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Uncertainty as an anxiety cue at high and low levels of threat

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ABSTRACT

Background and objectives: Intolerance of uncertainty and the overestimation of threat contribute to the maintenance of anxiety; however, the interaction between uncertainty and threat perception has not been examined empirically. The current study examined the extent to which explicitness of uncertainty is involved in perceptions of, and responses to, scenarios about threatening situations.
Methods: A series of systematically varied scenarios were used to examine whether manipulating uncertainty (implicit vs. explicit) and threat level (high vs. low) altered the perception of a situation as anxiety-inducing. Undergraduate participants (n = 373) responded to vignettes about common situations (e.g. taking an elevator) with ratings of anxiety and desire to perform a safety behavior.
Results: Results revealed that higher threat situations, and those in which uncertainty was made explicit, provoked higher ratings of anxiety and urge to perform a safety behavior. In addition, explicit uncertainty significantly increased anxiety and urge to perform a safety behavior at low, but not at high, levels of threat.
Limitations: Participants rated (via self-report) their hypothetical feelings as induced by vignettes, rather than actually experiencing these situations in vivo.
Conclusions: We found evidence for "uncertainty-based reasoning," in which an individual perceives a situation as more anxiety-provoking (and is more likely to have the urge to perform a safety behavior) when the uncertain aspects of a situation are obvious or explicit, than when such uncertainty is merely implied or tacit. Implications for the understanding of "uncertainty-based reasoning" are discussed.

1. Introduction

The cognitive model of emotion proposes that emotions arise from beliefs and appraisals (i.e., cognitions) about situations and stimuli, rather than from the situations or stimuli themselves (e.g., Beck, 1976). Moreover, this model specifies that certain types of cognitions give rise to particular emotions. For example, overly negative beliefs about loss and personal degradation (e.g., "I am a failure") lead to depression. Rigid beliefs about the importance of obeying rules and standards (e.g., "Others must not disobey me") lead to frustration and anger. A large body of literature indicates that anxiety is associated with beliefs, perceptions, and automatic thoughts concerning threat and the perceived inability to cope with negative outcomes (Beck, Emery, & Greenberg, 1985). In fact, the tendency to overestimate threat appears to play a role in the etiology and maintenance of clinical anxiety and fear (Beck, 1976; Eysenck, 1992; Mathews, 1990; Mathews & MacLeod, 1994, 2002; Williams, Watts, MacLeod, & Mathews, 1988). Such "catastrophic" thinking is also associated with the performance of "safety behaviors" (e.g., carrying a benzodiazepine in one's pocket) that serve as an escape from anxious feelings.

Research also suggests that intolerance of uncertainty (IU) is a cognitive feature of anxiety, worry, and mood disorders (e.g., Carleton, 2012; Carleton et al., 2012; Mahoney & McEvoy, 2012a). IU refers to a set of maladaptive beliefs about the necessity of having guarantees and the incapacity to cope with unpredictability or ambiguity (Obsessive Compulsive Cognitions Working Group, 1997). IU is considered a transdiagnostic factor that has been implicated in conditions such as generalized anxiety disorder (Dugas, Buhr, & Ladouceur, 2004), social anxiety disorder (e.g., Carleton, Collimore, & Asmundson, 2010; Mahoney & McEvoy, 2012b), illness anxiety (e.g., Fergus, 2013; Fergus & Bardeen, 2013), obsessive compulsive disorder (e.g., Tolin, Abramowitz, Brigidi, & Foa, 2003), and mood disorders (e.g., Carleton et al.,

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2012; Yook, Kim, Suh, & Lee, 2010). A meta analysis confirmed that IU is a broad construct not specific to any particular anxiety disorder per se, nor to this class of problems as a whole; in fact, IU correlates strongly with general negative affect (Gentes & Ruscio, 2011).

Examples of IU-related cognitions include thoughts that uncertainty is bad, reflects poorly on a person, and should be avoided. IU is also associated with the tendency to perceive ambiguous situations as threatening and with difficulty functioning in uncertain or ambiguous situations (Buhr & Dugas, 2002; Krohne, 1993). Most people, for instance, are tolerant of acceptable levels of ambiguity or risk and regard many mundane activities that hold at least *some* implicit uncertainty as fundamentally safe. Consider, as an example, using the oven in your home. Although the probability of starting a house fire is acceptably low, it is not zero. On the other hand, someone who is less tolerant of uncertainty might explicitly focus on the uncertain aspects of the situation (even in acceptably low risk situations) and focus on the fact that there is always *some* risk of causing a house fire.

As with the literature on threat perception, high levels of IU are associated with the tendency to overestimate the probability of negative events (Dugas et al., 2004; Dugas et al., 2005; Koerner & Dugas, 2008; Ladouceur, Talbot, & Dugas, 1997). In fact, experimentally increasing IU (e.g., by providing information about the probability of winning money in a gambling simulation) has been shown to lead to increased worry, suggesting a possible causal association between IU and symptoms of anxiety (de Bruin, Rassin, & Muris, 2006; Grenier & Ladouceur, 2004; Ladouceur, Gosselin, & Dugas, 2000; Rosen & Knäuper, 2009). That is, the experience of uncertainty itself serves as a threat cue for some individuals (i.e., “uncertainty based reasoning”). Findings from a study examining IU in relation to social anxiety suggested that the relationship persists independent of anxiety sensitivity, negative affect, and positive affect (Carleton et al., 2010). The extent to which peoples' levels of fear and anxiety are jointly influenced by their perception of threat and the degree to which they attend to uncertainty, however, has not been examined.

It is possible that the experience of anxiety in a given situation is the result of an interaction between one's attention to the uncertain aspects of the situation and one's perception of threat. Accordingly, the present study aimed to investigate how the experience of uncertainty might affect anxiety in situations of varying threat levels. We were also interested in the strength of urges to perform anxiety-reducing (i.e., safety seeking) behavior. We hypothesized that increasing the threat level within the situation would lead to higher ratings of anxiety and urges to perform safety behaviors. Similarly, we hypothesized that making uncertainty explicit would heighten ratings of perceived anxiety and urges to perform safety behaviors. Finally, given that existing cognitive models of anxiety favor threat perception as a key maintenance factor (e.g., Barlow, 2000, 2002; Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Clark, 1999), we predicted that at higher levels of threat, uncertainty would play less of a role in generating anxiety and producing urges to perform safety behaviors. Yet at lower levels of threat, we hypothesized that individuals would rely on their experience of uncertainty when judging their expected anxiety and desire to perform anxiety-reducing behaviors (i.e., “uncertainty-based reasoning”).

We elected to use a nonclinical sample for this study. The use of such a sample as an apt analogue for clinical anxiety is predicated on the assumptions that the experience of anxiety is prevalent in both clinical and non-clinical populations, is phenomenologically similar across both populations, and is associated with the same developmental and maintenance factors in clinical and nonclinical individuals. Research to date suggests that these assumptions have been met (e.g., Barlow, 2002).

2. Methods

2.1. Participants

Undergraduate volunteers ($n = 373$; 63.5% female) participated in the study for credit in an introductory psychology course at a large university in the southeastern United States. The group's mean age was 18.98 ($SD = 1.78$). The majority of participants ($n = 259$; 69.4%) were Caucasian, with other ethnic/racial groups represented as follows: 54 (14.5%) identified as African American, 30 (8.0%) identified as Asian, 14 (3.8%) identified as Latino/a or Hispanic, and 16 did not specify their racial/ethnic background. Participants were recruited via the SONA system from the university's introductory psychology course participant pool. Two criteria for inclusion were used: (a) age 18 or older, and (b) fluency in English.

2.2. Materials

2.2.1. Stimuli

The researchers developed a computer-administered task, which consisted of a series of 10 vignettes about various situations. Our aim was to create vignettes about common situations that university students face. The situations, while generally considered safe, entailed some degree of threat and uncertainty regarding negative outcomes. The featured situations were chosen following extensive discussion, interviews, and pilot testing with graduate and undergraduate students. The following situations were included: (a) leaving your own residence and locking the door, (b) waiting in a doctor's office, (c) noticing a mole on your body, (d) being at a party with someone you are interested in romantically, (e) being alerted to a potentially dangerous situation on campus, (f) sending an email to a course instructor, (g) meeting your roommate's friends, (h) submitting a term paper online, (i) riding in an elevator, and (j) working with classmates on a group project for a grade.

We developed four versions of the vignette for all 10 situations. Within each situation, the four versions began with an identical stem but ended differently with either: (a) an objectively low level of threat of the negative outcome and uncertainty only implied (Threat-L/Uncertainty-I condition), (b) an objectively high level of threat of the negative outcome and uncertainty only implied (Threat-H/Uncertainty-I condition), (c) an objectively low level of threat of the negative outcome and uncertainty made explicit (Threat-L/Uncertainty-E condition), or (d) an objectively high level of threat of the negative outcome and uncertainty made explicit (Threat-H/Uncertainty-E condition). To clarify, in the Uncertainty-E condition, scenarios specifically mentioned the sense of uncertainty, whereas in the Uncertainty-I condition, there was no mention of uncertainty. For example, all four versions of vignette (g) began as follows:

> Your roommate has invited a group of friends over, and you are meeting them for the first time. You have been talking with them for a little while when you get a phone call that you take in another room.

The Threat-L/Uncertainty-I version continued as follows:

> When you return, your roommate's friends smile at you and welcome you back into the conversation.

The Threat-H/Uncertainty-I version continued as follows:

> When you return, your roommate's friends are speaking in hushed voices and become quiet when you walk in the room.

The Threat -L/Uncertainty-E version continued as follows:

When you return, your roommate's friends smile at you and welcome you back into the conversation. You aren't certain of what your roommate's friends are thinking. You want to know if they like you or not.

The Threat −H/Uncertainty-E version continued as follows:

When you return, your roommate's friends are speaking in hushed voices and become quiet when you walk in the room. You aren't certain of what your roommate's friends are thinking. You want to know if they like you or not.

Following each vignette, participants responded to five questions using a computerized, sliding visual analogue scale (VAS) ranging from 0 ("Not at all") to 100 ("Extremely"). Questions included: (a) "How threatening does this situation seem to you?" (b) "How anxious would you feel if you were in this situation?" (c) "How uncertain do you feel about this situation?" (d) "How relevant is this situation to you?" and (e) "If you were in this situation, how much would you want to _____?" For item (d), a situation-specific anxiety-reduction strategy completed the blank. For the previous example, this question would appear as, "If you were in this situation, how much would you want to ask your roommate what his/her friends thought of you?" The anxiety-reduction strategy for each vignette was chosen following interviews and pilot testing. The full set of 40 vignettes and accompanying anxiety-reduction behaviors appears in the Appendix.

2.2.2. Depression, anxiety, and stress Scale-21 (DASS-21; Antony, Bieling, Cox, Enns, & Swinson, 1998)

The DASS-21 is a short form of the original 42-item DASS (Lovibond & Lovibond, 1995). The scales comprise three separate subscales, measuring self-reported depression, anxiety, and stress on a scale from 0 ("*Did not apply to me at all*") to 3 ("*Applied to me very much, or most of the time*"). The DASS-21 subscales have been found to have good reliability and construct validity in both clinical (Page, Hooke, & Morrison, 2007) and non-clinical samples (Henry & Crawford, 2005). The three subscales of the DASS demonstrated acceptable to good reliability in the present study (range in $\alpha = .75$–$.93$). The DASS was included in this study to control for levels of general distress, which might predict anticipatory anxiety.

2.3. Procedure

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national). All participants completed the study in a classroom in the Department of Psychology. Data were collected in groups ranging from 10 to 20 participants, and two trained experimenters (laboratory research assistants) were available during data collection to obtain informed consent, review instructions for participation, answer questions, and debrief the participants upon completion.

Participants arrived at the classroom and were seated at a desk with a computer, monitor, keyboard, and mouse. The experimenters distributed a consent form describing the study's stated purpose ("perceptions of situations") and procedure. Once all scheduled participants were present, an experimenter read a script reviewing the study procedure to the group. The script explained that participants would read 10 scenarios on the computer screen about situations that they might encounter. Participants were asked to imagine themselves in each situation as they read the particular scenario. Next, the experimenter explained how to use the VAS to answer the five questions following each vignette. Finally, participants were then told that they would compete a questionnaire (i.e., the DASS) containing questions about thoughts, feelings, and behaviors more generally. The experimenters explained that the study would take no more than 30 min and that participants could stop the experiment at any time and still receive course credit (no participants stopped the study prematurely). Participants then signed the consent form and were given instructions for logging into the computer and completing the experiment. All responses were logged automatically by the survey platform Qualtrics and exported directly into an electronic database. We used Qualtrics' "question randomization" function to (a) randomize the order of vignettes and (b) randomize the conditions (i.e., high/low threat) displayed to participants. Once all participants in the group had completed the experiment, they were thanked for their time and given a verbal description of the study aims and hypotheses. Participants were then provided with a written debriefing form, dismissed, and granted credit for participation.

3. Results

3.1. Preliminary considerations

3.1.1. Threat manipulation check

To determine whether the Threat-H versions of the vignettes provoked greater perception of threat relative to Threat-L versions, we compared the threat VAS ratings for both versions of all vignettes. Independent samples t-tests and Mann–Whitney U-tests were performed to determine the significance of the differences between the two versions. Specifically, in Table 1 we report descriptive (i.e., means and standard deviations) and inferential (t) statistics, significance values (p), and effect sizes (d) for all scenarios in which assumptions for normality (i.e., skewness, kurtosis, and homogeneity of variance) were met. In cases where assumptions for normality were not met (i.e., skewness or kurtosis $> \pm 1$, or Levene's test $p < .05$) we report descriptives (median) and inferential (U) statistics, significance values (p) and effect sizes (r) from non-parametric testing (Mann–Whitney U tests). Skewness and kurtosis values are also reported in Table 1. In cases where Levene's test indicated unequal variances, degrees of freedom were adjusted accordingly. We observed significant differences (in the expected direction) for all 10 vignettes.

3.1.2. Uncertainty manipulation check

To determine whether the Uncertainty-E versions of the vignettes provoked a greater sense of uncertainty relative to the Uncertainty-I versions, we compared the uncertainty VAS ratings for both versions of all vignettes. Results from these analyses, as described in 3.1.1., appear in Table 1. We observed significant differences (in the expected direction) for 6 of the 10 vignettes. In subsequent analyses, we only included data collected from the 6 vignettes that withstood both manipulation checks.

3.1.3. Relevance

The far right column in Table 1 shows the mean (and *SD*) VAS relevance rating for all situations. As can be seen, there was considerable variability in participants' perception of relevance. In fact, further inspection indicated that participants' relevance ratings for all situations employed the full range, from 0 to 100. Accordingly, we used an idiographic approach to stimuli selection in which only data from the situation (of the 6 identified in the manipulation check reported above) rated as most relevant by each participant (i.e., the situation that received the highest relevance rating) was used in the subsequent analyses.

Table 1
Mean/median visual analogue scale (VAS) ratings of uncertainty and relevance for situations and vignettes.

Situation	VAS threat (0–100)					VAS uncertainty (0–100)					VAS relevance (0–100)
	Threat–high	Threat–low	Skew	Kurtosis	Test statistic (effect size)	Uncertainty -explicit	Uncertainty -implicit	Skew	Kurtosis	Test statistic (effect size)	
Leaving your residence	50	19	.24	−1.24	*10953.5*^^ (.31)	50	18	.24	−1.15	*8588.5*^^ (.43)	51.91 (30.17)
Doctor's office	45.75 (27.67)	13.29 (19.03)	.75	−.60	13.19** (1.46)	25.99 (23.98)	23.02 (27.53)	.95	−.001	1.11 (.12)	39.49 (29.17)
Mole on shoulder	56	10	.33	−1.20	*6181.5*^^ (.55)	34.47 (26.72)	26.42 (27.75)	.53	−.88	2.83* (.30)	33.32 (30.84)
Romantic interest	46.62 (27.27)	15.72 (19.40)	.62	−.81	12.59** (1.37)	49	36	.16	−1.12	*14220*^^ (.15)	52.84 (29.03)
Campus alert	58	10	.44	−1.10	*6109*^^ (.56)	28.52 (26.63)	22.32 (24.24)	.89	−.20	2.35** (.25)	50.06 (31.08)
Email to instructor	34.06 (25.02)	12.50 (17.78)	.87	−.26	9.57** (1.04)	24.74 (25.32)	21.52 (24.39)	.94	−.25	1.24 (.13)	54.85 (31.04)
Roommate's friends	44.08 (26.56)	14.95 (20.30)	.64	−.78	11.84** (1.27)	34.32 (27.83)	29.38 (28.76)	.51	−.97	1.68 (.18)	31.32 (29.94)
Submit paper online	61	25	.05	−1.41	*10721.5*^^ (.33)	52	30	.14	−1.22	*12288.5*^^ (.24)	69.22 (27.01)
Riding in elevator	39	0	1.05	−.16	*6046*^^ (.57)	13	6	1.21	.45	*14325*^ (.12)	34.23 (31.61)
Group project	32.64 (23.75)	15.12 (19.55)	.90	−.13	7.74** (.82)	24.48 (22.65)	23.98 (29.98)	.75	−.48	.22 (.02)	46.84 (28.07)

For parametric testing: *$p < .05$, two-tailed; **$p < .01$, two-tailed; for non parametric testing: ^ $p < .05$, ^^$p < .01$.
Note: Italicized test statistics refer to results from non-parametric testing.

In 65 instances, participants rated two or more situations as equally highly relevant. Further inspection revealed that all 65 participants received different uncertainty or threat versions of the situations they rated as most relevant (such that the ratings could not be averaged). Accordingly, data from these participants were not viable in comparisons between different vignette versions; as such, they were excluded from analyses comparing responses to different levels of uncertainty and threat. Although this reduced the overall sample size to 308, we retained sufficient power to detect even small effects. The number of participants rating each of the six situations as most personally relevant is shown in Table 2.

3.2. Effects of threat and uncertainty manipulations

The mean (*SE*) anxiety VAS ratings across levels of uncertainty and threat for participants' most relevant vignette were as follows: Uncertainty-I/Threat-H = 66.41 (3.18), Uncertainty-I/Threat-L = 20.97 (2.76), Uncertainty-E/Threat-H = 71.13 (2.89), and Uncertainty-E/Threat-L = 51.48 (3.00). Fig. 1 graphically displays these group means. The mean (*SE*) VAS ratings of urge to perform safety behaviors were as follows: Uncertainty-I/Threat-H = 81.55 (3.69), Uncertainty-I/Threat-L = 59.80 (3.20), Uncertainty-E/Threat-H = 83.21 (3.35), and Uncertainty-E/Threat-L = 75.48 (3.48). These group means are depicted in Fig. 2.

3.2.1. Anxiety in the situation

To examine our hypothesis that making uncertainty explicit would lead to higher estimates of anxiety at low, but not high, levels of threat, we computed a 2 (Threat: H, L) × 2 (Uncertainty: I, E) analysis of covariance (ANCOVA), controlling for DASS total score, with VAS-anxiety ratings as the dependent variable. This analysis revealed a significant main effect of uncertainty, $F(1, 289) = 35.36$, $p < .001$, partial $\eta^2 = .11$. Participants reported that they would feel more anxiety in situations in which uncertainty was made explicit in the vignette. There was also a significant main effect for threat level, $F(1, 289) = 120.50$, $p < .001$, partial $\eta^2 = .29$. Participants reported that more threatening situations would provoke more feelings of anxiety. The uncertainty by threat interaction was also significant, $F(1, 289) = 18.83$, $p < .001$, partial $\eta^2 = .06$. Participants rated the low threat situations as more anxiety-provoking when uncertainty was made explicit than when it was kept implicit. A significant difference between explicit and implicit uncertainty, however, was not observed among the more threatening versions of the situations.

Table 2
Frequencies of participants' highest relevance rating by situation.

Vignette	*n (%)*
Leaving your residence	44 (14.3)
Mole on shoulder	21 (6.8)
Romantic interest	67 (21.8)
Campus alert	34 (11.0)
Submit paper online	117 (38.0)
Elevator	25 (8.1)

3.2.2. Urge to perform safety behaviors

A second 2 × 2 ANCOVA with VAS-Safety Behavior Urge ratings as the dependent variable was conducted to examine whether making uncertainty explicit would lead to greater urges to perform a safety behavior in the low, but not the high threat situations. This analysis revealed a significant main effect of uncertainty, $F(1, 289) = 6.38$, $p = .01$, partial $\eta^2 = .02$. Participants reported greater urges to perform safety behaviors in situations in which uncertainty was made explicit in the vignette. There was also a significant main effect for threat level, $F(1, 289) = 18.37$, $p < .001$, partial $\eta^2 = .06$. Participants reported that more threatening situations would provoke greater urges to perform safety behaviors. The uncertainty by threat level interaction was also significant, $F(1, 289) = 4.14$, $p = .04$, partial $\eta^2 = .01$. Participants reported a greater urge to complete a safety behavior in the less threatening situations when uncertainty was made explicit than when it was kept implicit. This pattern between explicit and implicit uncertainty was not observed among the situations involving higher threat (the differences between group means were not significantly different).

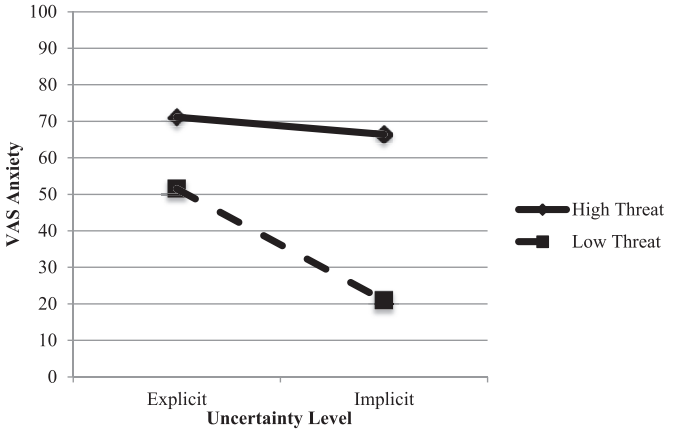

Fig. 1. Mean VAS ratings of anxiety across levels of uncertainty and threat for the most relevant vignette.

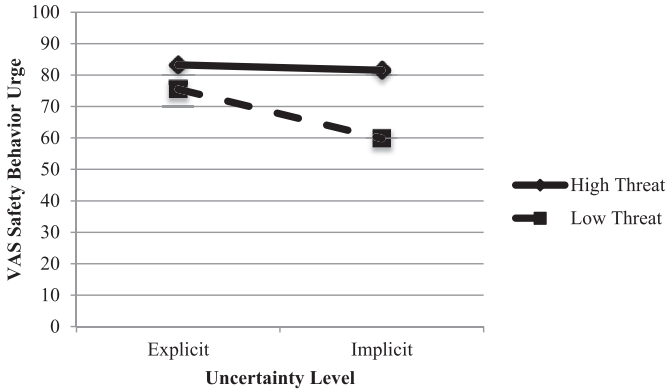

Fig. 2. Mean VAS ratings of urge to perform a safety behavior across levels of uncertainty and threat for the most relevant vignette.

4. Discussion

Cognitive models implicate inflated threat perception and IU as variables related to the experience of emotions (e.g., anxiety; Carleton, 2012). The aim of the present study was to experimentally examine how the experience of implicit versus explicit uncertainty would affect the anticipated degree of anxiety and urge to perform safety behaviors in situations of greater and lesser threat. Overall, as predicted by the cognitive model, we observed "threat-based reasoning:" objectively threatening situations were rated as more anxiety provoking than less threatening situations. Moreover, participants rated themselves more likely to perform anxiety-reduction behaviors when the situation was highly threatening than when it was less threatening. We also found evidence for "uncertainty-based reasoning," in which an individual perceives a situation as more anxiety-provoking (and is more likely to have the urge to perform a safety behavior) when the uncertain aspects of a situation are obvious or explicit, than when such uncertainty is merely implied or tacit. Importantly, these effects were found after controlling for general levels of depression, anxiety, and stress, and therefore cannot be attributed to the presence of these emotional states.

We specifically hypothesized that such uncertainty-based reasoning would be observed to a greater extent in objectively low-, as compared to objectively high-, threat situations. Consistent with this prediction, participants rated low-threat situations as more anxiety-provoking and more likely to provoke a safety behavior when uncertainty was made explicit than when it was kept implicit; however, this difference was not observed among ratings of highly threatening situations (i.e., on average, participants rated highly threatening situations as anxiety-inducing and likely to provoke safety behaviors, regardless of information about uncertainty). Perhaps in situations where risk seems relatively low but uncertainty is explicit, *possibility* (i.e., uncertainty) becomes confused with *probability* (i.e., risk level). For example, even when the *risk* of being rejected by a peer group is low, one might defer to uncertainty-based reasoning when the *possibility* of rejection is made explicit. Perhaps when uncertainty is obvious, it causes the individual to contemplate a broader range of negative outcomes than when uncertainty is only implied. A similar phenomenon is sometimes observed among individuals with the fear of flying. Such individuals often conflate probability and *severity*; for example, by reasoning that although the *likelihood* of a plane crash is extremely small, the *outcome* of such a crash would be catastrophic, and such catastrophizing trumps even logical estimates of risk. As alternative explanations, explicit uncertainty may be the most salient threat-information, and under implicit conditions participants may simply be unable to infer the anxiety conferred by the uncertainty present. Moreover, a *mention* of uncertainty may have primed the participant to feel that engaging in a safety behavior (i.e., seeking reassurance) would be reasonable, whereas no mention of uncertainty did not prime this interpretation.

Although a wealth of research on the role of uncertainty and IU in anxiety exists (e.g., Carleton, 2012; Gentes & Ruscio, 2011; Mahoney & McEvoy, 2012a), scant research has addressed how uncertainty interacts with other factors (e.g., threat) with regards to the experience of anxiety. Thus, additional work is needed to more clearly elucidate this relationship. Our findings provide further evidence that uncertainty exerts a fairly powerful influence upon anxiety, and extends the existing literature by indicating that this influence occurs especially at low levels of threat. In essence, our data suggest that making uncertainty explicit causes an otherwise low threat situation to appear as highly threatening.

To the extent that our findings have implications for clinical populations with anxiety, worry, and mood disorders, they suggest that uncertainty should be addressed in various aspects of treatment (e.g., psychoeducation). For example, psychoeducation could highlight the role of uncertainty and IU in cognitive models of emotion by clarifying that the presence of explicit uncertainty and ambiguity, while anxiety provoking, may not be equivalent with danger. Second, cognitive therapy techniques could be used to challenge maladaptive beliefs and perceptions of uncertainty (Wilhelm & Steketee, 2006). Third, exposure therapy could help patients learn to tolerate the experience of uncertainty by emphasizing the unknowable nature of outcomes when performing exposure (e.g., imaginal exposure to not knowing whether a feared outcome will occur; Abramowitz & Arch, 2014). Learning tolerance for uncertainty via exposure is also consistent with acceptance-based therapies, which encourage the patient to be willing to welcome unpleasant internal states, such as uncertainty (Roemer & Orsillo, 2002).

Finally, a number of limitations of the present study should be considered and addressed in future studies. First, participants merely rated their hypothetical feelings as induced by vignettes, rather than actually experiencing these situations in vivo. Although our manipulation checks confirmed that the vignettes induced both threat and uncertainty, exposing participants to in vivo situations, in which threat could be made explicit or implicit, might strengthen confidence in our findings. Thus, future research should consider modifying our methodology accordingly. Second, all participant responses were obtained by self-report and were thus subjective. Greater method variance would bolster our results. Accordingly, future studies should consider the use of psychophysiological measures (e.g., skin conductance) to complement self-report or interview data collection. Third, our results are based on responses to only a single vignette for each participant. While the vignette for each participant was salient, subsequent studies might examine whether our findings can be replicated across multiple situations. Relatedly, the vignettes in the present study tended to focus on social concerns, and other situations highly relevant for university students. This might impact the generalizability of our findings to other types of situations and populations. Fourth, we did not include measures of trait IU (i.e., Carleton, Norton, & Asmundson, 2007; Mahoney & McEvoy, 2012c) or specific anxiety domains (i.e., social anxiety, health anxiety); as such, we were not able to control for potential participant differences. Lastly, we did not formally account for multiple comparisons. Although we would expect 5% ($n = 1$) of the comparisons to have uncorrected p-values less than .05 (based on chance alone), we obtained 15 p-values less than .05.

Future studies should acknowledge the aforementioned trait and symptom differences. Additionally, future research should attempt replication of our findings in clinical populations. Despite

these shortcomings, our results suggest that a low threat situation may be perceived as more anxiety-inducing when uncertainty becomes explicit.

Appendix

I. Leaving your residence
   a. Threat-H/Uncertainty-E: You have left your apartment/dorm room for spring break. The building will be empty for the next week. On your way out of town, you remember that you left some of your valuable items sitting out on a table. They will be there all week. You try really hard to remember whether or not you locked the door to your apartment/dorm room, but you are just not sure. You're thinking it's possible that someone could get into your dorm/apartment.
   b. Threat-L/Uncertainty-E: You have left your apartment/dorm room for spring break. The building will be empty for the next week. You remembered to bring all your valuable items with you since you will be gone all week. You try really hard to remember whether or not you locked the door to your apartment/dorm room, but you are just not sure. You're thinking it's possible that someone could get into your dorm/apartment
   c. Threat-H/Uncertainty-E: You have left your apartment/dorm room for spring break. The building will be empty for the next week. On your way out of town, you remember that you left some of your valuable items sitting out on a table. They will be there all week.
   d. Threat-L/Uncertainty-I: You have left your apartment/dorm room for spring break. The building will be empty for the next week. You remembered to bring all your valuable items with you since you will be gone all week.
   e. Safety behavior: “check if the door is locked”

II. Doctor's office
   a. Threat-H/Uncertainty-E: You have checked in and are waiting to see your doctor for a routine check-up. You look around the waiting room and realize that it is pretty crowded with people who seem to be sick. In fact, the person sitting right next to you is continuously coughing and sneezing. You find yourself wondering if there are any germs in the waiting room that are contagious, and if you'll catch any viruses. You really don't know whether or not you will get sick from being in the waiting room.
   b. Threat-L/Uncertainty-E: You have checked in and are waiting to see your doctor for a routine check-up. You look around the waiting room and realize it is empty. You find yourself wondering if there are any germs in the waiting room that are contagious, and if you'll catch any viruses. You really don't know whether or not you will get sick from being in the waiting room.
   c. Threat-H/Uncertainty-E: You have checked in and are waiting to see your doctor for a routine check-up. You look around the waiting room and realize that it is pretty crowded with people who seem to be sick. In fact, the person sitting right next to you is continuously coughing and sneezing.
   d. Threat-L/Uncertainty-I: You have checked in and are waiting to see your doctor for a routine check-up. You look around the waiting room and realize it is empty.
   e. Safety behavior: avoid touching anything and then wash your hands as soon as possible

III. Mole on shoulder
   a. Threat-H/Uncertainty-E: It's morning and as you are getting dressed and ready for the day, you look at your reflection in the mirror and notice that a mole has recently appeared on your shoulder. The mole is large and strangely shaped. As you're looking at it, you're feeling unsure and starting to wonder whether or not you might have skin cancer.
   b. Threat-L/Uncertainty-E: It's morning and as you are getting dressed and ready for the day, you look at your reflection in the mirror and notice the mole that has been on your shoulder since you were a child. The mole is small and circular and has never changed. As you're looking at it, you're feeling unsure and starting to wonder whether or not you might have skin cancer.
   c. Threat-H/Uncertainty-E: It's morning and as you are getting dressed and ready for the day, you look at your reflection in the mirror and notice that a mole has recently appeared on your shoulder. The mole is large and strangely shaped.
   d. Threat-L/Uncertainty-I: It's morning and as you are getting dressed and ready for the day, you look at your reflection in the mirror and notice the mole that has been on your shoulder since you were a child. The mole is small and circular and has never changed.
   e. Safety behavior: “visit the doctor and have the mole examined”

IV. Romantic interest
   a. Threat-H/Uncertainty-E: You are at a party with someone you have been interested in for a while, and with whom you've gone on one date. As you're talking to them, you notice their eyes looking around the room. You turn to see who they are looking at and notice that they are checking out someone attractive. You're wondering if they're interested in continuing to date you. You're not sure if they really like you or not.
   b. Threat-L/Uncertainty-E: You are at a party with someone you have been interested in for a while and with whom you have gone on one date. As you're talking to them, you notice that they seem to be gazing into your eyes, are very interested in what you are saying, and are giving you compliments. You're wondering if they're interested in continuing to date you. You're not sure if they really like you or not.
   c. Threat-H/Uncertainty-E: You are at a party with someone you have been interested in for a while and with whom you have gone on one date. As you're talking to them, you notice their eyes looking around the room. You turn to see who they are looking at and notice that they are checking out someone attractive.
   d. Threat-L/Uncertainty-I: You are at a party with someone you have been interested in for a while and with whom you have gone on one date. As you're talking to them, you notice that they seem to be gazing into your eyes, are very interested in what you are saying, and are giving you compliments.
   e. Safety behavior: “try and find out if the person is interested in you”

V. Campus alert
   a. Threat-H/Uncertainty-E: You receive an Alert Carolina email notifying the campus community that someone has been assaulted and the culprit has not been caught. You realize that the assault took place very close to where you are living. You're wondering about your own safety. You're unsure whether or not you're in danger.
   b. Threat-L/Uncertainty-E: You receive an Alert Carolina email notifying the campus community that someone has been assaulted, but the culprit has been caught. You

realize that the assault took place far from where you are living. You're wondering about your own safety. You're unsure whether or not you're in danger

c. Threat-H/Uncertainty-E: You receive an Alert Carolina email notifying the campus community that someone has been assaulted and the culprit has not been caught. You realize that the assault took place very close to where you are living.
d. You receive an Alert Carolina email notifying the campus community that someone has been assaulted, but the culprit has been caught. You realize that the assault took place far from where you are living.
e. Safety behavior: "stay inside"

VI. Email to instructor
a. Threat-H/Uncertainty-E: You decide to send an email to one of your professors asking for clarification about an assignment. This professor is a highly respected leader in their field who seems to have a no-nonsense attitude when dealing with other people. You carefully type and send your email. After hitting the "send" button, you start to wonder if your email was unnecessary. You don't know whether or not your email will bother the professor
b. Threat-L/Uncertainty-E: You decide to send an email to the teaching assistant (TA) for one of your classes to ask for clarification about an assignment. Your TA seems like a laid back graduate student who enjoys interacting with your class. You carefully type and send your email. After hitting the "send" button, you start to wonder if your email was unnecessary. You don't know whether or not your email will bother the TA.
c. Threat-H/Uncertainty-E: You decide to send an email to one of your professors asking for clarification about an assignment. This professor is a highly respected leader in their field who seems to have a no-nonsense attitude when dealing with other people. You carefully type and send your email.
d. Threat-L/Uncertainty-I: You decide to send an email to the teaching assistant (TA) for one of your classes to ask for clarification about an assignment. Your TA seems like a laid back graduate student who enjoys interacting with your class. You carefully type and send your email.
e. Safety behavior: "apologize for potentially bothering them with your email"

VII. Roommate's friends
a. Threat-H/Uncertainty-E: Your roommate has invited a group of friends over and you are meeting them for the first time. You have been talking with them for a while when you get a phone call that you take in another room. When you return, your roommate's friends are speaking in hushed voices and get quiet when you walk in the room. You aren't certain of what your roommate's friends are thinking. You want to know if they like you or not.
b. Threat-L/Uncertainty-E: Your roommate has invited a group of friends over and you are meeting them for the first time. You have been talking with them for a while when you get a phone call that you take in another room. When you return, your roommate's friends smile at you and welcome you back into the conversation. You aren't certain of what your roommate's friends are thinking. You want to know if they like you or not.
c. Threat-H/Uncertainty-E: Your roommate has invited a group of friends over and you are meeting them for the first time. You have been talking with them for a while when you get a phone call that you take in another room. When you return, your roommate's friends are speaking in hushed voices and get quiet when you walk in the room.
d. Threat-L/Uncertainty-I: Your roommate has invited a group of friends over and you are meeting them for the first time. You have been talking with them for a while when you get a phone call that you take in another room. When you return, your roommate's friends smile at you and welcome you back into the conversation.
e. Safety behavior: "ask your roommate what his/her friends thought of you"

VIII. Submit paper online
a. Threat-H/Uncertainty-E: You have a term paper due at midnight. The paper is for an important class in your major and your grade is on the line. It's 11:45 pm and you have just finished and submitted the paper using an electronic system that you have not used before. You remember that your professor is very strict about deadlines and will not accept late papers for any reason. You're not sure if your paper was uploaded correctly on the website. You're wondering if it will be in on time to meet the deadline.
b. Threat-L/Uncertainty-E: You have a term paper due at midnight. The paper is for an important class in your major and your grade is on the line. It's 11:45 pm and you have just finished and submitted the paper using an electronic system that you have used many times before. You remember that your professor is pretty lenient about deadlines and has been willing to accept late papers in the past. You're not sure if your paper was uploaded correctly on the website. You're wondering if it will be in on time to meet the deadline.
c. Threat-H/Uncertainty-E: You have a term paper due at midnight. The paper is for an important class in your major and your grade is on the line. It's 11:45 pm and you have just finished and submitted the paper using an electronic system that you have not used before. You remember that your professor is very strict about deadlines and will not accept late papers for any reason.
d. Threat-L/Uncertainty-I: You have a term paper due at midnight. The paper is for an important class in your major and your grade is on the line. It's 11:45 pm and you have just finished and submitted the paper using an electronic system that you have used many times before. You remember that your professor is pretty lenient about deadlines and has been willing to accept late papers in the past.
e. Safety behavior: "double check to make sure the paper was submitted correctly"

IX. Riding in elevator
a. Threat-H/Uncertainty-E: You have an appointment on the 4th floor of a building. You press the button for the elevator, and when the door opens the elevator seems to be old looking. You step inside, look at the inspection log, and notice that the elevator is overdue for an inspection. You aren't completely sure whether or not the elevator is working properly today. You wonder whether the elevator might get stuck or not.
b. Threat-L/Uncertainty-E: You have an appointment on the 4th floor of a building. You press the button for the elevator, and when the door opens the elevator seems to be new and modern looking. You step inside, look at the inspection log, and notice that the elevator has been inspected recently. You aren't completely sure whether or not the elevator is working properly today. You wonder whether the elevator might get stuck or not.

c. Threat-H/Uncertainty-E: You have an appointment on the 4th floor of a building. You press the button for the elevator, and when the door opens, the elevator seems to be old looking. You step inside, look at the inspection log, and notice that the elevator is overdue for an inspection.
d. Threat-L/Uncertainty-I: You have an appointment on the 4th floor of a building. You press the button for the elevator, and when the door opens, the elevator seems to be new and modern looking. You step inside, look at the inspection log, and notice that the elevator has been inspected recently.
e. Safety behavior: "take the stairs"

X. Group project
a. Threat-H/Uncertainty-E: You are working on a group assignment for one of your classes. Your group of five students decides to meet one evening to discuss plans and ideas for this project. You don't know the other students very well, but you have some ideas for the project and you make some suggestions to the group. No one, however, seems to be going along with what you are saying. You'd like to know for sure what the other people in the group think of your suggestions. You're wondering if they think you're smart or not.
b. Threat-L/Uncertainty-E: You are working on a group assignment for one of your classes. Your group of five students decides to meet one evening to discuss plans and ideas for this project. You don't know the other students very well, but you have some ideas for the project and you make some suggestions to the group. The other students seem to agree with what you are saying. You'd like to know for sure what the other people in the group think of your suggestions. You're wondering if they think you're smart or not.
c. Threat-H/Uncertainty-E: You are working on a group assignment for one of your classes. Your group of five students decides to meet one evening to discuss plans and ideas for this project. You don't know the other students very well, but you have some ideas for the project and you make some suggestions to the group. No one, however, seems to be going along with what you are saying.
d. Threat-L/Uncertainty-I: You are working on a group assignment for one of your classes. Your group of five students decides to meet one evening to discuss plans and ideas for this project. You don't know the other students very well, but you have some ideas for the project and you make some suggestions to the group. The other students seem to agree with what you are saying.
e. Safety behavior: "try to find out what the group members think of you"

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