Chapter 17
Final Synthesis and Conclusions

An anxious person surely views threats as possible or even as likely to occur and to cause harm or damage. Cognitive models (Carr, 1974; Clark & Beck, 2010; Foa & Kozak, 1986; Rapee & Heimberg, 1997) have long set forth the key variables in anxiety as the person's judgments of probability, cost, proximity, or similar static forms of relevant dimensions of threat estimation. In addition to this, the looming vulnerability model (LVM) suggests that dynamic features are also of overriding importance. Perceptions of looming vulnerability constitute a very different kind of appraisal. Although they involve the same dimensions of appraisal, they concern the dynamic patterns of change in these dimensions.

There are two parts to this issue that the LVM raises. We suggest that while static judgments on these appraisal dimensions of probability, proximity, cost, etc. can contribute to anxiety, they represent a limited and lifeless extract. We do not dispute that these underlying appraisal *dimensions* are key to anxiety. Our disagreement concerns efforts to define threat solely in terms of static judgments on these dimensions. It could be argued that patterns of dynamic change on these appraisal dimensions are the defining attributes of threat appraisal that elicit anxiety, not the static judgments on the dimensions alone. Said otherwise, the LVM proposes that the dynamics of the motion and speed with which the threat is increasing provides additional information that influences anxiety beyond the probability or position of the threat.

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Our primary purpose in this chapter is to attempt to synthesize or pull together the diverse material we have presented throughout this volume. This material from interdisciplinary sources has supported the supposition that many circumstances that create anxiety are dynamic and that adaptive psychological mechanisms have evolved to address the dynamic elements of threat. In addition, it has supported the idea that standard CT/CBT models have overlooked the importance of the dynamic elements of threat and can be improved by incorporating these theoretical features of threat. To this end, we presented considerable evidence from many intersecting lines of theoretical and empirical work and argued that the LVM has implications for understanding anxiety and anxiety disorders, cognitive vulnerability, and treatment.

There Is a Dynamic Element to Threat

The things that people fear facing in their lives have dynamic features. People are afraid of spiders crawling toward them. They worry about deadlines coming closer. They are afraid of rapid social rejections or rapidly spreading rumors. They are concerned about fires breaking out in electric circuits and spreading. They are concerned about contaminants spreading or diseases spreading. They worry about cancers growing wi*thin* us. Beyond that, it is more generally true that across the entirety of the animal kingdom, dynamic approaching objects evoke defensive reactions.

Response to Dynamic Elements as an Evolved Psychological Adaptation

As mentioned previously, it seems obvious that the foregoing observations must be related to anxiety and anxiety disorders, but how? The LVM suggests that a person's anxiety derives in great part from perceptions of rapid gains in dynamic *growing* threat. Put differently, the dynamics of the motion provides additional information to rouse anxiety beyond the probability or position of the threat. Human cognition itself has its roots in basic sensory systems and perceptual processes (Fodor, 1972, 1976; Freyd, 1987; Shepard, 1981; Shepard & Podgomy, 1978) that are designed to be sensitive to dynamic objects, motion and change. Moreover, a general principle of neural organization is that neural circuity that originally functioned for some purposes are conserved and adapted for other functions during the course of evolution (Anderson, 2010; Anderson, 2016). As a result, humans are inherently constructed to perceive and think about threats in dynamic terms (see Chap. 3). Add to this the fact that early experiences with the dynamic properties of the world provide a scaffolding or superstructure for thought (Lakoff, 2015; Williams & Bargh, 2008).

The LVM Differs from Other Contemporary CT/CBT Models

The LVM differs from other contemporary CT/CBT models in at least two closely interrelated and fundamental ways. These include the fact that the LVM emphasizes the role of a person's perceptions (simulations and imaginings) of patterns of change involving dynamic gains in growing threats. Moreover, these perceptions and simulations usually involve visual and sensorimotor processing of dynamic elements of threats and dynamic gains.

As mentioned, contemporary CT/CBT models have failed to explore or consider the role of dynamic features. In this sense, there has been an interdisciplinary divide between CT/CBT models and other fields in recognizing the central role of the dynamism, movement, and change of stimuli for perceptual and cognitive processes and behavioral responses. Unlike CT/CBT models, researchers in many adjoining fields have fully recognized the distinct additional importance of the kinetic dynamic properties of stimuli. These include fields studying: (1) wildlife behavior (Chap. 2), (2) defensive neural circuits responding to looming stimuli (Chap. 4), (3) basic cognitive and perceptual processes (see Chap. 6) such as attention and memory, (4) social cognition (see Chap. 8; e.g., Aspinwall & Taylor, 1997; Taylor, Pham, Rivkin, & Armor, 1998), and (5) emotion (Chap. 6, e.g., Baumeister & Bratslavsky, 1999; Ortony, Clore, & Collins, 1988; Scherer & Brosch, 2009).

Contemporary CT/CBT models overlook the fact that to protect themselves, all organisms must determine in some way whether threat is approaching or gaining, as opposed to static, or receding. As noted, a second related concern is, they disconnect the person's judgments from his/her visual and sensorimotor processing that embody perceptual experiences of rapid dynamic gains.

In addition, a further limitation of these contemporary models is that they define maladaptive cognitions as differing from the "realistic" judgments of an idealized "rational" person. While this view is partially derived from rational choice models in classical economics, it has become clear it lacks verisimilitude to how human judgment works. As demonstrated by work on cognitive biases in the human judgment of risk (e.g., Kahneman, 2011; Kahneman & Tversky, 1979), people are not intrinsically rational. Despite the considerable progress that CT/CBT approaches have made in understanding and treating anxiety disorders, they remain unnecessarily impoverished because they underestimate the similarities between humans and other organisms.

Across the animal kingdom, warning signals of danger are provided by an organism's sensory perceptions that potential threats are *making rapid dynamic gains i*n their proximity, size, or intensity over their previous levels (Chap. 2). Human anxiety doesn't simply derive from the proximity or probability of a threatening event or object but is also evoked by the perception that these or other aspects of threat are rising and gaining. Like other animals, moreover, the judgments that evoke human anxiety responses to threat involve *visual or other sensorimotor* processing of patterns of change and dynamic gains.

General Theoretical Implications of the LVM

The dynamic features of possible emergent threats are suggested to play potential roles in: (1) information processing in attention, memory, and threat appraisal; (2) physiological reactions and neural defense circuits; (3) affective reactions; (4) behavioral reactions.

As we demonstrated in Chap. 6, dynamic objects not only capture attention better than static objects but are also better remembered. Moreover, increases in perceived threat have potential effects on multiple psychological systems. We proposed that at each separate increase in threat, the threat re-establishes and maintains its salience and re-engages a person's attention. In addition, each separate increase reconfirms that the threat must be reckoned with and heightens its behavioral urgency. As mentioned in Chap. 5, the impact of dynamic patterns of change and gains in threats is compounded further by the fact that people extrapolate from information at hand to evaluate future threat. Put another way, it is easier for individuals to imagine the process by which the negative outcome will actually happen when there is some perception of dynamic gain or progression. In effect, the perception (or mental simulation) of rapid dynamic gains in threats makes it easier for a person to "fast-forward" to imagine and extrapolate that the negative event will occur. In contrast, when taken out of a pattern of context of implicit dynamic gain, an unchanging probability or proximity of an outcome is more difficult to extrapolate to the outcome happening.

We suggest that perceptions of patterns of change and rapid dynamic gains have effects on central etiological pathways in anxiety. One key output is in emotional reactions. As previously mentioned, contemporary CBT/CT models predict that two threats of equal magnitude (e.g., in terms of the current simple proximity or probability of a threat) would generate equal levels of anxiety or fear, even if one threat is dynamically gaining and the other is not. Drawing on emotions theories (e.g., Baumeister & Bratslavsky, 1999; Ortony et al., 1988; Scherer & Brosch, 2009), Helson's (1964) theory of adaptations levels, and other research (Chaps. 3 and 4), the LVM posits that dynamic change is a necessary condition for a more intense and sustained perception of threat.

Converging lines of evidence we have presented throughout this volume have provided abundant support for the proposed importance of perceptions of dynamic patterns of change and rapid gains in potentially emergent threats for anxiety. Few CT/CBT models have considered any of these different interlocking streams of literature. The LVM integrates them into a theoretically coherent and unified formulation that affords a more complete understanding of anxiety and the evolutionary origins of its cognitive underpinnings. Moreover, it not only helps to take account of and integrate these diverse lines of prior investigation, but also stimulates a program of research that generates new findings.

The evidence we have presented shows that perceptions of dynamic features of stimuli influence: (a) initial orienting responses and attentional capture (Chap. 6; e.g., Franconeri & Simons, 2003; Parker & Alais, 2006), (b) memory (Chap. 6; e.g., Buratto, Matthews, & Lamberts, 2009; Lander, Christie, & Bruce, 1999), (c) threat appraisals and perceptual distortions (Chap. 5; e.g., Pietri, Fazio, & Shook, 2012; Riskind, Kelly, Moore, Harman, & Gaines, 1992), and (d) affective reactions (Chaps. 5 and 7; e.g., Davis, Gross, & Ochsner, 2011; Hsee, Tu, Lu, & Ruan, 2014); Mobbs et al., 2010; Riskind et al., 1992).

Moreover, the link between dynamic features, vigilance and perceptual processes, and fear is supported by other studies. Auditory looming studies have revealed that tendencies to overestimate the closeness of approaching sound sources (e.g., Neuhoff, 2001) are stronger in individuals who are anxious or fearful (Riskind, Kleiman, Seifritz, & Neuhoff, 2014; Vagnoni, Lourenco, & Longo, 2012), less physically fit (Neuhoff, Long, & Worthington, 2012), female rather than male (Neuhoff, Planisek, & Seifritz, 2009), and hampered by an additional cognitive load (memorizing a seven digit number) (McGuire, Gillath, & Vitevitch, 2016). A stronger auditory looming response is observed when an approaching sound source signals potential danger (Riskind et al., 2014) such as the approach of an image of a spider as compared to a bunny rabbit (Labos & Neuhoff, 2014). Moreover, these findings converge with observations that animals in the wild (which are exposed to greater physical danger) tend to initiate flight in response to approaching objects sooner than domesticated animals (Stankowich & Blumstein, 2005).

Research has also provided abundant evidence that manipulations of dynamic approach movement have effects on negative affect, anxiety, and fear. Moreover, it has demonstrated that the effect extends to phobic stimuli such as tarantulas (Davis et al., 2011; Dorfan & Woody, 2006; Mobbs et al., 2010; Mühlberger, Neumann, Wieser, & Pauli, 2008; Riskind et al., 1992; Riskind & Maddux, 1993; Riskind, Wheeler, & Picerno, 1997) as well as to a variety of negative images or aversive stimuli, and even positive stimuli (Hsee et al., 2014; Mühlberger et al., 2008; Tajadura-Jiménez, Väljamäe, Asutay, & Västfjäll, 2010).

Research was presented that suggests that individuals don't necessarily become more anxious simply because they are at closer proximity to threats (Andrews, Freed, & Teeson, 1994; Poulton & Andrews, 1994; Rachman, 1994) and don't have a good intuitive grasp of probabilities (probability neglect; Sunstein, 2002; Sunstein & Zeckhauser, 2010). To the contrary, theoretical and empirical work on the "probability neglect" phenomenon has indicated that enormous differences in the probabilities of negative outcomes have relatively little effect on how individuals assess risk, and this is even more true when negative consequences or emotional reactions are high (Chap. 5; e.g., Bankhart & Elliott, 1974; Monat, Averill, & Lazarus, 1972; Slovic, Monahan, & MacGregor, 2000). In conjunction with this, we presented evidence in Chap. 5 that dynamic increases in probability and proximity have significant, distinct importance beyond the effects of probabilities or proximities alone (Hsee et al., 2014; Mobbs et al., 2010).

In line with the LVM, fears of spiders, contamination, rejection, disease, or other threats are associated with tendencies to simulate and overestimate the extent that the threats are rapidly dynamically gaining and increasing in probability and proximity, over their prior levels (Dorfan & Woody, 2006; Hsee et al., 2014; Riskind, Rector, & Cassin, 2011; Tolin, Worhunsky, & Maltby, 2004). As we will reiterate, a maladaptive “looming cognitive style” (LCS) has also been studied in scores of studies that document that it correlates with and predicts future liability to anxiety symptom changes (Adler & Strunk, 2010; González-Díez, Orue, & Calvete, 2016; Riskind, Tzur, Williams, Mann, & Shahar, 2007; Sica et al., 2012).

Implications of the LVM for Understanding Anxiety Disorders

The LVM has implications for improving the ecological validity of contemporary conceptualization of anxiety and anxiety disorders. Adaptive mechanisms that are applied inflexibly can lead to dysfunctional behavior. A temporary freezing response, for example, can help organisms to escape detection from predators as well as allow them to assess the magnitude of danger and their available coping options (Hagenaars, Oitzl, & Roelofs, 2014). Sagliano, Cappuccio, Trojano, and Conson (2014) showed that such adaptive freezing responses are more likely when individuals are exposed to approaching threats (images of threatening animals presented as approaching). However, Riskind, Sagliano, Trojano, and Conson (2016) showed that when individuals have the LCS for physical danger, and characteristically tend to exaggerate the dynamic approach of threats, they tend to respond with maladaptive and excessive freezing reactions. Namely, these cognitively vulnerable individuals tended to “freeze up” and respond with slower reaction times even if they are presented with stimuli that are nonthreatening or even receding. Perhaps a similar point can be made about other defensive responses such as worry and thought suppression.

Implications of the LVM for Understanding Cognitive Vulnerability

The LVM proposes that some people more than others are predisposed to anxiety because they develop the LCS. The LCS is a cognitive vulnerability construct associated with the LVM that was introduced to capture unique aspect of cognitive vulnerability and to help address gaps in current cognitive models of anxiety. Individuals who are cognitively vulnerable with the LCS are biased to overestimate higher-order dynamic properties of threat. The LCS leads them to interpret ambiguous and potentially emergent threats and to perceive mental simulations of threats as dynamically growing, approaching, and rapidly rising in risk.

As we have seen, the LCS has consistently been shown to cross-sectionally correlate with anxiety (Chaps. 8–10) and predict future liability to anxiety symptom changes over periods ranging from 1 week to 6 months (González-Díez et al., 2016; Riskind et al., 2007; Sica et al., 2012), and particularly after the occurrence of negative life events (Adler & Strunk, 2010). Further, the LCS is elevated in anxiety disorders (Riskind et al., 2011; Riskind & Williams, 2006) and increments the prediction of anxiety and memory and interpretative biases for threat information, above and beyond the effects of anxiety sensitivity, intolerance of uncertainty, general distress, and neuroticism (Elwood, Riskind, & Olatunji, 2011; Reardon & Williams, 2007; Riskind et al., 2007). Thus, research using cross-sectional, prospective, and lab-based experimental tasks have shown that it has promise in better understanding anxiety.

The LCS has been shown to predispose individuals to anxiety after exposure to negative environmental stimuli or life events (Chap. 8; e.g., Adler & Strunk, 2010; Williams, 2002). Further, the LCS prospectively predicts increases in levels of general anxiety, worry, social anxiety, and OCD symptoms (after adjusting for initial symptom levels) at future distances ranging from intervals of 7 days to up to 6 months. Consistent with expectations, the LCS as well as specific looming vulnerability themes has been shown to be elevated in anxiety disorders (see Chap. 9; Riskind et al., 2011; Riskind & Williams, 2006).

There is also evidence that the LCS can also lead to a state of greater behavioral urgency, and influence self-protective reactions including freezing and affect avoidance (Riskind et al., 2016; Riskind & Kleiman, 2012). Further, LCS can contribute to a cascade of negative reactions to threat in which LCS predicts increases in anxiety, and anxiety about salient threats increases LCS (Chap. 9). Furthermore, LCS may also lead to maladaptive behaviors such as stress generation (Kleiman & Riskind, 2013; Riskind, Black, & Shahar, 2010; Riskind, Kleiman, Weingarden, & Danvers, 2013).

As we have seen, there is evidence that the LCS can derive from antecedent developmental experiences such as early parenting, attachment patterns, and parental emotional abuse (Chap. 8; González-Díez et al., 2016). Moreover, paternal LCS may particularly contribute to intergenerational transmission of anxiety in college students (Riskind, Sica, Bottesi, Ghisi, & Kashdan, 2017).

Notably, the LCS may be associated not only with a predisposition to experience higher anxiety, but when mental depletion or hopelessness about evading negative events occurs, it may also be associated with anxiety-depression comorbidity (Chap. 8; Hong et al., 2017; Tzur-Bitan, Meiran, Steinberg, & Shahar, 2012). For example, cancer patients with leukemia have more depression as well as anxiety when they have the LCS (Levin, Li, & Riskind, 2007). For another example, the looming cognitive style can contribute to depression when individuals also have a depressive explanatory style (Kleiman & Riskind, 2012). The work on the LCS encourages further attention to whether disorder-specific cognitive factors can help to differentiate anxiety from depression as well as help to explain their comorbidity. For example, perseverative negative thinking and rumination appear to cross diagnostic lines and are associated with both disorders and syndromes (Ehring & Watkins, 2008; McEvoy, Watson, Watkins, & Nathan, 2013; McLaughlin & Nolen-Hoeksema, 2011; Muris, Roelof, Rassin, Franken, & Mayer, 2005).

A great deal of recent work in the field has emphasized the transdiagnostic processes that cross supposed boundaries between anxiety and depression or different subtypes of anxiety (Harvey, Watkins, Mansell, & Shafran, 2004). We do not dispute the importance of transdiagnostic processes. Nevertheless, if we want to know what makes anxiety and depression different, it will help to learn what disorder-specific cognitive features they have. The research we have described on the LVM may help in advancing these important efforts.

Implications of the LVM for Prevention and Clinical Treatment

The fundamental premise that dynamic changes on threat dimensions are crucial to anxiety also has implications for prevention and treatment. We have suggested that the LCS and LVM can improve practitioners' ability to identify cognitively vulnerable individuals as well as provide new opportunities to reduce the risk of first episodes or recurrences and relapses in anxiety disorders. The LCS may also prove valuable in helping to assess whether anxiety disorders are treated successfully. Katz, Rector, and Riskind (2017) found evidence that LCS scores in anxiety disorder patients can be reduced by a standard 12-week CBT program (Katz et al., 2017). Moreover, their data showed that change in LCS predicted end of treatment anxiety when controlling for pre-treatment anxiety. Thus, changes in LCS could theoretically serve as cognitive markers of improvement as well as cognitively mediate the symptom improvement that occurs in CBT protocols.

An intriguing implication of this line of reasoning is that patients in CBT who don't normalize or decline in their levels of looming vulnerability distortions and LCS with treatment might be more likely than others to relapse. Relatedly, it could imply that conventional treatments for anxiety are more likely to fail if dysfunctional looming cognitive vulnerability distortions or perceptions aren't addressed. For example, exposure treatments (e.g., for spider phobias or contamination fears) could be more likely to fail if the patients' mental imagery of dynamic growing threat (e.g., they imagine spiders crawling on their bodies) isn't addressed. Supporting this idea, Dorfan and Woody (2006) found that college students failed to habituate to urine drops placed on their arms, as would otherwise be expected by conventional exposure theory, when they were given movement imagery instructions to imagine the urine drops spreading on their bodies.

It has often been our clinical impression that the interventions we presented in Chap. 15 often work by countering the feelings of mental paralysis felt by individuals with anxiety disorders (Clark & Beck, 2010). When this occurs, they seem to become ruled by the primary appraisal of "I am in danger and must get away." As such, their attention becomes narrowly focused on the perceived rapidly growing danger to themselves and their potential coping resources fade into the background. Some of the interventions to reduce looming vulnerability distortions can help to correct the short-circuiting of the secondary appraisal process and proffer the person a view in which they perceive they have additional time and space to figure out how to best cope.

In addition to standard CT/CBT protocols, there are reasons to believe that mindfulness training or other interventions may help to mitigate the effects of perceptions and distortions of rapid dynamic growing threat (e.g., by training anxious patients to focus on the present moment). However, we suggested that CT/CBT interventions that are specifically designed to target looming vulnerability distortions may help to augment the efficacy of these protocols (Chap. 15). By targeting dysfunctional perceptions of dynamic growing threat, these interventions may help to improve the efficacy of standard and familiar interventions, especially for patients who aren't responding adequately to exposure, decatastrophizing, or other of the familiar tools in the standard CBT repertoire. Thus, the CBT strategies and concepts we described in Chap. 14 promise to provide new tools for cognitive-behavioral treatments.

Integrative Power and New Directions Suggested by the LVM

The LVM model helps to integrate existing cognitive models of anxiety such as Clark and Beck's (2010) with findings from a great many diverse lines of interdisciplinary investigation outside of the clinical domain, including work on animal behavior, attention, memory, and emotion that have not been previously related to cognitive models of anxiety. We suggest that the LVM not only synthesizes disparate interdisciplinary observations but would seem to offer a more nuanced and evolutionarily informed cognitive formulation of anxiety.

More broadly, the LVM points to fruitful new directions in theory, research, and clinical practice. Thus, beyond its direct clinical implications, the LVM underscores the importance of going beyond the confining limits of using static (immobile) stimuli in experimental cognitive studies of basic adaptive processes such as anxiety, attention, memory, fear-relevant correlations, and fear conditioning. An overreliance on static stimuli will limit the advancement of understanding of cognitive processes and lack external validity outside of the laboratory (Basanovic, Dean, Riskind, & MacLeod, 2017; Riskind, Williams, Gessner, Chrosniak, & Cortina, 2000).

As we have shown throughout this volume, the LVM provides a conceptual framework for incorporating a myriad of theoretical and empirical developments from neuroscience studies of the impact of looming stimuli and studies on perception, attentional capture, and memory. Notably, the work we have presented in this volume on the LVM can be conversely integrated into a complex biopsychological framework for anxiety disorders that connects with many current trends in the field beyond narrow CT/CBT models and which includes many biological, behavioral, and social variables. For example, the LVM can be integrated with broader neuroimaging work being conducted in the anxiety disorders. As we have described, several studies have demonstrated that objects that exhibit approaching movement (i.e., they "loom") are associated with distinct signatures of brain activation during neuroimaging tasks (Bach, Neuhoff, Perrig, & Seifritz, 2009; Billington, Wilkie, Field,

& Wann, 2011; Coker-Appiah et al., 2013; Mobbs et al., 2007). For another example, several studies have indicated that neural mechanisms underlie the effects of looming stimuli on time dilation distortions (van Wassenhove, Wittmann, Craig, & Paulus, 2011; Whitman, Wassenhove, Craig, & Paulus, 2010). The LVM also connects with emotions theories (Baumeister & Bratslavsky, 1999; Carver & Scheier, 1990; Lazarus, 1991; Ortony et al., 1988; Scherer & Brosch, 2009), embodied cognition (Briñol & Petty, 2008; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005), theoretical work on the hedonic treadmill (Brickman, Coates, & Janoff-Bulman, 1978), evolutionary theory (Dixon, 1998; Fanselow & Lester, 1988; Gilbert, 2001; Haselton, Nettle, & Andrews, 2005; Nesse, 2001; Ohman & Wiens, 2004), and ethological research (Grandin, 1980; Stankowich & Blumstein, 2005).

To conclude, we suggested in Chap. 16 that the LVM also has potentially novel and intriguing implications for understanding other problems and disorders. As mentioned, for example, it may be fruitful to examine the notions that inflated perceptions of patterns of change and rapidly escalating provocation ("looming provocation") can incrementally contribute to anger, while inflated perceptions of patterns of rapid dynamic gains in opportunities and gratification ("looming opportunity") can importantly contribute to problems such as gambling or bipolar disorders. We are hopeful that this volume stimulates work in these and other potentially fruitful new directions.

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