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Disentangling trait and daily experiences of uncertainty and meaning in life: implications for daily anxiety, negative affect, and somatic symptoms

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ABSTRACT

Background: Although there is growing evidence supporting the association between intolerance of uncertainty (IU) and psychopathology, little is known about the covariation of IU and psychological distress day-to-day. The purpose of this ecological momentary assessment (EMA) study was to examine negative emotional and somatic correlates of trait IU and daily uncertainty, while investigating how a source of stability, meaning in life (MIL), might buffer against deleterious effects of IU and uncertainty.

Design and Methods: Adult community members ($n = 62$) from a mid-size town in the Rocky Mountain region completed baseline measures of IU and MIL and ecological momentary assessments (EMA) of meaning, uncertainty, affect, and somatic symptoms over the course of one week.

Results: Results indicate individuals high in trait IU experience more uncertainty day-to-day and greater distress when they feel uncertain compared to individuals lower in trait IU; however, MIL plays a stronger protective role for high IU compared to low IU individuals.

Conclusions: These findings support and extend previous research showing IU is associated with psychological distress and that MIL may be a critical resource to cultivate. Interventions promoting meaning day-to-day may reduce the effects of uncertainty on the well-being of those highly intolerant of uncertainty.

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Negative affect; intolerance of uncertainty; meaning in life; somatic symptoms; ecological momentary assessment; anxiety

Uncertainty, or not knowing how an event or outcome will turn out, is embedded in our everyday experiences. Some people find uncertainty highly bothersome whereas others may savor moments when they feel uncertain. Intolerance of uncertainty (IU) is a dispositional characteristic defined as a “tendency to react negatively on an emotional, cognitive, and behavioral level to uncertain situations” (Buhr & Dugas, 2009, p. 216). Because uncertainty is inherent in everyday life, people high in intolerance of uncertainty experience impairment in their daily functioning and experience daily life as more stressful than those low in intolerance of uncertainty (Chen & Hong, 2010; Zlomke & Jeter, 2014). Although intolerance of uncertainty has been extensively investigated in the development and maintenance of anxiety disorders and is considered a transdiagnostic risk factor for affective disorders (Carleton, 2016; McEvoy & Mahoney, 2012; Yook et al., 2010), less is

known about the mechanisms by which high intolerance of uncertainty may affect individuals' emotional and somatic experiences day-to-day. Examining the ebb and flow of uncertainty across daily experiences is crucial for understanding how intolerance of uncertainty contributes to risk for disease and identifying ways to intervene to counteract the potentially deleterious effects of intolerance of uncertainty on health.

Intolerance of uncertainty (IU) and psychological distress

Intolerance of uncertainty is conceived of as an inclination all humans are born with because being intolerant of uncertainty promotes survival; however, over time, it ideally diminishes with experiences of safety (Brosschot et al., 2016). In other words, as people acquire self-efficacy in coping with uncertainty and come to have experiences of uncertainty resulting in non-aversive outcomes, their intolerance of uncertainty decreases (Brosschot et al., 2016; Carleton, 2016). Some individuals do not experience reductions in intolerance of uncertainty and continue to respond to uncertainty in maladaptive ways. For example, individuals high in intolerance of uncertainty tend to experience chronic anticipatory anxiety about the future, believe uncertainty is aversive, and engage in worrying, reassurance seeking, and hypervigilance to reduce feeling uncertain (Barlow, 2002; Carleton, 2016). Unsurprisingly, intolerance of uncertainty is considered a transdiagnostic risk factor for a range of psychological disorders, primarily internalizing forms of psychopathology (e.g., McEvoy & Mahoney, 2012), as it is associated with symptoms like worry (Thielsch et al., 2015) and negative affect (Talkovsky & Norton, 2018). Indeed, intolerance of uncertainty is present at higher than normative levels in patients diagnosed with social anxiety (Carleton et al., 2010), panic disorder and agoraphobia (Carleton et al., 2012), generalized anxiety (Buhr & Dugas, 2002; Gentes & Ruscio, 2011), posttraumatic stress (Bardeen et al., 2013), obsessive-compulsive symptoms (Jacoby et al., 2013), and depression (van der Heiden et al., 2010).

Emerging empirical research supports that intolerance of uncertainty plays a role in individuals' daily affective experiences. Thielsch and colleagues (2015) found that participants higher in trait intolerance of uncertainty reported significantly more worry day-to-day than participants lower in intolerance of uncertainty. Moreover, Chen and Hong (2010) found that individuals high in intolerance of uncertainty experienced more anxiety in response to daily hassles than individuals low in intolerance of uncertainty. If additional research continues to suggest that trait intolerance of uncertainty affects people's daily experiences in ways that may cumulatively affect their global psychological health and well-being, then it is important to identify qualities that can mitigate these effects.

Meaning in life (MIL) and psychological well-being

Whereas someone high in intolerance of uncertainty is wired to look for cues of uncertainty and detect cues fairly indiscriminately, meaning in life (MIL) attunes people to cues related to certainty and stability that may promote a state of safety and regulation. Meaning in life reflects an individual's sense about the nature of their existence derived from 3 distinct facets: coherence, purpose, and significance (George & Park, 2016; Martela & Steger, 2016). *Coherence* refers to the extent to which one's experiences make sense as well as the extent to which one understands oneself and one's fit in the world (e.g., Steger et al., 2006). *Purpose* denotes motivation toward overarching goals and aims in life (Martela & Steger, 2016) and having "goals, intentions, and a sense of direction, all of which contribute to the feeling that life is meaningful" (Ryff, 1989, p. 1071). *Significance* refers to a sense that one's life is inherently valuable and matters (e.g., George & Park, 2016; Martela & Steger, 2016). Thus, people with high levels of meaning in life tend to operate from a framework that their life makes sense (coherence), that they have some ultimate aim (purpose), and that their existence matters (significance). Naturally, people who experience high levels of meaning in life tend to report greater psychological well-being and better physical health (Roepke et al., 2014).

The interplay between meaning in life and intolerance of uncertainty

Both intolerance of uncertainty and meaning in life are described in the literature as lenses or frameworks that guide attention to stimuli and shape how people perceive the world (McEvoy & Erceg-Hurn, 2016). An individual operating from a framework dominated by intolerance of uncertainty perceives the world with an attentional bias likely to contribute to heightened distress, whereas an individual operating from a framework dominated by meaning in life likely perceives greater stability and experiences greater psychological well-being. In fact, when examined at the trait level, intolerance of uncertainty and meaning in life are negatively associated such that people who tend to be highly intolerant of uncertainty report lower levels of meaning in life than people who are more tolerant of uncertainty (e.g., Garrison & Lee, 2017; Morse et al., 2021).

Trait and daily meaning and uncertainty

Although a few studies have reported intolerance of uncertainty and meaning in life to be negatively associated at the trait level, it is possible that people who are highly intolerant of uncertainty nonetheless experience meaning in specific moments. In other words, the relationship between intolerance of uncertainty and meaning in life at the trait level may be stronger than at the daily level. Although no extant research on this relationship was found, research on related constructs suggests that on days when people experience more meaning, life is less distressing (e.g., Kashdan & McKnight, 2013). Additionally, studies suggest meaning in life tends to be higher on days people report positive social interactions (Machell et al., 2015), when they engage in meaningful behaviors (Steger et al., 2008), when they experience achievement (Machell et al., 2015) and positive affect (Tov & Lee, 2016), and more. Thus, social, purpose-enhancing, mastery, and enjoyable experiences can contribute to people's experience of meaning on a particular day. Fluctuations in daily meaning in life may provide insight into important processes related to the development and maintenance of a global sense of meaning in life as well as ways in which meaning in life might serve as a protective factor against daily psychological and physical health symptoms, especially for people high in intolerance of uncertainty.

The present study

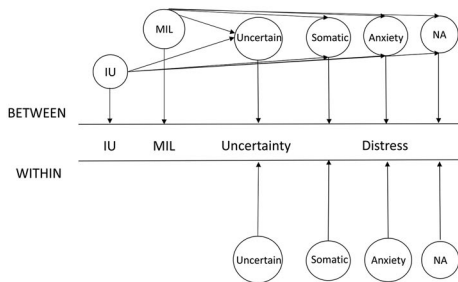
In the first paper introducing intolerance of uncertainty, Freeston and colleagues (1994) defined it as "a relatively broad construct representing cognitive, emotional, and behavioral reactions to uncertainty in *everyday life* situations" (p. 792, emphasis added), yet little empirical research has been conducted to examine intolerance of uncertainty in a daily context. Because uncertainty is inherent in everyday life, it is likely that those high in intolerance of uncertainty experience more psychological and somatic distress day to day than those who are more tolerant of uncertainty. However, meaning in life may be protective against the deleterious effects of uncertainty on emotional and physical well-being. The current study seeks to zoom into people's daily experiences of uncertainty and meaning to investigate mechanisms by which intolerance of uncertainty conveys risk for psychological and physical distress as well as how meaning in life might serve a protective role in providing people with a sense of stability.

Research questions and hypotheses

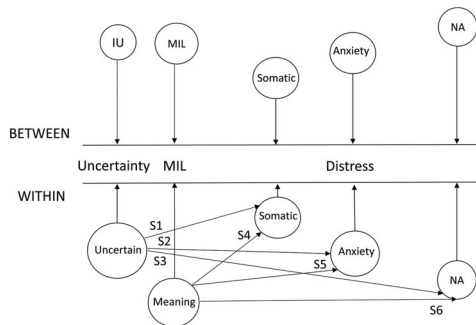
The current study sought to examine associations between trait intolerance of uncertainty and daily uncertainty and distress (negative affect, anxiety, and somatic symptoms) and trait meaning in life and daily distress (see Figure 1).

Hypothesis 1 (H1): We hypothesized participants higher in trait intolerance of uncertainty would report more daily uncertainty and distress (negative affect, anxiety, and somatic symptoms)

Path model diagrams of hypotheses tested
H1



H2



H3

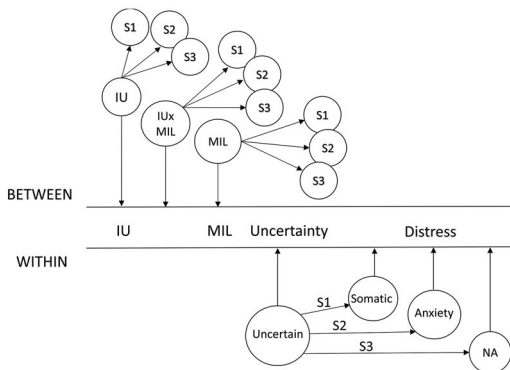


Figure 1. Path model diagrams of hypotheses tested. Note. H1: Direct effects of trait variables (IU and MIL) on the between-level variance of daily uncertainty and distress (anxiety, NA, daily somatic symptoms). H2: S1 represents the within level random slope of daily uncertainty predicting daily somatic symptoms; S2 represents the within level random slope of daily uncertainty predicting daily anxiety; S3 represents the within level random slope of daily uncertainty predicting daily NA; S4 represents the within level random slope of daily meaning predicting daily somatic symptoms; S5 represents the within level random slope of daily meaning predicting daily anxiety; S6 represents the within level random slope of daily meaning predicting daily NA. H3: S1 represents the within level random slope of daily uncertainty predicting daily somatic symptoms; S2 represents the within level random slope of daily uncertainty predicting daily anxiety; S3 represents the within level random slope of daily uncertainty predicting daily NA; IU represents the person average of intolerance of uncertainty estimated at the between level, MIL represents the person average of MIL estimated at the between level, and IUxMIL represents the between level interaction between IU and MIL. In the figure, the between level effects predict (i.e., moderate) the within-level random slopes.

compared to participants lower in intolerance of uncertainty, and participants higher in trait meaning in life would report less daily uncertainty and distress (negative affect, anxiety, and somatic symptoms) compared to participants lower in meaning in life.

We sought to examine associations between daily experiences of uncertainty and meaning and daily distress **Hypothesis 2 (H2):** We expected on days participants reported more uncertainty than average, they would report more negative affect, anxiety, and somatic symptoms, and on days participants reported more meaning than average, they would report less negative affect, anxiety, and somatic symptoms than typical.

We sought to examine how daily experiences of uncertainty might exacerbate daily distress for people based on trait levels of intolerance of uncertainty and meaning in life, thus we examined the moderating roles of trait intolerance of uncertainty and trait meaning in life as well as the interaction between the two. **Hypothesis 3 (H3):** We expected the association between daily uncertainty and daily distress would be stronger for individuals high in trait intolerance of uncertainty and

weaker for individuals high in trait meaning in life. We were also interested in the potential distress-buffering effect of meaning in life for participants high in intolerance of uncertainty (high intolerance of uncertainty x high meaning in life versus high intolerance of uncertainty x low meaning in life). We hypothesized that of those participants who reported high levels of intolerance of uncertainty, the association between daily uncertainty and daily distress would be stronger for those who reported low meaning in life compared to those who reported high meaning in life. Thus, we expected meaning in life to buffer against the effects of high intolerance of uncertainty on daily distress in response to uncertainty.

Methods

Participants

Community members ($n = 62$) were recruited from a mid-size college town in the Rocky Mountain region to participate in a week-long ecological momentary assessment (EMA) study investigating the pathways through which chronic stressors affect physical and mental health. Data analyzed in this study were collected between July 2019 and March 2020. Participants were compensated up to \$200. The sample was 53.2% male and 77.4% White (1.6% South Asian, 11.3% Mexican (American), 1.6% Central American, 3.2% South American, 1.6% Other (Spanish American)). Given the focus of the parent study on age group differences, participants were eligible to participate if they were younger adults between 18–35 years old (58% of participants) or older adults at least 60 years old (42% of the sample).

Design and procedure

The study employed an ecological momentary assessment (EMA) survey design with six surveys per day over the course of seven consecutive days. Participants were loaned a mobile smart phone (Samsung Galaxy J3) with an app that pinged surveys to participants at semi-random intervals throughout the day during their waking hours. Surveys could occur no closer than 30 min apart or no greater than 4 h apart within the same day. Some items (daily meaning and daily uncertainty) were included in the last survey at the end of each day; other items were assessed at all 6 EMA surveys throughout the day. In addition to the EMA portion of the study, participants completed baseline measures of trait variables during visits to the laboratory. At the first lab visit ("Study Overview Session"), participants learned how to complete EMA surveys on the mobile phone provided to them. Throughout the week, participants came to the lab three times to complete questionnaires and physiological measures and undergo the Trier Social Stress Test (TSST) as part of the parent study. After the 7-day period, participants returned materials to the lab and were debriefed. For the purposes of this study, the main study measures were derived from trait questionnaires administered during lab visits and daily life questions from the EMA surveys. The Institutional Review Board at (Anonymized) University approved this study.

Measures

Trait level

Intolerance of Uncertainty (IU). IU was measured using the short Intolerance of Uncertainty Scale (IUS-12; Carleton et al., 2007). The IUS-12 measures reactions to ambiguous stimuli and perceptions of uncertainty. Participants rate 12 items on how characteristic the descriptor is of them on a scale of 1–5 (1 = *not at all characteristic of me*, 5 = *entirely characteristic of me*). Examples items include: "Unforeseen events upset me greatly" and "I always want to know what the future has in store for me." The IUS-12 has good construct and concurrent validity, strong internal consistency, and demonstrates measurement invariance across gender and ethnicity (see Hale et al., 2016 for

review). Previous studies suggest scores on the IUS-12 can be captured with one factor (total score) and two factor (prospective and inhibitory anxiety) solutions (Hale et al., 2016). In this sample, the subscales were correlated modestly ($r = .66$) and the overall scale ($\alpha = .89$) and each subscale demonstrated good internal consistency ($\alpha = .84$ and $.81$) (see Table 1 for sample statistics). Confirmatory factor analysis was conducted to inform the use of a 1 or 2-factor solution with this sample.

Meaning in Life (MIL). MIL was measured using the Meaning as Significance, Purpose, and Coherence Scale (MSPCS) measure (Martela & Steger, under review). This measure includes 12 items, with 4 items measuring each facet of meaning in life: coherence, purpose, and significance. Participants rate each item on a scale from 1 = *not at all true of me* to 7 = *very true of me*. Higher scores indicated higher levels of MIL components. Examples of coherence items include, “Most things happening in my life do make sense” and “By and large, I am able to understand the world around me.” Examples of purpose items include, “I have a set of core goals that give my life a sense of direction” and “My daily activities are consistent with a broader life purpose.” Examples of significance items include, “My personal existence is significant” and “My life is significant in the grand scheme of things.” The scale demonstrated good internal consistency ($\alpha = .89$) (Table 1).

Daily level

Daily meaning. Daily meaning was assessed each night in the EMA surveys using the Daily Meaning Scale (DMS; Steger et al., 2008). The DMS consists of 2 items: “How meaningful did you feel your life was today?” and “How much did you feel your life had purpose today?” These items are rated on a 7-point Likert scale from 1 = *not at all* to 7 = *very much*. Research suggests that average scores on the DMS correlate strongly ($r = .55$, $p < .0001$) with validated global meaning in life measures, indicating the DMS is a valid measure of daily MIL (Steger et al., 2008). Steger and colleagues also reported very high repeated-measures (within-person) reliability ($\alpha = .98$). In this sample, participants’ average daily meaning was 3.62 ($SD = 1.72$). The correlation between trait MIL and daily meaning was strong ($r = .63$). Daily meaning and purpose were highly correlated with each other ($r = .89$).

Daily uncertainty. Daily uncertainty was assessed each night in the EMA surveys using an item created for this study, “Today, how uncertain did you feel?” Participants responded on a scale of 0 = *not at all* to 6 = *extremely*. In the study overview session, participants were explained the following regarding how to answer this question, “People experience uncertainty when they lack information about something, and they cannot feel sure. For example, people report uncertainty when they are unsure about a decision, the future (e.g., the outcome of an event), how other people might behave, etc. Some people notice a discomforting or uneasy sensation when they feel uncertain”. The

Table 1. Trait and Daily Correlations, Means, Standard Deviations, Skew, and Kurtosis.

Trait	1	2			
1. Intolerance of Uncertainty	(.90)				
2. Meaning in life	-.28**	(.89)			
Mean	29.71	64.62			
SD	8.99	12.45			
Skew	0.46	-0.68			
Kurtosis	-0.34	0.31			
Daily	1	2	3	4	5
1. Uncertainty	-				
2. Meaning	-.16	-			
3. Anxiety	.53**	-.15	-		
4. Negative Affect	.37**	-.23*	.64**	-	
5. Somatic Symptoms	.12	.04	.25*	.35*	-
Mean	2.56	3.62	1.61	.99	2.74
SD	1.92	1.72	1.22	.78	3.67
Skew	.37	-.55	.38	1.16	2.20
Kurtosis	-.52	-.37	-.83	1.48	8.10

Note. ** $p < .01$, * $p < .05$.

intention of this item was to assess how much uncertainty participants experienced that day. It was expected that participants with high trait IU would report more uncertainty each day of the EMA study, on average, compared to those low in IU. We also predicted that those high in trait IU would experience greater distress than those low in IU when they experienced uncertainty. In this sample, participants' average daily uncertainty was 2.56 ($SD = 1.92$). There was also a modest positive correlation between trait IU and daily uncertainty ($r = .43$).

Daily distress

Negative affect (NA) and anxiety. At each EMA assessment (6 times per day for 7 days), participants were asked how they were feeling in the moment. They rated the following affect descriptors on a scale of 0 = *not at all* to 6 = *very strongly*: angry, sad, anxious, bored, and tired (Positive and Negative Affect Scale (PANAS); Watson et al., 1988). Because anxiety was of particular interest in this study due to its strong correlation with IU, anxiety was treated as a separate variable. Scores on angry, sad, bored, and tired were averaged together to form a negative affect (NA) composite each day. Thus, all 6 ratings of anxiety within each day were averaged together to form a participants' daily anxiety score and ratings for each within-day time point of the other negative affect variables were averaged to form a daily NA score. Across participants, average daily anxiety was 1.61 ($SD = 1.22$) and average daily NA was .99 ($SD = .78$).

Somatic symptoms. At each EMA survey, participants were asked, "Have you experienced any of the following symptoms? Please check all that apply: Headache or migraine, Bodily pains or aches, Cold/Flu symptoms (e.g., coughing, sore throat, runny nose), Fatigue, Irregular heart beats, Shortness of breath, Other, None of the above". Scores were summed over all time periods each day such that participants received a score of 0–7 physical symptoms for each EMA period, resulting in 0–42 symptoms for the day. The most symptoms reported on any single day by a participant was 30. Across participants, average daily somatic symptoms was 2.74 ($SD = 3.67$).

Results

Data analytic strategy

MPlus statistical software Version 8.0 (Muthen & Muthen, 1998–2012) was used for all analyses to conduct Structural Equation Modeling (SEM). To test H1 that trait intolerance of uncertainty (IU) and trait meaning in life (MIL) would be positively and negatively related to daily uncertainty and distress, respectively, we first conducted a confirmatory factor analysis of the IUS-12 and then tested the hypothesized structural equation models (SEMs) that trait IU, and subsequently, trait MIL, would predict daily uncertainty and distress. We used Maximum Likelihood (ML) estimation with 10,000 bootstrapped samples and significance was assessed by $p < .05$ (Preacher et al., 2010).

To test H2, we used multilevel SEM (MSEM) to determine associations between level 1 (within person) daily effects and level 2 (between person) trait effects. MSEM is advantageous in comparison to other multilevel methods because it partitions between- and within-person variance of observed variables into two variables that are not correlated with each other (e.g., Preacher et al., 2010). To ensure MSEM was appropriate for this sample, intraclass correlations (ICC) were calculated. ICC values provide an estimate of the percentage of variance within-persons. ICC values greater than .05 indicate data is hierarchical, necessitating the use of multilevel analysis (LeBreton & Senter, 2008). We examined how daily experiences of uncertainty and meaning in life relate to daily distress (NA, anxiety, and somatic symptoms). Variables were group-mean (within-person) centered based on recommendations from Enders and Tofghi (2007), and daily within-person associations were modeled as random slopes such that they could vary across days and across individuals. Thus, the slope between daily uncertainty and daily anxiety, NA, and somatic symptoms were allowed to vary across occasions within an individual and across individuals (Rush et al., 2019). Similarly, the slope between daily meaning and daily anxiety, NA, and somatic symptoms were modeled such

that the slope could vary across episodes within an individual and across individuals (Rush et al., 2019). The intercepts were also modeled as random such that the latent values could vary across individuals and days.

To test H3, we utilized MSEM and tested our multilevel moderation hypotheses using the Random Coefficient Prediction (RCP) Method with maximum likelihood estimation (e.g., Preacher et al., 2016). With the RCP method, a latent variable for the random slope is calculated. RCP methodology allows the slope to vary as a function of the predictors while minimizing the slope's residual variance. Specifying between- and within-level effects splits the between- and within-level variances such that they are not conflated, resulting in a within-level slope that has only within-level variance and a between-level moderator with only between-level variance (Preacher et al., 2016). Moderation is considered present if the cross-product interaction term significantly predicts the random slope. RCP is especially useful for testing moderation in cross-level interactions. For these analyses, an interaction term was calculated by multiplying MIL by the latent variable, IU.

Preliminary analyses

Participants ($n = 62$) completed a total of 2637 surveys, with an overall compliance rate of 92%. In this study, all hypothesized within-person variables had ICC values greater than .05. No outliers were detected, and all variables met normality expectations. Descriptive statistics for trait and daily variables are reported in Table 1. Power was estimated post-hoc based on the number of level 1 and level 2 datapoints as well as ICCs using SIMR (Green & MacLeod, 2016). Based on rules of thumb derived from a large-scale simulation study performed using SIMR, the minimum detectable effect sizes (MDEs) with a target level of power greater than or equal to .80 for the current study were .37 to .40 for level 2 direct effects, and .44 to .56 for cross-level interaction effects (Arend & Schäfer, 2019).

Confirmatory factor analysis was conducted using SEM to test 1- and 2-factor models of the IUS-12. Model fit statistics indicated good fit of a single latent factor ($RMSEA < .001$, $CFI = .99$, $SRMR < .001$), thus IU was modeled as 1 latent variable with both subscale scores (IUSi and IUSp) as indicators of the single latent variable.

H1: Testing Trait IU and MIL as Predictors of Daily Uncertainty and Distress

To test H1, we examined the cross-level direct effects of trait variables (IU and MIL) on daily uncertainty and distress (anxiety, NA, daily somatic symptoms). First, we tested the extent to which trait IU was related to daily uncertainty and distress via maximum likelihood estimation by regressing trait values on daily values with intercept and slope estimations fixed across individuals. Indices indicated excellent overall fit between the hypothesized multivariate model and the observed data ($\chi^2 [1, n = 62] = 1.03$, $p = .31$; $CFI = 1.00$, $RMSEA = .01$, $SRMR_{within} = .02$; $SRMR_{between} = .001$). Results largely supported the hypothesis, as higher trait IU was significantly related to greater daily uncertainty as well as anxiety and NA (Table 2). Next, we tested the extent to which trait MIL related to daily uncertainty and distress. Indices indicated excellent overall fit between the hypothesized multivariate model and the observed data ($\chi^2 [1, n = 62] = 1.02$, $p = .31$; $CFI = 1.00$, $RMSEA = .01$, $SRMR_{within} = .02$; $SRMR_{between} = .001$). In partial support of our hypothesis, trait MIL was significantly associated with daily anxiety and daily uncertainty such that higher MIL related to lower levels of daily anxiety and uncertainty (Table 2).

H2: Daily Uncertainty and Meaning as Predictors of Daily Distress

To test H2, we examined if daily experiences of uncertainty and meaning in life related to daily distress. Results supported that on days participants reported more than their average level of uncertainty, they reported more somatic symptoms, anxiety, and NA (Table 2). Conversely, on days

Table 2. Trait Intolerance of Uncertainty (IU), Meaning in Life (MIL), Trait IU x MIL, and Daily Uncertainty and Meaning as Predictors of Daily Uncertainty and Distress and Relationships between Daily Uncertainty and Daily Distress.

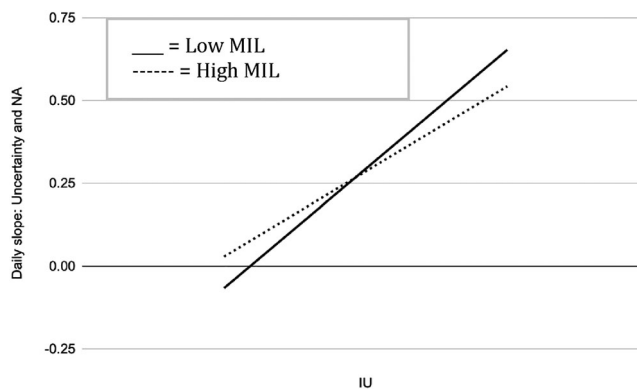
	Outcomes								
	Daily Anxiety		Daily negative affect		Daily Somatic Symptoms		Daily Uncertainty		
	<i>B</i>	SE	<i>B</i>	SE	<i>B</i>	SE	<i>B</i>	SE	
IU	0.45	0.12	0.34	0.11	0.2	0.12	0.48	0.1	
MIL	−0.26	0.1	−0.19	0.13	−0.053	0.11	−0.19	0.1	
Daily Uncertainty	0.22	0.04	0.19	0.04	0.12	0.04			
Daily Meaning	−0.14	0.05	−0.16	0.05	−0.002	0.03			
	Slope: Daily Anxiety-Uncertainty			Slope: Daily NA-Uncertainty			Slope: Daily Somatic-Uncertainty		
	Intercept	<i>B</i>	SE	Intercept	<i>B</i>	SE	Intercept	<i>B</i>	SE
IUxMIL	.47	−.08	.07	.29	−.20	.08	.15	−.05	.05
IU	.47	.02	.06	.29	.16	.07	.15	−.01	.07
MIL	.47	.03	.06	.29	−.03	.07	.15	−.02	.07

Note. Bold values indicate p -values < .05; IU = intolerance of uncertainty; MIL = meaning in life.

participants reported more than their average level of meaning, they reported significantly less daily anxiety and NA (Table 2).

H3: The Effect of Trait IU, Trait MIL, and the Interaction between Trait IUxMIL on the Relationship between Daily Uncertainty and Daily Distress

To test H3, we explored how trait levels of IU, MIL, and the interaction between IU x MIL affected the associations between daily uncertainty and daily distress. Trait MIL did not significantly moderate the association between daily uncertainty and daily distress. Trait IU significantly moderated the association between daily uncertainty and daily NA such that participants high in trait IU experienced more negative affect when they reported higher daily uncertainty compared to participants low in trait IU. We also calculated an product term, Trait MILxTrait IU, and examined if the interaction was significantly associated with relationships between daily uncertainty and daily distress (i.e., a cross-level moderated moderation of the within-level effect). Results indicate MILxIU significantly moderated the relationship between daily uncertainty and daily NA (Table 2). The interaction was probed by calculating simple slopes using the Aiken et al. (1991) method. As hypothesized, the relationship between daily uncertainty and NA was significantly stronger for participants who were low in MIL and high in IU (+/- 1 SD from the mean) than for participants who were high in MIL and high in IU (see Figure 2). Thus, for participants high in IU, MIL appears to serve a protective

**Figure 2.** Moderation of the Slope of Relationship between Daily uncertainty and Daily negative affect. Note. IU = intolerance of uncertainty; MIL = meaning in life; NA = negative affect

role such that the association between daily uncertainty and NA is not as strong. In other words, uncertainty does not elicit as much negative affect for participants highly intolerant of uncertainty who have a strong sense of meaning in their lives compared to those high in IU who lack MIL.

Discussion

The purpose of this study was to examine how people's dispositional intolerance of uncertainty (IU) and sense of meaning in life (MIL) relate to their daily experiences of distress to illuminate how intolerance of uncertainty and meaning in life are constructed, maintained, and adapted from everyday experiences of uncertainty and meaning. Understanding the processes by which intolerance of uncertainty conveys risk and meaning in life buffers against risk for psychological distress and physical health symptoms may provide vital information about how mental and physical health conditions develop and are maintained as well as how they might be prevented and treated.

Effects of trait intolerance of uncertainty and meaning in life on daily distress

On average, researchers have found trait intolerance of uncertainty negatively related to trait meaning in life, yet because intolerance of uncertainty, meaning in life, and uncertainty all fluctuate across day-to-day experiences, we sought to examine the dynamics among trait and daily intolerance of uncertainty and meaning in life. We tested the effects of each trait variable, intolerance of uncertainty and meaning in life, on daily uncertainty and distress. Based on prior research (e.g., Carleton et al., 2012) and theory (Grupe & Nitschke, 2013), we expected participants high in intolerance of uncertainty to experience more uncertainty day-to-day as well as more anxiety, negative affect, and somatic symptoms than participants low in intolerance of uncertainty. This hypothesis was supported, as participants high in trait intolerance of uncertainty reported significantly greater daily uncertainty, anxiety, and negative affect, as well as marginally more somatic symptoms in comparison to participants low in trait intolerance of uncertainty.

Although no extant studies have demonstrated relations between trait intolerance of uncertainty and these daily states, previous research supports strong links between trait intolerance of uncertainty and trait anxiety and negative affect and small to moderate associations between intolerance of uncertainty and somatization (e.g., Boswell et al., 2013; Carleton et al., 2012; Fergus et al., 2020). In line with the current study, one previous study (Thielsch et al., 2015) found trait intolerance of uncertainty significantly predicted episodic worry such that participants higher in intolerance of uncertainty experienced more worry everyday. Thus, in conjunction with previous research, the current study may help to explain why intolerance of uncertainty is considered a transdiagnostic risk factor for psychopathology (e.g., Beauchaine & Thayer, 2015), as participants high in intolerance of uncertainty experience more anxiety and negative affect on a daily basis that might additively contribute to the development and maintenance of anxiety, depression, and other forms of psychological distress. Individuals with higher trait intolerance of uncertainty also appear to experience more uncertainty day-to-day than individuals low in intolerance of uncertainty, and uncertainty tends to elicit negative emotional, behavioral, and cognitive responses in people highly intolerant of uncertainty, which could elucidate another pathway by which intolerance of uncertainty contributes to heightened risk for psychopathology. Another interpretation of this result is that the daily association between uncertainty and negative affect helps to shape trait intolerance of uncertainty. From this perspective, it is possible people form self-schemas about intolerance of uncertainty (i.e., "uncertainty makes me miserable") because they tend to experience stronger daily uncertainty and negative affect linkages. In other words, when they experience uncertainty, it is often paired with negative affect, which shapes their perceived inability to tolerate uncertainty. Thus, it is possible that intolerance of uncertainty both informs and is informed by these daily associations between uncertainty and negative affective experiences.

While we expected high trait intolerance of uncertainty to be associated with more daily uncertainty and distress, we predicted high trait meaning in life would be associated with less uncertainty and fewer negative daily emotional experiences and somatic symptoms (e.g., Machell et al., 2015). This hypothesis was partially supported as participants with higher meaning in life reported lower levels of uncertainty and daily anxiety than low meaning in life participants. Having a well-developed, stable framework from which to view the world (i.e., coherence) tends to make one's life feel predictable, familiar, and comprehensible (e.g., Stillman & Baumeister, 2009). Familiarity puts people at ease and provides them with a tool for making sense of unexpected or unfamiliar experiences as they arise, translating to less anxiety, negative affect, and uncertainty day-to-day. More broadly, meaning in life has been found to promote proactive coping and positive affect (e.g., Miao et al., 2017), which may protect against anxiety, uncertainty, or negative affect. Results of the current study indicate experiencing high levels of meaning in life plays a protective role against frequent and/or intense daily distress.

Effects of daily uncertainty and daily meaning on daily distress

In addition to investigating how trait intolerance of uncertainty and trait meaning in life influence daily distress, this study also examined how daily uncertainty and meaning influenced daily affective and somatic states. As expected, when participants reported more uncertainty than typical, they reported more distress regardless of trait levels of intolerance of uncertainty. Uncertainty management theories suggest people are motivated to keep uncertainty at manageable levels because uncertainty poses a critical adaptive challenge and tends to be experienced as aversive (e.g., Hirsh et al., 2012). Therefore, uncertainty prompts action toward resolution, which redirects attention from other desired goals, which may provoke distress. On the other hand, when participants reported more meaning than typical, they reported significantly less anxiety and negative affect. This aligns with previous studies noting on days people experience high meaning, they tend to experience more positive social and achievement events, positive affect, and reduced negative affect (e.g., Machell et al., 2015).

Moderating effects of trait IU, trait MIL, and trait IUxMIL on relationships between daily uncertainty and daily distress

Although heightened daily uncertainty seems to trigger negative affective and somatic states independent of intolerance of uncertainty, trait intolerance of uncertainty appears to exacerbate these effects. As hypothesized, trait intolerance of uncertainty amplified the relationship between daily uncertainty and negative affect. These results align with those of prior studies investigating related processes (e.g., Chen & Hong, 2010; Zlomke & Jeter, 2014). However, unlike Chen and Hong (2010) and Zlomke and Jeter (2014), we did not find significant moderating effects of intolerance of uncertainty on the daily relation between uncertainty and anxiety. This is surprising as the relation between uncertainty and anxiety has the strongest empirical and theoretical support (e.g., Buhr & Dugas, 2009) of all relations tested in this study.

Contrary to hypotheses, trait MIL did not moderate any of the associations between daily uncertainty and negative affective or somatic states. Even though high trait meaning in life was associated with significantly less daily negative affect, anxiety, and somatic symptoms in this sample, trait meaning in life did not buffer against the negative effects of heightened daily uncertainty on distress. This may indicate that heightened uncertainty is distressing to all, as even people who have a strong sense of meaning in life are not protected from the negative effects of uncertainty on a day. Future investigation of the distressing effects of uncertainty is vital, as the moderating effects of meaning in life may vary based on levels of trait intolerance of uncertainty and the amount of variability in day-to-day uncertainty, negative affect, and anxiety.

To further dissect the roles of trait intolerance of uncertainty and meaning in life, we examined the interaction between trait intolerance of uncertainty and trait meaning in life on the daily associations between uncertainty and distress and found on days when participants high in intolerance of uncertainty and low meaning in life experienced heightened uncertainty, they experienced more negative affect than participants high in intolerance of uncertainty with high levels of meaning in life. Although meaning in life did not independently moderate daily relations between uncertainty and negative affect, when meaning in life is examined in conjunction with intolerance of uncertainty, it appears to serve a protective role for participants high in intolerance of uncertainty. Thus, meaning in life buffers against the negative emotional effects of experiencing uncertainty for participants high in intolerance of uncertainty participants, protecting them from heightened daily distress in response to uncertainty.

Results reveal the importance of considering the effects of intolerance of uncertainty and meaning in life together, as the protective role of meaning in life does not appear when tested independently. This may be due to meaning in life operating differently at high and low levels of intolerance of uncertainty as well as differences in the magnitude of relations between daily uncertainty and daily distress. As discussed above, at high levels of intolerance of uncertainty, trait meaning in life appears to buffer against the effects of uncertainty on negative affect day-to-day. This aligns with theoretical assertions that meaning in life may serve as a crucial resource for individuals who are highly intolerant of uncertainty. Specifically, for individuals high in intolerance of uncertainty, having a coherent framework, a purpose, and a sense of mattering (high meaning in life) appears helpful in making sense of uncertainty, which may reduce the strain and distress intolerance of uncertainty causes. Interventions aimed at making meaning salient or cultivating meaning in moments of uncertainty may help to suppress the distressing effects of uncertainty, especially for individual highly intolerance of uncertainty.

Limitations

Although the sample was fairly diverse in terms of socioeconomic status, ethnicity, religion, and educational background, the study required in-person visits which may preclude inclusion of people who lack transportation and people who experience high levels of social anxiety and/or generalized anxiety which relate closely with high intolerance of uncertainty (e.g., Boelen & Reijntjes, 2009). Additionally, the sample was a convenience, non-clinical sample and results may be different with a clinical population.

Data collected via EMA was collected during the same week participants underwent three Trier Social Stress Tests (TSST), which may have contributed to changes in their affective experiences from a typical week. One of the primary aims of the parent study was to examine exposure to repeated stressors; however, the study also allowed us to look at processes that may have been reported less commonly (daily uncertainty) and to understand how people may be able to regulate their daily emotions when dealing with ongoing stressors. It is important for future studies to tease apart how these processes unfold for participants in a more “typical” week when they are not simultaneously undergoing lab stressors.

A novel measure was utilized in this study, Meaning as Significance, Purpose, and Coherence Scale (MSPCS; Martela & Steger, [under review](#)). Although it demonstrated adequate psychometric properties in this study, additional studies are needed to replicate and extend the current finding. Additionally, researchers have noted limitations related to the measurement of IU; however, recent studies suggest the IUS-12 is psychometrically sound (e.g., Hale et al., 2016). Even so, the IUS-12 may be best suited to detect intolerance of uncertainty and discriminate between levels of intolerance of uncertainty in clinical samples as compared to community samples. Because this study involved a community sample and in-person visits, people high in intolerance of uncertainty may be underrepresented. Due to the COVID-19 pandemic and related recruiting difficulties, our study was adequately powered to detect level 1 direct effects but underpowered in detecting

cross-level interaction effects. It is possible with more level 1 and level 2 datapoints, results that approached significance would be significant. Replication in a larger sample with more repeated measures is necessary.

Implications and future directions

Results of this study suggest uncertainty generally provokes higher levels of distress in people high in intolerance of uncertainty, whereas meaning is associated with less negative emotionality. Future studies should seek to replicate these results and extend them to more diverse and clinical samples and examine daily experiences during stressful (i.e., TSST) versus typical time periods. Future studies should also seek to examine how sociodemographic factors like gender, age, ethnicity, and income relate to study constructs.

Results indicate meaning in life might be helpful to cultivate as a protective factor for people high in intolerance of uncertainty. Research suggests people high in intolerance of uncertainty tend to engage in worry, rumination, and avoidance to reduce negative emotional states associated with uncertainty (i.e., anxiety). It is important to examine how people high in intolerance of uncertainty cope with uncertainty day-to-day and if trait or daily meaning in life improves coping. Future research should seek to determine if interventions promoting meaning can counteract the go-to tendencies of worry, rumination, and avoidance that maintain anxiety and depressive disorders in individuals high in intolerance of uncertainty.

Finally, a new item was developed to measure people's daily experiences of uncertainty, and, upon initial examination, it appears this item may be useful. Further investigation of this item as well as the differential effects of intolerance of uncertainty on daily uncertainty and experiences may promote understanding of the mechanisms by which intolerance of uncertainty contributes to psychological and physical disease.

Conclusion

Our study demonstrated both high trait intolerance of uncertainty and higher than average levels of daily uncertainty relate to more daily distress, whereas high levels of trait and daily meaning in life relate to significantly lower levels of daily distress. Cultivating stable and durable trait meaning in life appears to be crucial in promoting daily well-being, especially for individuals who are highly intolerant of uncertainty. Perhaps via interventions aimed at refocusing attention to sense-making (coherence), purpose, and/or mattering (significance), intolerance of uncertainty can be reduced, resulting in less distress in the context of uncertainty.

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Ethics approval & consent

The procedures used in this study adhere to the tenets of the Declaration of Helsinki, and all procedures performed in this study were approved by the Institutional Review Board at Colorado

State University (Protocol#16-6905H). Informed consent was obtained from all individual participants included in the study.

Data, materials and/or code availability

Data and study materials are not publicly available at this time; researchers can request this data from the second author (G. Luong: gloria.luongcolostate.edu). MPLus syntax is included as a supplementary material.

Authors' contribution statements

Jessica Morse: Conceptualization; Methodology; Formal analysis; Investigation; Data Curation; Visualization; Writing- Original draft preparation.

Gloria Luong: Conceptualization; Methodology; Investigation; Resources; Data Curation; Writing - Review & Editing; Supervision; Project administration; Funding acquisition.

Mark Prince: Methodology; Formal analysis; Writing – Review & Editing; Supervision.

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