EXPERT REVIEWS

The intolerance of uncertainty construct in the context of anxiety disorders: theoretical and practical perspectives

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Modern anxiety disorder models implicitly include intolerance of uncertainty (IU) as a critical component for the development and maintenance of these pervasive social and economic concerns. IU represents, at its core, fear of the unknown – a long-recognized, deep-seated fear identified in normative and pathological samples. Indeed, the intrinsic nature of IU can be argued as evolutionarily supported, a notion buttressed by initial biophysiological evidence from uncertainty-related research. Originally thought to be specific to generalized anxiety disorder, recent research has clearly demonstrated that IU is a broad transdiagnostic dispositional risk factor for the development and maintenance of clinically significant anxiety. The available evidence suggests that theorists, researchers and clinicians may benefit from explicitly incorporating IU into models, research designs, case conceptualizations and as a treatment target.

Keywords: anxiety • depression • intolerance of uncertainty • tolerance of ambiguity • transdiagnostic

Increasing interest in the potential broad applicability for intolerance of uncertainty (IU) in understanding psychopathology has prompted a recent surge in research. The present article was constructed to contextualize IU relative to existing models of anxiety; provide a historical, biological and evolutionary context therein; define and delineate IU; review current self-report measures for IU; review the transdiagnostic research on IU and discuss how IU functions in a clinical context. Avenues for future research are explored before being highlighted in the 'Expert commentary' and the 'Five-year view' sections.

Anxiety & uncertainty

Anxiety disorders represent a pervasive social and economic concern [1,2] warranting increased attention from researchers and policy makers. Key models of anxiety-related psychopathology describe anxiety and fear as having three key components [3]: physiological (i.e., autonomic nervous system activation), cognitive (i.e., interpretation of the environmental and physiological stimuli) and behavioral (i.e., the selected response to the stimuli). Theorists have also differentiated anxiety from fear in an attempt to facilitate explanations of the interactions between experience and behavior [3,4]. Fear has been described as a protective response to a current, identifiable threat (e.g., being attacked), typically accompanied by strong physiological reactions (e.g., increased autonomic arousal) and a fight or flight response [3]. Anxiety has been described as physiologically similar to fear in that there is increased autonomic arousal; however, rather than occurring in response to a current, identifiable threat, anxiety occurs in response to a pending or potential threat that may or may not occur (e.g., the possibility of being attacked, somewhere, sometime). That said, with respect to the experience of anxiety, it could be argued that most threatening stimuli are consequentially threatening, in that threatening stimuli (e.g., being attacked) are threatening as a function of anticipated consequences (e.g., pain or injury) and patterns of reinforcement, rather than being inherently threatening [5]. The anxiety response is then accompanied by proactive avoidance behaviors, rather than the reactive fight-or-flight response associated with fear.

A key cognitive distinction associated with anxiety appears to be a "sense of uncontrollability focused on the possibility of future threat, danger or other potentially negative events" [4]. In other

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words, the cognitive components of anxiety require a potential future threat coupled with the potential of insufficient agency to avoid or overcome the threat-related potential consequences.

In this context, agency refers specifically to human agency as described by Bandura [6] – an emergent reciprocal interactivity between internal and external determinants – and is influenced by efficacy beliefs, goal representations and anticipated outcomes. The absence of certainty or agency related to the threat and the associated potential consequences creates anxiety. By contrast, certainty about the threat and the associated potential consequences or agency necessarily results in either calm (e.g., no threat and/or capacity to avoid or cope with the threat and the associated potential consequences) or fear (e.g., the potential threat or potential associated consequences become realized). For example, if being attacked and the associated potential consequences somehow transitions from a possibility to an impossibility (i.e., all such threats and/or the associated potential consequences are permanently removed), there will be no anxiety about being attacked. Similarly, if capacity to avoid or cope with the threat-related potential consequences becomes certain (e.g., being attacked will not result in any form of injury considered threatening by the person being attacked), there will be no anxiety about being attacked. Alternatively, if being attacked and the associated potential consequences transitions from a future possibility into a current certainty (i.e., the attack begins), what may have been anxiety will have become fear.

There are at least three practical considerations within the aforementioned interpretation of Suárez and colleagues' quote [4] that further contextualize the experience of anxiety and uncertainty. The first consideration is absence of agency (i.e., a sense of uncontrollability), although the presence of agency has long been established as limited at best [7–9]. That said, the absence of agency is not necessarily inherently threatening. For example, many people willfully seek to abdigate some or all agency at different times and under different circumstances (e.g., deity-driven determinism; the popularity of disinhibitory substances). The second consideration involves the inescapability of the potential for future negative outcomes. Specifically, all persons will experience limitations of agency and all persons are at risk of experiencing future negative outcomes. These realities mean that all people will experience uncertainty, placing them at risk for experiencing anxiety; however, not all persons will experience clinically significant anxiety (i.e., associated with distress or impairment), which is a distinction of degree instead of a distinction of kind [10]. The distinction appears based on individual differences in capacity to tolerate the inevitable uncertainty associated with insufficient agency and negative outcomes. The third consideration involves events potentially perceived as threats that are unequivocally certain but are also, as of yet, unrealized. Practically speaking, there is only one such threat – death. All other future threats and the associated potential consequences remain uncertain (i.e., anxiety provoking) until they are realized, which prompts fear rather than anxiety. The full debate about these considerations is beyond the scope of this paper. In the interim, based on the definition from Suárez and colleagues [4] and the postulates of other researchers [11,12], uncertainty appears to be an important, if not necessary, component of anxiety.

Biological & evolutionary perspectives

The available evidence from large undergraduate [13,14], community [15] and clinical populations [12,16–21] has indicated that the ability to tolerate uncertainty is a ubiquitous dispositional characteristic with a range of scores, substantial construct variability, a generally normal distribution and observable influences on behavior [22,23]. Tolerating uncertainty as an individual difference variable is important in the experience of anxiety and readily integrates into the automatic (i.e., preconscious or preattentive) and strategic (i.e., elaborative) processing postulated in information processing models of anxiety [10,24]. Mathews and MacLeod conducted what may have been the first review of attention-based anxiety research and concluded that the earliest analyses of stimuli may serve only to classify a stimulus as threatening or not [25,26]. Since then, researchers have further supported the automatic classification of stimuli [27,28] and a recent review has underscored the system as important for the development and maintenance of anxiety disorders [29]. At this automatic level, the ability to tolerate uncertainty may be reflected in a bias towards classification of a novel stimulus as threatening, therein increasing autonomic arousal and facilitating perceptions of anxiety at strategic processing levels. Such speculation is supported by theory and evidence that uncertainty itself is considered threatening [30–32] and can exacerbate the perception of threat [33,34]. Indeed, people who are intolerant of uncertainty are more likely to interpret all ambiguous information as threatening [35], contributing to significant somatic stress reactions (e.g., increased heart rate, blood pressure [36,37]). Recent research has also demonstrated a relationship between inability to tolerate uncertainty and the startle response, independently of worry, which underscores the importance of automatic processing associated with uncertainty and threat [38]. During the subsequent strategic processing, a more complex assessment of the threat potential occurs that likely interacts with automatic and strategic assessments of the coping capacity; however, an inability to tolerate uncertainty may impair problem-solving skills, inhibiting action and increasing avoidance of uncertainty [39].

As stimuli become increasingly novel, the ability to tolerate ambiguity or uncertainty becomes increasingly important to explain the experience of anxiety. Novel situations (i.e., the unknown) activating the autonomic nervous system would have been evolutionarily supported so long as the system was not hyperactive. From an evolutionary perspective, activation of the autonomic nervous system while exploring a completely novel environment would help protect against predation, but activation caused by the presence of any novelty in an otherwise familiar environment would have been incapacitating. Furthermore, humans would be best served by balancing tolerance and IU [40–42], a balance best described by a continuum for fearing the unknown. Indeed, Kroener and Dugas [43] have provided compelling evidence supporting the ability to tolerate uncertainty as not just an individual difference variable, but as a dispositional characteristic; moreover, initial evidence suggests

the characteristics a continuous latent structure throughout the population [18]. In modern society (arguably in most industrial countries), tolerating uncertainty functions less as a critical component for survival and more as a broad dispositional risk factor for the development and maintenance of clinically significant anxiety and depression [12,19–21,44].

Defining IU

Specific references to tolerating uncertainty as a dispositional characteristic are increasingly popular, but remain relatively recent [11,12,18,20,43–47]. An early and potent reference to difficulties tolerating uncertainty was made by Lovecraft in 1927, "The oldest and strongest emotion of mankind is fear, and the oldest and strongest kind of fear is fear of the unknown" (as cited in [48]). The Lovecraft reference reflects the long-standing acceptance that a fear of the unknown is a very basic human fear. Subsequently, researchers have made references associated with uncertainty – such as intolerance of ambiguity [49] – but specific references to difficulty tolerating uncertainty did not appear until relatively recently [50,51]. Uncertainty was described as a state resulting from aversive or ambiguous stimuli, wherein increasing difficulty tolerating uncertainty results in hypervigilance for threat cues. Thereafter, difficulties managing uncertainty were empirically associated with less-effective responses to negative life events [52] and a desire for cognitive closure irrespective of the specifics associated with that closure [53].

Researchers later postulated a causal relationship between uncertainty and worry [31], specified the related construct as IU [32], and provided the first construct-specific definition "as a relatively broad construct representing cognitive, emotional, and behavioral reactions to uncertainty in everyday life situations" [32]. The definition was revised several times thereafter (Table 1). First, a focus on perception was added to the definition ([54], as cited in [55]) and the construct broadened to include difficulties with ambiguity and unpredictable changes ([56], as cited in [57]). Second, IU was described as a predisposition to react negatively to uncertain events, independently of the perceived probabilities and consequences associated therein [58]. Third, IU was described as an excessive tendency to consider negative events as unacceptable; however, the probability of such events to occur are small [59]. Fourth, IU was defined as a cognitive bias affecting the perception, interpretation and behaviors associated with uncertainty [60]. Fifth, IU was conceptualized as an excessive tendency to find uncertainty distressing, to believe surprises are negative and should be avoided, and to believe uncertainty about the future is unfair [61,62]. Sixth, the definition of IU was expanded to include beliefs about the inability to cope with ambiguity and change [47].

Reviews of the aforementioned research did not unanimously support a single definition [55,63], with some researchers arguing there are "major conceptual problems with the construct of IU" [63]. Since then, IU has been described as a future-oriented dispositional characteristic resulting from negative beliefs about uncertainty and its implications [45]. In the same year, a refined definition of Dugas *et al.* was also proposed – specifically, that IU is the tendency for an individual to consider the possibility of a negative event occurring as unacceptable and threatening, irrespective of the probability of its occurrence [11]. The definition included the notion that IU was best represented by prospective (e.g., cognitive) and inhibitory (e.g., behavioral) dimensions that reflect a latent fear of the unknown [12,64], a duality that was further supported by the originator of the IU construct, Freeston, and his colleagues [65]. Indeed, it appears that IU definitions have all been elaborations on responses to that "oldest and strongest kind of fear" (as cited in [48]), a fear of the unknown. Conceptualizing IU as representing, at its core, a dispositional fear of the unknown provides a clear and defensible starting point for developing the construct in normative and pathological samples. The suggested core definition is not intended to invalidate previous definitions; instead, the previous definitions can be reconceptualized as describing expressions (typically clinical) of the core construct with variable intensity along a continuum [18]. The proposed reconceptualization fits well with recent recommendations that IU should be defined continuously and specifically [65], as well as initial evidence for the continuous nature of IU [18]; however, the proposal warrants theoretical and practical debate that will hopefully lead to a consensus within the scientific community.

Uncertainty & ambiguity

A review of IU relative to (in)tolerance of ambiguity is important because of the semantic overlap and differences in research trajectories for the two constructs. A comprehensive history of the differentiation is beyond the scope of the current paper, but is available elsewhere [55]. In short, Frenkel-Brunswik posited tolerance and intolerance of ambiguity as representing a continuum of individual difference variables [49]. Tolerance of ambiguity was originally defined as the "tendency to perceive ambiguous situations as desirable", whereas intolerance of ambiguity was defined as "the tendency to perceive (i.e., interpret) ambiguous situations as sources of threat" [66]. Ambiguity was related to rigidity [67], authoritarian syndrome [49,66], and thought to pervasively influence human behavior [49,68]. Researchers have focused on tolerance of ambiguity [69,70], but there is a paucity of clinical research [52,71–73]. (In)tolerance of ambiguity has always implicitly or explicitly included IU [49,66,68], reflecting a shared fear of the unknown (see, for example, the Measure of Ambiguity Tolerance) [74–76].

Efforts to differentiate (in)tolerance of ambiguity and IU have occurred relatively recently. Greco and Roger may have provided the earliest direct conceptual distinction in that unambiguous life events (e.g., whether or not a person is being attacked) still involve uncertainty (e.g., the outcome of the attack remains unknown) [36]. Grenier *et al.* further delineated the constructs, starting with the initial overlapping definitions (i.e., ambiguity as a source of threat) [50,51] and then detailing the divergence [55]. As part of their comprehensive review, a conceptual difference between (in)tolerance of ambiguity and IU was provided; specifically, (in)tolerance of ambiguity focuses on the 'here and now' (i.e., situations characterized by ambiguous or equivocal

Table 1. Intolerance of uncertainty defined.

Historical definitions (paraphrased)	Year	Ref.
A broad construct representing cognitive, emotional and behavioral reactions to uncertainty in everyday situations	1994	[32]
Individual perceptions of information in uncertain situations that lead to a set of cognitive, emotional and behavioral reactions, as well as difficulties with ambiguity and unpredictable changes	1995	[54–57]
A predisposition to react negatively to uncertain events, independently of the perceived probabilities and consequences associated with the events	2000	[58]
The excessive tendency of an individual to consider it unacceptable that a negative event may occur, however small the probability of its occurrence	2001	[59]
A cognitive bias affecting the perception, interpretation and behaviors associated with uncertainty	2002	[60]
An excessive tendency to find uncertainty distressing, to believe surprises are negative and should be avoided, and to believe uncertainty about the future is unfair	2004	[61,62]
A set of beliefs about the inability to cope with ambiguity and change	2006	[47]
A future-oriented dispositional characteristic resulting from negative beliefs about uncertainty and its implications	2007	[45]
The tendency for an individual to consider the possibility of a negative event occurring as unacceptable and threatening, irrespective of the probability of its occurrence	2007	[11]

features), whereas IU focuses on future events (i.e., situations interpreted as threatening because of the potentially negative consequences). That said, there is a notable lacking of empirical research on the distinction, with some researchers calling the distinction "questionable" [63].

(In)tolerance of ambiguity and IU are likely expressed by the same neurological process biases at the automatic processing level [25,26,29,72]; however, conceptual differences likely occur during elaborative processing [55]. At the strategic level, (in) tolerance of ambiguity arguably describes a continuum of ability to cope with situations that have recognized but undefined elements (i.e., stimuli), resulting in a limited number of potential outcomes. For example, a significant other provides the ambiguous verbal stimuli, 'we need to talk'. The actors in the situation are all certain, as are the component definitions of the stimuli, but the overall meaning of the stimuli is ambiguous, and that ambiguity occurs in the present. Furthermore, uncertainty remains inherent in the ambiguity (i.e., even in a limited set of potential outcomes, the outcome itself – the consequences – remains unknown, as do the associated details therein). The consequences associated with the ambiguous stimuli exist in the future as an infinitely perpetuating series of interdependent responses that become increasingly difficult – eventually impossible – to predict. The consequences are necessarily uncertain (i.e., unknowable) in the present and remain uncertain even after the ambiguity is resolved. Accordingly, (in)tolerance of ambiguity and IU might be conceptualized as constructs that overlap as a function of the same core fear of the unknown; however, (in)tolerance of ambiguity may be subsumed by IU in that it reflects increasingly temporally immediate and circumscribed perspectives on fearing the unknown, based on the necessary narrowing of some possibilities into certainties (i.e., events that have already happened) as a person moves through time. By contrast, IU may reflect increasingly temporally distant perspectives on fearing the unknown, based on the necessary widening of possibilities into the future. In any case, such speculation awaits empirical evidence and further theoretical debate.

Irrespective of decisions on the final definitions, IU has, to date, received much more focus in clinical research than (in) tolerance of ambiguity [55]. The available evidence suggests modest associations between tolerance of ambiguity and psychopathology [77,78]; however, there is longstanding evidence that uncertainty can be inherently threatening [30], facilitating anxiety and exacerbating the perception of threat [33,34], therein potentiating an infinite series of catastrophic possibilities [79]. Based on the theoretical postulates herein, and in line with prior recommendations [55], it appears clinical research and practice should continue to focus on IU rather than (in)tolerance of ambiguity.

Measuring IU

The first measure designed to assess IU was the 27-item IU scale (IUS) [32] that used a 5-point Likert scale ranging from 1 (not at all characteristic of me) to 5 (entirely characteristic of me). The internal consistency and 5-week test–retest reliability were both high, and there was moderate convergent validity with measures of worry, anxiety and depression; however, the factor structure was unstable [14,32,60]. As such, the 12-item Intolerance of Uncertainty Scale, Short Form (IUS-12) [64] was proposed. The IUS-12 has a strong correlation with the original scale (rs = 0.94–0.96) [64,80], and has been shown to have two factors with identically high internal consistencies (i.e., $\alpha = 0.85$) [64]. The factor names originally made explict reference to anxiety, but McEvoy and Mahoney provided a compelling argument that resulted in the names being changed to prospective IU (seven items; e.g., 'I can't stand being taken by surprise'; cognitive or prospective) and inhibitory IU (five items; e.g., 'When it's time to act, uncertainty paralyses me'; behavioral or currently paralyzing). A recent comprehensive review article exploring the factor structures and associated latent components has provided strong evidence of the robust nature of the IU construct

as described [65]. Furthermore, evidence to date has indicated differential discriminant validity associated with each subscale, such that prospective IU appears more strongly associated with generalized anxiety disorder (GAD) and obsessive compulsive disorder (OCD; i.e., anticipation of uncertainty), whereas inhibitory IU appears more strongly associated with panic disorder, social anxiety disorder and depression (i.e., uncertainty produces inhibition) [12,19–21,44,81]. The IUS-12 has excellent convergent validity with the original [11,64,80] and the psychometric properties have all been replicated and reified in clinical and nonclinical samples [11,12,80]. The IUS-12 is particularly useful for research because it is psychometrically comparable to the longer IUS [80], the Uncertainty Response Scale (which is also much longer, but with a sound construction and good potential) [36], and the new symptom-focused Intolerance of Uncertainty Index (IUI) [82,83]. In addition, while the IUI was developed largely as a clinical and outcome measure for worry, the IUS-12 has been designed specifically to research the core aspects of IU across different populations and different disorders.

IU across anxiety disorders & depression

Researchers have historically focused on studying IU in GAD. Indeed, as an independent construct IU was originally developed as part of the explanation for the perpetual, often disabling worry described as the hallmark of GAD [31,32]. Worry was identified as a cognitive strategy used in attempts to control the unknown [58,84] and the initial research supported the notion that, relative to people with other anxiety disorders, people with a principle diagnosis of GAD reported higher levels of IU [61,85]; however, the initial sample sizes were relatively small and the tool used to measure IU was designed to help identify and describe GAD. With that in mind, IU as measured by the IUS is indeed a robust predictor of worry [77,86]. People with high IU have been shown to worry more when anxious than when calm [87], and some early research supported notions that IU represented an individual difference variable that distinguished GAD from other anxiety disorders [61,85,88]. Despite the associations between IU, worry and GAD, neither IU nor worry is exclusive to GAD [4,10,89] (see also [201]); moreover, other forms of repetitive negative thinking (e.g., rumination, postevent processing) are also not exclusive to GAD and instead appear to represent transdiagnostic constructs [90–92] that warrant additional research.

Initial suggestions that IU may be a construct applicable beyond GAD stemmed from indirect comparisons by Norton, who assessed relative contributions of IU across different ethnic groups and diagnostic symptoms [14,88]. A subsequent investigation by Norton using a large undergraduate sample was able to demonstrate the broad potential applicability of IU with structural equation modeling [93]. Contemporary evidence indicated that IU was comparable in undergraduate persons likely meeting criteria for OCD and/or GAD [47], as well as clinical samples with OCD [17]. The comparability was particularly strong for persons with OCD and checking behaviors, and the results have since been replicated [94,95].

Researchers working with large undergraduate samples have also found evidence for an interdependent relationship between IU, anxiety sensitivity – the fear of physical sensations associated with anxiety [96] – and panic disorder [11,87], such that IU may be necessary for anxiety sensitivity [11]. Similarly, data from undergraduate, community and clinical participants indicate the relationship between IU and social anxiety appears comparable to the relationship between the hallmark fear of negative evaluation and social anxiety [81,95,97–100]. There has also been recent evidence from similar samples of a relationship between IU and health anxiety [101]. Furthermore, there is growing evidence from undergraduate, community and clinical participant data that IU is related to depression [19–21,93,95,98–100,102–104]; however, the specific mechanisms underlying the relationship between IU and depression warrant additional research [103–105]. For example, IU may be related to depression as a function of the relationship between IU and anxiety, and the relationship between anxiety and depression. Rumination and worry about potentially negative consequences – neither of which is exclusive to GAD [90–92] – can also be expected to increase as a function of IU, which would then serve to increase depression symptoms. IU may also facilitate pessimistic certainty in that accepting negative consequences as inevitable may be preferred to tolerating uncertainty.

A recent meta-analysis including 58 articles from the available empirical research also found no support for the idea that IU is GAD specific [106]; instead, the authors suggested previous evidence that IU differentiates GAD from other disorders may have been influenced by the GAD-specific content assessed by the original IUS. That meta-analytic evidence was further supported by two studies using hierarchical regression analyses with data from large samples of clinical patients (n = 463 and n = 218) with various anxiety disorders [12,21], wherein IU explained variance in all symptom measures, even after controlling for neuroticism [12]. IU has predicted variance in symptoms beyond neuroticism [20,97], anxiety sensitivity [11,59,81,97], fear of anxiety [87], metabeliefs [16,107] and positive and negative affectivity [81]. Similarly, a large comparative analysis of IU – as measured by the IUS-12 – was recently completed using Kernel density estimation curves, analyses of variance, and a multiple-group confirmatory factor analysis of invariance with data from clinical (i.e., patients diagnosed with a variety of anxiety disorders or depression; n = 376), community (n = 571) and undergraduate samples (n = 428) [44]. The results indicated no differences in IU endorsement between persons diagnosed with different anxiety disorders or depression, but all such persons reported significantly and substantially higher IU relative to community and undergraduate samples. The aforementioned studies have also evidenced different relationships between prospective IU (i.e., the cognitively focused prospective dimension of IU), inhibitory IU (i.e., the behaviorally focused dimension of IU) and several symptom profiles. Specifically, the prospective IU subscale has been more related to worry and obsessive compulsive symptoms, whereas the inhibitory IU subscale has been more related to social anxiety, panic, agoraphobia and depression [12,19–21,44,95,108]. The inhibitory IU subscale also appears

to be specifically related to the startle response under threat conditions [38].

Based on the available evidence, there appears to be overwhelming support for the notion that IU, certainly as described herein and measured by the IUS-12, is not specific to GAD. Instead, IU appears to represent a broad dispositional risk factor for the development and maintenance of clinically significant anxiety and depression. The next steps involve working to more formally integrate IU into current theoretical models, while including measures of IU in subsequent research. Clinicians should also consider assessing IU with the IUS-12 as a dispositional risk factor and as an outcome measure for patients with clinically significant anxiety or depression.

Formal integration of IU into current theoretical models is well beyond the scope of this article. In the interim, this review should serve to provide insight and direction for theorists. As for measurement of IU, there appears to be evidence for GAD-specific elements within the original IUS [32,106]. Those elements have proved useful for GAD research and clinical work; however, researchers and clinicians working in other areas should consider using the now well-supported IUS-12 [12,64,80,100]. There are also other measures for researchers and clinicians to consider. The 48-item Uncertainty Response Scale [36] and the 45-item Intolerance of Uncertainty Index [82,83] also warrant additional exploration as more extensive measures of IU and related symptoms. Researchers have also developed a modified version of the IUS-12 that distinguishes between trait (IUS-12) and state (IUS-SS) IU [20,21]. The IUS-SS has participants select a primary concern, describe a related distressing situation, and then complete items from the IUS-12, but with specific reference to the described situation. This ingenious modification served to further underscore the transdiagnostic nature of IU and the potential research and clinical utility of the construct. Indeed, the evidence to date suggests an important, possibly interactive relationship between trait and state IU that warrants additional research.

IU & clinical perspectives

From a clinical perspective, IU may be extremely beneficial as a robust transdiagnostic construct. Longitudinal research on IU and GAD has consistently demonstrated that changes in IU predict changes in pathology [58,87,109–111]; moreover, there is now evidence that changes in IU are also associated with changes in social anxiety symptoms [112,113]. These clinical results further support a directional relationship wherein IU serves as a broad predispositional vulnerability factor.

In many ways, all therapies can be described as attempts to mitigate IU in one of five ways:

- Remove or minimize a catastrophic misperception of threat resulting from uncertainty (i.e., absent information);
- Remove or minimize a realistic threat;
- Remove or minimize the uncertainty;
- Creating capacity to cope with what are perceived as catastrophic eventualities associated with uncertainty;
- Increasing the ability to tolerate uncertainty (i.e., treating the uncertainty itself as a threat).

Correcting perceptions of exaggerated negative consequences stemming from the presence of uncertainty surrounding a real or perceived threat may well be sufficient, particularly if the exaggerated consequence was the primary area of concern. Removing a realistic threat, where possible, would also certainly be sufficient, at least in the short term; however, there are an infinite number of potentially realistic threats, making removing all threats impractical. Removing all uncertainty is also impractical, if not impossible. Creating capacity to cope is certainly practical and well warranted; however, ensuring that capacity generalizes from a necessarily few number of specific threats to a more general sense of realistic agency to cope with the infinite number of possible threats is a far more challenging task. Therapies that work to remove threats, increase certainty, and create coping capacity, all facilitate a sense of agency – illusory or otherwise – thereby reducing clinically significant symptoms of anxiety (and probably depression). Increasing tolerance for uncertainty, while potentially more challenging, may well provide the most pervasive benefits. Dugas and Ladouceur have already developed, tested and detailed a treatment designed to reduce IU [109]. Dugas and Ladouceur's treatment for IU – or elements therein (e.g., re-evaluation of worry beliefs; problem orientation training, cognitive exposure) – may provide substantial additional benefit to persons with any form of clinically significant anxiety or depression. From a slightly broader perspective, clinicians may benefit by being mindful of the IU implicit in anxiety and the reality that they have only the aforementioned avenues to interact with a patient's fear of the unknown. As such, clinical researchers should continue to explore the transdiagnostic treatment potential of reducing IU.

Expert commentary

"The oldest and strongest emotion of mankind is fear, and the oldest and strongest kind of fear is fear of the unknown" (as cited in [48]); there is no doubt in my mind that IU, as defined by a core fear of the unknown, represents a critical construct for understanding anxiety disorders. Despite initial theory and evidence of IU as specific to one or two anxiety disorders, there is now overwhelming evidence that it represents a broad transdiagnostic dispositional risk factor for the development and maintenance of clinically significant anxiety. The nonspecific nature of IU with respect to diagnoses does not mean the construct lacks utility. Instead, the specific and narrow core of the IU construct (i.e., fear of the unknown), coupled with its pervasive relevance as seen in the expanding clinical definitions, affords theoretical and clinical opportunities for a variety of disorders in a way that other constructs may not, particularly given new evidence of trait and state expressions of IU. The perceived longstanding relationship between IU and the human experience supports

substantial potential utility in making explicit the implicit fear of the unknown in our models of anxiety. Furthermore, there is growing evidence that IU also represents a dispositional risk factor for depression – an intriguing possibility that warrants substantially more investigation. I expect that the automatic and strategic methods people use to cope with IU will eventually help to explain not only the development and maintenance of anxiety and depression, but also the relationships between the three constructs.

Five-year view

International and transdiagnostic research exploring IU is now increasing at an exciting rate. As researchers and clinicians come to recognize the pervasive nature of IU, I expect we will see a substantial increase in related research and thereafter explicit integration into models of psychopathology. We will see refinement of measures and I expect a debate about the definition that may eventually refine the construct to a core fear of the unknown with several symptom expressions – possibly akin to the anxiety sensitivity construct and associated definitions [96]. I expect replications of the more recent investigations of IU, further assessing whether the transdiagnostic communalities found in the studies to date are indeed robust. Accordingly, I also expect there will be explorations of the transdiagnostic utility of Dugas and Ladouceur's protocol [109], using the entire IU-focused treatment or using elements of the treatment as adjuvants.

I expect there will be researchers who will fill the empirical gaps associated with the relationships postulated in this article regarding IU, cognitive psychology, neuropsychology, biological psychology and evolutionary psychology. In particular, I hope to see empirical investigations of IU as it relates to automatic and strategic processing, startle responses, as well as increasingly elegant biological models for understanding IU. We will also see a large increase in IU research with child, adolescent, and geriatric populations. We will see investigations detailing the impact of IU on readily apparent and replicable behaviors – not only presumed relationships with complex behaviors, but also demonstrated relationships with behaviors. Similarly, we will see replications and extensions of key research exploring IU and decision making [22,23]. I expect we will also see a great deal of investigation and debate regarding the inhibitory (e.g., behavioral) and prospective (e.g., cognitive) dimensions of IU and the practical and theoretical utility of those distinctions. Across both dimensions, the new research exploring the trait and state expressions of IU will further inform our understanding of how IU functions to facilitate the development and maintenance of psychopathologies.

We will also see an exploration of IU in nonclinical contexts, likely associated with explorations of IU and a variety of personality traits. I expect we will see increased recognition of the importance of IU, not just for mental health professionals, but for all health professionals. For example, recognizing IU as a broad vulnerability may help physicians and nurses to reduce patient health anxiety – and the associated personal and economic costs – by mitigating uncertainty in one of the aforementioned ways. As such, I expect there will be explorations of managing IU in a variety of contexts outside of what we currently recognize as the domain of mental health. We may even see IU explored in other domains where factors influencing decision-making play a prominent role, such as industrial/organization psychology. There is definitely no way to know exactly what will happen next as the research on IU proliferates, but in this case, the uncertainty is what makes research so exciting.

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Key issues

- Intolerance of uncertainty (IU) represents, at its core, fear of the unknown.
- IU and (in)tolerance of ambiguity are arguably distinct, with a key factor being relative distance in time; however, both share a core fear of the unknown.
- There is an argument to be made from the evolutionary psychology perspective that some IU is advantageously adaptive.
- The evolutionary argument coupled with attentional bias research of automatic and strategic biases suggest IU may have a measurable biological basis.
- Based on the current definition of anxiety, there may be a logically necessary dependency between anxiety and IU in most cases.
- The IUS-12 appears to be a more robust measure of IU as a construct with a core fear of the unknown, whereas the IUS appears to have elements specific to generalized anxiety disorder.
- IU is not specific to one anxiety disorder; instead, it appears to be a transdiagnostic dispositional risk factor for clinically significant anxiety and depression.
- Theoretical and clinical models of anxiety and depression may benefit from making explicit the nature of the relationships with IU.
- A variety of health professionals, mental health professionals and other professions would all likely benefit from understanding the pervasive impact IU can have on mental health, health-related behaviors and decision making.
- There is already at least one treatment specifically designed to reduce IU; the elements of that treatment warrant transdiagnostic exploration as an option for mitigating uncertainty.

References

Papers of special note have been highlighted as:
• of interest
•• of considerable interest

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