The impact of intolerance of uncertainty on anxiety after receiving an informational intervention about HPV: A randomised controlled study

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This study examined the impact of intolerance of uncertainty (IU) and an informational intervention about human papillomavirus (HPV) infection on perceived uncertainty about one's HPV testing status (referred to as 'HPV uncertainty') and anxiety. IU, HPV uncertainty and other pre-intervention measures were assessed through mailed questionnaires. Participants were then randomly assigned to receive either a long ($N = 125$) or short ($N = 124$) HPV-specific information pamphlet or a long ($N = 131$) or short ($N = 115$) control pamphlet about cancer prevention. Participants subsequently completed measures of HPV uncertainty and anxiety. Providing a lot of HPV information increased HPV uncertainty more than providing little HPV information and cancer prevention information. Among women who received the long HPV or the short control pamphlet, those with higher IU were more anxious than those with lower IU. 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 the provision of more information.

Keywords: intolerance of uncertainty; human papillomavirus; uncertainty; informational intervention

Introduction

Human papillomavirus (HPV) infections are either low risk (leading to genital warts or causing no clinically evident lesions) or high risk (causally linked to cervical cancer) (Trottier & Franco, 2006). Cervical cancer screening, through Pap or HPV DNA testing, is the only way to prevent precancerous lesions from developing into

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cervical cancer. HPV testing is a more sensitive screening test than the Pap test for detecting these lesions (Mayrand et al., 2007). Currently in Canada, HPV DNA testing is mainly used to triage women who receive abnormal Pap smear results for colposcopy (Arbyn et al., 2006). In the United States, HPV testing has also received approval as an adjunct to Pap testing (Smith, Cokkinides, & Eyre, 2006). As HPV testing becomes the preferred method of screening, it is increasingly important to evaluate the potential psychological consequences (e.g. increased uncertainty, anxiety) of providing women with information about HPV and HPV testing. The aim of the current study is to examine the impact of intolerance of uncertainty (IU) and an informational intervention about HPV on perceived uncertainty about one's HPV testing status and anxiety.

While some information concerning the natural history of HPV infections and HPV testing may be perceived as reassuring (e.g. that there is a low chance of developing cervical cancer in the 3 years following a negative result), other information may be perceived as uncertainty-inducing (e.g. that the infection can remain undetected (latent) for years). Perceived situational uncertainty occurs when a particular event or particular information induces doubt about whether or not an outcome will occur (Keren & Gerritsen, 1999). HPV facts that may increase perceived situational uncertainty about one's HPV status are henceforth referred as 'HPV uncertainty'. Rosen et al. (in press) identified several specific facts that induced HPV uncertainty in women: that the lifetime HPV prevalence is 75%, there is a possibility of undetected 'latent' infections and it is impossible to determine when and from whom HPV was transmitted (for others, see also Anhang, Wright, Smock, & Goldie, 1999). HPV uncertainty might also arise due to test results, a changing risk profile (e.g. new sexual partner) or from receiving new information that prompts the saliency of one's uncertainty (e.g. when one sees an advertisement for HPV testing).

Perceived situational uncertainty about a health threat, such as HPV uncertainty, can lead to increased anxiety, particularly when that uncertainty remains unresolved (Maissi et al., 2004). For example, women at increased risk for ovarian cancer reported elevated levels of psychological distress equivalent to that experienced by breast cancer patients (Schwartz, Lerman, Miller, Daly, & Masny, 1995). However, other researchers have found no evidence for increased distress among women who find out that they are carriers of the breast cancer gene mutation compared to non-carriers (Lerman et al., 1996). One possible explanation for these diverging results is that the amount of anxiety experienced may depend on the level of perceived uncertainty in the health threat. Another explanation is that there may be individual differences in responding to uncertainty that were not taken into account in the studies. It is important to examine individual differences in responding to uncertainty in order to fully understand the potential health outcomes.

One such individual difference in responses to uncertainty is called an IU. IU differs from situational uncertainty because it refers to a trait of the individual rather than the perceived characteristics of the situation. 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). An individual with a high IU views uncertain situations as unacceptable and aversive, whereas an individual with a low IU does not feel distraught by these same situations (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). Researchers have demonstrated that IU correlates positively with other negative mood states including worry ($r = 0.63$), anxiety ($r = 0.57$) and

depression ($r = 0.52$) (Freeston et al., 1994). Although the correlations are moderate to high, there is still a unique variance attributed to IU that cannot be captured by these other variables. Specifically, IU may be a higher-order factor with unique causal effects on other mood states. Indeed, researchers have shown that uncertain situations induce and perpetuate greater psychological distress in individuals who are higher in IU (Dugas, Gosselin, & Ladouceur, 2001; Greco & Roger, 2003; Ladouceur et al., 2000). To understand how to reduce the negative impact of IU, it is necessary to examine potential moderators of the relationship between IU and anxiety.

Impact of providing information on anxiety

One important moderator of the relationship between IU and anxiety may be information. Researchers have demonstrated that tailoring printed health messages such as pamphlets and brochures to recipients' individualised characteristics induces behavioural change, including increased mammography and pap screening uptake (Noar, Benac, & Harris, 2007; Paul, Redman, & Sanson-Fisher, 2004; Williams-Piehota, Pizarro, Schneider, Mowad & Salovey, 2005). 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). While there is limited research examining the psychological impact of tailored messages, some evidence suggest that tailored messages reduce negative psychological outcomes such as negative affect (Williams-Piehota et al., 2005). Previous researchers have established a 'fit' between health messages and the individual by tailoring the content of the information. However, we theorise that a fit can also be achieved by tailoring the 'amount' of information.

In the present study, we investigated how tailoring the amount of information that one receives about HPV can have differential outcomes depending on the level of IU. Indeed, an empirically validated relationship between higher IU and greater information seeking has been established (Rosen, Knäuper, & Sammut, 2007). Krohne (1993) theorised that some individuals whom he called 'vigilant' have a higher IU, which leads to an extensive and continual search for threat-relevant information. Rosen et al. (2007) tested this hypothesis and found that experimentally inducing higher IU led to a greater desire for threat-relevant information and higher information-seeking intentions and actual behaviour. Furthermore, higher IU leads not only to a desire for more information, but as noted earlier, also to higher anxiety when faced with a health threat (Greco & Roger, 2003). However, it remains to be seen whether meeting the information needs of individuals with higher IU, by giving them a lot of information, will alleviate their anxiety or whether it will increase their anxiety because the information induces greater uncertainty (e.g. for health threats such as HPV). We therefore aimed to examine the interaction between IU and amount of information (more versus less) on anxiety. Establishing how the impact of information changes according to the level of IU will allow health providers and educators who disseminate uncertainty-inducing information (e.g. HPV test results, written information, etc.) to tailor their interventions to reduce anxiety accordingly. To this end, we developed an intervention in which participants were randomly assigned to receive either a longer or a shorter experimental pamphlet containing varying amounts of information about HPV and its relationship to cervical cancer,

or a longer or a shorter control pamphlet about general cancer prevention. We describe the development of these materials in the 'Method' section.

Hypotheses

The hypotheses were addressed within the framework of a larger study examining the psychosocial impact of HPV testing called the 'Psychosocial Impact of Cervical Cancer Screening' (PICCS). Our participants were women who previously tested HPV negative on an average of 3 years prior to the current study. 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. Therefore, our first hypothesis is that providing a long HPV-specific information pamphlet will increase HPV uncertainty more than providing a short HPV-specific information pamphlet and a cancer prevention pamphlet (long or short), because the characteristics of HPV will become more salient. Given prior research on message tailoring, we expect that for the control conditions, providing higher IU-women with little information will result in higher anxiety rather than providing them with a lot of information because their elevated informational needs will not be met. However, for the experimental HPV conditions, uncertainty cannot be resolved through the acquisition of more information and therefore, providing higher IU-women with a lot (rather than a little) of information will result in higher anxiety. In sum, our second hypothesis is that among women who receive the long HPV-specific pamphlet or the short control pamphlet, those with a higher IU will report higher anxiety than those with lower IU.

Method

Participants

Participants enrolled in the Canadian Cervical Cancer Screening Trial (CCCaST), a randomised controlled trial comparing the efficacy of Pap versus HPV tests in screening for cervical cancer (Mayrand et al., 2006) were recruited for the PICCS study from September 2006 to August 2007. The 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. The average amount of time that passed between participation in CCCaST and enrolment into PICCS was 3.38 years (SD $= 0.58$ years). 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). For the current study, we contacted only those participants living in the Montreal and surrounding municipalities. Thus, 4194 Montreal participants were deemed eligible.

We recruited approximately 150–225 participants per month. Of the 1255 women who were randomly selected from CCCaST and contacted for participation, 723 out of the 1255 (58%) completed the pre-intervention questionnaires and were randomly
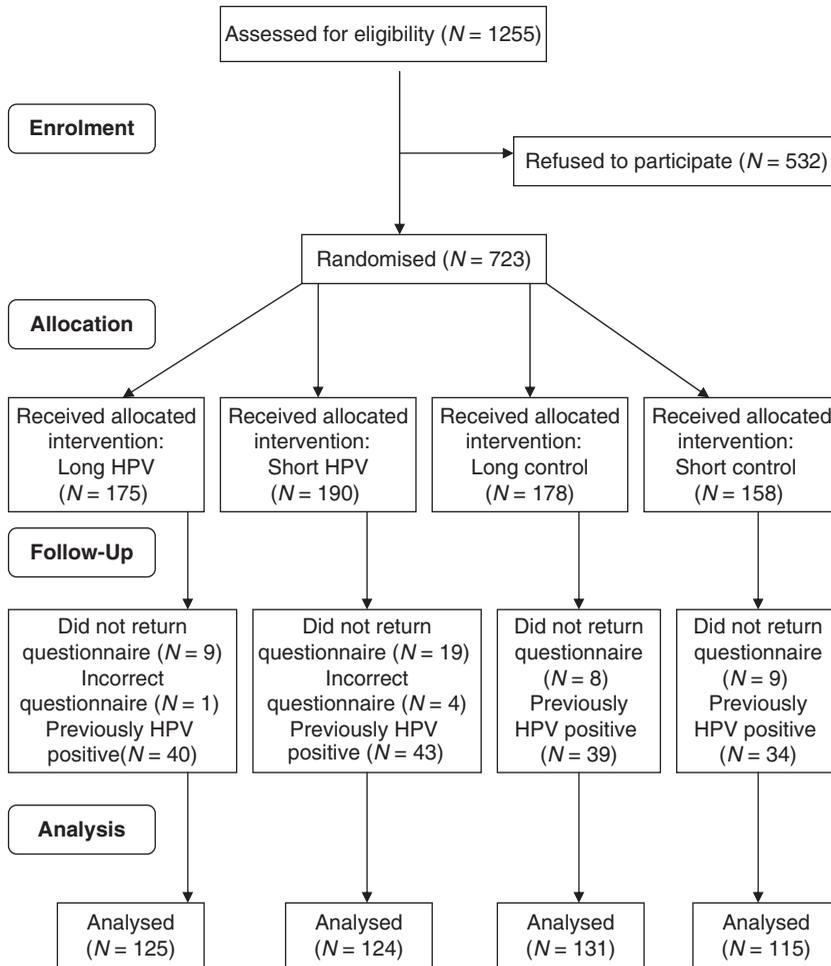
Figure 1. Flow diagram of participants.

assigned an intervention pamphlet that was received with the second set of questionnaires. One hundred and sixty-eight women (23% of participants) 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. Having previously tested positive for HPV may influence several of the predictor, covariate and outcome variables. Because this sample of women was not large enough to examine our hypotheses separately, we excluded these women from the analyses. A total of 495 women were included in the analyses. Figure 1 displays a flow diagram of participants through enrolment, randomisation, attrition and analysis for the study.

Table 1 presents the demographic characteristics of the participants by intervention group. The mean age of participants was 50.71 years (SD = 9.62, range = 33–75). The majority of the women were French-Canadian (89%), married or living with a partner (69%) and had completed college or university schooling (74%).

Table 1. Descriptive characteristics of participants by intervention group.

Intervention group	Experimental: HPV		Control: cancer prevention	
	Long (N = 121)	Short (N = 123)	Long (N = 127)	Short (N = 112)
Age (mean, SD)	50.29 (9.88)	50.43 (9.37)	51.19 (9.45)	50.93 (9.9)
Marital status				
Single/divorced/ widowed	35 (29%)	31 (25%)	40 (30%)	42 (38%)
Married or living with a partner	86 (71%)	90 (73%)	87 (70%)	69 (62%)
Education				
Incomplete high school	4 (3%)	8 (7%)	6 (5%)	5 (4%)
High school	26 (22%)	26 (21%)	22 (17%)	24 (21%)
College/University	89 (74%)	88 (72%)	99 (78%)	82 (73%)
Ethnicity				
French Canadian	107 (88%)	108 (88%)	116 (91%)	100 (89%)
Other	14 (12%)	15 (12%)	11 (9%)	12 (11%)

Note: HPV = Human papillomavirus.

Procedure

Ethics approval was obtained from both the McGill University and the Jewish General Hospital institutional 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, who spoke French as a first language. Randomly selected eligible participants were sent a letter that explained the collaboration with CCCaST and requested those participants contact us if they were 'not' interested in participating. Approximately 2 weeks later, the first questionnaire consisting of pre-intervention measures was mailed. To minimise attrition, a research assistant was called after 1 week to confirm its receipt and to answer questions. A second reminder phone call was made 1 week later and a final phone call was made 2 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 3 weeks of receiving their completed first questionnaire of pre-intervention measures. The same protocol of reminder phone calls was followed. Upon receiving the completed second questionnaire, participants were sent the long HPV pamphlet, which served as a debriefing, and a $20 gift certificate.

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, four page, version contained answers to the following nine questions: What are HPVs? How common are HPVs? What is the Pap versus 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, one page version contained answers to the first four of these questions. These questions were selected for the shorter pamphlet because they represent the most basic information about HPV. In total, the longer booklet contained 40 facts compared to the 17 facts in the shorter pamphlet.

H.M. Mayrand and E.L.Franco 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 and 10, using the Flesch–Kincaid readability scale (grade-level range, 0–12), 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 included information about health-related activities that may reduce the risk of developing cancer such as smoking, physical activity, sun protection, diet, hazardous materials and following screening guidelines. The pamphlets can be found at http://ego.psych.mcgill.ca/perpg/fac/knaeuper/supplementalmaterial.htm. All pamphlets were translated from English to French by an experienced translator specialised 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., revised and resubmitted) was conducted to determine that the information in the pamphlets were comprehensible and, if necessary, revisions were made.

Measures

Intolerance of uncertainty scale and need for closure scale

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. Participants responded (pre-intervention) 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 5 weeks period ($r = 0.74$; $p < 0.001$) 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 seven items from the predictability of future contexts subscale of the Need for Closure Scale (NFCS) (Webster & Kruglanski, 1994) which 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 onwards, which refer to the 'IUS' also include the NFCS items. Responses were summed and scores ranged from 39 to 151 ($M = 76.40$, SD = 21.87). Cronbach's α for the IUS/NFCS scale was 0.94.

State-trait anxiety scale

The 'state' factor of the State-Trait Anxiety Scale (STAI) (Spielberger, 1983) 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) and participants completed the measure pre- and post-intervention. The STAI has good convergent and discriminant validity and test–retest reliability. Responses were summed and scores ranged from 20 to 71 ($M = 32.03$, SD = 9.57) pre-intervention and 20 to 80 ($M = 33.38$, SD = 10.42) post-intervention. Cronbach's α was 0.93 (pre) and 0.94 (post-intervention) for the state subscale. Scores on the measure of anxiety were within the expected normal (i.e. non-clinical) range for 197–230 (86%) of women aged 19-49 years (raw score <47) and 200–248 (81%) of women aged 50-69 years (raw score <41) (Spielberger, 1983).

HPV uncertainty

Perceived uncertainty refers to the doubt that exists about whether or not a particular outcome will occur (Keren & Gerritsen, 1999). To assess perceived uncertainty about one's HPV status (HPV uncertainty), participants responded pre- 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. Mean reverse-coded scores for pre-intervention were 2.96 (SD = 2.07) and for post-intervention were 3.01 (SD = 2.10).

Manipulation check questions. We asked participants to indicate their agreement for post-intervention 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'.

Covariates of HPV uncertainty and state anxiety

Despite their conceptual differences, perceived uncertainty, risk and ambiguity have often been used interchangeably in research leading to methodological problems such as measuring uncertainty with a question that assesses perceived risk (e.g. O'Neill et al., 2006). We expected perceived risk and ambiguity to be significantly correlated with our outcome measure of HPV uncertainty and deemed it important

to include them in that case as covariates in order to assess the unique contribution of the intervention on HPV uncertainty. Perceived risk refers to perceptions of the likelihood that a particular outcome will occur (e.g. Maissi et al., 2004). To assess perceived risk for developing cervical cancer and for contracting HPV post-intervention, participants responded on a scale ranging from 1 (much lower chances) to 7 (much higher chances) to the statement 'In comparison to other women your age, what do you think your chances are of ever developing cervical cancer?' ($M = 3.52$, $SD = 1.58$) and 'In comparison to other women of your age, what do you think your chances are of contracting HPV?' ($M = 2.53$, $SD = 1.51$). Perceived ambiguity refers to an inability to assign meaning to a situation because of insufficient information or more than one possible interpretations of information (Budner, 1962; Mishel, 1981). To assess perceived ambiguity about HPV information post-intervention, participants responded to eight items from the Mishel Uncertainty in Illness Scale (MUIS) (Mishel, 1981) that were adapted to be content-specific to HPV. Responses were summed and scores ranged from 8 to 36 ($M = 20.86$, $SD = 5.79$). Cronbach's α was 0.70.

Higher perceived risk and higher perceived ambiguity about their HPV test results predict higher anxiety among women undergoing HPV testing (Maissi et al., 2004). In addition, researchers have documented a moderate to high correlation between negative affect and anxiety. Negative affect was assessed by the Negative subscale of the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988). 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. Scores ranged from 7 to 30 ($M = 8.50$, $SD = 2.84$). Cronbach's α was 0.83. It is therefore essential to include these covariates in the case that they are significantly related to state anxiety in order to assess the unique contribution of our predictors to anxiety.

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 pre-intervention in terms of demographic variables and our independent and dependent variables. Third, a linear relationship between a covariate and the dependent variable is requisite for any adjustment along the regression line (Pedhazur & Schmelkin, 1991). We therefore used correlational analyses to confirm the relationships of theoretically chosen covariates to the dependent variables. Further, this relationship should be substantive (Pedhazur & Schmelkin, 1991) in order to limit the number of covariates included in the regression, thereby reducing the chances of making a Type 1 error and improving the interpretability of the results (Cohen, 1990). A substantive effect can be defined as a moderate effect or $r = 0.30$ (Cohen, 1988). Thus, only those covariates that correlated greater than 0.30 were retained (Table 2).

The first hypothesis that providing a long HPV-specific information pamphlet will increase HPV uncertainty more than providing a short HPV-specific information pamphlet and a cancer prevention pamphlet (long or short), was tested with a univariate analysis of covariance followed by a planned contrast. The second

Table 2. Correlations among pre-intervention variables and covariates of HPV uncertainty and state anxiety.

Factor	HPV uncertainty (post-intervention)	Anxiety (post-intervention)
Intolerance of Uncertainty	0.04	0.44**
Pre-intervention variables		
HPV uncertainty	0.52**	0.10*
State anxiety	0.05	0.62**
Covariates post-intervention		
Negative affect	0.10*	0.65**
Perceived cervical cancer risk	0.27**	0.15*
Perceived HPV risk	0.37**	0.12*
Perceived ambiguity about HPV information	0.33**	0.20**

Note: Only variables whose correlations are greater than 0.30 are included as covariates.
$*p < 0.05$, $**p < 0.001$.

hypothesis that among women who receive the long HPV-specific pamphlet or the short control pamphlet, those with a higher IU will report higher anxiety than those with lower IU 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 pre-intervention scores and other covariates were entered in the first step. Centered IUS scores 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 versus the short HPV and long control pamphlets. Two additional contrasts were constructed separately for the experimental and control conditions: (1) to contrast the two experimental conditions and (2) to contrast the two control conditions. To avoid multicollinearity among predictors and their interaction, IUS scores were centred around zero before being multiplied with each contrast to compute a separate interaction term that was entered in the third step of the analysis. To determine whether the effect supported our hypothesis, a significant interaction was probed by calculating the significance of the simple slopes of the regression lines (Aiken & West, 1991).

Results

Participants

There were no significant differences between women in the experimental and control conditions in any of the demographic characteristics. There were also no pre-intervention differences between the pamphlet conditions in HPV uncertainty or state anxiety. However, women who received the short HPV pamphlet ($M = 80.01$, $SD = 1.99$) scored significantly higher on the measure of IU than women who received the long HPV pamphlet ($M = 73.14$, $SD = 1.99$), $F(3, 471) = 2.06$, $p = 0.11$, but $p = 0.02$ for pairwise comparisons). When we controlled for pre-intervention 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

pre-intervention anxiety as a covariate in our analyses. Thus, the pre-intervention differences in IU are resolved. Table 2 reports the results of the correlational analysis among potential covariates, independent and dependent variables.

Pamphlet evaluation

As expected, participants reported that the long HPV pamphlet provided details beyond the basic facts about HPV and cervical cancer ($M = 5.29$, SD $= 0.16$) more than the short HPV pamphlet ($M = 4.92$, SD $= 0.16$), $F(3, 475) = 9.22$, $p < 0.001$. Participants did not report any differences in the amount of detail between the long and short control pamphlets.

Uncertainty after receiving information

The first hypothesis that providing a long HPV-specific information pamphlet will increase HPV uncertainty more than providing a short HPV-specific information pamphlet and a cancer prevention pamphlet (long or short) was assessed with analysis of covariance. The dependent variable is measured by 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 pre-intervention, higher perceived risk of contracting HPV and higher ambiguity about HPV information, which were all associated with higher HPV uncertainty ($p < 0.001$). In support of our hypothesis, a planned contrast showed a significant interaction: providing a long HPV pamphlet ($M = 3.39$, SD $= 2.09$) increased HPV uncertainty more than providing a short HPV pamphlet ($M = 2.98$, SD $= 2.07$), a long control pamphlet ($M = 2.82$, SD $= 2.05$) or a short control pamphlet ($M = 2.86$, SD $= 2.09$), $F(1, 464) = 3.23$, $p = 0.03$ (none of which significantly differed from each other). Providing cancer prevention information did not increase HPV uncertainty, regardless of whether they got a lot or a little information.

Anxiety after receiving information

The second hypothesis that among women who receive a long HPV-specific pamphlet or a short control pamphlet, those with a higher IU will report higher anxiety than those with lower IU were assessed using hierarchical regression analysis (Table 3). We controlled for the significant covariates of state anxiety: Higher pre-intervention state anxiety and higher post-intervention negative affect, both of which significantly predicted higher state anxiety after the intervention ($p < 0.001$). 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, $\Delta F (1,468) = 9.27$, $p < 0.01$. Among women who received the long HPV or the short control pamphlet those with higher IU reported higher state anxiety than those with lower IU, $F(5,468) = 143.98$, $p < 0.01$. Figure 2 shows the interaction effects (means adjusted for covariates) for the experimental and control conditions

Table 3. Results of hierarchical regression analysis.

Step and predictor	ΔR^2	ΔF	β
State anxiety (log-transformed)	0.63	394.41**	
Step 1:			
State anxiety (pre-intervention)			0.13*
Negative affect			0.15*
Step 2:	0.01	4.38*	
IUS			0.03*
Pamphlet condition (contrast coded)			0.00
Step 3:	0.01	9.27*	
IUS × pamphlet condition (contrast coded)			0.03*

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

separately. Separate contrasts for the experimental and control conditions were significant ($p = 0.03$ and $p = 0.01$). As expected, the slope of the regression lines for the long HPV pamphlet and the short control pamphlet were significant, $t(468) = 2.11$, $p = 0.03$ and $t(468) = -3.24$, $p < 0.001$, respectively, whereas the slope of the regression lines for the short HPV and the long control pamphlets were not. The significant slopes indicate that receiving a long HPV or short control pamphlet induced higher state anxiety for women with higher rather than lower IU. Receiving a short HPV or a long control pamphlet did not interact with IU to affect the level of anxiety.

Discussion

We examined the role of uncertainty in women's psychological responses to receiving HPV information. We found support for both of our hypotheses. First, we showed that providing a long HPV information pamphlet increased HPV uncertainty more than providing a short HPV pamphlet or a cancer prevention pamphlet (regardless of length). Second, we found that receiving the long HPV-specific or the short control pamphlet caused more anxiety among women with higher IU than among women with lower IU, even after controlling for variables that are known to be linked to both IU and anxiety.

Previously, researchers have shown that individuals with higher IU who perceive higher situational uncertainty are more likely to seek information as a means of coping with the uncertainty than individuals with a lower IU who are less bothered by the uncertainty and therefore have a lower tendency to seek information. The authors suggested that 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) (Rosen et al., 2007; Rosen & Knäuper, in press).

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
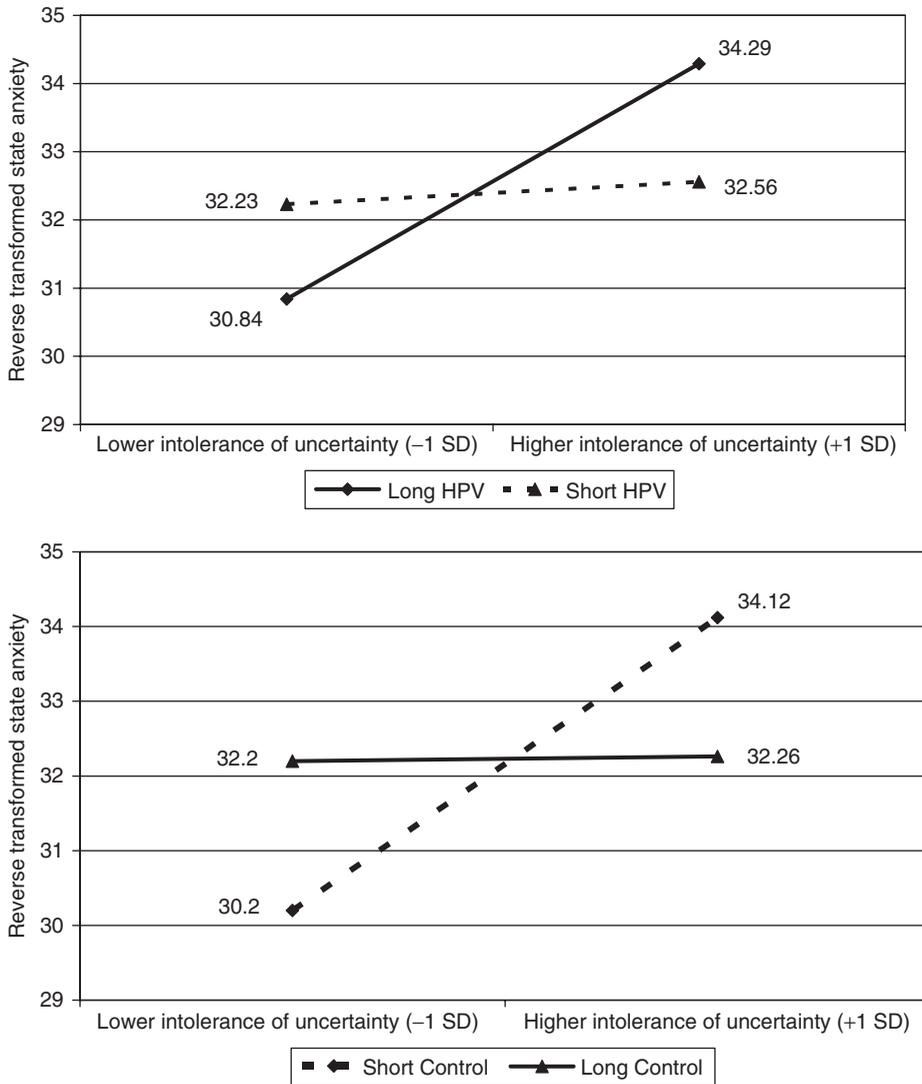
Figure 2. The IU by HPV pamphlet and IU by control pamphlet effects on anxiety.

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 additional information because of the specific characteristics of the virus and this uncertainty becomes more salient upon receiving a lot of HPV information. In support of our first hypothesis, we found that providing a long HPV information pamphlet increased HPV uncertainty more than providing a short HPV pamphlet or a cancer prevention pamphlet (regardless of length). Health providers should know that providing a lot of HPV information may induce uncertainty and they are in a position to help manage uncertainty.

The present study examined, via our second 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 than a mis-match in informational needs (i.e. giving women with higher IU less information). These results are consistent with previous research which found that matching health messages to individual differences reduce negative psychological outcomes (Williams-Piehota et al., 2005). In contrast, for the experimental condition, we showed that providing a lot of HPV information led to higher anxiety for women with higher IU rather than for women with lower IU. We propose that this differential pattern of results occurs because of the experimental condition, receiving more information about HPV cannot permanently resolve their uncertainty concerning HPV and in fact their uncertainty becomes even more salient (compared to those in the control conditions) as demonstrated by the findings in support of our first hypothesis.

Our results add to the growing literature on the impact of tailoring health messages to individual differences. Kreuter, Strecher, and Glassman (1999) have suggested that tailored messages increase positive, and reduce negative, outcomes by making information more personally relevant. Our findings demonstrate that this increased attention to personally relevant information may have a positive or a negative psychological impact depending on the characteristics of the health information being provided. 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 in coping with this ambiguous information because their 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 generalising 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) than non-participants, $\chi^2(4) = 50.92$, $p < 0.001$. 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 the 11) of the questions on our HPV knowledge test. This level of knowledge is slightly higher than what is usually found in general population samples of women (e.g. Waller et al., 2003) but still reflects large gaps in knowledge. It should also be noted that there were pre-intervention differences between women who received the long HPV pamphlet versus the short HPV pamphlet on our measure of IU. However, the group differences were no longer significant when pre-intervention state anxiety was included in the analysis.

Second, the present study included only women who previously received a negative HPV test result. Researchers have shown that anxiety is higher among women who receive positive HPV test results than women who receive negative results (e.g. Maissi et al., 2004). Thus, it is possible that for women with higher IU,

those who also have a history of testing positive will experience even greater anxiety. Future research should compare women who had previously tested HPV positive with those who have a negative HPV test history. 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).

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. Finally, health providers should offer opportunities for discussing one's emotional response to the potential health threat. 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). It may be useful to encourage individuals high in IU to bring a supportive relative or friend to appointments in which they will receive test results that imply uncertainty in one's future health.

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 in 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 need to be established empirically.

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