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ORIGINAL ARTICLE

Beyond Logical Errors: Preliminary Evidence for the "Looming Vulnerability Distortions Questionnaire" of Cognitive-Perceptual Distortions in Anxiety

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Abstract

Background In cognitive models, faulty threat appraisals that are associated with threat cognitions in anxiety are frequently seen as the outcome of logical errors. The looming vulnerability model expands upon such views by emphasizing the role of perceptual and phenomenological distortions in threat estimation. It assumes that anxiety is associated with cognitive-perceptual distortions of time, space, and movement (e.g., space and time compression) that heighten the subjective impression that threats are rapidly approaching, even when they aren't. The present study was undertaken to develop an easy-to-administer and implement self-report measure to assess such perceptual distortions.

Methods University students ($N=751$; 71% female) completed a battery of online questionnaires that included the Looming Vulnerability Distortions Questionnaire (LVDQ) and measures of the looming cognitive style (LCS), cognitive distortions, social desirability, anxiety, worry, intolerance of uncertainty, and depression.

Results A bifactor ESEM model displayed excellent fit indices and reliability for the LVDQ. Although the results provided strongest support for the use of a general score over specific subscales, they also support the secondary use of some specific scores for some types of distortions. The LVDQ uniquely predicted variance in LCS, anxiety, worry, intolerance of uncertainty, and depression. Moreover, both the LVDQ and LCS also uniquely predicted scores on a face-valid lab-based task, not explained by logical reasoning distortions.

Conclusions These results support the idea that the LVDQ is a valid measure of cognitive-perceptual distortions associated with anxiety and indicate that it predicts unique variance in anxiety and other emotional distress not explained by a typical measure of logical errors. Clinical implications and future directions are discussed.

Keywords Looming vulnerability distortions · Estimation biases · Threat estimation · Cognitive-perceptual distortions in anxiety · Perceptual distortions in anxiety

Cognitive models of anxiety have viewed distorted threat appraisals as core etiological factors in anxiety (Rapee & Heimberg, 1997; Clark & Beck, 2010). For example, Beck's influential cognitive model states that anxious individuals overestimate the probability of occurrence, the severity or cost, and the imminence of threatened events while underestimating their personal resources for coping with the events. Their faulty appraisals and threat estimation are thought to involve logical thinking errors characterized by using evidence to jump to arbitrary conclusions, using biased evidence/or discounting evidence, overgeneralizing, and catastrophizing.

The looming vulnerability model (Riskind et al., 2000; Riskind & Rector, 2018) augments Clark and Beck (2010) and comparable models by stressing dynamic aspects of threat in anxiety. When individuals perceive (or misperceive) threats as dynamic, changing, and swiftly advancing, they experience more anxiety, fear, and urgency. A person can have the subjective impression that danger is dynamic, swiftly progressing, and rising in risk because the threat seems to be getting closer in space, time, or certainty (likelihood). Such perceptions function as powerful warning signals, because such threats require rapid action to prevent

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damage or harm. Slow, static, or receding stimuli reduce anxiety and urgency since they don't require fast action.

The looming vulnerability model is founded on a large body of evidence gathered from research in experimental, developmental, cognitive neuroscience, social psychology, and animal studies (Riskind & Rector, 2018). This work has repeatedly shown that dynamic objects, particularly approaching and looming objects, serve as important warning cues of imminent danger. Numerous studies, for example, have demonstrated that rapidly approaching looming stimuli preferentially capture attention, are better remembered, and elicit more negative emotional reactions and distinctive patterns of brain activation on imaging tasks than static and receding stimuli. (e.g., Franconeri & Simons, 2003; Judd et al., 2004; Mobbs et al., 2010; Parker & Alais, 2007; Pilz et al., 2011; Van Wassenhove et al., 2011). Furthermore, animal and developmental studies indicate that virtually all vertebrate animals, including human newborns and adults, as well as invertebrates of all types, show defensive reactions to looming stimuli, such as escaping, hiding, ducking, or fleeing (e.g., Gwilliam, 1963; Ball & Tronick, 1971; Dill, 1990; Westby et al., 1990; Card & Dickenson, 2008).

Thus, it appears that practically all animals have evolved adaptive strategies to prevent being caught unprepared by rapidly approaching dangers. In addition, perceptual and cognitive biases that even overestimate the apparent speed with which threats may approach may also have evolutionary advantages, because false negatives (e.g., underestimating the speed of a predator) are considerably more dangerous to survival than false positives (overestimating the speed) (Haselton & Buss, 2000). However, any chronic or extreme bias by to overestimate the rapid approach of threat might generate an excessive predisposition for anxiety and extreme threat reactions that are dysfunctional and unwarranted (Riskind & Rector, 2018).

The "Looming Cognitive Style"

Why are some individuals more likely to get anxious than others? A variety of factors contribute to these differences, including stressful life events, but cognitive factors are also important. According to the looming vulnerability model, some individuals are especially at risk of anxiety because they have a trait-like vulnerability known as the looming cognitive style (or LCS; Riskind et al., 2000; Riskind & Rector, 2018). The LCS assesses an exaggerated tendency to perceive mental simulations and images of potential threats as rapidly progressing and approaching and expanding in their negative consequences, even when they aren't. Individuals with this LCS are also more likely to suffer from depression under particular circumstances, such as when thinking they are unable to leave a bad situation (Kleiman & Riskind, 2012). The LCS is thought to be a core aspect of vulnerability to anxiety that develops as a result of inadequate parenting and faulty attachment bonds, as well as previous life traumas and abuse. Several studies have found evidence for these developmental antecedents (González-Diez et al., 2016; Riskind et al., 2017a, 2017b; Altan-Atalay & Ayvaşık, 2019; Greenblatt-Kimron & Cohen, 2020; Milovanović et al., 2022).

Yeo et al. (2020) conducted a meta-analysis that synthesized 141 effect sizes from 61 articles and 69 independent samples. This meta-analysis demonstrated strong associations between the LCS and general anxiety, simple and social phobias, and OCD symptoms (counting OCD as anxiety-related). While LCS was linked to depression, it was significantly weaker than its link to anxiety. LCS scores are related to heightened memory biases, perceptual, and interpretive biases for threatening stimuli (Riskind et al., 2000, 2014), as well as self-reported sleep disruption (Zamani et al., 2021), freeze responses to threatening stimuli (Riskind et al., 2016), and stress generation (Kleiman & Riskind, 2014; Riskind et al., 2010). Moreover, more than ten prospective studies have shown that LCS acts as a risk factor that can drive subsequent anxiety, worry, and spontaneous threat cognitions throughout time periods ranging from one week to a year (Adler & Strunk, 2010; Calvete et al, 2016; Carnahan et al., 2022; González-Díez et al., 2015; Riskind et al., 2000; ; Kleiman & Riskind, 2012; Sica et al., 2012).

Beyond the LCS: Devising a Measure of Looming Vulnerability Distortions

Regarding the present research, a theoretical expectation of the looming vulnerability model is that anxiety and the LCS are linked to a range of cognitive-perceptual distortions of time, space, size, closeness, and movement (Riskind & Williams, 1999; Riskind et al., 2012; Riskind & Rector, 2018). These are also known in the broader literature as estimation biases (Givon-Benjio & Okon-Singer, 2020). In the model, such distortions are referred to as "looming vulnerability" distortions (or biases) because they can all contribute to a distorted impression that threat is dynamic and quickly coming and rising in risk and urgency,

According to research, people overestimate the time of arrival and speed of approaching stimuli, especially when the stimuli are seen as threatening and fear-relevant (e.g., spiders or snakes) rather than neutral or benign (butterflies, bunnies) (Vagnoni et al., 2012; Basanovic et al., 2019; McGuire et al., 2021). Rachman and Cuk (1992) found that people experiencing spider and snake phobias overestimate how often the animals jumped or moved toward them (see also Riskind et al., 1992, for a different nonverbal demonstration). Persons who are terrified of spiders perceive them as dynamic and rapidly approaching (Riskind et al., 1992, 1995), whereas people who are afraid of germs and contaminants imagine them rapidly increasing and spreading towards them (Riskind et al., 1997; Tolin et al., 2004; Riskind & Rector, 2007; Elwood et al., 2011).

Additional research shows that people perceive threatening stimuli such as spiders or menacing strangers as closer and larger than they are (Vasey et al., 2012; Leibovich et al., 2016; Shiban et al., 2016). Cole et al. (2013) found that respondents exposed to threatening stimuli (e.g., a tarantula or a belligerent confederate) judged them to be closer than neutral stimuli but did not do this for disgusting stimuli. As compared to less anxious people, Givon-Benjio and Okon-Singer (2020) found that individuals with social anxiety seem to overestimate the physical proximity of strangers.

When threatened, people also experience time as passing more swiftly, judging that more time as passed. They do this when blindfolded and travelling in a cart on an elevated rather than flat stage (Langer et al., 1961, 1965), when exposed to spiders (Watts & Sharrock, 1984), or when encountering threatening images (Effron et al., 2006; Bar-Haim et al., 2010; Droit-Volet et al., 2011; Fayolle et al., 2015). Asking individuals to focus on competing goals makes them feel like their time is more inadequate than telling them to simply list their goals (Etkin et al., 2015).

These repeatedly demonstrated estimation biases are cognitive-perceptual distortions of size, time, proximity, and threat movement rather than logical errors. It seems plausible that many of these distortions would tend to co-occur as indicators of a more general tendency because they would functionally serve to heighten a perception of looming vulnerability to help keep individuals safe and out of the reach of possible dangers. This idea is in keeping with findings of Langer et al. (1961, 1965) that participants overestimated both their physical proximity to threat as well as the elapsed time of their exposure to it (experiencing time as moving more swiftly than it was).

Given the wealth of evidence that has amassed demonstrating estimation errors and cognitive-perceptual distortions, it is remarkable that so little effort has made to bring these perceptual distortions together into a coherent integrative framework. Few attempts have been made to build a battery of lab-based activities to measure these distortions, and it would be onerous to administer. Furthermore, few attempts have been made to construct an easy-to-implement and administer self-report instrument for assessing these distortions. It should be noted that the looming maladaptive style questionnaire is used to assess the LCS (LMSQ; Riskind et al., 2000). The LCS, as assessed by the LMSQ, should predict more looming vulnerability distortions on such an instrument, but it was never designed to assess the distortions in a more fine-grained, nuanced, and richly textured manner.

Purpose of the Present Research

Given the abundance of evidence associating anxiety and lab-based threat estimation measures involving cognitive-perceptual distortions, a psychometrically validated self-report measure of such distortions could be useful for both researchers and practitioners. For example, an easy-to-administer and easy-to-implement self-report measure might help advance understanding of perceptual distortions in estimation biases in anxiety and fear and have clinical utility for screening, assessing, and offering more personalized therapy interventions.

Based on these considerations, the present study aimed to develop and psychometrically validate such a measure. Drawing on empirical studies on estimation biases and clinical observations (Riskind & Williams, 1999; Riskind et al., 2012; Riskind & Rector, 2018), we designed the "Looming Vulnerability Distortions Questionnaire" (LVDQ) to assess 10 suspected expected estimation errors and perceptual distortions.

The cognitive-perceptual distortions include perceiving threatening stimuli as closer in space than they are (Space Compression), as larger than they are (Size Distortion) and as closer in time than they are (Time Compression). We've also noticed that anxious people tend to perceive too many threats as coming at once (All-at-Once Distortion), probably because they compress the future time horizon, bringing many possible threats closer. Anxious individuals also seem to experience the chances or probabilities of dangerous events as growing swiftly and advancing towards more certainty, even when they aren't (Rapidly Rising Odds Distortion). Due to these perceptual distortions, anxious people often overwhelm themselves because they underestimate the time they have left to cope and feel more overwhelmed and powerless than they are (Minimizing Coping Time). Since their inner clocks speed up during threat, anxious people seem to think time is passing more quickly (Rapid Time). They may also experience time as drastically slowing down or standing still (Slowing Time) when they feel helpless to leave an unfolding threat situation (e.g., a car accident). Riskind and Rector (2018) postulated that this may be a reaction to an accelerated internal clock when compensatory self-protective action is not possible.

Importantly, we designed the LVDQ to measure cognitive-perceptual distortions using the same self-report format as prior measures of cognitive distortions that assess logical errors, particularly the Cognitive Distortions Scale

(Covin et al., 2011). We used the same format as this existing, cognitive distortions self-report questionnaire in order to evaluate if the LVDQ contributes anything incremental or unique beyond what that measure explains. Additionally, we included a measure of social desirability responding (Paulhus, 1988) to address a possible limitation of self-report measures of distorted cognitions and perceptions. If such measures just rely on verbal self-reports, outcomes might be skewed by social desirability responding or mood.

Finally, we sought to address the possibility that there may well be discrepancies between how individuals might report they tend to perceive stimuli when they respond to the new LVDQ and how they might experience these. To do this, we included a quasi-in vivo lab-based task to cross-validate the LVDQ by assessing whether participants reported specific perceptual distortions for a series of standardized potential threat situations (e.g., a video of an approaching spider, an image of someone holding a knife, or two people having a potential romantic quarrel).

Given that we expected that these distortions can work in concert to create a sense of looming vulnerability, it was expected that many of the perceptual distortions would co-occur as part of a more general tendency (e.g., an approaching threat will be seen as closer and larger). The primary hypothesis investigated in this study was that the LVDQ would be strongly associated with the LCS, as well as anxiety and related constructs (worry, intolerance of uncertainty), and the lab-based cross-validation task. Based on past findings for the LCS, we also expected comparable, albeit lower, associations between the LVDQ and depression and hostility (Riskind et al., 2013; Yeo et al., 2020). A critical prediction in this study was that the LVDQ will make unique contributions that account for an additional, distinct, and unique portion of the variance in LCS, anxiety, and related measures, over and above what can be accounted for by the standard thinking errors in logic and social desirability responding. Finally, we examined the structure of the LVDQ. As this is a newly constructed questionnaire, we adopted an integrative strategy that included the evaluation of several measurement models to test the existence of the 10 specific dimensions of LVD as well as the existence of a generic dimension that account for the specific dimensions.

Method

Participants

Seven hundred and fifty-one college students aged between 18 and 62 years old (*mean* age = 20.53, *SD* = 3.37) participated in an online study for course credit. Regarding gender, approximately 27% identified themselves as male, 71% as female, and 2% indicated different gender identities (non-binary and transgender). Approximately 48% of the sample identified themselves as Caucasian, 22.6% Asian, 16.4% African American, and 13% as another ethnicity.

Procedure

All participants completed a questionnaire on demographic information and the following self-report measures. Because the whole sample for the study was drawn from several subsamples, some participants differed in whether they completed the whole set of measures in the questionnaire packet. In addition, 241 participants completed a shorter version of the survey that did not include the cross-validation task.

Measures

The Looming Vulnerability Distortions Questionnaire (LVDQ). The LVDQ is a new instrument devised for this study to measure cognitive and perceptual distortions of time, space, and movement. The scenarios and items were developed from small focus groups of clinical professionals and graduate students and researchers in the field of anxiety disorders. It is a 30-item measure that assesses the frequency of 10 types of "looming" distortions (Size Overestimation, Space Compression, Misperceiving Threats as Physically Moving Closer, Time Compression, All-At-once, Experiencing Time as Moving Faster than It Is, Odds Rising Too Rapidly, Time Moving Too Slowly, Minimizing Intervening Events, Minimizing Coping Time) across both social, achievement (e.g., school or work), and physical threat domains. Respondents are presented with a definition of a distortion or type of thinking following the example of Covin et al. (2011) in the Cognitive Distortions Scale (see below) to reduce defensiveness. They are then provided with an example of each distortion in three domains (see Appendix for full questionnaire). As an example, for Time Compression, the following definition is provided: "People sometimes experience the closeness (or distance) in time between themselves and an event that is threatening to them or that makes them uncomfortable as smaller than is true." The corresponding example for social contexts is: "Monty just remembers that he has forgotten to get his good friend a gift for his wedding that is coming up in three weeks. Despite the fact that Monty has plenty of time, he experiences the wedding as if it were going to occur more soon than is true." The example in an achievement situation is: "Erica has weeks to finish a project for work that is important to her career. Despite the fact that she has plenty of time, she experiences the deadline as it were only a week away," and the example in a physical situation is:" Julia is terrified of flying and has an airplane flight ticket to fly in three weeks. Despite the three weeks, she experiences the date of her flight as if it were much closer than is true." Participants indicate the frequency with which they engage in the type of thinking in each situation on a seven-point Likert-type scale (1 = *Never*, 7 = *All the time*) in each type of situation.

Cognitive Distortions Scale (CDS; Covin et al., 2011). The CDS is a 20-item self-report measure that assesses the frequency of 10 types of logical errors (mindreading, catastrophizing, all-or-nothing thinking, emotional reasoning, labeling, mental filtering, overgeneralization, personalization, should statements, minimizing or disqualifying the positive) across both social and achievement related (e.g., school or work) situations. Participants are presented with a definition of the distortion or "thinking type" and provided with an example of that distortion in an interpersonal and achievement context. For example, the following definition is provided: "People sometimes think that things should or must be a specific way" and the example for interpersonal contexts is: "Anne believes that she must be funny and interesting when socializing." Participants indicate the frequency with which they engage in the type of thinking on a seven-point Likert-type scale (1 = *Never*, 7 = *All the time*) in social and achievement situations. Total, social, and achievement scores are obtained by adding items. Past research has indicated that the CDS has good psychometric properties in undergraduate (Covin et al., 2011) and clinical samples (Özdel et al., 2014), including internal consistency, test–retest reliability over two weeks, and construct, discriminant, convergent, and divergent validity. The CDS showed excellent internal reliability. α coefficients were 0.93 for the total scale, 0.86 and 0.87 for the social and achievement scales, and between 0.60 and 0.78 for the subscales.

Looming Maladaptive Style Questionnaire-Revised (LMSQ-R; Riskind et al., 2000). LMSQ-R is a well-validated measure that is designed to assess a person's tendency to interpret and perceive mentally simulated threats as rapidly progressing and approaching and as expanding in risk and negative consequences (i.e., the looming cognitive style). The LMSQ requires participants to read six brief vignettes describing potentially stressful situations (e.g., threat of a car accident; perceiving odd looks from a lover) and then complete three questions for each vignette using a five-point Likert scale (1–5) (i.e., (1) "In this scene are the chances of your having difficulty decreasing or expanding with each moment?" (2) "Is the level of threat in the encounter staying fairly constant or is it growing rapidly larger with each passing moment?" (3) "How much do you visualize your problem as in the act of becoming progressively worse?"). Thus, the questions on the LMSQ-R assess the extent to which individuals perceive the probability, proximity, and rate of approach of potential harm as increasing dynamically with each moment (or "looming") not just as low or high in terms of absolute values. A total looming cognitive style (LCS) score is calculated by aggregating responses to these three items across the six vignettes. Although separate indices of social looming (i.e., LCS social) and physical looming (LCS physical) can be derived by aggregating responses to their three vignettes, only the total LCS score was used for purposes of the present study. Riskind et al. (2000) provided evidence for the predictive, convergent, and discriminant validity of the measure, as well as its internal consistency and test–retest stability over 7-months ($r = 0.72$). In the present study, the alpha coefficient for the LMSQ total scale score was 0.91.

The Brief Symptom Inventory (BSI; Derogatis, 1992). The anxiety, depression, and hostility subscales of the BSI were used to measure the severity of these symptoms. Each subscale is composed of five-six 5-Likert-Type items (1 = *Not at all*, 5 = *Extremely*) assessing the severity of the symptoms over the past week. The subscales yield satisfactory levels of internal consistency (ranging between 0.70 and 0.89, Derogatis & Melisaratos, 1983; Boulet & Boss, 1991). Validation studies of the BSI (Boulet & Boss, 1991) find strong reliability and convergent validity in both inpatient and outpatient samples. In the present study, adequate internal consistency was found for each of these three subscales of the BSI (α coefficients: 0.84–0.87).

The *Beck Anxiety Inventory* (BAI; Beck et al., 1988) is a 21-item self-report scale with excellent psychometric properties that measures cognitive and physiological symptoms of anxiety on a 4-point Likert scale (0 = *Not at all*, 3 = *Severely, it bothered me lot*). While not assessing primary symptoms of panic disorder such as the frequency or severity of panic attacks, it measures somatic symptoms associated with severe anxiety and panic disorder (Cox et al., 1996). In the present study, the α coefficient for the BAI total scale score was 0.94.

The *Penn State Worry Questionnaire* (PSWQ; Meyer et al., 1990) is a well-validated 16-item inventory designed to assess chronic worry and to capture the generality, excessiveness, and uncontrollability characteristics of pathological worry. Each item is rated on 1 (Not at all typical of me) to 5 (Very typical of me) Likert-type scale. In the present study, the α coefficient for the PSWQ was 0.83.

The *Balanced Inventory of Desirable Responding* (Paulhus, 1988) is a commonly used self-report measure of social desirability responding, and it contains a self-deception (SDE) and an impression management subscale. In this study, only the SDE was used (α = 0.92). Self-deception is conceptualized as the unconscious process of deceiving the self to protect against threat; it assesses the stable characteristic of implicitly maintaining a self-protective (and self-serving) stance. Each item is rated on a 1(*Not true*) to 7 (*Very true*) Likert-type scale.

The Intolerance of Uncertainty Scale (IU; Freeston et al., 1994; Buhr & Dugas, 2002) is a well-studied measure of the tendency to find uncertainty uncomfortable and threatening.

The 27 items of the scale concern the idea that uncertainty is unacceptable, reflects badly on a person, and leads to frustration, stress, and the inability to take action. Items are rated on a five-point Likert scale ranging from ‘‘not at all characteristic of me’’ to ‘‘entirely characteristic of me.’’ The IUS shows excellent internal consistency, good test–retest reliability over a 5-week period, and convergent and divergent validity when assessed with measures of worry, depression, and anxiety (Buhr & Dugas, 2002). In the present study, the α coefficient was 0.92.

The Cross-validation Lab Task. A possible constraint on self-report measures of cognitive distortions is that they rely entirely on self-reports of how often they typically think in those ways. A possible limitation of such ratings may be colored by the bias created by current moods or by social desirability responding. To partially get around such limitations, we constructed a lab-based task to cross-validation the LVDQ. This task presented the participants with two video clips (on an approaching spider or a potential automobile accident) and eight other images of potential threats (e.g., a romantic conflict, a dangerous person with a knife, a business meeting with supervisors) and asking them to respond to eight questions in each situation on 1–5 scales about their visual-spatial and temporal experience when imagining themselves in the situation. An example of the questions asked are as follows.

1. As you imagine yourself in this scene, how close or far away from you does it feel that the person with the knife is to you? (Not Close/Very Close).
2. How large or big does it feel to you that the person and his knife are (Not big at all/Very Large).
3. How massive? (Not massive at all/Very Massive).
4. How urgent does it feel that you that must immediately do something to respond or act? (Not Urgent at All/Very Urgent).
5. Does it feel like you have enough time to respond or do something to escape harm? (Not Enough Time/ More than Enough Time).
6. How quickly does it seem to you that the person with the knife is approaching and moving towards you? (Not Quickly at All/Very Quickly).
7. To what extent does it feel that you are facing many different problems in the future coming towards you all at once? (Not At All/Very Much Like This).

To ensure that participants adequately performed the task, we specifically asked participants questions such as “Were you able to play the video before scoring it?” Participants who were unable to play the video adequately were discarded for analyses. In addition, we excluded participants who completed the study with unrealistic short times. A total of 58 participants were eliminated for the above reasons leaving 452 participants for the analyses of the cross-validation task.

Data Analysis

Studying the factor structure of the LVDQ involved the estimation of several alternative models (see Fig. 1). First, we conducted confirmatory factor analysis (CFA) and exploratory structural equation modeling (ESEM) analysis of the LVDQ items to test the fit of 10-dimensional (i.e., one factor per distortion type) models. In the CFA model, each item specifically loaded only on the factor it was designed to measure, and correlations between the factors were freely estimated. The ESEM model was specified with similar factor loading patterns as its CFA analog. However, instead of setting the cross-loadings to zero, we used the target rotation, such that all cross-loadings were freely estimated but “targeted” to be as close to zero as possible (Asparouhov & Muthén, 2009). Next, we estimated bifactor models, which represent a top-down paradigm in which a general factor explains the highest variance of observed variables, and specific factors explain residual variances that are not explained by the general factor (Markon, 2019). Support for a bifactor model allows for the reporting of scores for both a general factor and sub-scores for specific factors of the questionnaire.

All factor analyses on the LVDQ were conducted with Mplus Version 8.9 (Muthén & Muthén, 2021) using the weighted least square mean and variance adjusted (WLSMV) estimator. The goodness of model fit was evaluated using the comparative fit index (CFI), the Tucker–Lewis index (TLI), the standardized root-mean-square residual (SRMR), and the root-mean-square error of approximation (RMSEA). CFI and TLI values of 0.95 or higher indicate an excellent fit. SRMR and RMSEA values lower than 0.08 indicate a good fit. Following prior recommendations, we considered changes in RMSEA greater than 0.015 and changes in CFI and TLI greater than 0.01 to be significant when comparing measurement models (Cheung & Rensvold, 2002; Chen, 2007). The quality of the factor loadings was also examined; values above 0.60 were considered very good, above 0.45 were adequate, and below 0.30 were poor (Comrey & Lee, 1992). In order to study the measurement model of the questionnaire, the sample was randomly divided into two subsamples. Thus, the models were estimated in subsample 1 ($N=375$) and then replicated in subsample 2 ($N=376$). These subsamples were similar in age and gender.

The Ordinal alpha coefficient was used to estimate the reliability of the correlational models whereas the Omega coefficients (ω), using the Omega program (Watkins, 2013), were obtained to assess the reliability of the bifactor models. Total omega (ω) indicated the proportion of the total variance attributable to all sources of common variance. The Omega of a subscale (ωs) indicated the proportion of the variance of the

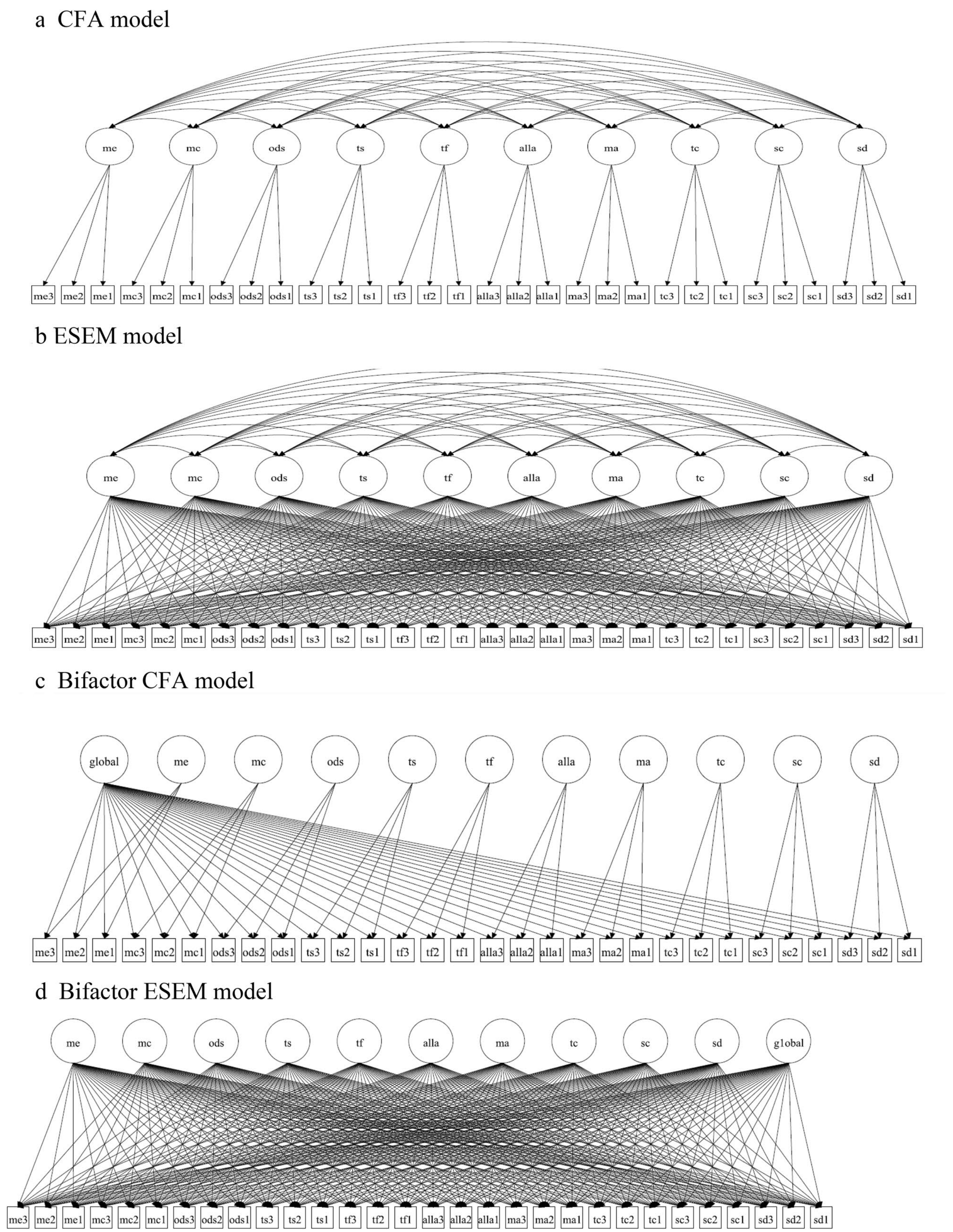

Fig. 1 Conceptual models of the looming vulnerability distortions questionnaire. *SD* size distortion, *SC* space compression, *TC* time compression, *PMC* physically moving closer, *ALLA* all-at-once distortion, *RT* rapid time, *ST* slowing time, *OD* odds distortion, *MCT* minimizing coping time, *MIE* minimizing intervening events

subscale score that could be attributed to all common factors (i.e., the general factor plus the specific factors). The hierarchical omega (ωH) indicated the proportion of the variance of the total score that could be attributed to the general factor after accounting for all specific factors. The hierarchical subscale omega (ωHS) indicated the proportion of the variance of the subscale score that could be attributed to a specific factor after accounting for an overall factor. It has been suggested that ωH and ωHS should be above 0.50 and preferably close to 0.75 (Reise et al., 2013). ωHS values below 0.50 indicate that most of a specific subscale score's variance was due to a general factor (Hammer & Toland, 2016). We computed H, the percentage of uncontaminated correlations (PUC), and the explained common variance (ECV). High values of H (> 0.70) indicate higher replicability between samples (Rodriguez et al., 2016). The PUC indicates the proportion of correlations explained by the overall factor. The LCA is the proportion of the variance explained by all the factors that is explained by the overall factor. If both the PUC and the ECV are high (> 0.70), a unidimensional model is supported (Rodriguez et al., 2016).

To examine the validity of the LVDQ, we used Mplus Version 8.9's path analysis and the robust maximum likelihood (MLR) estimation method to examine the associations between the LVDQ scores and measures of anxiety and depressive symptoms, worry, looming cognitive style, and uncertainty. We included the score on the CDQ in the model to check whether the LVDQ contributed significant, distinct, and unique variance to the prediction of the other variables beyond the CDS. Moreover, social desirability was controlled in the model to determine whether the LVDQ predicted variance in the other variables beyond mere social desirability responding. Finally, the associations between the LVDQ scores and the scores of the additional lab-based cross-validation task were examined by path analysis.

Results

Factorial Structure of the LVDQ

Following the recommendations of Morin et al. (2016), we began by comparing the CFA model with the equivalent ESEM model and next we estimated the bifactor models. The analyses were first performed in subsample 1 and then replicated in subsample 2.

CFA and ESEM models: Fit indices were adequate for both the 10-correlated-factor CFA model and its corresponding ESEM model, although the ESEM model represented an improvement in CFI and TLI indices (ΔCFI = 0.033; ΔTLI = 0.025, Table 1). Factor loadings are shown in Table 2. In the CFA model, factor loadings were adequate for all specific factors (|λ| range: 0.60–0.85, M = 0.74). In the ESEM model, factor loadings were statistically significant (|λ| range: 0.22–0.88, M = 0.48). Items of value lower than the cut-off of 0.46 (Comrey & Lee, 1992) belonged to the subscales of Size Distortion (2 items), Space Compression (2 item), Threats as Physically Moving Closer (1 item), and Physically Moving Closer (1 item). Several items were cross loaded significantly in the other subscales. The correlation coefficients between specific factors ranged between 0.64 and1.00 in the CFA model and between 0.02 and 0.66 in the ESEM model. The ordinal alpha coefficients for the CFA-based subscales ranged between 0.73 and 0.87, except for Size Distortion, which obtained a lower value (0.67). In the ESEM model, ordinal alpha coefficients ranged between 0.34 and 0.78.

Bifactor models: In the next step, we estimated bifactor models to test whether a general looming distortion factor could explain the data. Both the bifactor CFA and the bifactor ESEM model obtained adequate fit indices (Table 1). The bifactor ESEM model did not increase fit indices compared to the ESEM model ΔRMSEA = 0.006; ΔTLI = 0.007; ΔCFI = 0.004). However, the bifactor ESEM model improved the fit indices in

Table 1 Fit indices of the estimated models

Model	Subsample 1	Subsample 2
CFA model	$\chi2$ (360, *n* = 375) = 911, *p* < .001; RMSEA = .064 (90%: .059–.069), *p* < .001; CFI = .954; TLI = .944, SRMR = .040	$\chi2$ (360, *n* = 376) = 982, *p* < .001; RMSEA = .068 (90%: .063–.073), *p* < .001; CFI = .953; TLI = .944, SRMR = .039
ESEM model	$\chi2$ (180, *n* = 375) = 334, *p* < .001; RMSEA = .048 (90%: .040–.056), *p* = .660; CFI = .987; TLI = .969, SRMR = .016	$\chi2$ (180, *n* = 376) = 349, *p* < .001; RMSEA = .050 (90%: .042–.058), *p* = .490; CFI = .987; TLI = .969, SRMR = .016
Bifactor CFA model	$\chi2$ (375, *n* = 375) = 1001, *p* < .001; RMSEA = .067 (90%: .062–.072), *p* < .001; CFI = .947; TLI = .939, SRMR = .043	$\chi2$ (375, *n* = 376) = 1018, *p* < .001; RMSEA = .068 (90%: .063–.073), *p* < .001; CFI = .952; TLI = .944, SRMR = .042
Bifactor ESEM model	$\chi2$ (160, *n* = 375) = 267, *p* < .001; RMSEA = .042 (90%: .033–.051), *p* = .926; CFI = .991; TLI = .976, SRMR = .014	$\chi2$ (160, *n* = 376) = 298, *p* < .001; RMSEA = .048 (90%: .039–.056), *p* = .648; CFI = .990; TLI = .972, SRMR = .014

Table 2 ESEM and CFA models in subsample 1

	ESEM											CFA	
	SD	SC	TC	PMC	ALLA	RT	ST	OD	MCT	MIE	Uniqueness	S	Uniqueness
Size Distortion 1	**.40**	.07	.17	.12	.04	−.16	.05	−.02	.13	.11	.59	**.60**	.65
Size Distortion 2	**.57**	.31	−.07	−.01	.12	−.01	.04	.06	.05	.07	.42	**.64**	.60
Size Distortion 3	**.22**	.28	.12	−.11	.04	.13	.14	−.34	.03	.23	.42	**.64**	.60
Space Compression 1	.15	**.34**	.06	.27	.05	.09	−.06	.19	.07	.01	.53	**.65**	.58
Space Compression 2	.31	**.42**	−.01	.19	.06	.03	−.04	.34	.03	.00	.39	**.66**	.57
Space Compression 3	.21	**.41**	.18	−.01	−.04	.23	.14	−.23	.13	.04	.29	**.75**	.44
Time Compression 1	.07	−.06	**.61**	.08	.13	.05	.04	.10	.03	−.09	.42	**.74**	.46
Time Compression 2	.18	−.12	**.57**	−.08	.16	.10	.04	.17	−.04	.01	.38	**.74**	.45
Time Compression 3	−.18	.19	**.57**	.04	.09	−.03	−.06	−.01	.19	.03	.36	**.72**	.49
Physically Moving Closer 1	−.01	.03	.05	**.88**	.00	−.09	.09	−.07	−.06	.05	.18	**.64**	.59
Physically Moving Closer 2	.05	.01	−.10	**.46**	.08	.30	.07	.03	.10	.03	.46	**.76**	.42
Physically Moving Closer 3	−.07	.20	.02	**.41**	.18	.07	.08	−.12	.07	.07	.46	**.77**	.41
All-At-Once Distortion 1	.15	−.13	.06	.03	**.85**	.01	.01	−.06	.00	.01	.17	**.86**	.26
All-At-Once Distortion 2	.05	−.17	.07	.10	**.68**	.11	−.03	.00	.07	.06	.28	**.85**	.28
All-At-Once Distortion 3	−.17	.22	.09	−.01	**.69**	−.04	.10	.03	−.06	.04	.28	**.79**	.37
Rapid Time 1	−.02	−.03	.08	.15	.07	**.53**	.07	.06	.13	.02	.40	**.74**	.45
Rapid Time 2	.01	.13	.01	−.01	.16	**.61**	.05	.11	.07	.05	.24	**.81**	.34
Rapid Time 3	−.17	.25	.23	.19	.02	**.18**	.00	−.05	.05	.26	.41	**.72**	.48
Slowing Time 1	.11	−.09	.17	.09	−.03	.09	**.72**	−.02	.02	−.10	.33	**.82**	.33
Slowing Time 2	.05	−.13	−.09	.02	−.01	.16	**.70**	.06	−.02	.13	.33	**.78**	.39
Slowing Time 3	−.10	.09	−.15	.06	.11	−.26	**.73**	.13	.10	−.03	.38	**.63**	.61
Odds Distortion 1	.01	−.01	.15	.00	−.04	.04	.08	**.45**	.19	.21	.42	**.74**	.45
Odds Distortion 2	.04	.10	.11	−.07	.04	.12	.19	**.47**	.12	.13	.33	**.82**	.33
Odds Distortion 3	−.15	.25	.15	−.08	.09	.08	.23	**.30**	.02	.11	.48	**.71**	.50
Minimizing Coping Time 1	.02	.05	.16	.07	−.10	−.12	.11	−.02	**.53**	.13	.43	**.71**	.50
Minimizing Coping Time 2	.03	−.04	−.07	.03	.04	.08	.03	.10	**.88**	−.06	.16	**.83**	.31
Minimizing Coping Time 3	.06	−.03	.10	−.09	.10	.14	.07	.05	**.48**	.10	.38	**.81**	.35
Minimizing Intervening Events 1	.09	−.14	−.02	.18	.01	−.02	.02	.05	.10	**.67**	.33	**.78**	.39
Minimizing Intervening Events 2	.09	−.08	.01	−.02	.02	.10	.05	.22	−.13	**.74**	.31	**.76**	.43
Minimizing Intervening Events 3	−.02	.11	−.09	.08	.01	−.12	.04	−.09	.23	**.48**	.45	**.72**	.49

The values in bold represent the factor loadings of the items corresponding to each subscale

SD size distortion, *SC* space compression, *TC* time compression, *PMC* physically moving closer, *ALLA* all-at-once distortion, *RT* rapid time, *ST* slowing time, *OD* odds distortion, *MCT* minimizing coping time, *MIE* minimizing intervening events

comparison with the bifactor CFA model (ΔRMSEA = 0.025; ΔTLI = 0.037; ΔCFI = 0.044). As can be seen in Table 3, in the bifactor CFA model, factor loadings supported the existence of a strong general factor of looming distortions (|λ| range: 0.49–0.74, $M = 0.64$). Factor loadings for specific subscales were poorer (|λ| range: 0.01–0.79, $M = 0.38$), suggesting that the general factor accounted for the majority of the variance of several items in the LVDQ. In the bifactor ESEM model all factor loadings on the general factor were adequate (|λ| range: 0.52–0.75, $M = 0.63$). As in the ESEM model, factor loadings on the specific subscales were lower (|λ| range: −0.18 to 0.77, $M = 0.38$). In short, these results suggest that, for most purposes, the bifactor ESEM model is preferable because, unlike the ESEM model, it allows for the reporting of scores for both the general and the specific subscales of the LVDQ.

Table 4 shows the omega coefficients for the bifactor models. Except for the Size Distortion subscale, all ω and ωs values were greater than 0.70, indicating that the proportion of the variance of both the general and specific factors explained by all common sources of variance was high. The hierarchical ω was high only for the general factor, whereas the ωhs values were low (< 0.50), indicating that the reliability of the specific subscales was low once the variance of the general factor was controlled. In both models, H values were greater than 0.70 for the general factor but not for the specific subscales. Therefore, replicability between samples was supported only for the general factor. Finally, the PUC

Table 3 Bifactor ESEM and CFA models in subsample 1

	Bifactor ESEM												Bifactor CFA		
	G	SD	SC	TC	PMC	ALLA	RT	ST	OD	MCT	MIE	Uniqueness	G	S	Uniqueness
Size Distortion 1	**.50**	**.35**	.06	.10	.13	.03	−.10	.00	.05	.08	.06	.58	**.53**	.32	.62
Size Distortion 2	**.54**	**.43**	.24	−.05	−.02	.02	.04	−.02	.01	−.01	.04	.45	**.56**	.54	.40
Size Distortion 3	**.62**	**.23**	−.22	−.07	−.12	−.09	−.02	−.07	−.18	−.11	−.04	.44	**.57**	.07	.67
Space Compression 1	**.59**	.08	**.27**	.00	.16	−.02	.00	−.09	.05	−.01	−.04	.54	**.58**	.30	.66
Space Compression 2	**.59**	.16	**.62**	−.02	.05	−.04	.01	−.04	.05	−.02	−.02	.23	**.60**	.53	.61
Space Compression 3	**.75**	.24	**−.18**	−.06	−.06	−.17	.02	−.12	−.11	−.10	−.20	.24	**.69**	.13	.52
Time Compression 1	**.60**	.01	.03	**.47**	.03	.12	.05	.00	.02	.02	−.05	.40	**.62**	.68	.16
Time Compression 2	**.59**	.11	.01	**.44**	−.08	.16	.13	.01	.13	−.01	.03	.39	**.63**	.30	.51
Time Compression 3	**.66**	−.19	−.06	**.30**	−.04	−.03	−.19	−.14	−.10	.02	−.13	.35	**.61**	.21	.58
Physically Moving Closer 1	**.49**	.01	.10	.02	**.77**	.03	−.11	.03	−.06	−.01	.04	.14	**.49**	.72	.24
Physically Moving Closer 2	**.58**	.04	.06	−.07	**.36**	.08	.23	.03	.05	.06	.04	.46	**.61**	.34	.51
Physically Moving Closer 3	**.64**	−.04	−.05	−.08	**.32**	.06	−.08	−.05	−.08	−.03	−.07	.46	**.61**	.34	.51
All-At-Once Distortion 1	**.67**	.10	.00	.12	.06	**.58**	.08	.02	−.01	.00	.01	.17	**.70**	.62	.13
All-At-Once Distortion 2	**.66**	.03	−.04	.10	.12	**.50**	.13	−.01	.06	.04	.04	.27	**.69**	.45	.32
All-At-Once Distortion 3	**.71**	−.20	.04	.00	−.06	**.37**	−.15	.00	−.08	−.12	−.09	.26	**.67**	.31	.46
Rapid Time 1	**.66**	−.04	−.03	.07	.05	.06	**.40**	.03	.02	.04	.03	.40	**.68**	.22	.50
Rapid Time 2	**.74**	−.03	.03	−.01	−.11	.07	**.44**	−.03	.03	−.04	.00	.23	**.74**	.79	.18
Rapid Time 3	**.72**	−.17	−.04	.04	.06	−.11	**.04**	−.10	−.16	−.08	.03	.39	**.68**	.01	.54
Slowing Time 1	**.66**	.08	−.08	.13	.04	.00	.09	**.44**	.03	.05	−.01	.34	**.68**	.40	.38
Slowing Time 2	**.62**	.01	−.03	−.05	−.04	.00	.17	**.50**	.05	.03	.16	.31	**.65**	.49	.35
Slowing Time 3	**.52**	−.13	.05	−.14	.04	.02	−.26	**.47**	.10	.09	.00	.38	**.51**	.39	.59
Odds Distortion 1	**.60**	−.04	.14	.11	−.01	−.02	.03	.10	**.31**	.13	.17	.45	**.64**	.33	.48
Odds Distortion 2	**.68**	.03	.03	.00	−.04	.01	.05	.06	**.67**	.01	.03	.08	**.70**	.57	.19
Odds Distortion 3	**.64**	−.14	.00	.01	−.10	−.02	−.08	.06	**.22**	−.07	−.03	.50	**.62**	.26	.56
Minimizing Coping Time 1	**.65**	.02	−.06	.05	.05	−.13	−.17	.07	−.03	**.30**	.05	.43	**.64**	.29	.51
Minimizing Coping Time 2	**.73**	−.02	.07	−.04	.02	.00	.06	.09	.04	**.58**	.00	.12	**.74**	.50	.20
Minimizing Coping Time 3	**.72**	.04	−.09	.05	−.08	.04	.08	.05	.09	**.26**	.04	.39	**.73**	.25	.40
Minimizing Intervening Events 1	**.66**	.05	.00	−.03	.14	−.01	−.01	.08	.02	.09	**.44**	.34	**.69**	.44	.34
Minimizing Intervening Events 2	**.64**	.02	.07	−.01	−.07	−.01	.08	.09	.13	−.06	**.50**	.30	**.66**	.40	.40
Minimizing Intervening Events 3	**.66**	−.01	−.13	−.17	−.03	.02	−.14	−.03	−.04	.08	**.19**	.45	**.64**	.20	.55

The values in bold represent the factor loadings of the items corresponding to each subscale

SD size distortion, *SC* space compression, *TC* time compression, *PMC Physically Moving Closer*, *ALLA* all-at-once distortion, *RT* rapid time, *ST* slowing time, *OD* odds distortion, *MCT* minimizing coping time, *MIE* minimizing intervening events

and ECV values tended to be high (> 0.70), indicating that the use of a general score for the LVDQ was appropriate.

Importantly, all models were next estimated in subsample 2. The results, which are displayed in Table 1, replicated the excellent psychometric characteristics of the LVDQ obtained in subsample 1. Finally, examined two additional structural models that focus on three LVD domains: social, achievement, and physical. The first is a three-factor CFA model (S1), and the second is a hierarchical CFA model in which a general factor explains the scores of the three specific domains (S2). Because of space constraints, we offer only a brief summary of these results; however, the corresponding tables and figures are provided in the Supplemental Materials. Both models obtained excellent fit indices and high factor loadings. α coefficients for the social, achievement, and physical domains were ranged between 0.87 and 0.90 in both subsamples. These models can be useful to clinicians and researchers interested in specific anxiety problems.

Associations Between LVDQ Scores and Other Variables

After establishing the robustness and reliability of the general looming vulnerability distortions factor, we examined whether the scores could explain a unique, distinct portion of variance in anxiety and related constructs not accounted for by either the CDS measure of the familiar cognitive distortions in logic or social desirability responding. To

Table 4 Omega coefficients for bifactor models

	ω or ωS	ωH or ωHS	H	ECV	PUC
Bifactor ESEM					
General	.97	.93	.96	.69	.93
Size distortion	.67	.19	.30		
Space compression	.77	.09	.42		
Time compression	.78	.24	.38		
Threats physically moving closer	.81	.35	.63		
All-at-once distortion	.88	.29	.50		
Rapid time	.82	.10	.30		
Slowing time	.81	.31	.46		
Rapidly rising odds distortion	.81	.23	.49		
Minimizing coping time	.85	.19	.40		
Minimizing intervening events	.81	.20	.38		
Bifactor CFA					
General	.97	.94	.96	.70	.93
Size distortion	.68	.16	.35		
Space compression	.75	.16	.34		
Time compression	.80	.23	.50		
Threats physically moving closer	.79	.32	.57		
All-at-once distortion	.87	.27	.50		
Rapid time	.86	.17	.63		
Slowing time	.79	.26	.41		
Rapidly rising odds distortion	.81	.21	.40		
Minimizing coping time	.83	.16	.33		
Minimizing intervening events	.80	.17	.32		

Table 5 Associations between the looming vulnerability distortions questionnaire and indicators of anxiety, depression, hostility, and other cognitive vulnerabilities

	Estimate	S.E	Est./S.E	*P*-value
Worry				
LVDQ	0.21	0.05	4.53	< .001
CDQ	0.42	0.04	9.86	< .001
Social desirability	0.07	0.04	1.72	.085
Hostility				
LVDQ	0.19	0.06	3.08	.002
CDQ	0.25	0.06	4.51	< .001
Social desirability	0.09	0.04	2.12	.034
BSI-anxiety				
LVDQ	0.27	0.05	5.33	< .001
CDQ	0.33	0.05	6.22	< .001
Social desirability	0.05	0.04	1.36	.174
BAI-anxiety				
LVDQ	0.27	0.06	4.67	< .001
CDQ	0.34	0.05	6.24	< .001
Social desirability	0.06	0.04	1.63	.102
BSI-depression				
LVDQ	0.18	0.05	3.29	.001
CDQ	0.38	0.05	7.14	< .001
Social desirability	0.07	0.04	1.79	.074
LMSQ-R				
LVDQ	0.31	0.05	5.70	< .001
CDQ	0.25	0.05	5.22	< .001
Social desirability	0.09	0.04	2.34	.019
Uncertainty				
LVDQ	0.23	0.05	5.23	< .001
CDQ	0.46	0.05	10.22	< .001
Social desirability	0.06	0.04	1.77	.077

Standardized coefficients are displayed

LVDQ looming vulnerability distortions questionnaire, *CDQ* cognitive distortions scale, *BSI* brief symptom inventory, *BAI* beck anxiety inventory, *LMSQ* looming maladaptive style questionnaire-revised

this effect, we saved the factor scores obtained in the bifactor ESEM model and, using path analysis, estimated associations between the scores on the general looming distortions factor and the numerous indicators (looming cognitive style, anxiety and depressive symptoms, hostility, worry, and uncertainty). Scores for social desirability and CDS were also included in the model as predictors. The results indicated that the general looming vulnerability distortions factor was significantly associated with all indicators. The model displayed excellent fit indices [$\chi 2$ (8, $n = 510$) = 8.40; RMSEA = 0.010 (0.000–0.053); CFI = 1.000; TLI = 0.999]. Table 5 displays the regression coefficients of the model. Correlation coefficients between the study variables and their descriptive statistics are provided in the Supplementary Materials (S3). All correlation coefficients were statistically significant, and the total score of the LVDQ showed high correlations with the rest of the variables. Correlation coefficients between the subscales of the LVDQ and the CDS are included in S4. The coefficients were all statistically significant, with medium to high values.

Associations Between LVDQ Scores and Lab-Based Measure

Then, we looked at whether the perceptual distortions assessed by the questionnaire items on the LVDQ and the LCS predicted the perceptual distortions on the lab-based cross-validation task. Evidence for the cross-validation task can be seen in its consistent significant correlations with anxiety and the anxiety-related constructs. For instance, the correlation coefficients were 0.50, 0.35, and 0.33, with the LCS, worry, and BAI-Anxiety (see Supplemental Table S5). We conducted a regression model to determine whether the

LVDQ and LCS scores explained the scores obtained in the lab-based cross-validation task. The first step of the model included all of, the variables of the study as predictors except for the LVDQ (i.e., depressive and anxiety symptoms, worry, hostility, uncertainty, social desirability, looming cognitive style, and logical errors on the CDS) and accounted for significant variance in scores on the cross-validation task (31%). Of the predictors, only the other measures of "distortions," the CDS ($\beta = 0.15$, $t = 2.49$, $p = 0.013$) and LMSQ ($\beta = 0.38$, $t = 7.66$, $p < 0.001$), were significant unique predictors. As expected, when, the LVDQ was added as predictor in the second step of the model, only the LVDQ ($\beta = 0.33$, $t = 6.23$, $p < 0.001$) and the LMSQ ($\beta = 0.33$, $t = 6.60$, $p < 0.001$) were significantly associated with the score on the cross-validation task. Hence, CDS was no longer significantly associated with the cross-validation task when LVDQ was included in the model. The final model explained 36% of the variance of the cross-validation task score.

Considered together, the present findings provide evidence that the LVDQ scores make a unique distinct contribution to variance in emotional variability, irrespective of other anxiety-linked distortions. Furthermore, they demonstrate a robust relationship between the LVDQ questionnaire items and the face-valid lab-based measure of looming vulnerability distortions.

Discussion

The current study developed and psychometrically validated the "Looming Vulnerability Distortions Questionnaire," (i.e., LVDQ) a self-report assessment of cognitive-perceptual threat distortions that create the perception that the danger is dynamic and rapidly approaching and escalating in risk and urgency (or "looming"). A key feature of this new measure is that it measures perceptual distortions rather than logical distortions.

This study confirmed the excellent psychometric characteristics of the LVDQ, which were replicated on a second independent subsample. Consistent with expectations of the looming vulnerability model, the results support the validity of the LVDQ and these dynamic cognitive-perceptual distortions and of the LVDQ as representing a novel and unique construct. The LVDQ accounted for unique variance in anxiety and related constructs, as well as scores on the face-valid cross-validation.

The psychometric properties of the LVDQ were evaluated by a series of factor analyses. The results supported a bifactor ESEM model where a general factor for looming vulnerability distortions is interpretable and accounts for the majority of the variance. As expected, these results reflected a general tendency for people who report some of the perceptual (i.e., looming vulnerability) distortions to exhibit many others. The excellent fit indices of the bifactor model and the excellent reliability of the general looming vulnerability distortions score justify its use. In addition, a conventional CFA supported individual scores for each perceptual distortion on the LVDQ. The subscales for the individual distortions had adequate ordinal alpha coefficients and may conceivably prove to be useful in research or clinical settings when there is interest in identifying or addressing specific perceptual distortion. Furthermore, adequate fit indices and excellent reliability indices were also found for additional domain analyses of the LVDQ that were provided as supplemental owing to space limitations. These domain analyses were replicated in both subsamples, and we think that the support for these domain analyses can be useful for clinicians.

The results revealed that the general score on the LVDQ was strongly associated with the LCS, anxiety, and worry, as well as with the logical errors (such as jumping to conclusions, black-white thinking, catastrophizing) on the CDS (Covin et al., 2011). Of note, we purposely adopted the same structure and self-report format as the CDS to more stringently investigate whether looming vulnerability to threat distortions add anything incrementally to the assessment of cognitive distortions in anxiety. We defined each distortion in the measure, provided examples from several domains (e.g., social, achievement), and asked participants to assess their likelihood of expressing that reaction. The critical difference in the measures is that the LVDQ incorporated cognitive-perceptual and phenomenological threat distortions rather than logical errors; also, we enlarged the LVDQ's scope by introducing a third target domain (apart from accomplishment and social) for physical dangers not captured on the CDS.

Despite the common method variance and the strong correlation discovered between the LVDQ and the CDS, the findings revealed that the LVDQ accounts for a significant and unique portion of the variance in anxiety, worry, depression, and hostility that the CDS does not. In combination with this finding, to cross-validate the LVDQ, we additionally incorporated a face-valid lab-based task to measure looming vulnerability threat distortions. We found consistent significant links between the score on the cross-validation task and all anxiety related variables and, in the regression model, where all the variables were included as predictors of that score, only the LCS (LMSQ) and the LVDQ remained significantly associated with the cross-validation task. Thus, consistent with theoretical expectations, the general score for looming vulnerability distortions on the LVDQ as well as the LCS both accounted for significant unique variance in the overall score on the face-valid lab-based task; this contrasted sharply with the scores for the CDS logical errors of distortions in reasoning, as well as intolerance of uncertainty, anxiety, and worry, which did not predict significant unique variance on the lab-based task (beyond the variance explained by the LVDQ and LCS).

Theoretical Considerations

Consistent with the looming vulnerability model, the results are in accord with the proposition that the dynamic aspects of threat are a crucial component of threat appraisal. This significantly extends the scope of the potential content that cognitive models explicitly target, which have largely assumed that threat is defined by judgements about parameters such as probability (or certainty, cost, and proximity) (e.g., Carr, 1974; Foa & Kozak, 1986; Rapee & Heimberg, 1997; Clark & Beck, 2010). By contrast, the looming vulnerability paradigm is unique from other models in emphasizing that this almost universally accepted set of acknowledged threat parameters such as the likelihood and severity or proximity are not always the same; rather, threats are "moving targets" that must increase in proximity and move towards greater certainty to bring about harm. Therefore, the perception that threats are dynamic and approaching in space and time and rising in risk and urgency are a critical source of information and of potential alarm and warning signals.

The current results are also in accordance with the looming vulnerability model's hypothesis that the LCS, which is a putative core aspect of cognitive vulnerability, is linked to a suite of interrelated cognitive-perceptual distortions. Consistent with this idea, individuals with higher scores on the LCS were more likely to report cognitive-perceptual distortions on the LVDQ and lab-based task of threats as physically larger and closer in space and time, as dynamic and moving towards them, as coming all at once, and as coming too quickly to deploy effective responses to cope.

Moreover, in line with the idea that the perceptual distortions are unique and nonredundant with logical distortions, the LCS and LVDQ independently predicted a significant portion of variance in anxiety. The influence of perceived dynamic parameters of threat are compatible with a large amount of empirical data from the clinical and social cognitive literatures, as well as the animal and cognitive neuroscience literatures. In addition, there are multiple studies using lab-based tasks that have repeatedly reported them (e.g., Langer et al., 1961; Rachman & Cuk, 1992; Bar-Haim et al., 2010; Leibovich et al., 2016; Shiban et al., 2016; Givon-Benjio & Okon-Singer, 2020).

Despite the relative paucity of evidence at the current time that perceptual distortions measured by the LVDQ as well as those on lab-based tasks have any direct causal impact on anxiety and fear, there is substantial evidence that indicates that mental images have emotional impact (Holmes & Mathews, 2010; Shafir et al., 2013; Ji et al., 2016). Furthermore, Davis et al. (2011) found that teaching people to imagine unpleasant stimuli as expanding and approaching caused them to have more negative emotional reactions than picturing them as static or as shrinking and moving away. These effects were the same as those observed in other studies (e.g., Muhlberger et al. (2008); Davis et al., 2011), when experimentally altering the pictures' actual direction of motion. Likewise, video-clips of approaching spiders trigger greater anxiety and unique brain activation signatures than static or receding spiders (Riskind et al., 1992; Mobbs et al., 2010).

Future Research Questions

Future research investigating the LVDQ could benefit from exploring several interesting questions. For example, do perceptual distortions and estimation biases arise before and help drive subsequent distortions in logical reasoning or merely reflect them? Tentatively suggesting that perceptual distortions can sometimes come first, research has previously found that college students exhibited more primitive thinking during the week of an impending major exam than the previous week before the exam or after (Paulhus & Lim, 1994). Prospective investigations could explore this question as well as explore whether LVDQ distortions potentially contribute to inducing anxiety or whether they merely reflect anxiety symptoms.

As another example of future questions, a previous study by Katz et al. (2017) discovered that a 12-week standard CBT protocol reduced the LCS scores of anxiety disorder patients. Moreover, they found that after adjusting for pretreatment anxiety, LCS-change predicted end-treatment anxiety. Thus, future research could explore whether LVDQ distortions function as cognitive mediators or markers of therapeutic change. Another question that logically requires further attention is whether perceptual distortions on the LVDQ like time or space compression in social interaction versus physical threat situations differ by disorders (e.g., social anxiety versus panic, OCD, or simple phobias).

Regarding these issues, it should be noted that the LVDQ was not intended to measure every threat estimation bias or perceptual and phenomenological distortion. For instance, numerous studies have found that fear of heights is associated with an overestimation of the distance between the tops of buildings, balconies, or other high points and the ground (Teachman et al., 2008; Dreyer-Oren et al., 2019), whereas anxiety related to anorexia nervosa and body dysmorphic disorder may be related to perceptual distortions of body size or physical body characteristics (Feusner et al., 2011; Waldman et al., 2013). While many of these estimation biases may be seen as versions of the size distortion (where the greater the distance to the ground or the larger the size of a body component, the more threatening), the LVDQ clearly does not assess them. With that said, future studies could explore the possibility that many people with these disorders may have high LVDQ scores.

It could also be reasonable to question whether it is possible that a general tendency to perceive looming vulnerability distortions simply reflects the influence of underlying trait neuroticism. However, in four studies, Liu et al. (2013) found evidence that individuals with higher levels of neuroticism viewed rescheduled events as occurring further away in the future, and therefore as being more distant from the self's need to deal with them. In addition, they judged the sizes of words with varied font sizes to be smaller, even when negative in valence, and viewed words that appeared to shrink or expand to shrink faster than they expanded. Therefore, any effect of neuroticism in this study, which Lin et al. suggest is associated with "distancing" motivation, would have worked in the opposite direction than presently observed for the LVDQ.

Relation to Other Current Distortion Concepts and Related Constructs in Anxiety

Although there are several current measures of cognitive distortions, what makes the LVDQ unique is that it emphasizes the importance of perceptual and phenomenological distortions rather than in illogical reasoning. Current measures assume that anxiety and related disorders are heightened by distortions in logical reasoning such as "jumping to conclusions," "either-or" thinking, or "catastrophizing." We hypothesize that anxiety is not just influenced by such distortions in reasoning or in language-based cognitive representations, but by cognitive-perceptual distortions of threats that heighten the impression that they are rapidly increasing and coming, even when they aren't.

Recently, considerable attention has also been directed to estimation biases (Clerkin et al., 2009; Vasey et al., 2012; Witt & Sugovic, 2013; Leibovich et al., 2016; Shiban et al., 2016; Givon-Benjio & Okon-Singer, 2020), which are typically assessed with lab-based tasks. Even though such estimation biases aren't typically considered as logical thinking distortions, they are usually evaluated using discrete or separate disorder-specific tasks. Such estimation biases have not typically been thought of as parts of a more general tendency, as was found by the bi-factor analysis. However, such a general tendency would seem theoretically expected if it is assumed that perceptual threat distortions have a functional role in protecting individuals from keeping out of reach of possible dangers.

There has also been much attention to another line of research on the relationship between distortions in mental imagery and anxiety (Holmes & Mathews, 2010). In many circumstances, images are more vivid and disturbing if they are seen from a field perspective as if through the person's eyes instead of an external or observer perspective. It would be interesting to see whether looming vulnerability distortions are present in the disturbing mental imagery associated with anxiety, and if so, whether such distortions contribute to the vividness or negative impact of the imagery. A field perspective (viewing threats as if through the person's own eyes) would likely increase the perception of looming vulnerability, much as an observer perspective (seeing threat in the image from external perspective) might often reduce it. Likewise, a perception of looming vulnerability would also likely increase the tendency to take a first-person viewpoint.

Despite the intriguing and novel findings, the present study has limitations. First, generalizability of the findings is limited by the fact that it did not use a clinical sample with anxiety disorders and the sample was made up of undergraduate students at a university in the United States. Thus, future research in other cultures is needed but the present study sample was recruited from one of the most diverse institutions in the country and includes many international students. Nevertheless, future studies should examine the structure of the questionnaire in other samples, including clinical and gender-balanced samples.

While self-report measures might be influenced by social desirability, the current findings were obtained even when social desirability responding was controlled for. Additionally, we included a face-valid, "quasi-in-vivo" lab-based task to rule out that there may be substantial discrepancies between what people report about how they tend to perceive stimuli on the LVDQ and how they might actually experience these. While the results for this lab-tased task strongly supported the validity of the questionnaire items on the LVDQ, a caveat is that it still used a verbal response format and future studies could be done to replicate these findings using methods that do not require verbal self-reports. In addition, the lab-based task is also limited because we had no prior evidence for the task's validity. Nonetheless, as we have indicated, numerous independent studies utilizing lab-based nonverbal tasks and responses have demonstrated that anxiety and fear are associated with comparable threat estimation biases (Langer et al., 1961; 1965; Rachman & Cuk, 1992; Clerkin et al., 2009; Bar-Haim et al., 2010; Vasey et al., 2012; Witt & Sugovic, 2013; Leibovich et al., 2016; Shiban et al., 2016; Givon-Benjio & Okon-Singer, 2020). Thus, those studies lend indirect support to the LVDQ.

A further issue is that we did not examine the relevance, salience and imaginability of the various scenarios on the LVDQ to participants. In addition, the LVDQ assumes that the corresponding social, achievement and physical threat scenarios for each distortion subscale (e.g., time compression or rapidly rising odds) are sufficiently similar in other ways that they are equivalent. Other studies could explore this further in the future. However, it should be noted that the scenarios used in this questionnaire are typically elicitors of anxiety in people with anxiety problems and that in some ways they are similar to those used in other questionnaires that use multiple scenarios such as the CDS (Covin et al., 2011) Moreover, the use of scenarios is a usual method in numerous measures designed to assess cognitive and emotional vulnerabilities, such as social information processing (e.g., Crick & Dodge, 1996; Calvete et al., 2015) and inferential styles (Haeffel et al., 2008).

Despite these limitations the current study's results are novel and indicate that the LVDQ provides a promising and innovative new method for assessing cognitive- perceptual distortions in threat-overestimation in anxiety. Better understanding of the role of dynamic perceptual distortions in threat might help in developing cognitive models of anxiety and afford new possibilities for personalized assessment and treatment. Moreover, having an easy-to-administer and implement self-report assessment of such cognitive-perceptual distortions might be beneficial in research where a battery of lab-based experimental tasks is more difficult to perform. In addition, from a clinical standpoint, it may be necessary to assess the potential value of the LVDQ as a tool for treatment evaluation and the development of personalized assessment and treatment plans.

Appendix: LVDQ Questionnaire

Instructions:

In this questionnaire, we are studying different types of thinking that people have when are anxious or worry about situations. For every type of thinking listed below, there will be three examples–one dealing with social relationships, one dealing with personal achievement (in jobs, school, or career), and one dealing with physical threats. We would like you to do your best to read and understand what each of these types of thinking is like. You will be asked to estimate how often you engage in each type of thinking in the three categories described above (social, achievement, and physical). Please consider each of your answers carefully.

1. *__Size Distortion__

When people see something or someone that is possibly threatening or makes them uncomfortable (e.g., an angry boss, a spider, a stain on their shirt when in public), they sometimes perceive the threat to be physically larger or bigger in size than it is.

A. Social Situation Example. Clark sees a stain on his shirt when in public and sees the stain as much bigger than it actually is.

Please estimate how often you engage in size distortion when in social situations (like when you're with friends, partners, family or in public).

1 2 3 4 5 6 7

Never Sometimes All the Time

B. Achievement Situation Example. Jack is called into his boss' office to talk about a recent mistake that he just made. Jack sees his boss is much bigger in size than is true. Please estimate how often you engage in size distortion when in achievement situations (such as in school or work).

1 2 3 4 5 6 7

Never Sometimes All the Time

C. Physical Threat Situation. When Kelly sees a spider on the other side of the room, the spider seems much bigger in size than is true.

Please estimate how often you engage in size distortion when in when in situations that seem physically threatening.

1 2 3 4 5 6 7

Never Sometimes All the Time

2. *__Space Compression__

People sometimes perceive the amount of distance or physical space between themselves and something or someone that is threatening as being smaller and closer than it is.

To illustrate this, please read the following passages:

A. Social Situation Example. While at a party, Neil sees the romantic partner that he just broke-up with glaring angrily at him from 10 feet away. She looks like she is ready to start a fight and Neil sees her as standing much closer than is true.

Please estimate how often you engage in Space Compression when in social situations (like when you're with friends, partners, family or in public)).

1 2 3 4 5 6 7

Never Sometimes All the Time

B. Achievement Situation Example. Phil gets called into his boss' office to talk about Phil's recent mistakes. He experiences boss as sitting closer than is true.

Please estimate how often you engage in Space Compression when in achievement situations (such as in school or work).

1 2 3 4 5 6 7

Never Sometimes All the Time

C. Physical Threat Situation Example. When leaving her tent while camping, Nora sees a large snake. The snake is several yards away, but she sees it as being much closer than is true.

Please estimate how often you engage in Space Compression when in situations that seem physically threatening.

1 2 3 4 5 6 7

Never Sometimes All the Time

3. ***Misperceiving Threats as Physically Moving Closer**

People may see potentially threatening things as moving closer and physically approaching them when this is not the case.

A. Social Example. While grocery shopping, Beth sees someone who recently said ugly and insulting things to her. She sees the person as physically moving in her direction even though they aren't.

Please estimate how often you engage in the misperceiving threats as approaching distortion when in social situations (like when you're with friends, partners, family or in public)).

1 2 3 4 5 6 7

Never Sometimes All the Time

B. Achievement Example. Rick's boss moves into the hallway by his office as Rick is playing a game on his computer. Rick sees her as walking towards him more than is true.

Please estimate how often you engage in the misperceiving threats as approaching distortion when in achievement situations (such as in school or work).

1 2 3 4 5 6 7

Never Sometimes All the Time

C. Potential Physical Threat Example. When visiting a neighborhood park, Brad notices a large stray dog and is unsure whether it is dangerous. Brad sees it as moving closer to him more than is true.

Please estimate how often you engage in the misperceiving threats as approaching when in situations that seem physically threatening.

1 2 3 4 5 6 7

Never Sometimes All the Time

4. ***Time Compression**

People sometimes experience the closeness (or distance) in time between themselves and an event that is threatening to them as or that makes them uncomfortable as smaller than it is.

A. Social Situation Example. Monty just remembers that he has forgotten to get his good friend a gift for his wedding that is coming up in three weeks. Despite the fact that Monty has plenty of time, he experiences the wedding as if it were going to occur more soon than is true.

Please estimate how often you engage in time compression when in social situations (like when you're with friends, partners, family or in public)).

1	2	3	4	5	6	7
Never			Sometimes			All the Time

B. Achievement Situation Example. Erica has weeks to finish a project for work that is important to her career. Despite the fact that she has plenty of time, she experiences the deadline as it were only a week away.

Please estimate how often you engage in time compression when in achievement situations (such as in school or work).

1	2	3	4	5	6	7
Never			Sometimes			All the Time

C. Potential Physical Threat Example. Julia is terrified of flying and has an airplane flight ticket to fly in three weeks. Despite the three weeks, she experiences the date of her flight as if it were much closer than is true.

Please estimate how often you engage in time compression when in situations that seem physically threatening.

1	2	3	4	5	6	7
Never			Sometimes			All the Time

5. ***ALL-at-Once Distortion**

People may experience a number of independent or unique things that they are worried about in the future, as though they will come all at once.

A. Social Situation Example. Sarah has an important date with someone new next week, a party she needs to plan for her friend's graduation in a month, and a difficult visit with family members in six months. DESPITE the distance in time between the different events Sarah experiences them as if she has to deal with them all- at- once.
B. Achievement Situation Example. Larry has a work project due next week, a job review he's concerned about in a month, and is getting a new boss he doesn't know in six months. Despite the distance in time between the events, Larry feels as if he has to deal with all of the events at the same time.
C. Physical Threat Situation. Jonah will be going on a difficult fitness test he is nervous about during the next two weeks, a long and uncomfortable trip in a month, and major surgery in six months. In spite of the distance in time between the events, Jonah experiences the events as if he has to deal with them all at the same time.

6. ***Experiencing Times as Moving Faster Than It Is**

When confronted with a potentially threatening or unpleasant situation, people often experience time as passing far more quickly than is actually the case.

A. Social Situation Example. Jim agreed to speak at his best friend's wedding despite a fear of public speaking. As the date approaches, he feels like time is going by much faster than it is.
B. Achievement Situation Example. Jane could fail to make the course grade she needs if she doesn't get a good grade on an exam that is coming up. As she thinks about the coming exam, she experiences time as passing by faster than is true.
C. Physical Threat Situation. Jake is in the middle of the street and sees a car coming. Despite the fact that Jake

has plenty of time to get across the street to safety, he experiences time as passing by much faster than it is.

7. ***Odds Rising Too Rapidly**

People sometimes see the odds (or chances) of feared or dreaded things occurring as increasing faster than is true as the events approach.

A. Achievement Situation Example. Shelly waits for someone to arrive for their first date which starts in 20 min. As each minute passes, she feels more and more convinced that the date will probably go badly.
B. Becky is about to take a big exam in 30 min that she must pass to get a job. She has the skill, but as each minute passes she gets more convinced that she will probably fail.
C. Dan is waiting for test results that will determine whether or not he needs to go to the hospital for a painful surgery. As each minute passes while he waits, he becomes increasingly convinced that he will probably need the surgery.

8. ***Time Moving Too Slowly**

When facing threatening or uncomfortable situations, people may experience time as passing more slowly than appears natural, causing them to perceive time as practically stationary and standing still.

A. Social Situation Example. Diana has delivered some painful news to a friend. While waiting for the friend to respond, she experiences time as if is moving is standing still and moving in extreme slow motion.
B. Achievement Situation Example. While Andrew is waiting for a job interview to begin, he experiences time as if it is standing still and each moment as it is taking forever.
C. Physical Threat Situation. As Allison finds that her car is skidding and sliding on a wet road, see sees that she is just about to hit a bus. As she watches, she experiences time as if it is moving in extreme slow motion.

9. ***Minimizing Intervening Events**

When people worry that an event could happen in the future, they sometimes overlook many other factors that could affect the outcome.

A. Social Situation Example. Mark hears the beginnings of a rumor that could cause harm to his reputation. He doesn't consider that others may not hear the rumor or believe the rumor or keep spreading the rumor.
B. Achievement Situation Example. After failing her first-class exam, Anne feels she is sure to fail the whole class. She overlooks the fact that she would need to fail all her other exams and well as neglect all her future homework and final project to fail the course.
C. Physical Threat Situation. After Bailey hears about a house robbery nearby, she fears sure that the robber will break into her house. She doesn't consider that the there are many other houses in the neighborhood that the robber can break into, and that the robber can move on to other neighborhoods or caught soon.

10. ***Minimizing Coping Time**

People sometimes perceive that they don't have enough time to influence events when, in fact, they do.

A. Social Situation Example. Sally will host her sister's graduation party in a month. She has plenty of time but experiences herself as having less time than is true.
B. Achievement Situation Example. Sean has to pass an upcoming exam. Although he has plenty of time, he experiences self as having too little time to prepare.
C. Physical Threat Situation. Carla sees a large wasp at rest on the wall on the other side of the room. She has plenty of time to get away, but she experiences herself as not having enough time to do this.

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Conflict of Interest John H. Riskind and Esther Calvete declare that they have no conflict of interest.

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (national and institutional).

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