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ORIGINAL ARTICLE

Examining the Role of Anxiety Sensitivity and Intolerance of Uncertainty in the Relationship Between Health Anxiety and Likelihood of Medical Care Utilization

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Abstract
Health anxiety is associated with reassurance-seeking behaviors, including persistent medical care utilization. The current study sought to identify targetable and underlying (transdiagnostic) factors that may influence the relationship between health anxiety and medical care utilization. We examined the role of both anxiety sensitivity (AS; fear of arousal-related sensations) and intolerance of uncertainty (IU; fear of the unknown) in the relationship between health anxiety and likelihood of utilization of general, specialist, and emergency care among 566 adults (M_{age} = 20.47, SD = 3.54, 79.9% female). A three-way interaction revealed that AS strengthened the association between health anxiety and likelihood of general medical care utilization within the context of higher, but not lower, levels of IU. Only the main effects of AS and IU were significantly associated with odds of emergency care utilization, and there were no significant predictors of odds of specialist care utilization. Future directions and clinical implications are discussed.

Keywords Health anxiety · Medical care · Anxiety sensitivity · Intolerance of uncertainty · Transdiagnostic

Introduction

Health anxiety reflects an excessive preoccupation with one's health due to a fear of having or contracting a serious medical illness or disease (Abramowitz et al. 2002) and is typically associated with a persistent pattern of healthcare utilization and greater healthcare costs (e.g., Barsky et al. 2001). A cognitive-behavioral model of health anxiety, previously termed "hypochondriasis," has been put forth over the last few decades, positing that individuals with health anxiety tend to misinterpret bodily sensations and other health-relevant information and that these misinterpretations are associated with inaccurate beliefs that they currently have, or are at risk of developing, a serious medical illness (Salkovskis and Warwick 1986; Salkovskis et al. 2003; Warwick and Salkovskis 1990).

Individuals with elevated health anxiety often maintain a greater desire for certainty regarding the nature of their symptoms (Abramowitz and Braddock 2008). Reassurance- and safety-seeking behaviors among individuals with health anxiety are common, particularly greater utilization of healthcare services (e.g., Barsky et al. 2001, 2005; Conroy et al. 1999; Creed 2011; Fergus et al. 2015; Weiss et al. 2017). For individuals with heightened health anxiety, however, excessive safety-seeking behaviors, such as recurrent visits to the doctor, often provide only temporary relief from anxiety-related concerns (e.g., Abramowitz and Moore 2007). Therefore, high levels of healthcare utilization may ultimately be part of a feedback loop of persistent anxiety and continued reassurance-seeking over time. In addition to the significant psychological costs of high healthcare utilization, these behaviors also contribute to significant economic and societal burden (e.g., Fink et al. 2010). To better inform intervention efforts for health anxiety and ultimately reduce its associated individual and societal costs, it is important to identify targetable underlying (transdiagnostic) factors that

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may be associated with higher levels of medical care utilization among those with elevated health anxiety.

Two transdiagnostic factors that are consistently associated with health anxiety are anxiety sensitivity (AS; Reiss and McNally 1985) and intolerance of uncertainty (IU; Carleton 2016). Intolerance of uncertainty—the dispositional fear of the unknown—has demonstrated strong associations with health anxiety across multiple studies in both clinical populations (Deacon and Abramowitz 2008) and healthy young and older adult samples (e.g., Boelen and Carleton 2012; Gerolimatos and Edelstein 2012). AS, or fear of arousal-related sensations (e.g., heart palpitations) due to their perceived negative physical, cognitive, and social consequences (McNally 2002; Reiss and McNally 1985; Taylor et al. 2007), is a transdiagnostic risk factor for the development of a range of anxiety and mood disorders (e.g., Boswell et al. 2013a; Naragon-Gainey 2010) and has also been shown to have significant associations with health anxiety (e.g., Deacon and Abramowitz 2006; Gerolimatos and Edelstein 2012; Jones et al. 2014). AS and IU have been found to incrementally contribute to the prediction of health anxiety (Fergus and Bardeen 2013), and a recent study supported a model in which IU was indirectly associated with health anxiety through AS (O'Bryan and McLeish 2017), suggesting an important shared relationship between these three variables.

Most of the research to date has focused on the associations of IU and AS with health anxiety, but not specifically on their associations with behaviors related to health anxiety. Due to the negative individual and societal costs of high healthcare utilization, it is important to identify transdiagnostic vulnerabilities not only associated with the experience of health anxiety, but also specifically with care utilization among individuals with health anxiety. There is some evidence that AS and IU are important and relevant constructs in health anxiety-related behaviors; for instance, one study found that AS was associated with a higher number of emergency department visits among individuals with asthma (Favreau et al. 2014). In addition, both AS and IU have been associated with frequent use of the internet to search for medical information (Fergus 2015; Norr et al. 2015), and such behavior, in turn, was associated with increased AS (Norr et al. 2014). Importantly, in Norr et al. (2014) study, in which individuals who were instructed to view websites about medical information reported higher AS after doing so compared to those instructed to view control websites, individuals only reported higher AS if they *also* had high levels of IU. This finding, in addition to O'Bryan and McLeish's (2017) finding that AS mediates the association between IU and health anxiety, suggests a kind of synergistic relationship between these variables. Overall, however, research that clarifies how these constructs relate specifically to medical care-seeking behaviors is limited; further exploration of how AS and IU specifically relate to healthcare utilization among individuals with health anxiety is needed, as this will allow for more specific targeting of the underlying processes involved in the relationship between health anxiety and medical care-seeking behaviors, and clarify how all three of these constructs may function in conjunction with each other in their prediction of medical care-seeking behaviors.

Theoretically, it may be the case that higher AS and IU serve to strengthen the association between health anxiety and healthcare utilization. AS is often referred to as an anxiety amplifier because when individuals with high AS experience anxiety, their fear of arousal-related sensations leads to their further intensification (Taylor et al. 2007). AS may not only predict the experience of health anxiety, but it may also serve to amplify the anxiety and feared negative consequences associated with health-related concerns, driving individuals to engage in reassurance-seeking behavior. Individuals with elevated IU, for whom ambiguous situations are particularly distressing, may also be more likely to engage in these behaviors in the hope of reducing the ambiguity surrounding health anxiety-related fears. Therefore, AS and IU may serve as vulnerability factors in the association between health anxiety and healthcare utilization such that, among individuals with elevated health anxiety, greater AS and IU may each predict greater likelihood of healthcare utilization. Furthermore, given past evidence on the potential synergistic relationship of AS and IU (e.g., McLeish and O'Bryan 2017; Norr et al. 2014), it may also be the case that these constructs work together to amplify the relationship between health anxiety and healthcare utilization. In other words, individuals with health anxiety with a more pronounced tendency to fear the negative consequences of anxiety-related phenomena *and* who also have greater difficulty tolerating the unknown may be particularly vulnerable to seeking reassurance via medical care.

To test this model, the current study sought to examine how AS and IU may influence the relationship between health anxiety and the likelihood of general medical care, emergency care, and specialist care utilization. Specifically, we examined the three-way interaction between health anxiety, AS, and IU in predicting the likelihood of utilization of all three types of care over a six-month period. An examination of these three types of care rather than overall care utilization is consistent with past research on the relationship between health anxiety and utilization of these distinct domains of care (e.g., Barsky et al. 2001, 2005) and serves to clarify in which contexts these transdiagnostic vulnerabilities are most relevant. Although there is clear utility to examining these questions within both clinical and diverse samples, for the current study we chose to examine these relationships in an undergraduate and graduate student sample, in line with evidence that variations in health anxiety are predictive of medical care utilization even in non-clinical

samples (Conroy et al. 1999). It was hypothesized that both AS and IU would strengthen the association between health anxiety and utilization of general, specialist, and emergency care services. Furthermore, it was hypothesized that the relationship between greater health anxiety and greater likelihood of care utilization would be strongest among individuals with higher levels of *both* AS and IU.

Methods

Participants

Participants were undergraduate and graduate students ($N = 566$, $M_{age} = 20.47$, $SD = 3.54$, age range: 17–50 years) who received psychology course credit for their participation. To be included in the current study, participants had to be at least 18 years old and fluent in written and spoken English. There were no exclusion criteria for the study. Most participants were female ($n = 456$, 80.6%), and the majority of participants ($n = 533$, 94.4%) reported being single (not married). Most participants were full-time students ($n = 308$, 54.4%), and 36.9% ($n = 209$) participants reported being employed part-time, 3.9% ($n = 22$) reported being employed full-time, and 4.8% ($n = 27$) of participants chose not to report or reported having another work status. Over half ($n = 301$, 53.8%) of the sample identified as White, 14.7% ($n = 83$) identified as Black, 14.1% ($n = 80$) as Asian or Asian American, 6.0% ($n = 34$) as Hispanic, 0.7% ($n = 4$) as Native American, and 10.2% ($n = 58$) as mixed or other ethnicity. Several participants in the study ($n = 6$; 1.1%) chose not to report their race/ethnicity. In addition, 13.1% ($n = 74$) of participants reported that they were born outside of the United States; these participants reported having lived in the United States for an average of 11.65 ($SD = 7.21$) years. Several participants reported having a current medical illness ($n = 60$, 10.6%); the majority included chronic illnesses such as inflammatory bowel disease, Type I diabetes, thyroid disease, arthritis, heart disease, multiple sclerosis, HIV, and depression [assessed via a single item from the Illness Attitudes Scale (Kellner 1986)]. Brief descriptive statistics and bivariate correlations of study variables (described below) are reported in Table 1.

Measures

Demographic Questionnaire

Demographic information collected included age, biological sex, gender, race/ethnicity, education, and length of time living in the United States. We also included an item from the Illness Attitudes Scale (Kellner 1986) to assess the presence of a current medical condition ("Has your doctor told you that you have an illness now? If yes, what illness?").

Short Health Anxiety Inventory (SHAI; Salkovskis et al. 2002)

The SHAI is an 18-item self-report measure that assesses health-related concerns, body vigilance, and feared consequences of having an illness. Each item consists of a group of four statements from which individuals select the statement that best reflects their feelings over the past six months; statements are rated on a 4-point scale ranging from 0 (e.g., "I do not have any difficulty taking my mind off thoughts my health") to 3 (e.g., "Nothing can take my mind off thoughts

Table 1 Descriptive statistics and bivariate correlations among study variables

	6.	7.	8.	9.	10.	11.	Mean (SD) or %	Range
1. Age	−.051	−.059	−.050	−.074	−.062	−.023	20.47 (3.54)	17–50
2. Biological sex (female)	.053	.171***	.051	.026	−.005	.047	80.6%	
3. Race/ethnicity (white)	.173***	.169***	.030	−.007	−.049	−.016	53.8%	–
4. Born in US (yes)	.099*	.038	.041	.035	.024	−.001	85.9%	–
5. Medical illness (yes)	.043	.097*	.185***	−.007	.038	.185**	10.6%	–
6. General care (at least one visit)	–	.289***	.199***	.116**	.056	.122**	57.8%	–
7. Specialist care (at least one visit)	–	–	.157***	.074	.045	.096*	38.2%	–
8. Emergency care (at least one visit)	–	–	–	.140**	−.010	.116**	19.4%	–
9. ASI-3 total	–	–	–	–	.542***	.464***	20.30 (14.20)	0–68
10. IUS-12 total	–	–	–	–	–	.300***	32.10 (9.83)	12–60
11. SHAI-main total	–	–	–	–	–	–	12.83 (7.25)	0–42

ASI-3 = Anxiety Sensitivity Index-3, IUS-12 = Intolerance of Uncertainty Scale-12-item version, SHAI-Main = Short Health Anxiety Inventory general health anxiety subscale, Biological Sex: 0 = male and 1 = female, Race/Ethnicity: 0 = Non-White and 1 = White, Born in US: 0 = No and 1 = Yes, Medical Illness: 0 = No and 1 = Yes

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

about my health"). Existing research on the measure consistently supports a two-factor structure, comprised of a 14-item SHAI-Main subscale that assesses general health anxiety and a 4-item Negative Consequences subscale, that assesses perceived negative consequences of having an illness (Alberts et al. 2013). Past work indicates that the Negative Consequences subscale does not contribute unique information above and beyond the SHAI-Main subscale (Alberts et al. 2013); therefore, only the SHAI-Main subscale was used in the current study. The SHAI-Main has been shown to have good psychometric properties (Alberts et al. 2013) and demonstrated good internal consistency (Cronbach's $\alpha = .90$) in the current study.

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al. 2007)

The ASI-3 is an 18-item self-report measure that assesses the extent to which individuals are concerned about the potential negative consequences of anxiety-related symptoms and sensations (e.g., "When I notice my heart skipping a beat, I worry that there is something seriously wrong with me"). The ASI-3 was derived, in part, from the original Anxiety Sensitivity Index (Reiss et al. 1986). Each of the items is rated on a 4-point scale ranging from 0 (*Very Little*) to 4 (*Very Much*) and summed to a total score. The ASI-3 has demonstrated excellent psychometric properties (Taylor et al. 2007) and demonstrated excellent internal consistency ($\alpha = .94$) in the current study.

Intolerance of Uncertainty Scale–12-item version (IUS-12; Carleton et al. 2007)

The IUS-12 is an abbreviated version of the original 27-item scale (Freeston et al. 1994) and correlates $r = .96$ with the original (Carleton et al. 2007). It is designed to assess emotional, cognitive, and behavioral reactions to situations involving uncertainty and/or ambiguity (e.g., "I always want to know what the future has in store for me"). Items on the measure are rated on a 4-point scale ranging from 1 ("Not at all characteristic of me") to 5 ("Entirely characteristic of me"), with total scores ranging from 12 to 60. The IUS-12 has demonstrated high internal consistency in both undergraduate (Carleton et al. 2007) and clinical samples (Laposa et al. 2015). The IUS-12 demonstrated good internal consistency in the current study ($\alpha = .91$).

Medical Utilization Questionnaire (MUQ; Abramowitz et al. 2007)

The MUQ assesses two domains of health-related behaviors (medical care utilization and safety behaviors). Because of the current study's focus on healthcare utilization, only the first domain of the measure was examined. In this first domain, respondents indicate whether they have utilized each of 20 medical services (e.g., Student Health Service) in the past 6 months and, for each utilized service, the number of visits in the past 6 months. Total scores for this domain can be calculated by summing the total number of visits across providers. This subscale score has demonstrated adequate psychometric properties and has been used as a measure of medical utilization in previous studies (Abramowitz et al. 2007; Olatunji et al. 2007) but has also failed to demonstrate adequate reliability in one previous study (Fergus and Valentiner 2009; $\alpha = .45$) as well as in the current study ($\alpha = .47$). Therefore, instead of utilizing the subscale as a continuous, 20-item measure, we chose to utilize items on the measure as dichotomous outcomes to determine the likelihood of participants having utilized certain types of care at least once over the past 6 months. Specifically, we chose to group together thematically similar medical services to examine whether respondents had utilized a "type" of medical service in the past 6 months. For example, the student health service item and the general/family practitioner item were grouped together as indicators of "general care" utilization, and all specialist services (e.g., dermatologist, cardiologist) were grouped together to examine "specialist care" utilization. Finally, we examined "emergency care" utilization via the single item assessing use of hospital emergency room or outpatient emergency clinic over the past 6 months. Although this was not a perfect measure of *excessive* care utilization, we determined that it would still be a clinically meaningful and/or theoretically valuable outcome within a primarily undergraduate sample, based on published reports that university students average about one visit per year—and therefore less than one visit per every 6 months—to student health services (American College Health Association 2010), which is notably less frequent than the average number of 3.1 visits to a physician's office per year by the average adult in the US (Centers for Disease Control and Prevention [CDC] 2015).

Procedure

Data for this study were collected online through a posting on Temple University's research participation site. All participants received partial academic credit for their participation. A full description of all study procedures was provided in the posting, and potential participants who remained interested after reading the study description provided informed consent and then completed the study measures online in a single session. Included in the battery of questionnaires were the demographics questionnaire, as well as the SHAI, ASI-3, IUS-12, and MUQ. This study was conducted in compliance with the Code of Ethics of the World Medical Association

(Declaration of Helsinki) and was approved by the Institutional Review Board at Temple University.

Data Analyses

Data analyses were conducted with SPSS version 24 (International Business Machines Corporation 2016). We used a series of hierarchical logistic regression models to examine the associations between health anxiety, AS, IU, and utilization of general, specialist, and emergency care services. First, independent variables were centered at their means, and interaction terms were produced by multiplying the centered variables. We tested three models with covariates in the first step, health anxiety, AS, and IU in the second step, their two-way interactions in the third step, and the three-way interaction between all three independent variables in the fourth step, predicting utilization of (1) general, (2) specialist, and (3) emergency care services. Because having a current diagnosed medical illness would contribute to greater likelihood of medical care use, each model controlled for the presence of a medical illness, as well as biological sex, race, and whether one was born in the U.S., given evidence of the association of these variables with degree of healthcare utilization (e.g., Bertakis et al. 2000; Ku and Matani 2001; Mayberry et al. 2000). We chose to control for rather than exclude on the basis of a current medical illness in order to include all participants for whom health anxiety and associated behaviors may be relevant, while assuring that the observed variance in medical care utilization accounted for by health anxiety, AS, and IU was not attributable to the presence of a medical illness itself.

Results

General Medicine

In predicting general medicine utilization, the model including covariates and main effects of health anxiety, AS, and IU fit the data well (χ^2 (12) = 42.85, $p < .001$). When examining the individual predictors, only AS (*OR* 1.02, *SE* = 0.01, $p = .04$, 95% CI [1.001, 1.04]), but not health anxiety (*OR* 1.02, *SE* = 0.02, $p = .34$, 95% CI [0.98, 1.05]) or IU (*OR* 1.00, *SE* = 0.01, $p = .80$, 95% CI [0.97, 1.02]), was a significant predictor of general medicine utilization. After including the two-way interactions, model fit improved (χ^2 (15) = 55.87, $p < .001$). Only the interaction between health anxiety and AS was significantly associated with general medicine utilization (*OR* 1.003, *SE* = 0.001, $p = .02$, 95% CI [1.001, 1.01]), such that, among those with higher (*OR* 1.05, *SE* = .02, $p = .03$), but not lower AS (*OR* .96, *SE* = .02, $p = .12$), higher health anxiety was predictive of greater likelihood of at least one general medicine visit. Specifically, for those with higher AS, a one-point increase in health anxiety was associated with 1.05 higher odds of general medicine utilization, whereas for those with lower AS, health anxiety was not significantly associated with general medicine utilization. Neither the interactions between health anxiety and IU (*OR* 1.002, *SE* = 0.002, $p = .32$, 95% CI [0.998, 1.01]), nor AS and IU (*OR* 1.00, *SE* = 0.001, $p = .90$, 95% CI [0.998, 1.002]), were significant predictors of general medicine utilization.

When examining the three-way interaction, the overall model showed good fit (χ^2 (16) = 60.75, $p < .001$). The three-way interaction of health anxiety, AS and IU was significantly associated with general medicine utilization (*OR* 1.0003, *SE* = .0001, $p = .04$, 95% CI [1.00002, 1.0005]). When examining the significance of the association between health anxiety and general medicine utilization at differing levels of both AS and IU, results indicated that health anxiety was only significantly associated with greater odds of general medicine utilization when both IU and AS were high (*OR* 1.11, *SE* = .04, $p = .003$, 95% CI [1.04, 1.19]). When both AS and IU were high, a one-point increase in health anxiety was associated with 1.11 higher odds of general medicine utilization. The interaction between health anxiety and AS in relation to general medical utilization was significant only at higher (*OR* 1.01, *SE* = .002, $p = .003$, 95% CI [1.002, 1.001]), but not lower (*OR* 1.0003, *SE* = .002, $p = .85$, 95% CI [.997, 1.003]) levels of IU (see Fig. 1). Specifically, the odds ratios of health anxiety on general medicine utilization between those with high AS and low AS were only significant for those who also demonstrated elevated IU.

Specialist Care

In predicting specialist care utilization, the model including covariates, health anxiety, and AS, and IU fit the data well (χ^2 (12) = 47.43, $p < .001$). However, neither health anxiety (*OR* 1.01, *SE* = 0.02, $p = .55$, 95% CI [0.98, 1.04]), AS (*OR* 1.01, *SE* = 0.01, $p = .16$, 95% CI [1.00, 1.03]), nor IU (*OR* 0.997, *SE* = 0.01, $p = .78$, 95% CI [0.97, 1.02]) were significant predictors of specialist care utilization. After including the two-way interactions, model fit slightly improved (χ^2 (15) = 48.77, $p < .001$). However, none of the interactions—between health anxiety and AS (*OR* 1.00, *SE* = 0.001, $p = .70$, 95% CI [0.998, 1.001]), health anxiety and IU (*OR* 1.00, *SE* = 0.002, $p = .34$, 95% CI [.998, 1.005]), nor AS and IU (*OR* 1.00, *SE* = 0.001, $p = .97$, 95% CI [0.999, 1.001])—were significant predictors of specialist care utilization. The inclusion of the three-way interaction slightly improved model fit (χ^2 (16) = 49.42, $p < .001$), but the three-way interaction term between health anxiety, AS, and IU was also not significant (*OR* 1.00, *SE* = 0.00007, $p = .42$, 95% CI [0.998, 1.00008]).

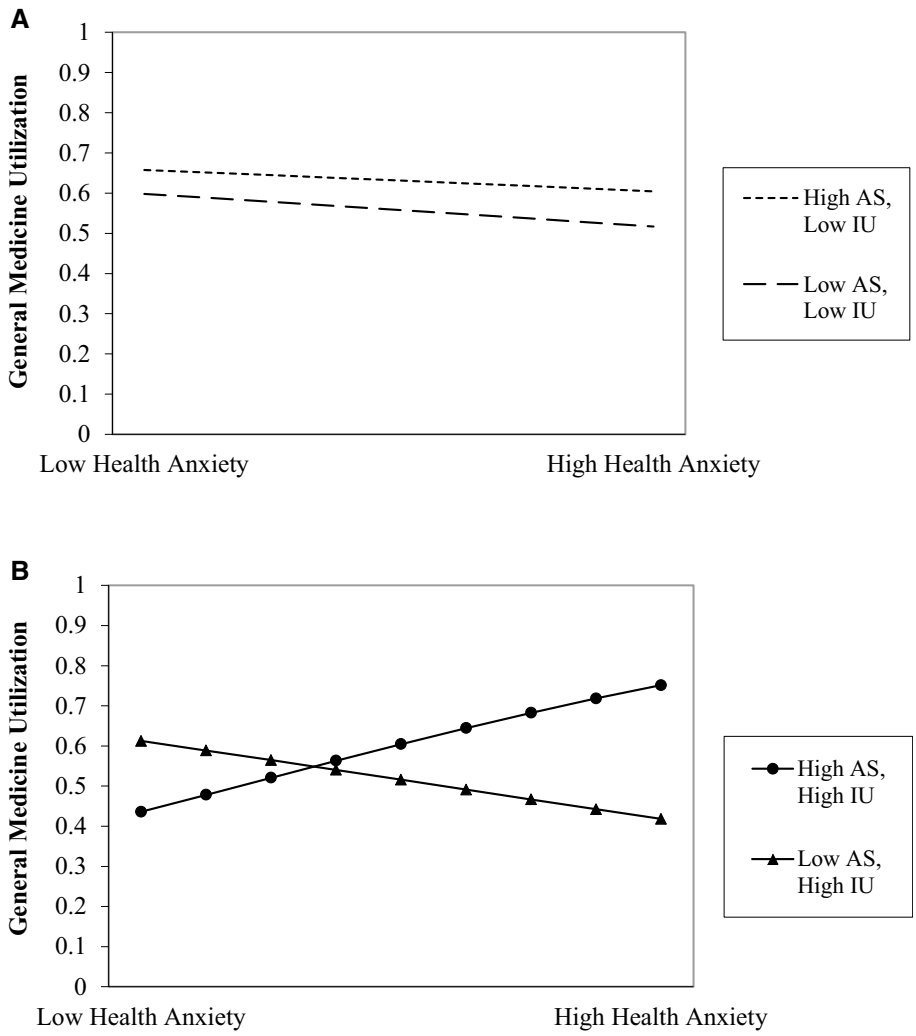

Fig. 1 The interaction between health anxiety and anxiety sensitivity (AS) at low (**a**) and high (**b**) levels of intolerance of uncertainty (IU) in predicting likelihood of general medicine utilization over the past 6 months. The terms "Low" and "High" refer to 1 standard deviation (SD) below and above the mean, respectively

Emergency Care

In terms of emergency care utilization, the model including covariates and main effects of health anxiety, AS, and IU fit the data well (χ^2 (12) = 41.05, $p = .001$). Examining the individual predictors revealed that both AS (*OR* 1.04, *SE* = 0.01, $p < .001$, 95% CI [1.02, 1.06]) and IU (*OR* 0.96, *SE* = 0.02, $p = .006$, 95% CI [0.93, 0.99]), but not health anxiety (*OR* 1.01, *SE* = 0.02, $p = .62$, 95% CI [0.97, 1.05]), were significant predictors of emergency care utilization. However, whereas higher AS was predictive of an greater likelihood of emergency care utilization, higher IU was predictive of a decreased likelihood of emergency care utilization. After including the two-way interactions, model fit slightly improved (χ^2 (15) = 42.27, $p < .001$). However, none of the two-way interactions—between health anxiety and AS (*OR* 1.00, *SE* = 0.001, $p = .61$, 95% CI [0.998, 1.003]), health anxiety and IU (*OR* .998, *SE* = 0.002, $p = .33$, 95% CI [0.99, 1.002]), nor AS and IU (*OR* 1.00, *SE* = 0.001, $p = .99$, 95% CI [0.998, 1.002])—were significant predictors of emergency care utilization. The inclusion of the three-way interaction again slightly improved model fit (χ^2 (16) = 44.20, $p < .001$), but the three-way interaction term between health anxiety, AS, and IU was also not significant (*OR* 1.00, *SE* = 0.00008, $p = .16$, 95% CI [1.00, 1.0002]). Full results of all logistic regression analyses are reported in Table 2.

Discussion

The current study examined the associations between health anxiety, AS, and IU in the prediction of healthcare utilization in an adult sample. Consistent with prediction, there was evidence that health anxiety was associated with greater odds of at least one general medical visit over the past 6 months among individuals with higher levels of *both* AS and IU. These interactive effects were evident even when controlling for the presence of a current medical illness, sex, race, and whether one was born in the U.S. This pattern of

Table 2 Results of logistic regression analyses

	OR	SE	95% CI	*p* value
Criterion variable: general care				
Step 1				
Sex (female)	0.09	0.24	0.94, 2.41	.09
Black	0.60	0.29	0.34, 1.05	.08
Hispanic	0.45	0.39	0.21, 0.97	.04
Asian	0.38	0.29	0.22, 0.68	.001
Native American	0.19	1.24	0.02, 2.15	.18
Mixed race	1.49	0.43	0.64, 3.46	.36
Other race	0.50	0.61	0.15, 1.63	.25
Born in US	1.56	0.30	0.86, 2.83	.14
Medical illness	1.58	0.35	0.80, 3.13	.19
Health anxiety	1.02	0.02	0.98, 1.05	.34
AS	1.02	0.01	1.001, 1.04	.04
IU	0.997	0.01	0.97, 1.02	.80
Step 2				
Health anxiety × AS	1.003	0.001	1.001, 1.01	.02
Health anxiety × IU	1.002	0.002	0.998, 1.01	.32
AS × IU	1.0001	0.001	0.998, 1.002	.90
Step 3				
Health anxiety × AS × IU	1.0003	0.0001	1.00002, 1.0005	.04
Criterion variable: specialist care				
Step 1				
Sex (female)	3.002	0.27	1.76, 5.12	< .001
Black	0.42	0.30	0.23, 0.76	.004
Hispanic	0.72	0.40	0.33, 1.58	.41
Asian	0.39	0.31	0.21, 0.72	.003
Native American	1.82	1.23	0.16, 20.53	.63
Mixed race	0.57	0.38	0.27, 1.21	.14
Other race	0.35	0.70	0.09, 1.37	.13
Born in US	0.96	0.32	0.51, 1.79	.88
Medical illness	1.85	0.31	1.00, 3.40	.049
Health anxiety	1.01	0.02	0.98, 1.04	.55
AS	1.01	0.008	0.995, 1.03	.16
IU	0.997	0.01	0.97, 1.02	.78
Step 2				
Health anxiety × AS	0.999	0.001	0.998, 1.001	.70
Health anxiety × IU	1.002	0.002	0.998, 1.005	.34
AS × IU	1.00003	0.001	0.999, 1.001	.97
Step 3				
Health anxiety × AS × IU	0.999	0.00007	0.9998, 1.00008	.42
Criterion variable: emergency care				
Step 1				
Sex (female)	1.32	0.32	0.71, 2.48	.38
Black	0.85	0.37	0.42, 1.75	.67
Hispanic	1.56	0.46	0.63, 3.85	.34
Asian	0.78	0.39	0.37, 1.67	.52
Native American	2.03	1.26	0.17, 23.80	.57
Mixed race	0.58	0.53	0.21, 1.62	.30
other race	1.80	0.73	0.43, 7.51	.42
Born in US	1.81	0.43	0.78, 4.20	.17
Medical illness	4.01	0.33	2.09, 7.68	< .001
Health anxiety	1.01	0.02	0.97, 1.05	.62
AS	1.04	0.01	1.02, 1.06	< .001
IU	0.96	0.02	0.93, 0.99	.006
Step 2				
Health anxiety × AS	1.001	0.001	0.998, 1.003	.61
Health anxiety × IU	0.998	0.002	0.994, 1.002	.33
AS × IU	0.999	0.001	0.998, 1.002	.99
Step 3				
Health anxiety × AS × IU	1.0001	0.00008	0.999, 1.0002	.16

AS = anxiety sensitivity, IU = intolerance of uncertainty; race variables are dummy coded with White as the comparison group

findings seems to suggest a synergistic effect of AS and IU as potential vulnerability factors in the association between health anxiety and health care utilization, such that the relationship between health anxiety and general medicine utilization is strengthened by AS, but only in the context of greater IU. These results may indicate that individuals with higher levels of both AS and IU are more impacted by their health anxiety, leading to a greater likelihood of their utilizing general care services. These results may also indicate that the presence of IU increases vulnerability to AS, which would be in line with past findings that AS mediates the association between IU and health anxiety (O'Bryan and McLeish 2017) and that internet searches for medical information increase levels of AS, particularly among those high in IU (Norr et al. 2014); both studies suggest that IU may set the context or in some way predispose individuals to AS, perhaps because individuals may fear arousal-related sensations *due to* difficulty tolerating the uncertainty associated with their potential negative consequences. Although the current findings do not address the temporal relationships between these variables, they do suggest that AS and IU together strengthen the association between higher health anxiety and the likelihood of general medical care utilization. It should also be noted that, although the average college student has a much lower rate of general medical care utilization than the general population, one medical visit over a six-month period may still lie within a relatively normative range for this population (American College Health Association 2010). Therefore, while these findings do not provide information on predictors of *maladaptive* levels

of healthcare utilization *per se*, they may instead provide a theoretical foundation or conceptual framework from which to direct future research on the relationship between these variables and more explicitly maladaptive forms of care-seeking. Therefore, examining whether health anxiety, AS, and IU are similarly associated with more excessive patterns of healthcare utilization, as well as examining the temporal relationships between health anxiety, AS, IU, and healthcare utilization, will be logical and important next steps in further elucidating these relationships and extending these findings to more maladaptive forms of care-seeking behavior.

There were no significant main or interactive effects of health anxiety, AS, or IU in predicting utilization of specialist care. There were significant main effects of both AS and IU in predicting utilization of emergency care, but neither AS nor IU significantly interacted with health anxiety in predicting utilization of emergency care and the three-way interaction between health anxiety, AS, IU was also not a significant predictor of emergency care utilization. The results for AS and emergency care are consistent with past findings on the association between AS and a greater number of emergency department visits among individuals with asthma (Favreau et al. 2014) and extend this finding to a primarily healthy adult sample. The main effect for IU, however, was in the opposite direction than predicted, such that higher levels of IU predicted a *lower* likelihood of emergency care utilization. One explanation for this finding is that some individuals with high IU may experience behavioral paralysis in the face of potentially emergent medical concerns. In fact, two distinct domains of IU have been previously established: prospective IU, which describes the desire for predictability, and inhibitory IU, which instead describes behavioral paralysis due to uncertainty (Carleton et al. 2007). Some past research has found that inhibitory, rather than prospective, IU is specifically positively associated with both health anxiety and online medical information-seeking (Fergus and Bardeen 2013; Norr et al. 2015). It may be the case that inhibitory IU is what drove our current results as well and that, although "uncertainty paralysis" is associated with a *higher* degree of anxiety and solitary information-seeking, it may actually be associated with a *lower* likelihood that an individual will proactively seek emergency care. However, the current study only examined IU as a unitary construct; future work is needed to more closely examine these distinct domains of IU in the context of emergency care utilization.

Despite these main effects, the overall pattern of our findings suggests that the relationship between health anxiety and utilization of medical care is strengthened by AS and IU only in the case of general, but not emergency or specialist, care. One possible explanation for the greater strength of findings for general medical care is that, because our sample consisted of university students, individuals may have been more likely to pursue the type of services that are immediately available to them (e.g., student health services). Students may also have limitations in access to other types of care beyond what the university provides. Another possible explanation is that specialist services often require a referral from primary care physicians, and it is possible that, after seeking this general level of care, individuals simply do not receive (or do not follow through on) referrals for these types of services. It also may be that individuals with health anxiety may not have a specific and/or specialized medical concern when seeking services; instead, they may prefer to seek a more general examination that could provide reassurance regarding a wider range of potential medical problems. Alternatively, some recent theories suggest that, for some individuals, health anxiety may result in avoidance or lower—rather than higher—utilization of healthcare (e.g., American Psychiatric Association 2013; Taylor and Asmundson 2004); therefore, it may also be the case that these null findings are a result of some health anxious individuals within our sample avoiding these services altogether. Our findings that IU is associated with a decreased likelihood of emergency care use suggest that IU may also play an important role in avoidance of healthcare services and that this is an area worthy of future examination for all types of care.

Overall, our findings have potentially important implications for treating health anxiety and specifically in addressing medical care-seeking behaviors both by medical and mental health professionals; however, future work must focus on whether these findings extend to maladaptive levels of care-seeking. Nevertheless, the currently findings highlight the potential utility of incorporating assessments of health anxiety, AS, and IU in primary care to provide healthcare professionals with a more comprehensive understanding of the factors that may be bringing patients into their office. Although these assessment tools should not be used to turn away patients in need of medical care, they can instead be used to inform treatments and referral processes when indicated. Currently, there are existing interventions that specifically target AS, including interoceptive exposure (e.g., exercise; LeBouthillier and Asmundson 2015), and treatments that focus on decreasing IU (e.g., Dugas and Ladouceur 2000). Both AS and IU have been recognized as important transdiagnostic treatment targets for several anxiety and related conditions (e.g., Barlow et al. 2017; Boswell et al. 2013a, b; Norton and Paulus 2017). Future research is needed to determine the utility of transdiagnostic treatments in targeting these processes within the context of health anxiety and specifically in reducing reassurance-seeking behaviors such as over-utilization of medical care.

The current study has several limitations. First, the data were cross-sectional, limiting our ability to make causal inferences regarding our findings. Future examination of

these factors within a longitudinal framework will help elucidate the direction of associations between AS and IU, health anxiety, and healthcare utilization. Second, the effects that we found for both two-way and the three-way interactions were relatively small; therefore, the results of this study should be interpreted with caution until they are replicated in other samples. In addition, the use of a dichotomous outcome variable only allowed us to predict the likelihood of utilizing care at least once over the past 6 months, which does not necessarily reflect maladaptive healthcare utilization. Therefore, future work should not only work to replicate these findings in other samples, but also test whether these relationships apply to excessive or maladaptive forms of care-seeking. Third, participants from the current study were recruited from a primarily healthy university sample; therefore, findings may not be generalizable to a broader population or to individuals experiencing clinical levels of health anxiety. Although there is some utility to examining these constructs in non-clinical samples, future research should confirm these findings among both clinical and more demographically diverse samples. Fourth, our sole reliance on retrospective self-report in tracking healthcare utilization patterns may have limited the accuracy of our findings (e.g., Roberts et al. 1996). In addition, exclusive reliance on self-report measures throughout the study may have increased risk of bias due to shared method variance. Future research should include multiple methods of measurement to more conclusively establish these relationships. Finally, the current study only examined IU as a unitary construct. Future work should examine the distinct domains of IU (prospective vs. inhibitory) in the context of healthcare utilization, especially given that the behavioral paralysis captured by the inhibitory IU construct may be particularly relevant and informative in our understanding of those individuals with health anxiety who choose to avoid, rather than seek, healthcare services.

Overall, our findings suggest that health anxiety, AS, and IU all interact to predict utilization of general care, such that greater odds of utilization over a six-month period is present only in the context of higher levels of all three characteristics. In addition, both AS and IU may be important variables in predicting the use of emergency care, although in distinct directions.

Compliance with Ethical Standards

Conflict of Interest Arielle Horenstein, Andrew H. Rogers, Jafar Bakhshaie, Michael J. Zvolensky, and Richard G. Heimberg declare that they have no conflicts of interest to report.

Ethical Approval This study was approved by the IRB of <Blinded for Review> University.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Research Involving Human and Animal Participants All procedures in the study involving human participants were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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