score < 41) (Spielberger, 1983). The third hypothesis that state anxiety would be higher among women with higher IU who received the long HPV or the short control pamphlet compared to those who received the short HPV or the long control pamphlet was assessed using hierarchical regression analysis. We controlled for the significant covariates of state anxiety: Higher baseline state anxiety and higher negative affect, which both significantly predicted higher state anxiety after the intervention ($p < .001$). The main effect of pamphlet condition was not significant. Higher IU predicted higher anxiety. In line with our hypothesis, the addition of the IU by pamphlet condition interaction (based on covariate adjusted means) to the regression model significantly improved the model fit over a model that included only the covariates and main effects. Among women with higher IU, those who received the long HPV or the short control pamphlet reported higher state anxiety than those who received the short HPV or the long control pamphlet. Figure 3 shows the interaction effects (means adjusted for covariates) for the experimental and control conditions separately. Separate contrasts for the experimental and control conditions were significant ($p = .04$ and $p = .01$). As expected, the slope of the regression lines for the long HPV pamphlet and the

short control pamphlet were significant, $t(618) = 2.19$, $p = .03$ and $t(618) = -3.64$, $p < .001$, respectively, whereas the slope of the regression lines for the short HPV and the long control pamphlets were not.

Discussion

We examined the role of uncertainty in women's information-seeking intentions and their psychological responses to receiving HPV information. We found support for all three of our hypotheses. First, we showed that women with a higher IU had higher information-seeking intentions when they also reported higher uncertainty about their HPV status (HPV uncertainty) rather than lower HPV uncertainty. Second, we showed that providing an HPV information pamphlet increased HPV uncertainty compared to providing a cancer prevention pamphlet and that this uncertainty was higher the more information the women received. Last, we found that among women with higher IU, those who received the long HPV or the short control pamphlet were more anxious than those who received the short HPV or the long control pamphlet.

Our findings in support of the first hypothesis replicate the results by Rosen and Knäuper (in press), but with an older, community sample of women and with a real, rather than fictitious, health threat. Our results lend credence to an important implication suggested by Rosen and her colleague: namely, that the impact of individual differences in IU on people's choice of coping mechanism (i.e. whether or not to seek information) depends on their perceived level of situational uncertainty, in this case, their perceived level of uncertainty about whether or not they have HPV. Individuals with higher IU who perceive higher

situational uncertainty may be more likely to seek-information as a means of coping with the uncertainty compared to individuals with a lower IU who are less bothered by the uncertainty and therefore have a lower tendency to seek information. When information can resolve factual uncertainties, a higher IU and higher perceived situational uncertainty may lead to more adaptive health behaviours (e.g., seeking information about cervical cancer screening guidelines).

However, health providers must be mindful of the fact that oftentimes, uncertainty may go factually unresolved or even increase after receiving health information. For many health threats, uncertainty is inherent to the disease and treatment trajectories and there is no possible information that can provide permanent certainty about one's health. Previously, researchers have shown that information about HPV may induce uncertainty in some women (Anhang et al., 1999; Rosen et al., in press). In the case of HPV, uncertainty cannot be permanently resolved through information because of the specific characteristics of the virus and this uncertainty becomes more salient upon receiving HPV information. In support of our second hypothesis, we found that providing an HPV information pamphlet increased HPV uncertainty compared to providing a cancer prevention pamphlet and this uncertainty was higher the more information the women received. Health providers should know that providing HPV information may induce uncertainty and they are in a position to help manage uncertainty.

The present study is the first to examine, via our third hypothesis, the psychological impact of meeting the informational needs of women with higher

IU. For the control conditions, we found that matching the informational needs of women with higher IU (i.e. giving them more information about cancer prevention) and lower IU (i.e. giving them less information) resulted in lower anxiety compared to a mis-match in informational needs (i.e. giving women with higher IU less information). These results are consistent with previous research that found that matching health messages to individual differences reduces negative psychological outcomes (Williams-Piehota et al., 2005). In contrast, the results for the experimental condition show that because receiving more information about HPV cannot permanently resolve their uncertainty concerning HPV, women with higher IU felt more anxious when they received more, rather than less, HPV information. The availability of HPV testing and the HPV vaccine mean that HPV information is more accessible through the media and Internet. Given that women with higher IU are more likely to seek information in order to meet their greater informational needs, our results suggest they may have difficulty coping with this ambiguous information because it is a health issue for which factual uncertainties cannot be resolved through more information.

It is important to note the following study limitations. First, the older age, high educational status, and the fact that participants were mostly married or living with a partner warrants caution in generalizing from the results. There was no significant difference in the age of women who chose to participate versus those who did not. However, women who chose to participate had more education (college or university) compared to non-participants, $\chi^2(4) = 50.92$, $p < .001$. We assessed the reading grade level of our materials (grade 9-10) to be appropriate

given the educational status of the sample, but the results might differ in a less educated group of women. Although the women in our sample had prior experience with HPV DNA testing, they correctly answered approximately 50% (6 of 11) of the questions on our HPV knowledge test correctly. This level of knowledge is slightly higher than what is usually found in general population samples of women (e.g., Waller, McCaffery, Forrest, Szarewshi, Cadman, & Wardle, 2003) but still reflects large gaps in knowledge.

Second, we were not able to make comparisons between women who had previously tested HPV positive versus negative in the CCCaST study. Of the 168 women who participated in PICCS and received a positive HPV test according to the CCCaST records, only 68 reported knowing their test result. All women who received a positive result in CCCaST were referred for colposcopy and thus it is likely that many women simply did not remember their results. The number of women who were aware of their positive test result was too small to obtain sufficient power for conducting comparison analyses by experimental condition. Previously, researchers have shown that anxiety is higher among women who receive positive HPV test results compared to negative results (e.g., Maissi et al., 2004). Thus, it is possible and even likely that for women with higher IU, the increase in anxiety upon receiving HPV information might be greater among women with a history of testing positive.

Third, the effect of IU on anxiety when receiving HPV information at the same time as getting one's actual test result might differ from receiving information at a later time when the issue is less salient and anxiety might be

lower overall (as seen in the current study). Our findings show that a lot of HPV information received at any time can induce more anxiety in women with higher IU placing them at greater risk for distress. Future research should explore the possible cumulative effects of IU and anxiety when HPV information is provided alongside test results. A final, methodological concern is that our measure of HPV uncertainty was a single-item measure. However, single-item measures of constructs such as cancer risk, cancer worry, and perceived cancer preventability have been shown to predict outcomes including cancer screening (e.g., Lipkus, Iden, Terrenoire, & Feaganes, 1999).

We find it encouraging that the overall level of anxiety for most women in our sample (more than 80%) was within the normal range, suggesting that the intervention did not cause undue distress. However, the results of this study do point to a subset of individuals (higher IU) who may be at risk for experiencing higher anxiety when they seek out or receive a lot of HPV information. The introduction of HPV testing and the HPV vaccine means that HPV information is more accessible through the media and Internet and these women may have difficulty coping.

We suggest that it is possible to prospectively identify individuals with higher IU through the use of a screening tool. Recently, researchers have established the reliability and validity of a short-form of the IUS (12 items, IUS-12; Carleton, Norton, & Asmundson, 2007). Use of this tool in a clinical setting would allow for a quick assessment of IU so that a health provider can tailor his or her communications accordingly. Alternatively, health providers could be

trained to incorporate a few screening questions for IU (based on the IUS) into their communications with patients. The reliability and validity of these questions would need to be established empirically.

Researchers who study uncertainty management provide some insights for health providers communicating uncertain information that may be especially relevant for women with higher IU. Social support from healthcare providers may affect uncertainty by i) encouraging patient reappraisals of the uncertainty as positive or ii) by increasing patient's perceptions of control (Brashers, Neidig, & Goldsmith 2004). For example, when communicating an HPV test result, the health provider can offer instrumental support 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 higher perceived uncertainty about one's HPV status and anxiety in women with higher IU, the educators should accompany this information with clear guidelines for cervical cancer screening. Individuals can then develop a screening routine for managing uncertainty.

Table 8: Descriptive characteristics of participants by intervention group. From Rosen et al. (2008). Manuscript submitted for publication.

Intervention group	Experimental: HPV		Control: cancer prevention	
	Long (n = 165)	Short (n = 167)	Long (n = 170)	Short (n = 149)
Age (mean, *SD*)	49.61 (9.47)	49.92 (9.43)	50.54 (9.75)	49.95 (10.0)
Marital status				
Single/divorced/widowed	61 (37%)	48 (29%)	61(36%)	63 (42%)
Married or living with a partner	104 (63%)	117 (70%)	109 (64%)	85 (57%)
Education				
Incomplete high school	5 (3%)	10 (6%)	8 (5%)	7 (4%)
High school	31 (19%)	39 (23%)	26 (15%)	30 (20%)
College/University	127 (77%)	117 (70%)	136 (80%)	111 (74%)
Ethnicity				
French Canadian	143 (87%)	151 (90%)	148 (87%)	130 (87%)
Other	22 (13%)	16 (10%)	21 (13%)	19 (13%)

HPV status*				
Positive	44 (26%)	44 (26%)	43 (26%)	37 (22%)
Negative	121 (25%)	123 (26%)	127 (26%)	112 (23%)

*HPV = Human papillomavirus; positive = received an HPV positive test result either at enrollment or at follow-up in CCCaST.

Table 9: Correlations among baseline variables and covariates of information-seeking, HPV uncertainty and state anxiety. From Rosen et al. (2008). Manuscript submitted for publication.

Factor	Information-seeking (baseline)	HPV uncertainty (post-intervention)	Anxiety (post-intervention)
Baseline variables			
Perceived cervical cancer risk	.20**	-	-
Perceived HPV risk	.14*	-	-
HPV uncertainty	.20**	.52**	.10*
State anxiety	.02	.11*	.62**
Covariates post-intervention			
Negative affect	-	.10*	.65**
Perceived cervical cancer risk	-	.28**	.15*
Perceived HPV risk	-	.39**	.12*
Perceived ambiguity about HPV information	-	.33**	.20**

*$p < .05$, **$p < .001$

Note. Only variables whose correlations are greater than .20 and significant at $p < .001$ are included as covariates. Post-intervention scores on covariates are included in the analyses for variables that were assessed at both baseline and post-intervention (e.g., perceived cervical cancer risk).

Table 10: Results of hierarchical regression analyses. From Rosen et al. (2008). Manuscript submitted for publication.

Step and predictor	ΔR^2	ΔF	β
Information-seeking			
Step 1:	.05	15.95***	
IUS			.20*
HPV uncertainty			.46***
Step 2:	.01	5.54*	
IUS x HPV uncertainty			.21*
State anxiety (log transformed)			
Step 1:	.55	393.32***	
State anxiety (baseline)			.12***
Negative affect			.13***
Step 2:	.01	4.77**	
IUS			.03**
Pamphlet condition (contrast coded)			-.00
	.01	7.97**	
Step 3:			.02**
IUS x pamphlet condition (contrast coded)			

*$p < .05$; **$p < .01$; ***$p < .001$

Note. All covariates were centered before being entered into the model. IUS = Intolerance of Uncertainty Scale; HPV = human papillomavirus; Contrast = Long HPV and short control pamphlets vs. short HPV and long control pamphlets

Figure 1: Flow diagram of participants. From Rosen et al. (2008). Manuscript submitted for publication.

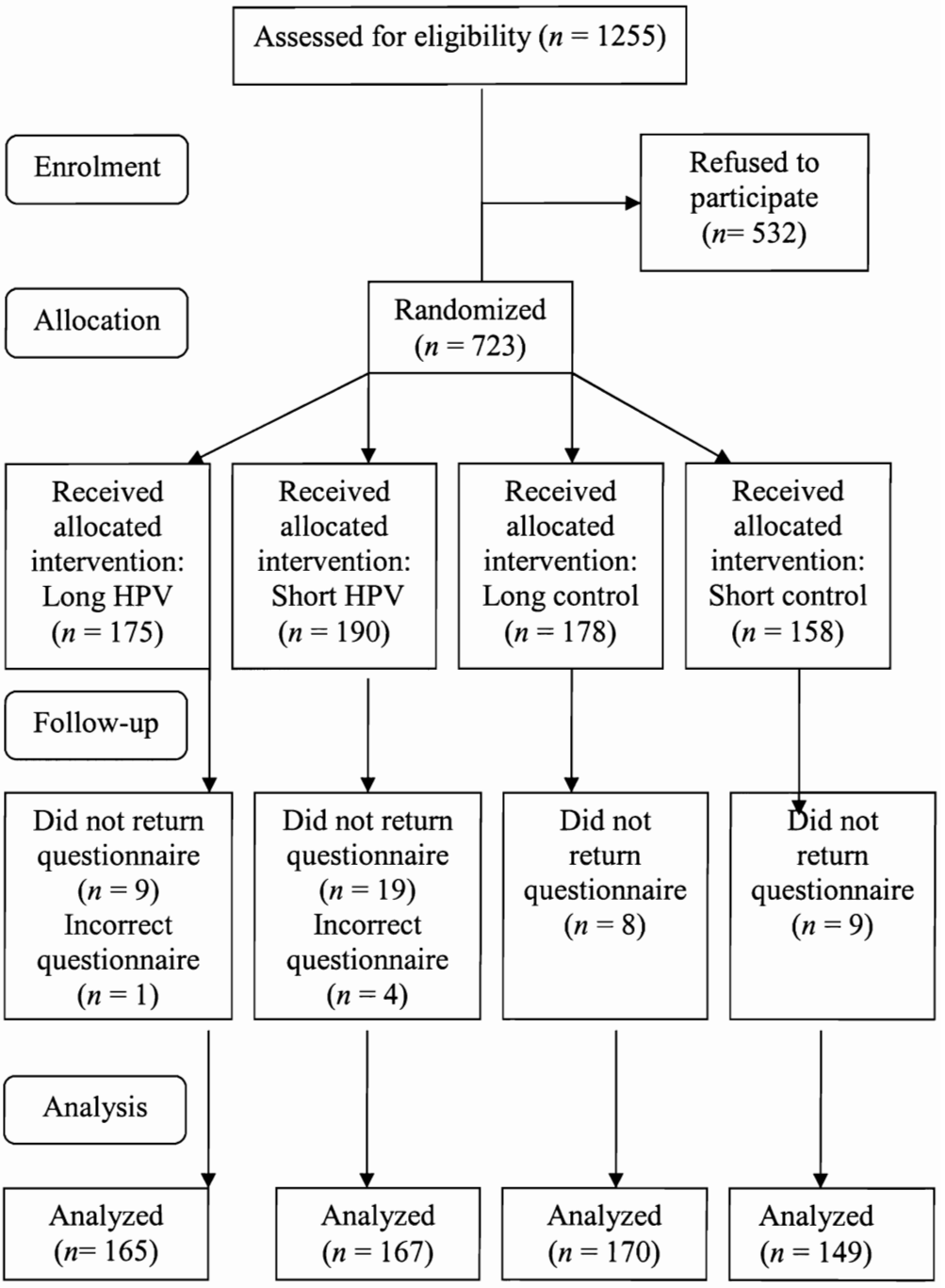


Figure 2: The IU by HPV Uncertainty effect on information seeking intentions. From Rosen et al. (2008). Manuscript submitted for publication.

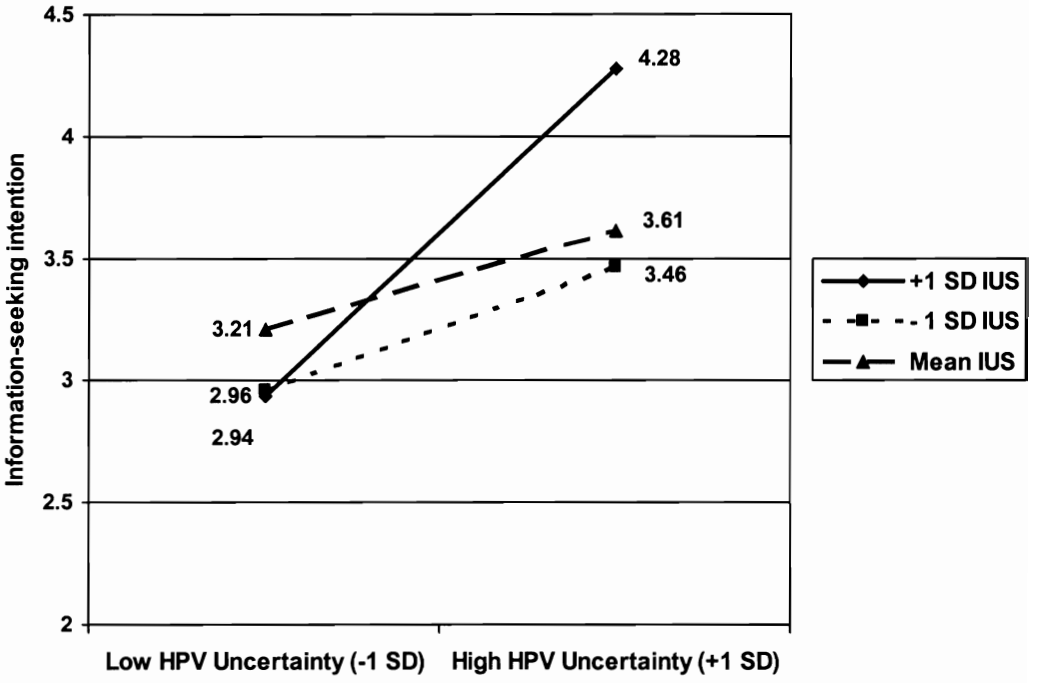
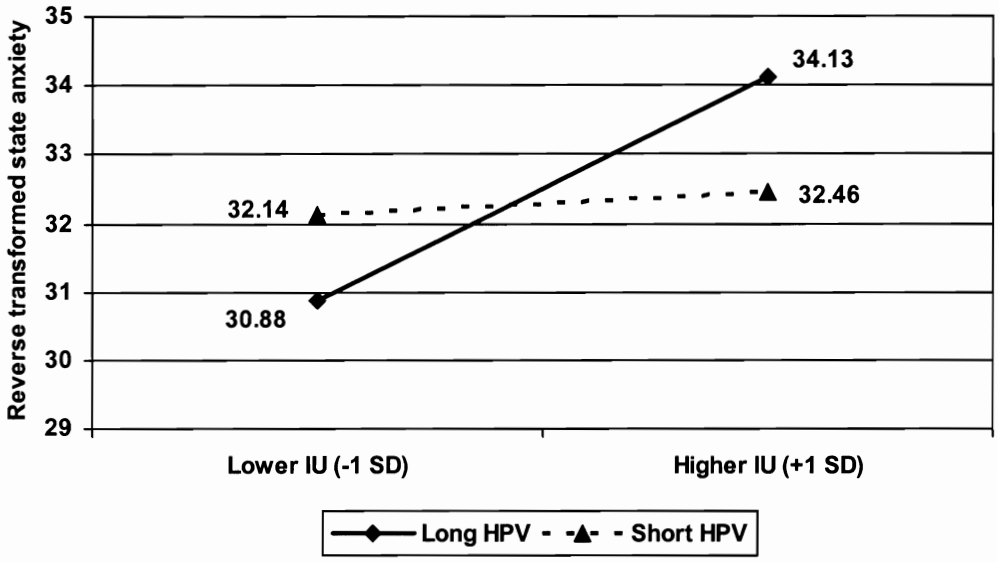
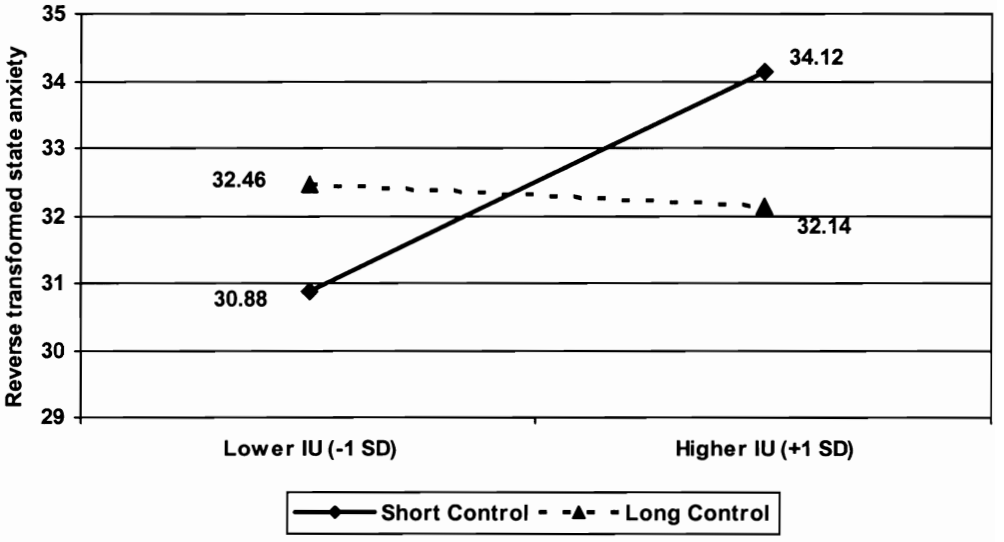


Figure 3: The IU by HPV pamphlet and IU by control pamphlet effects on anxiety. From Rosen et al. (2008). Manuscript submitted for publication.





GENERAL DISCUSSION

The aim of this dissertation was to investigate the psychosocial impact of trait and state differences in uncertainty when individuals are confronted with a health threat. The first manuscript established that a higher intolerance of uncertainty (IU) leads to greater information-seeking. The second manuscript showed that this relationship is moderated by perceived situational uncertainty (SU) and that the IU by SU interaction also affects worry. Manuscripts 3 and 4 examine my questions within a community sample of women and for the real health threat of the human papillomavirus (HPV). Manuscript 3 describes specific facts about HPV that make women feel uncertain and reassured of their HPV status. The final manuscript demonstrates that meeting the informational needs of women with higher IU (i.e. giving them a lot of information about HPV) increases their anxiety compared to giving them less information, presumably because HPV-related uncertainty cannot be permanently resolved through more information due to the specific characteristics of the infection.

This thesis represents an important original contribution to knowledge with theoretical and applied implications as well as many avenues for future research. In the following section I will outline these implications and future research directions.

Theoretical Implications and Future Research

Although health researchers have long established that uncertainty impacts an individuals' affective and behavioural responses to health threats (e.g., Babrow, Kasch, & Ford, 1998; Brashers, Neidig, & Goldsmith, 2004; Maissi et

al., 2004; Mishel, 1981; Mishel, 1988; Mishel, Germino, Gil, Belyea, Laney, Stewart et al., 2005; Stiegelis, Hagedoorn, Sanderman, Bennenbroek, Buunk, Van den Bergh et al. 2004), the studies in my thesis are among the first to apply the construct of an IU to a health context (e.g., O'Neill et al., 2006). I established empirical evidence in support of Krohne's (1993) proposition from 15 years ago that a higher IU leads to a greater search for threat-relevant information. Furthermore, I extended Krohne's theory to show that individuals with high IU seek the most information when they perceive the situational uncertainty (SU) surrounding a health threat to be higher rather than lower. Krohne also proposed that the relationship between IU and information-seeking would be mediated by a desire to reduce uncertainty. However, I did not find support for this assertion and instead showed that the desire to reduce uncertainty was an independent predictor of information-seeking. I suggest that one possible explanation for their independence is that IU is an individual difference assumed to remain relatively stable across situations. In contrast, the motivational factor of wanting to reduce one's uncertainty may be situation-dependent and therefore apply regardless of individual differences in IU, hence the lack of correlation between the two variables. This explanation is also consistent with the definition of IU as a clinical construct that focuses on the psychological effects of uncertainty, in contrast to the constructs of need for cognitive closure (NCC) and uncertainty-orientation which are motivational in nature and focus on the desire to approach or avoid uncertainty. Thus, I speculate that the desire to reduce uncertainty may be more

likely to mediate the relationships between NCC or uncertainty-orientation and information-seeking.

The question of what accounts for the relationship between IU and information-seeking remains to be investigated in future research, but I will speculate on one possibility. Recently, researchers have shown that a higher IU leads to a greater threat perception (i.e. overestimation of the probability of the threat occurring and of the costs for negative outcomes), which partially mediated the relationship between IU and worry (Bredemeier & Berenbaum, 2008). Thus, a person with higher IU may be more likely to believe that there is a greater probability of negative consequences when faced with an uncertain health threat compared to a person with lower IU and this increased threat perception may lead them to seek more information in addition to worrying more.

Manuscript 2 also showed that individuals worried more due to uncertainty when there was higher SU and they were induced to have higher IU compared to when there was lower SU and they were induced to have lower IU. Many researchers have found a relationship between higher IU and greater worries (e.g., Dugas et al., 1997; Dugas et al., 1998). They have since begun to elucidate possible mechanisms to account for this relationship that may also apply to understanding the effects of the IU by SU interaction on worry (Dugas et al., 2005; Koerner & Dugas, 2007). First, researchers have demonstrated that individuals with higher IU show cognitive biases for uncertain information that account for greater worries (Dugas et al., 2005). The authors found that individuals with higher IU are more likely to recall uncertainty-related

information compared to individuals with lower IU. But do individuals with higher IU selectively attend to uncertain information or do they simply have a better memory for it, or both? Future research will shed light on these mediating process variables.

Second, researchers have provided some evidence for another possible mediator: Individuals with higher IU appraise uncertain situations as more negative compared to individuals with lower IU and this leads to greater worries (Dugas et al. 2005; Koerner & Dugas, 2007). Thus, for example, individuals with higher IU who feels uncertain about whether or not they have HPV (i.e., they perceive high SU) may appraise the information that HPV is very prevalent as more negative (e.g. "I probably will contract HPV and this means I might get cancer"), which leads to greater worries compared to a person with lower IU who may appraise this same information as reassuring (e.g. "I probably will contract HPV but so do many other people and they do not develop cancer") and consequently does not worry much.

Another important theoretical contribution of this thesis is that it was the first to examine the psychological impact of meeting the informational needs of women with higher IU. For the control conditions, I found that matching the informational needs of women with higher IU (i.e. giving them more information about cancer prevention) resulted in lower anxiety compared to a mis-match in informational needs (i.e. giving women with higher IU less information). In contrast, the results for the experimental condition showed that women with higher IU felt more anxious when they received more, rather than less, HPV

information. Given that women with higher IU are more likely to seek information in order to meet their greater informational needs; our results suggest they may have difficulty coping when this information (e.g. for HPV) makes them feel uncertain. HPV is an example of a health threat whereby receiving more information cannot permanently resolve uncertainties concerning HPV. Therefore, my findings contribute to the literature on message tailoring by showing that tailoring information to recipients based on IU depends on whether or not additional information can resolve factual uncertainties about the specific health threat. For example, uncertainty about one's status for other STIs such as Chlamydia or Syphilis can be resolved through testing (although new uncertainty may arise once the individual has unprotected sex with a new partner). Therefore, for these health threats, providing individuals with higher IU with more information (including their test result) rather than less should lead to lower anxiety because their uncertainty has been resolved. Future research should investigate the psychosocial impact of IU for health threats whereby uncertainty can be resolved through additional information.

Applied Implications and Future Research

The results of my thesis lead me to suggest that it may be useful to prospectively identify individuals with higher IU to aid health providers in the delivery of uncertainty-inducing information. Recently, researchers have established the reliability and validity of a short-form of the IUS (12 items, IUS-12; Carleton et al., 2007) that would allow for a quick assessment of IU (less than 5 minutes). Patients could be asked to complete the questionnaire while waiting to

meet with a primary care provider. Similar self-report mental health questionnaires have been found to be useful, efficient and valid for detecting mental health problems (e.g., Lewin, Knäuper, Roseman, Adler, & Melus, in press; Mulrow, Williams, Gerety, Ramirez, Montiel & Kerber, 1995; Spitzer, Kroenke, Williams et al., 1999). One study found that approximately 80% (417/521) of family physicians surveyed had used one or more of the 11 listed psychological measures (e.g., Beck Depression Inventory, Hamilton Rating Scale for Anxiety) in clinical practice and most had done so in the preceding 12 months (Sansone, Wiederman, & Sansone, 1998).

Alternatively, health providers could incorporate even fewer screening questions for IU (based on the IUS) into their communications with patients. Currently, physicians are trained (in medical school) to incorporate screening questions for detecting mental health problems based on the diagnostic criteria in the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; 1994). Recent research has demonstrated the validity of 2-item screening tools for depression (e.g., Arroll, Khin, & Kerse, 2003; Kroenke, Spitzer, & Williams, 2003; Löwe, Kroenke, & Gräfe, 2005; Whooley, Avins, Miranda, & Browner, 1997) and a 2-item tool for anxiety (Kroenke, Spitzer, Williams, Monohan, & Löwe, 2007) in primary care settings. I suggest health providers (primary care or otherwise) could similarly incorporate brief questions to assess IU in their discussions with patients. The reliability and validity of these questions would need to be established empirically.

Identifying individuals with higher IU is useful because my research suggests that this is a subgroup that is more likely to request additional information, however health providers may provide it without realizing that when uncertainty cannot be resolved by more information, the information may induce more distress. Moreover, health providers are in a position to help manage the distress. Making individuals aware of their level of IU could itself have positive effects by normalizing the difficulty of dealing with uncertainty and identifying that the person may have difficulty coping. Use of a screening measure in a practical clinical setting such as a psychology clinic or an STI clinic, or use of a few screening questions by health providers such as family physicians *before* they disseminate a lot of health information would allow for a quick assessment of IU so that the provider can tailor his or her communications accordingly. If IU is higher, then health providers can provide the individual with more information to meet their greater informational needs. However, for health threats where more information cannot resolve uncertainties (such as HPV) a higher IU would signal the health provider that information should be accompanied by strategies for managing that uncertainty.

Future research is necessary for discovering the optimal intervention for helping individuals with higher IU cope with information that induces uncertainty about their health, but I will list a few suggestions for the specific case of HPV. First, when communicating an HPV test result, the health provider can offer instrumental support 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. Second, when health educators disseminate HPV information that may induce higher perceived uncertainty about one's HPV status and anxiety in women with higher IU, the educators could accompany this information with clear guidelines for cervical cancer screening. Individuals can then develop a screening routine for managing uncertainty.

A third, more general suggestion for intervening with individuals with higher IU, is that health providers and therapists (if the individual is in therapy and coping with chronic uncertainty about their health such as cancer) could target IU through the use of cognitive restructuring techniques. Cognitive restructuring involves identifying maladaptive beliefs and replacing them with more realistic beliefs through techniques such as examining the evidence for beliefs, conducting behavioral experiments, self-monitoring, problem solving, etc. (Beck, 1995). For example, the provider could use cognitive restructuring techniques to identify and replace maladaptive beliefs about uncertainty (e.g., "by worrying about the future I can control it") with more realistic beliefs (e.g., "I cannot control the future but I can learn coping skills such as relaxation to deal with my present anxiety"). Dugas and his colleagues provide more detailed descriptions of cognitive-behavioural techniques for targeting IU in a therapeutic context (e.g., Dugas & Ladouceur, 2000; Robichaud & Dugas, 2006).

The current findings may be relevant to a number of other health contexts where uncertainty cannot be permanently resolved (e.g., genetic testing, cancer). Uncertainty-reduction has been cited as a primary motivation for genetic testing; but many individuals do not experience a reduction in uncertainty about their own

risk and the risk of their family members following test results (e.g., Crouch, DeShano, Blackwood, Calzone, Stopfer, Campeau et al., 1997; O'Neill et al., 2006; Shih, Couch, Nathanson, Blackwood, Rebbeck, Armstrong et al., 2002). An example of a specific health context that the current findings might apply to is genetic testing for mutations on the BRCA1/2 gene. Women who undergo genetic testing for the BRCA1/2 mutations receive either a positive test result, which means that they are at increased risk for breast and/or ovarian cancer, or an uninformative test result due to the possibility that the mutation went undetected or that a mutation exists in another gene (O'Neill et al., 2006). Therefore, women who receive positive results experience heightened uncertainty about whether or not they will develop cancer and women who receive uninformative results experience ongoing uncertainty about their cancer risk. Thus for this health context, like HPV, uncertainty cannot be permanently resolved due to the nature of the genetic testing results. Future research should investigate whether the current findings generalize to other similar health contexts so that health providers can tailor their interventions appropriately.

To conclude, a higher intolerance of uncertainty (IU) has been found to cause greater information-seeking and greater worries when individuals perceive higher situational uncertainty (SU) about a health threat compared to a lower IU and lower SU. But for some health contexts such as HPV, meeting the greater informational needs of individuals with higher IU (i.e. providing them with more information about the health threat) leads to more anxiety. I propose that this heightened anxiety arises because HPV is an example of a health threat whereby

uncertainty cannot be resolved through more information. Thus, this subset of individuals may be at risk for greater distress when they seek out or receive uncertainty-inducing information.

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