University of Cincinnati

Date: 2/15/2016

I, Emily M O'Bryan B.S., hereby submit this original work as part of the requirements for the degree of Master of Arts in Psychology.

It is entitled:
The Indirect Effect of Anxiety Sensitivity in terms of Intolerance of Uncertainty and Health Anxiety

Student’s name: Emily M O'Bryan B.S.

This work and its defense approved by:

Committee chair: Alison Mcleish, Ph.D.

Committee member: Farrah Jacquez, Ph.D.

Committee member: Kristen Jastrowski Mano, Ph.D.
The Indirect Effect of Anxiety Sensitivity in terms of Intolerance of Uncertainty and Health Anxiety

A thesis submitted to the
Division of Graduate Education and Research
of the University of Cincinnati

in partial fulfillment of the
requirements for the degree of

Master of Arts

In the Department of Psychology
Of the College of Arts and Sciences

December 2015

by

Emily M. O'Bryan
B.S., University of Cincinnati, 2013

Committee: Alison C. McLeish, Ph.D. (chair)
Farrah M. Jacquez, Ph.D.
Kristen E. Jastrowski Mano, Ph.D.
Abstract

Health anxiety is a preoccupation with one’s health without objective reason for concern and involves health-related worry, body vigilance, and excessive reassurance-seeking from physicians in order to gain certainty regarding health status. Given the role that uncertainty plays in health anxiety, researchers have demonstrated associations between intolerance of uncertainty, broadly defined as negative reactions to uncertainty, and greater health anxiety in both clinical and non-clinical populations. However, despite this well-established relationship, further work is needed to identify mechanisms that underlie this association. Given that anxiety sensitivity (AS), particularly the physical concerns domain, also negatively impacts health anxiety, AS may serve as such an explanatory factor. Thus, the purpose of the present investigation was to examine the indirect effect of AS-Physical Concerns in terms of the associations between IU and health anxiety. Participants were 640 medically healthy undergraduate students (68.1% female, $M_{\text{age}} = 19.21$, $SD = 2.10$). A simple mediation analysis was conducted using PROCESS (Hayes, 2013) to examine the indirect effect of the predictor variables (global IU [$X_1$], prospective IU [$X_2$], and inhibitory IU [$X_3$]) on the criterion variable (SHAI [$Y$]) through the proposed mediator (ASI-PC [$M$]) using bias-corrected bootstrapping in order to directly test the significance of the indirect effect (10,000 resamples; Hayes, 2013). Consistent with hypothesis, after controlling for gender and negative affect, there was a significant indirect effect of AS-Physical Concerns in terms of the relationship between Global IU (indirect effect = .05; $SE = .01$; 95% CI = .02 to .06), and both Prospective IU (indirect effect = .04; $SE = .02$; 95% CI = .02 to .08) and Inhibitory IU (indirect effect = .11; $SE = .03$; 95% CI = .06 to .17) and health anxiety. These findings suggest that individuals who experience negative reactions to uncertainty have higher levels of health anxiety because they have a greater fear of anxiety-related sensations due their perceived negative physical consequences.
# Table of Contents

Abstract ................................................................................................................................. ii
Table of Contents ................................................................................................................... iv
List of Tables and Figures ....................................................................................................... v

## Introduction

- Intolerance of Uncertainty and Health Anxiety ........................................................... 4
- Anxiety Sensitivity and Health Anxiety ........................................................................ 5
- Intolerance of Uncertainty, Anxiety Sensitivity, and Health Anxiety .......................... 6
- Current Study .................................................................................................................. 7

## Method

- Participants ....................................................................................................................... 9
- Measures .......................................................................................................................... 9
- Procedure ......................................................................................................................... 11
- Data Analytic Plan .......................................................................................................... 12

## Results

- Zero-Order Correlations ................................................................................................. 12
- Mediation Analyses ......................................................................................................... 13
  - Global IU ....................................................................................................................... 13
  - Prospective IU ............................................................................................................. 13
  - Inhibitory IU ................................................................................................................ 14

## Discussion

- Limitations and Future Directions .................................................................................. 16
- Clinical Implications ....................................................................................................... 17
- Conclusion ....................................................................................................................... 18

## References ..................................................................................................................... 19
List of Tables and Figures

Table 1: Descriptive Statistics and Intercorrelations among all Study Variables.........29
Figure 1.........................................................................................................................30
Figure 2.........................................................................................................................31
Figure 3.........................................................................................................................32
Figure 4.........................................................................................................................33
The Indirect Effect of Anxiety Sensitivity in terms of Intolerance of Uncertainty and Health Anxiety

Health anxiety is a preoccupation with one’s health that occurs without an objective reason for concern and involves health-related worry and vigilance toward bodily sensations and changes (Salkovskis, Rimes, Warwick, & Clark, 2002). Health anxiety is conceptualized as existing on a continuum from mild to severe. While mild or low levels of health anxiety can be adaptive and motivate individuals to seek appropriate medical care, severe health anxiety can result in significant levels of functional impairment and psychological distress (Mykletun et al., 2009; Sunderland, Newby, & Andrews, 2013; Warwick & Salkovskis, 1990).

It should be noted that, originally, severe health anxiety was considered to be the Diagnostic and Statistical Manual (DSM) 4th Edition Text Revision diagnosis of hypochondriasis, which is characterized by a preoccupation with having or obtaining a severe physical disease due to misinterpretation of bodily sensations that perseveres despite reassurance and medical assessment (American Psychiatric Association [APA], 2000). This diagnosis was not maintained in the current version of the DSM (DSM-5). Instead, features of hypochondriasis are now found in two new diagnoses: illness anxiety disorder and somatic symptom disorder (APA, 2013). Somatic symptom disorder involves somatic symptoms that are distressing or result in significant functional impairment combined with persistent thoughts about the seriousness of one’s symptoms, anxiety about one’s health or symptoms, and/or excessive time or energy expenditure related to health concerns or symptoms (APA, 2013). Illness anxiety disorder involves preoccupation with having or acquiring a serious medical condition. Typically, this concern occurs despite the absence of any physical symptom, or, if symptoms are present, the symptoms are mild or the concern is out of proportion to the objective severity of the symptoms. This preoccupation is further complicated by high levels of anxiety related to health and maladaptive behaviors (e.g., excessive reassurance-seeking behaviors, avoidance. Given the limited research on these new diagnoses, the current study is based on the original
conceptualization hypochondriasis as the most severe form of health anxiety, although health anxiety itself is not a diagnosis. Thus, the terms hypochondriasis and severe health anxiety will be used interchangeably.

It is estimated that between 1% and 5% of the population will experience hypochondriasis during their lifetime (APA, 2000). Despite these low prevalence rates, individuals with severe health anxiety place a significant burden on the healthcare system (Barsky, Ettner, Horsky, & Bates, 2001); it is estimated that the healthcare utilization by individuals with severe health anxiety is 41%-78% higher than that of individuals with a true medical condition (Fink, Ørnbøl, & Christensen, 2010). Adding to these costs, hypochondriasis also frequently co-occurs with other forms of psychopathology, including panic disorder, obsessive-compulsive disorder, generalized anxiety disorder, specific phobias, and depressive disorders (Abramowitz, Olatunji, & Deacon, 2007; Barsky, Wyshak, & Klerman, 1992; Bienvenu, et al., 2000; Noyes, 1999; Noyes et al., 1994; Rasmussen & Tsuang, 1986).

Cognitive-behavioral models of health anxiety posit that health anxiety develops as a result of knowledge of, or direct experience with, illness in oneself or others and learned patterns of symptom interpretation and associated reactions (e.g., always having been taken to the doctor as a child when physiological symptoms arose; Abramowitz et al., 2002; Warwick & Salkovskis, 1990). Such experiences lead to the acquisition of maladaptive health-related beliefs (e.g., increased likelihood of having an illness, dangerousness of body sensations), which then lead individuals to selectively attend to information that confirms their beliefs, while also discounting evidence that would disconfirm their beliefs. Therefore, when exposed to health-related triggers, these core health-related beliefs are activated and result in negative automatic thought patterns (e.g., worry, rumination) that culminate in health anxiety. These processes are often triggered by ambiguous health-related situations in particular, and research has found that individuals who are high in health anxiety tend to overestimate the chance of
negative outcomes when faced with such situations (Haenen, De Jong, Schmidt, Stevens, & Visser, 2000).

Once health anxiety has developed, there are a number of physiological, behavioral, and cognitive factors that then serve to maintain health anxiety (Abramowitz et al., 2002; Warwick & Salkovskis, 1990). For example, the chronic autonomic activation resulting from anxious arousal serves to maintain health anxiety, because it typically results in the misinterpretation of symptoms associated with such arousal as signs of illness (Abramowitz et al., 2002; Warwick & Salkovskis, 1990). Moreover, the cognitive biases held by individuals with high levels of health anxiety maintain health anxiety by causing the individual to attend to information that confirms ill health, while ignoring disconfirming information. Similarly, body vigilance, or selective attention toward (and monitoring of) physiological sensations and bodily changes, is another key maintaining factor (Abramowitz et al., 2002). Given that physiological sensations are often misinterpreted as signs of illness, excessive body monitoring may feed into illness worry and rumination on the potential causes of these physical symptoms.

In order to reduce anxiety and gain certainty about health status, individuals high in health anxiety engage in a number of safety behaviors, including avoidance of disease-related situations and behaviors that could lead to illness (e.g., hospitals, shaking hands), excessive reassurance seeking, or obsessive checking (e.g., internet searches, self-examinations; Warwick & Salkovskis, 1990; Abramowitz et al., 2002). However, although these behaviors successfully reduce anxiety and health-related uncertainty in the short term, they are problematic in the long term because they fail to disconfirm the individual’s maladaptive health-related beliefs. Indeed, engaging in safety behaviors even over a period of only one week can lead to increases in health anxiety (Olatunji, Etzel, Tomarken, Ciesielski, & Deacon, 2011). Given the important role that ambiguous situations and uncertainty appear to play in health anxiety, researchers have begun to examine the cognitive risk factor of intolerance of uncertainty in terms of its relation to health anxiety.
Intolerance of Uncertainty and Health Anxiety

Intolerance of uncertainty (IU) is a cognitive risk factor that broadly reflects a fear of the unknown (Carleton, 2012). More specifically, IU has been conceptualized as the tendency to react negatively to uncertainty as well as ambiguous situations and future events because of beliefs that uncertainty is unfair (cognitive domain) and will result in negative consequences (behavioral domain; Carleton, Norton, & Asmundson, 2007; Dugas, Gosselin, & Ladouceur, 2001; Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). Individuals high in IU tend to perceive uncertain situations as inherently stressful and aversive. As a result, they hold beliefs that such situations should be avoided and have difficulty functioning under conditions of uncertainty. IU was originally developed to help understand generalized anxiety disorder (GAD) and its primary symptom of worry. Part of the goal of worry is to decrease feelings of uncertainty about future situations; thus, not surprisingly, IU has shown significant associations with worry and GAD (Dugas, Freeston, & Ladouceur, 1997; Buhr & Dugas, 2009, 2012) and is a key factor in differentiating individuals with GAD from nonclinical controls (Dugas, Gagnon, Ladouceur, & Freeston, 1998; Buhr & Dugas, 2002). Growing evidence suggests that IU is not specific to worry and may serve as a more transdiagnostic risk factor. Indeed, individuals high in IU also report increased symptoms of obsessive-compulsive disorder, social anxiety disorder, panic disorder, posttraumatic stress disorder, and depression (Boelen & Reijntjes, 2009; Dugas, et al., 2001; Fetzner, Horswill, Boelen, & Carleton, 2013; Miranda, Fontes, & Marroquin, 2008).

In terms of associations with health anxiety, IU has been shown to be significantly associated with greater overall health anxiety as well as the specific health anxiety domains of worry about illness, the tendency to perceive the consequences of having an illness as particularly severe, body vigilance, and health habits (e.g., bodily checking; Boelen & Carleton, 2012; Fergus & Bardeen, 2013; Fergus, Bardeen, & Orcutt, 2015; Fergus & Valentiner, 2009; Fetzner et al., 2014; Gerolimatos & Edelstein, 2012). IU is also elevated among individuals with severe health anxiety (Deacon & Abramowitz, 2008), and greater IU has been found to interact
with frequency of health-related Internet searches in predicting greater health anxiety (Fergus, 2013). Although there are clear associations between IU and health anxiety, IU is just one of a number of cognitive risk factors that play a role in health anxiety. One other factor that is related to, yet distinct from, IU (Carleton, Sharpe, & Asmundson, 2007) that has received a great deal of research attention in terms of its associations with health anxiety is anxiety sensitivity.

**Anxiety Sensitivity and Health Anxiety**

Anxiety sensitivity (AS) is defined as the fear of anxiety- and arousal-related physical and psychological sensations (McNally, 2002; Reiss & McNally, 1985) due to their perceived negative physical, cognitive, and social consequences (Taylor et al., 2007). AS reflects a relatively stable, albeit malleable, cognitive predisposition that results in an amplification of pre-existing anxiety levels such that a person who is high in AS will be more reactive to any personally-relevant threat stimulus. For example, an individual who is high in AS who experiences heart palpitations will experience an increase in fear because of concerns about having a heart attack and a further amplification in this fear due to this anxious responding to such sensations. AS is distinct from trait or state anxiety symptoms and other negative affective states (e.g., depression; Olatunji & Wolitzky-Taylor, 2009; Rapee & Medoro, 1994). Whereas trait anxiety denotes one’s anxiety proneness and state anxiety denotes how anxious one is in a particular moment or situation, AS denotes a fear of this anxiety or the symptoms one experiences when anxious.

AS is concurrently and prospectively associated with an increased risk of anxiety symptoms and disorders. AS demonstrates the strongest associations with panic attacks, panic disorder, and posttraumatic stress disorder (Lang, Kennedy, & Stein, 2002; Maller & Reiss, 1992; Schmidt, Zvolensky, & Maner, 2006), but is also significantly associated with social anxiety, specific phobias, generalized anxiety disorder, obsessive-compulsive disorder, and major depressive disorder (McNally & Steketee, 1985; Rapee & Heimberg, 1997; Taylor, Koch, Woody, & McLean, 1996; Zinbarg, Barlow, & Brown, 1997). Recent empirical work has also
examined associations between AS and health anxiety. Specifically, high AS predicts greater health anxiety as well as the fear of acquiring an illness (Fergus, 2014; Fergus & Bardeen, 2013; Fergus & Valentiner, 2010; Fetzner et al., 2014; Gerolimatos & Edelstein, 2012; Norton, Sexton, Walker, & Norton, 2005; Olutunji et al., 2009; Sexton, Norton, Walker, & Norton, 2003). Moreover, individuals with clinical levels of health anxiety have higher levels of AS compared to those with subclinical levels (Wheaton, Berman, & Abramowitz, 2010). Health anxiety has shown the strongest associations with the physical concerns domain of AS in both clinical and non-clinical samples (Deacon & Abramowitz, 2008; Fergus & Bardeen, 2013; Wheaton et al., 2010), although some studies have also found significant associations with the cognitive concerns domain (Olutunji et al., 2009; Fetzner et al., 2014).

**Intolerance of Uncertainty, Anxiety Sensitivity, and Health Anxiety**

Extant research has established that IU and AS are related, yet distinct constructs that are both associated with anxiety psychopathology (Carleton, Sharpe, & Asmundson, 2007). In an effort to better understand relations between IU, AS, and health anxiety, recent research has begun to examine the relative contributions of IU and AS in terms of health anxiety. Findings from this small body of work have been somewhat equivocal. Two studies have found that AS predicts greater health anxiety above and beyond the effects of IU, but that IU does not predict health anxiety over and above AS (Sexton et al., 2003; Norton et al., 2005). On the other hand, when looking at the specific domains of IU and AS, Fergus and Bardeen (2013) found that the behavioral IU domain predicted health anxiety above and beyond the AS domains and that the physical concerns domain of AS significantly predicted health anxiety above and beyond the effects of IU. A related study found that IU moderated the association between AS and medical website viewing such that medical website viewing led to increases in AS among individual high, but not low, in IU (Norr, Capron, & Schmidt, 2014). Although medical website viewing could be seen as a behavioral trigger for, or consequence of, health anxiety, rather than actual health anxiety, these findings highlight the need to understand the interplay between AS and IU.
Current Study

Taken together, empirical work indicates that health anxiety is associated with substantial levels of impairment and healthcare costs. Moreover, the transdiagnostic cognitive risk factors of IU and AS have been found to negatively impact health anxiety. Recent research has begun to examine the collective impact of IU and AS in terms of health anxiety. However, these studies have been primarily focused on determining the relative importance of one variable over the other. The only study, to date, that has examined how IU and AS combine to affect health anxiety (Norr et al., 2014) did not focus on health anxiety per se, but behavior that might serve as a proxy for health anxiety or as a risk factor for health anxiety. Further, this study focused on understanding conditions under which the AS-health anxiety relationship holds true (i.e., under conditions of high vs. low IU). As IU is also an important contributor to greater health anxiety, it is important to understand potential mechanisms that underlie the IU-health anxiety association as well.

It has been theorized that IU reflects negative reactions to uncertainty in general, while AS reflects a more specific fear of uncertainty related to the outcome or meaning of anxiety-related sensations (Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Carleton, 2012; Carleton, Duranceau, Freeston, Boelen, McCabe, & Antony, 2014; Carleton, Sharpe, & Asmundson, 2007). Thus, AS, specifically the physical concerns domain, may serve to explain the association between IU and health anxiety. That is, individuals who are unable to tolerate uncertainty in general may be more worried about their health and vigilant about changes in bodily sensations (i.e., have greater health anxiety) because they fear these physical sensations and the uncertainty about their outcomes or meaning. Given that body sensations are often misinterpreted as signs of illness within the context of health anxiety, it would follow that a broad-based inability to tolerate uncertainty would impact the ability to tolerate uncertainty concerning the consequence of anxiety-related physical sensations (e.g., serious illness). In other words, this limited capacity to withstand uncertainty leads the individual to fear any
arousal-related sensations occurring within her or his body, as they could be signs of a serious medical condition that could lead to future death. These sorts of catastrophic thoughts then fuel health related worry and subsequent attention toward bodily sensations and changes, ultimately leading to higher levels of health anxiety.

Therefore, the purpose of the present investigation was to examine the indirect effect of AS-Physical Concerns in terms of the associations between IU and health anxiety among medically healthy undergraduates (see Figure 1). In addition, building on previous research that has found differential effects of the IU subdomains in relation to health anxiety when taking AS into consideration (Fergus & Bardeen, 2013), the indirect effects of both the cognitive and behavioral domains of IU (i.e., Prospective and Inhibitory IU) were examined. An undergraduate sample was chosen in order to be consistent with other research on health anxiety and transdiagnostic cognitive risk factors (e.g., Boelen & Carleton, 2012; Fergus & Valentiner, 2009; Wheaton et al., 2010). Further, the use of a healthy sample (i.e., without confounding medical problems) helps to ensure that true health anxiety is being assessed, rather than anxiety regarding an actual medical condition. It was hypothesized that, after controlling for the effects of gender and negative affect, there would be a significant indirect effect of global IU on health anxiety through AS-Physical Concerns. Specifically, higher levels of IU would be associated with greater health anxiety because of higher levels of AS-Physical Concerns. Based on the findings of Fergus and Bardeen (2013), it was hypothesized that the would also be a significant indirect effect for behavioral IU. Although this study did not find that the cognitive IU domain predicted health anxiety above and beyond AS, given that the current study is examining AS as an explanatory mechanism, it was expected that there would be significant indirect effects for the cognitive IU domain as well. Gender and negative affect were chosen as covariates on an a priori basis to be consistent with prior research on health anxiety (e.g., Abramowitz, Deacon, & Valentiner, 2007; Fergus & Bardeen, 2013; Macatee & Cougle, 2013; Marcus, Hughes, & Arnau, 2008; Olatunji et al., 2009). Further, negative affect was employed as a covariate in
order to ensure that observed associations were not simply due to a general propensity to experience more frequent negative mood states.

**Method**

**Participants**

Participants were 640 medically healthy undergraduate psychology students (68.1% female, $M_{age} = 19.21$, $SD = 2.10$, Range = 18-42 years). The current sample represents a subset of a larger sample (N = 1420) of undergraduate students in Introductory Psychology courses who participated in a study on college student health for course credit. Participants were selected for the current study based on having complete data for all study variables and no chronic medical conditions. Specifically, only participants who reported no history of the following medical conditions were included in the current study: arthritis, heart attack, high blood pressure, diabetes, HIV/AIDS, ulcer, back or neck problems, frequent or severe headache, other chronic pain, stroke, heart disease, asthma, other chronic lung disease (e.g., COPD, emphysema), kidney problems, epilepsy/seizures, or cancer. In terms of the racial composition of the sample, 85.3% self-identified as Caucasian, 6.3% Black or African American, 5.0% Asian, 2.8% multiracial, and .6% did not specify. 3.1% of the sample reported Hispanic ethnicity.

**Measures**

**Positive Affect Negative Affect Schedule (PANAS).** The PANAS (Watson, Clark, & Tellegen, 1988) is a measure of general positive and negative emotional states commonly used in psychopathology research (Watson, 2000). Items are rated on a 5-point Likert-type scale (1 = *very slightly or not at all* to 5 = *extremely*) and higher scores indicate greater levels of positive or negative affect. In the present study, only the negative affect subscale (PANAS-NA) was used as an index of the broad-based disposition to experience negative affective states (e.g., anger, anxiety, depression, guilt). A large body of literature supports the reliability and validity of the PANAS (Watson, 2000; Watson, Clark, & Tellegen, 1988). Cronbach’s alpha for the PANAS-NA in the current sample was good ($\alpha = .87$).
Intolerance of Uncertainty Scale, Short Form (IUS-12). The IUS-12 is a 12-item measure assessing reactions to ambiguity, uncertainty, and the future (Carleton et al., 2007). This measure is a shortened version of the original 27-item IUS (Freeston et al., 1994). Items are rated on a 5-point Likert-type scale (1 = not at all characteristic of me to 5 = entirely characteristic of me) with higher scores indicating greater IU. The IUS-12 consists of two factors tapping into the two domains of IU: (1) a 7-item subscale that assesses the cognitive IU domain (e.g., “One should always look ahead so as to avoid surprises”; Prospective IU) and (2) a 5-item subscale that assesses the behavioral IU domain (e.g., “When I am uncertain I can’t function very well”; Inhibitory IU). In addition to these two subscales, a total score (i.e., Global IU) can be used to assess intolerance of uncertainty more broadly (Carleton et al., 2007). The psychometric properties of the IUS-12 are comparable to that of the original IUS (Carleton et al., 2007; Khawaja & Yu, 2010). The IUS-12 has also demonstrated good to excellent internal consistency reliability for both the subscales and total score (Carleton et al., 2007), and good convergent validity in terms of its relation to measures of anxiety, depression, worry, and generalized anxiety (Carleton et al., 2007). Internal consistency in the current sample was excellent ($\alpha = .91$) for Global IU and good for the Prospective IU and Inhibitory IU subscales ($\alpha = .86$ and .84, respectively).

Anxiety Sensitivity Index-3 (ASI-3). The ASI-3 is an 18-item self-report measure that assesses the degree to which individuals fear negative consequences stemming from anxiety symptoms (Taylor et al., 2007). Items are rated on a 5-point Likert-type scale (0 = very little to 5 = very much) and higher scores indicate greater AS. The ASI-3 is comprised of one higher-order AS factor and three specific lower-order factors tapping into physical, social, and cognitive concerns (Taylor et al., 2007). Only the physical concerns subscale (AS-Physical Concerns) was used in the current study (e.g., “It scares me when my heart beats rapidly”). The ASI-3 has demonstrated the strongest psychometric properties of any current measure of AS (Taylor et al.,
Cronbach’s alpha for the AS-Physical Concerns subscale in the current sample was good ($\alpha = .80$).

**Short Health Anxiety Inventory (SHAI).** The SHAI is an 18-item self-report measure that assesses health-related worry, vigilance toward bodily changes and sensations, and feared consequences of having an illness independent of actual physical health status (Salkovskis et al., 2002). Item statements are rated on a 4-point scale (ranging from 0 to 3) based on item-specific response choices that indicate varying degrees of health anxiety. Higher scores indicate higher levels of health anxiety. Extant research on the factor structure of the SHAI most consistently supports a two-factor structure: a 14-item general health anxiety subscale measuring health-related worry and body vigilance (SHAI-Main; e.g., “I spend most of my time worrying about my health”) and a 4-item Negative Consequences subscale (e.g., “If I had a serious illness I would be completely unable to enjoy life at all”; Alberts, Hadjistavropoulos, Jones, & Sharpe, 2013). However, psychometric research has determined that the Negative Consequences subscale does not contribute any unique information beyond the general health anxiety subscale; thus, only the SHAI-Main subscale was used in the present study (Alberts et al., 2013), hereafter referred to as SHAI. The SHAI has demonstrated good psychometric properties and been shown to be uniquely predictive of healthcare utilization, somatization, and safety-seeking behaviors (Alberts et al., 2013). Internal consistency for the SHAI in the current study was good ($\alpha = .86$).

**Procedure**

Undergraduate students from Introductory Psychology courses at a large, urban university who were over the age of 18 were invited to participate in the study. Students interested in participating emailed the researcher and were provided with a link to complete study measures online at their convenience. Study data were collected and managed using REDCap (Research Electronic Data Capture; Harris et al., 2009), a secure, web-based
application designed to support data capture for research studies. Participants were given a re-
entry code in order to enable them to complete the surveys at their own convenience over the
course of the semester. Information regarding participants’ IP addresses was not collected to
ensure anonymity. After submitting the survey online, participants contacted the researcher via
email and were granted course credit for their participation. The Institutional Review Board
approved all study materials and procedures prior to the collection of data.

Data Analytic Plan

First, the data were examined for the presence of outliers. Six univariate outliers, defined
as a z score greater than 3 or less than -3, were identified and excluded from subsequent
analyses. Then, 14 multivariate outliers were identified using Mahalanobis’ distance and
excluded from subsequent analyses. Thus, the analyses were based on a final sample of 620.
Next, zero-order correlations among all study variables were examined. Finally, a simple
mediation analysis was conducted to examine the indirect effect of the three predictor variables
(Global IU [X₁], Prospective (cognitive) IU [X₂], and Inhibitory (behavioral) IU [X₃]) on the
criterion variable (SHAI [Y]) through the proposed mediator (AS-Physical Concerns [M]; Figure
1). Gender and negative affect were included as covariates in all models. Analyses were
conducted using PROCESS, a conditional process modeling program that utilizes an ordinary
least squares-based path analytical framework to test for both direct and indirect effects (Hayes,
2013). The indirect effect was computed by multiplying the path a coefficient by the path b
coefficient. In order to test the significance of the indirect (i.e., mediational) effect, bias-corrected
bootstrapping (10,000 resamples) was employed in order to generate a 95% confidence interval
(Hayes, 2013).

Results

Zero-Order Correlations

Associations between all study variables are presented in Table 1. Health anxiety was
significantly correlated with negative affect ($r = .45, p < .01$), all IU variables (range: .31 to .37),
and AS- Physical Concerns ($r = .52, p < .01$). AS- Physical Concerns was significantly associated with gender ($r = .12; p < .05$), negative affect ($r = .36, p < .01$), and all IU variables (range: .26 to .35). Negative affect was significantly correlated with gender ($r = .14, p < .01$) and all IU variables (range: .46 to .58). Finally, all IU variables were significantly associated with one another (range: .70 to .95).

**Mediation Analyses**

**Global IU.** The results for the mediational analyses for Global IU are presented in Figure 2. Both the total effect model ($R^2 = .22, df = 3, 616, F = 57.71, p < .001$) and the direct effect model with AS-Physical Concerns as the mediator (i.e., full model; $R^2 = .36, df = 4, 615, F = 86.40, p < .001$) were significant. In terms of the total effect model, greater Global IU was significantly predictive of greater health anxiety when accounting for the effects of gender and negative affect (path c). For the full model, greater negative affect ($b = .21, t = 6.46, p < .001$) was a significant covariate, but gender was not. Greater levels of Global IU significantly predicted AS-Physical Concerns (path a) and greater AS-Physical Concerns predicted greater health anxiety (path b). Regarding the test of the indirect (mediational) effect, Global IU was predictive of greater health anxiety indirectly through the effect of AS-Physical Concerns (indirect effect = .05; $SE = .01; 95\% CI = .02 to .06$). The direct effect of Global IU on health anxiety when controlling for the covariates and the mediator remained significant (path c').

**Prospective IU.** See Figure 3 for a depiction of the mediation model with Prospective IU as the predictor variable. Both the total effect model ($R^2 = .21, df = 3, 616, F = 56.02, p < .001$) and the direct effect model ($R^2 = .36, df = 4, 615, F = 86.23, p < .001$) were significant. For the total effect model, greater Prospective IU significantly predicted greater health anxiety when controlling for covariates. In terms of the full model, greater negative affect ($b = .31, t = 9.62, p < .001$) was the only significant covariate. Greater levels of Prospective IU significantly predicted AS-Physical Concerns and greater AS-Physical Concerns predicted greater health anxiety. Regarding the test of the indirect effect, Prospective IU was predictive of greater health anxiety
indirectly through the effect of AS-Physical Concerns (indirect effect = .04; SE = .02; 95% CI = .02 to .08). The direct effect of Prospective IU on health anxiety when controlling for the effects of the covariates and AS-Physical Concerns remained significant.

**Inhibitory IU.** Figure 4 depicts the mediation model with Inhibitory IU as the predictor variable. Both the total effect model ($R^2 = .22$, $df = 3, 616$, $F = 7.46$, $p < .001$) and the direct effect model ($R^2 = .36$, $df = 4, 615$, $F = 85.75$, $p < .001$) were significant. Greater Inhibitory IU predicted greater health anxiety when accounting for gender and negative affect in the total effect model. For the full model, greater negative affect ($b = .21$, $t = 6.46$, $p < .001$) was the only significant covariate. Greater levels of Inhibitory IU significantly predicted AS-Physical Concerns and greater AS-Physical Concerns predicted greater health anxiety. Regarding the test of the indirect effect, Inhibitory IU was predictive of greater health anxiety indirectly through the effect of AS-Physical Concerns (indirect effect = .11; SE = .03; 95% CI = .06 to .17). The direct effect of Inhibitory IU on health anxiety was no longer significant when controlling for the effects of the covariates and AS-Physical Concerns.

**Discussion**

There has been a growing level empirical attention given to examining the role of transdiagnostic cognitive risk factors in health anxiety. IU and AS-Physical Concerns, in particular, have demonstrated robust associations with health anxiety (Boelen & Carleton, 2012; Deacon & Abramowitz, 2008; Fergus & Bardeen, 2013; Fergus et al., 2015; Fergus & Valentiner, 2009; Fetzner et al., 2014; Gerolimatos & Edelstein, 2012; Wheaton et al., 2010). However, our theoretical understanding of these associations is limited because only one study, to date, has examined the interplay between these factors (Fergus & Bardeen, 2013). Therefore, the aim of the current study was to examine the indirect, or mediating, effect of AS-Physical Concerns in terms of the relationship between global and specific facets of IU and health anxiety.
Consistent with prediction, greater Global, Prospective, and Inhibitory IU were all associated with greater AS-Physical Concerns, and greater AS-Physical Concerns was directly associated with greater health anxiety. Further, as hypothesized, there was a significant indirect effect of Global, Prospective, and Inhibitory IU on health anxiety through AS-Physical Concerns. These results were significant after accounting for the effects of gender and negative affect. Thus, these findings suggest that individuals who experience negative reactions to uncertainty due to beliefs that uncertainty is unfair and will result in negative consequences have higher levels of health anxiety because they have a greater fear of anxiety-related sensations due their perceived negative physical consequences. Therefore, it appears that AS-Physical Concerns serves as one mechanism by which the inability to tolerate uncertainty impacts health anxiety. Moreover, there was consistency across all IU domains indicating that both cognitive and behavioral reactions to uncertainty are associated with health anxiety because of fears of anxiety-related physical sensations.

Interestingly, however, the only model in which AS-Physical Concerns fully accounted for the relationship between IU and health anxiety (i.e., total effect, path c, was significant while direct effect, path c’, was not) was for Inhibitory IU. Although the current analytic and conceptual approaches to examining mediation do not retain the concepts of full and partial mediation since no one construct is likely to fully account for the relationship between any two variables (Hayes, 2013), this finding does suggest that fear of anxiety-related sensations due to their perceived negative physical consequences best explains the relationship between behavioral IU (i.e., beliefs that uncertainty will prevent an individual from acting) and health anxiety. Moreover, this finding is consistent with previous research suggesting that Inhibitory IU may be most relevant to health anxiety (Fergus & Bardeen, 2013).

These findings also lend support to the conceptual model of IU and health anxiety described above. Given that catastrophizing about physical sensations is a key component of health anxiety, it logically follows that AS-Physical Concerns helps to explain why IU
exacerbates health anxiety. That is, individuals only fear anxiety-related sensations because of a fear of uncertainty as to the negative physical consequences of these sensations (Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Carleton, 2012; Carleton, Sharpe, & Asmundson, 2007). It may also be that AS-Physical Concerns further exacerbates anxious reactions to uncertainty that are inherent when one is high in IU. As this anxiety intensifies as a result of the individual’s fear of their anxiety symptoms, increases in health anxiety are encountered because individuals are perceiving that there will be dangerous physical consequences to these anxiety symptoms. For example, an individual with elevated levels of health anxiety might encounter an uncertain health-related situation, such as receiving ambiguous feedback regarding their health status from a physician. Given that uncertainty is high, these individuals will experience heightened anxiety. Once this increase in anxious arousal is detected, fear of said arousal begins due to catastrophic patterns of thinking with regard to possible physical outcomes of this arousal. In turn, the individual will experience increases in health-related worry and body vigilance. Another possibility is that the increases in anxiety resulting from fear of anxiety (i.e., AS) leads to more opportunities for individuals high in IU to perceive physiological arousal as signs of illness, thereby leading to greater levels of health concerns.

**Limitations and Future Directions**

While the present study contributes to and extends previous work on transdiagnostic cognitive risk factors and health anxiety, there are a number of limitations that warrant consideration. First, the present cross-sectional design does not allow the investigation of the causal nature of these relations. While these findings suggest that the fear of anxiety-related sensations may, at least partially, explain the previously observed relations between IU and health anxiety, it is also possible that IU mediates the association between AS-Physical Concerns and health anxiety. Future work using longitudinal designs will be necessary in order to parse apart the directional nature of these relations and to better understand how these factors interact with one another over time.
Second, the sample was relatively homogenous with regard to gender, race, and ethnicity, which limits the generalizability of the findings to other populations. Similarly, the sample, by design, consisted of young adults without a history of significant medical problems. While this approach is consistent with past work and ensures that individuals are reporting anxiety regarding the possibility of a serious medical condition rather than an actual medical condition, it will be important for future work to examine the interplay between IU and AS-Physical Concerns in terms of health anxiety in an older sample. Further, although health anxiety involves anxiety about one’s health without an objective reason for concern, medical conditions are commonly found in the general population; thus, it will be important for to examine how health anxiety “works” in medically ill populations. For example, future work could examine the presence of medical conditions as a moderator of the mediation model (i.e., moderated mediation).

Along these same lines, it will be important for future work to replicate these findings in clinical samples. However, mitigating this concern somewhat, there was substantial variability in health anxiety in the current sample with 19.8% meeting the suggested SHAI clinical cutoff of 18 (Rode, Salkovskis, Dowd, & Hanna, 2006). Further, 3.9% of the sample met the more rigorous cutoff of 27 (Abramowitz, Olatunji, et al., 2007), which is broadly consistent with expected prevalence rates of hypochondriasis in the general population (APA, 2000; Creed & Barsky, 2004; Faravelli et al., 1997; Noyes, Happel, & Yagla, 1999; Rief, Hessel, & Braehler, 2001). Lastly, the use of self-report measures as the primary assessment methodology does not fully protect against reporting errors and may be influenced by shared method variance. Future studies could build on the present work by utilizing a multi-method assessment approach. For example, laboratory-based studies could be used to manipulate uncertainty and/or induce physiological arousal and then assess subsequent health-related distress.

**Clinical Implications**
Despite these limitations, a number of clinical implications can be drawn from the present findings. These findings suggest that one way to not only decrease health anxiety, but also to decrease the burden on the healthcare system and reduce unnecessary medical costs associated with health anxiety is by targeting AS. Indeed, interventions using interoceptive exposure to elicit feared physical sensations have been shown to successfully reduce AS (e.g., Broman-Fulks & Storey, 2008; Feldner, Zvolensky, Babson, Leen-Feldner, & Schmidt, 2008; Gardenswartz & Craske, 2001). Anxiety Sensitivity Amelioration Training (ASAT; Schmidt et al., 2007) may be particularly useful for this population because it is a brief one-session intervention that can be easily implemented by trained lay professionals (i.e., a licensed psychologist is not necessary) in physician offices. It may also be useful to implement such interventions among individuals high in IU as a way to prevent the development of clinically elevated levels of health anxiety.

**Conclusions**

Taken together, the present findings suggest that the mechanism by which IU exacerbates health anxiety is through increased in AS-Physical Concerns. Therefore, it may be useful to target AS, particularly among individuals with elevated levels of IU, in prevention and intervention efforts for health anxiety.
References


spectrum disorders: Results from a family study. Biological Psychiatry, 48, 287-293. doi:10.1016/S0006-3223(00)00831-3


process for providing translational research informatics support. *Journal of Biomedical Informatics, 42,* 377-381. doi:10.1016/j.jbi.2008.08.010


<table>
<thead>
<tr>
<th>1. Gender</th>
<th>M</th>
<th>SD</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Negative Affect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Global IU</td>
<td>3.66</td>
<td>1.45</td>
<td>4.66</td>
<td>1.04</td>
<td>6.36</td>
<td>1.39</td>
<td>1.03</td>
<td>0.13</td>
</tr>
<tr>
<td>4. Prospective IU</td>
<td>7.06</td>
<td>0.32</td>
<td>4.60</td>
<td>0.21</td>
<td>6.22</td>
<td>0.03</td>
<td>0.12</td>
<td>0.01</td>
</tr>
<tr>
<td>5. Inhibition IU</td>
<td>5.77</td>
<td>0.22</td>
<td>4.60</td>
<td>0.21</td>
<td>6.17</td>
<td>0.02</td>
<td>0.11</td>
<td>0.01</td>
</tr>
<tr>
<td>6. AS-PQ</td>
<td>5.21</td>
<td>0.14</td>
<td>4.11</td>
<td>0.52</td>
<td>6.89</td>
<td>0.76</td>
<td>0.34</td>
<td>0.73</td>
</tr>
<tr>
<td>7. SHAI</td>
<td>9.65</td>
<td>5.22</td>
<td>7.35</td>
<td>3.41</td>
<td>12.76</td>
<td>1.37</td>
<td>0.70</td>
<td>0.20</td>
</tr>
<tr>
<td>8. SHAI</td>
<td>0.42</td>
<td>0.26</td>
<td>0.76</td>
<td>1.31</td>
<td>0.24</td>
<td>0.41</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Note:</strong> Gender: 1 = male, 2 = female. Negative Affect: Positive Affect Negative Schedule. Negative Affect Subscale.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1. Proposed indirect effect model.
Note. Unstandardized OLS regression path coefficients are shown. Solid line represents the total effect of Global IU on health anxiety. Dotted line represents the direct effect model with AS-Physical Concerns included as a mediator. Gender and negative affect were included as covariates but are not represented here.

Fig 2. Diagram of simple mediation analysis of Global IU on health anxiety through AS-Physical Concerns.
* $p < .05$, ** $p < .01$, *** $p < .001$

**Note.** Unstandardized OLS regression path coefficients are shown. Solid line represents the total effect of Prospective IU on health anxiety. Dotted line represents the direct effect model with AS-Physical Concerns included as a mediator. Gender and negative affect were included as covariates but are not represented here.

*Figure 3.* Diagram of simple mediation analysis of Prospective IU on health anxiety through AS-Physical Concerns.
Note. Unstandardized OLS regression path coefficients are shown. Solid line represents the total effect of Inhibitory IU on health anxiety. Dotted line represents the direct effect model with AS-Physical Concerns included as a mediator. Gender and negative affect were included as covariates but are not represented here.

Figure 4. Diagram of simple mediation analysis of Inhibitory IU on health anxiety through AS-Physical Concerns.