Worry and Generalized Anxiety Disorder: A Review
MG Newman, S Cho, and H Kim, The Pennsylvania State University, University Park, PA, United States
© 2017 Elsevier Inc. All rights reserved.

Normal and Pathological Worry

Generalized anxiety disorder (GAD) has been viewed as the basic anxiety disorder due to findings showing that its fundamental characteristics may reflect central processes of all emotional disorders (Rapee, 1991). People with GAD suffer from chronic symptoms of anxiety and the course of GAD is persistent (Newman et al., 2016; Rodriguez et al., 2006; Yonkers et al., 2003). Furthermore, GAD serves as a gateway to other anxiety disorders. For example, in a study which analyzed the longitudinal relationship between GAD and other psychiatric disorders, active GAD at time one increased the odds of having new onsets of panic disorder and posttraumatic stress disorder at time two compared to remitted GAD (Ruscio et al., 2007). Therefore, examining the theoretical and clinical characteristics of GAD may be beneficial in understanding the fundamental mechanisms of anxiety disorders (Newman, 2000).

Among the symptoms of GAD, worry serves a particularly crucial role in the maintenance of GAD. However, experience of worry is normative and its occurrence is not limited to individuals with GAD (Caes et al., 2016; Dupuy et al., 2001). Worry also can be found in other mental disorders (Kircanski et al., 2015). When controlling for GAD, worry was independently correlated with higher depression, poorer well-being and decreased functioning in individuals with depression, bipolar disorder and psychosis (Kertz et al., 2012).

Although the uncontrollable and persistent nature of worry has been considered the central diagnostic criteria of GAD, the diagnostic description of GAD has undergone several changes. Historically, there have been questions in the literature about whether GAD is a stand-alone disorder. The following section reviews how GAD became established as an independent diagnosis.
Diagnostic Description of Generalized Anxiety Disorder

The definition of GAD emerged from the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III). Before DSM-III, anxiety disorders were defined as “anxiety neurosis.” The concept of anxiety neurosis was based on Freud’s early theoretical description of “free-floating anxiety” and the concept included both panic disorder and GAD concurrently. In the subsequent revisions, efforts to distinguish the two disorders resulted in the establishment of GAD as a standalone disorder. However, in DSM-III, GAD was still categorized as a residual diagnosis, which was only given to patients who did not meet diagnostic criteria for any other anxiety disorders. In the revised version of the third edition (DSM-III-R), GAD was categorized as an independent anxiety disorder and worry was regarded as the cardinal diagnostic criterion of GAD. Throughout the fourth edition of the manual (DSM-IV) and its revised version (DSM-IV-TR), more empirical studies accumulated on the processes of GAD symptoms. In these revisions, the diagnostic description underwent several changes. Thus, GAD was defined by excessive and uncontrollable worry and the number of associated symptoms became simplified as six different criteria. The associated symptoms were restlessness or feeling keyed up or on edge, being easily fatigued, difficulty concentrating or mind going blank, irritability, muscle tension, and sleep disturbance (American Psychiatric Association, 2013). In the most recent edition of the manual (DSM-5), the criteria have not been changed from those in DSM-IV.

Additionally, there have been suggestions that GAD and MDD could be better conceptualized as one higher order transdiagnostic construct. These suggestions were based on the high comorbidity between GAD and MDD and overlapping characteristics between worry and rumination. Based on these high correlations, researchers have attempted to conceptualize the two disorders under the umbrella of a distress disorder (Barlow and Campbell, 2000; Watson, 2005). However, ample evidence has shown that GAD is a distinct construct. For example, even within some of the hierarchical model studies, GAD still demonstrated distinct features such as arousal whereas MDD was better characterized by anhedonia (Bjelland et al., 2002; Brown et al., 2001; Cannon and Weems, 2006; Watson, 2005). In addition, the onset of pure GAD was influenced by higher familial risk than MDD (Kendler et al., 2003). Furthermore, researchers found that GAD and MDD manifested different biological characteristics (Martin and Nemeroff, 2010; Weinberg et al., 2012). It has also been documented that the course of illness differed for GAD and MDD (Brown, 2007). For example, physical inactivity was a specific risk factor for depression (Strine et al., 2008). Also, rumination, which is associated with MDD, was demonstrated to have distinct characteristics when compared to worry. Factor analytic evidence indicated that worry and rumination formulated different symptom constructs not only at a trait level but also at a state level (Aldao et al., 2013; Fresco et al., 2002; Goring and Papageorgiou, 2008; Muris et al., 2004). Furthermore, worry was more strongly associated with cardiovascular inflexibility than rumination, suggesting that worry was associated with a stronger threat state than rumination (Thayer et al., 2000). These findings support the notion that GAD is a stand-alone diagnostic construct.

Importance of GAD

The most recent version of the National Comorbidity Survey found that the lifetime prevalence of GAD was 5.7% and 12-month prevalence was 3.1% (Kessler and Wang, 2008). However, a follow-up study suggested a comparatively higher prevalence of GAD. When lifetime prevalence was measured by prospective data, GAD prevalence increased to 14.2%, which was two times higher than results from previous retrospective data. Twelve-month prevalence was increased to 4.2%. Such data shows that lifetime GAD prevalence could have been underestimated due to the inaccuracy of long-term recall (Moffitt et al., 2010). The average age of onset of GAD was found to be in the early to middle of 30s. The relatively later average onset compared to other anxiety disorders, might be due to the longer duration criterion of GAD (Kessler et al., 2005; Ruscio et al., 2007). In a study which used shorter duration of GAD was found to be in the early to middle of 30s. The relatively later average onset compared to other anxiety disorders, might prevalence could have been underestimated due to the inaccuracy of long-term recall (Moffitt et al., 2010). In addition, the severity of symptoms were maintained after treatment. These results indicate that although GAD individuals with comorbid...
disorders are more likely to manifest more severe symptomatology, cognitive-behavioral treatment of GAD can alleviate the comorbid symptoms (Newman et al., 2010).

**Basic Research on the Nature, Functions and Origins of Worry and GAD**

There is a growing evidence base suggesting that GAD is characterized by constant alertness to potential threat (Bar-Haim et al., 2007; Mogg and Bradley, 2005). Compared to non-anxious populations, individuals with GAD are more likely to experience a negative view of the future (Bögels and Zigterman, 2000). In addition, the contents of worry are not limited to obvious misfortune but they also can come from minor issues in their daily lives (Joormann and Stöber, 1997; McCarthy-Larzelere et al., 2001; Tallis et al., 1994). However, in GAD, the perceived danger is not present but it exists in their thoughts as catastrophic anticipation. Therefore, avoidance from the danger cannot be fulfilled behaviorally and coping responses to the perceived dangers can be carried out by their internal activities such as corrective perceptions of the risks (e.g., LaFreniere and Newman, 2016). In this sense, understanding internal coping processes of GAD is important to understanding maintenance of GAD. In the following sections, theories of the information processing mechanisms of GAD will be reviewed and an overview on the physiology and neurobiology of GAD will be provided.

**GAD and Information Processing**

**Worrisome Thinking and Cognitive Processing of GAD**

Systematic reviews provide empirical support for biased attention in GAD (Mathews and MacLeod, 2005). In Mogg and Bradley (2005), 10 studies using the dot probe detection method consistently showed a positive correlation between GAD and greater hypervigilance to threat cues. Similarly, a meta-analysis of 172 studies also found strong evidence that individuals with GAD have attentional bias toward threat relevant stimuli (Bar-Haim et al., 2007). At the same time, people with GAD have shown poor attentional control, particularly during worry (Stefanopoulou et al., 2014). Several studies also applied attention modification training to individuals with GAD and found that improvements in attentional bias was associated with decreased anxiety in GAD (Amir et al., 2009; Hirsch et al., 2009; MacLeod et al., 2002). These results suggest that attentional bias may play a role in the maintenance of GAD.

Individuals with GAD are also distinct from non-anxious controls in terms of the way they interpret information. They sometimes have distorted views of their future and tend to interpret ambiguous information negatively (Eysenck et al., 1987, 1991; Mathews et al., 1989). Also, the effects of worry on biased threat perception were stable over time (Muris et al., 2004). However, their negative predictions can be illogical and most of them are based on extremely small probabilities. In a series of studies using worry outcome monitoring, 84%–91% of their anticipated catastrophes never happened and they still coped better than they predicted when the negative situations actually happened (Borkovec et al., 1999; LaFreniere and Newman, 2016).

Similar threat perception findings arose in children. When stories about ambiguous situations were presented, children with GAD interpreted the stories significantly more negatively than a control group (Bögels and Zigterman, 2000). Likewise, higher levels of GAD in children predicted increased levels of threat that were significantly lower than in control participants (Taghavi et al., 2003). All of these findings suggest that individuals with GAD are more attentive to threat-relevant information and are likely to over-estimate the negative outcome of situations. This cognitive sensitivity could impede objective evaluation of threat materials and prevent learning from processing corrective information.

Such interpretive bias can be induced in non-anxious participants via repeated accessing of negative outcomes related to emotionally ambiguous information (Hirsch et al., 2007; Mathews and Mackintosh, 2000; Wilson et al., 2006). Furthermore, repeated accessing of benign meanings led to worry reduction in high worriers (Hayes et al., 2010; Hirsch et al., 2009). In addition, a recent treatment component analysis found that monitoring realistic worry outcome using a brief ecological momentary measure (worry outcome journal) helped GAD patients to yield greater reduction in worry (LaFreniere and Newman, 2016) compared to a thought log control condition. This evidence suggests that although individuals with GAD have negatively biased perceptions, objective monitoring of their worry outcome could help them to cope better with their worry.

Although information-processing models have posited that individuals with GAD have biases toward threat-related memories, mixed evidence has been found on this topic (Coles et al., 2007; Coles and Heimberg, 2002). Unlike previous studies, which found biases in the encoding and recall of threat-relevant implicit information (Borkovec and Roemer, 1995; Bradley et al., 1995), ample follow-up studies failed to replicate these results (Becker et al., 1999; MacLeod and McLaughlin, 1995; Williams et al., 1996). One study found modest support for an explicit memory bias for threat words among individuals with GAD (Coles et al., 2007), yet there has been very little consensus in this literature. According to Williams et al. (1988), researchers have hypothesized that inconsistent findings might be attributable to sequential differences in processing of threatening information. Specifically, this hypothesis suggests that after initial vigilance to threat-relevant information, individuals with GAD move their attention away from the threat and this cognitive avoidance may make it difficult to recall threat related memories. Nonetheless a recent study actually found the opposite effect. Individuals with GAD showed impaired inhibition of memory (e.g., had difficulty forgetting) with respect to threat information (Kircanski et al., 2016a). However, there is still very little evidence about retrieval and more studies should be conducted on this topic.
Worrisome Thinking and Emotional Processing of GAD

Worry has been considered a cognitive mechanism which regulates emotional reactivity to threat stimuli. In order to examine the role of worry in emotion regulation, an early experimental study attempted to compare the effects of worry, relaxation and neutral induction on cardiovascular response during threat exposure. Researchers found that individuals in the worry induction condition reported greater subjective fear to threat images but their heart rate reactivity during threat exposure was significantly lower than participants in relaxation condition when a preceding worry induction was used as the baseline (Borkovec and Hu, 1990). Based on these findings, Borkovec et al. (2004) suggested the Cognitive Avoidance theory of worry. This model posits that worry functions as a cognitive mechanism employed to cope with emotional dysfunction and to maintain control over emotions. This theory has contributed to our understanding of the role of worry in emotional dysregulation. Subsequently, the Cognitive Avoidance model was incorporated into other models of GAD and extended to suggest that worry helped individuals with GAD to avoid negative emotional experience during threat exposure. Nonetheless, ample studies have shown that worry actually induces negative emotionality and such induced negative emotionality is sustained throughout threat exposure (Andor et al., 2008; Brosschot et al., 2007; Llera and Newman, 2010; Stapinski et al., 2010).

In order to clarify inconsistencies across prior studies, a series of experimental attempts were made to test the function of worry with respect to emotional avoidance (Llera and Newman, 2014, 2010). In these studies, effects of induced worry were compared to relaxation and neutral inductions on emotional and physiological reactivity pre and post threat exposure. When compared to a resting baseline, worry indeed yielded heightened negative emotional experience and arousal. Moreover, regardless of whether worry or relaxation was induced, there was no difference in the absolute level of negative emotion experienced during subsequent exposure to negative emotional stimuli. In fact, worry did not enable avoidance of negative emotion, but instead perpetuated heightened negative emotion. Furthermore, low negative emotionality during relaxation and neutral inductions allowed for sharp increases in negative emotion in response to exposures. Also, those with GAD reported that worry was more helpful than relaxation in enabling coping with the negative emotional stimuli, whereas those without GAD found that relaxation was more helpful than worry in this regard (Llera and Newman, 2014, 2010). These results are consistent with previous findings showing difficulty in coping with mismatch between happy and fearful cues in people with GAD (Etkin et al., 2010). Based on these findings, Newman and Llera proposed the Contrast Avoidance theory of Worry (Newman and Llera, 2011; Newman et al., 2014a). This model suggests that the function of worry is not to avoid aversive emotional experience but the reason GAD patients employ worry before anticipated negative events is to induce and sustain negative emotion via worry in order to preclude a sharp shift toward a negative emotional state. This theory was further supported by empirical studies documenting that GAD participants were significantly more likely to endorse using worry to sustain negative emotion and to avoid sharp negative emotional shifts than those who did not have GAD (Llera and Newman, 2014, 2017).

Biological Mechanism of GAD

Accumulating evidence suggests that individuals with GAD are likely to demonstrate patterns of physiological inflexibility. In addition, researchers have found alterations in their brain connectivity, which may contribute to abnormalities in their information processing. The following sections focus on the differences between GAD and non-anxious populations in regard to their biological reactivity.

Physiological Mechanism of GAD

When threats are perceived, anxiety is accompanied by a fight or flight response. The main purpose of this physiological reactivity is to prepare our body for combat and survival. This reaction requires a sudden increase in energy for immediate action. Such sudden activation evokes various types of changes in our physiological systems. Traditionally, the fight or flight response has been thought to involve a general discharge of the sympathetic nervous system, which consists of one of the two sub-components of the autonomic nervous system. Anxiety disorders are characterized by heightened reactivity of the sympathetic nervous system. However, as the source of anxiety differs across different types of anxiety disorders, it is possible that each anxiety disorder may have a different pattern in its physiological reactivity (Friedman and Thayer, 1998; Lyonfields et al., 1995). Although only a few studies have assessed physiological states in individuals with GAD, examining physiological characteristics could be helpful in understanding the unique nature of the disorder.

In GAD, the fear is not about imminent danger but instead it is about potential future threats. For this reason, researchers have theorized that the physiological response in GAD may be more chronic and less variable than in other anxiety disorders. There is some evidence to support this theory. Although the general physiological activity in GAD tends to be similar to that of most other anxiety disorders, all showing lower heart rate variability (higher heart rate) compared to non-anxious individuals (Licht et al., 2009; Pittig et al., 2013), those with panic disorder and GAD tended to have higher heart rate during hyperventilation whereas those with social anxiety disorder and obsessive compulsive disorder did not (Pittig et al., 2013). Also, studies have found that such higher baseline sympathetic arousal tends to predict lesser reactivity to a laboratory stressor (Fisher et al., 2010; Llera and Newman, 2010). Taken together, these results suggest that GAD and worry are related to more chronic activation which may reduce the sudden increase in energy (negative contrast) needed for the fight or flight response.

Similarly, GAD has been linked to distinct patterns of parasympathetic regulation. Specifically, individuals with GAD demonstrated significantly lower vagal tone at baseline as compared to non-anxious controls (Lyonfields et al., 1995; Thayer et al., 1996). Vagal tone has been thought to be the key element of the parasympathetic nervous system, which regulates the resting
state of the internal organ systems. Findings of restricted vagal tone indicate that those with GAD may be characterized by their deficient parasympathetic control. Similarly, during a 4-day ecological momentary assessment, researchers found that patients with GAD had lesser respiratory sinus arrhythmia than control participants (Hoehn-Saric et al., 2004). Respiratory sinus arrhythmia is heart rate variability in synchrony with respiration, which indicates the level of parasympathetic nervous system activity.

More recent studies have suggested that worry plays a causal role in autonomic nervous system activity. Worry leads to increased sympathetic nervous system activity and decreased parasympathetic activity. Specifically, during worry inductions, GAD patients showed increased cardiovascular activity, higher electrodermal activity and reduced heart rate variability (Brosschot et al., 2005; Lyonfelsds et al., 1995; Pieper et al., 2010; Thayer et al., 1996). In addition, laboratory-based experimental studies also showed that worry evoked decreased heart rate variability in response to threat exposure (Fisher and Newman, 2013; Kircanski et al., 2016b). These results show that worry may facilitate autonomic inflexibility and anxious arousal in GAD.

**Neurobiological Mechanism of GAD**

Along with improvements in neuroimaging devices, new findings have accumulated on the neural circuits of GAD in recent years. Most of the neurobiological studies on GAD have focused on the abnormalities in brain reactivity during threat exposures. The amygdala is thought to play a key part in hypervigilance to threat. Previous evidence showed that when patients with GAD were exposed to threat, blood oxygen levels in the amygdala increased (McClure et al., 2007). In addition, compared to nonanxious youth, adolescents diagnosed with GAD demonstrated greater right amygdala activation in response to threatening facial expressions. This heightened activity was positively correlated with severity of GAD symptoms (Monk et al., 2008). Furthermore, GAD was associated with a larger amygdala volumethan a control group (De Bellis et al., 2000).

Available evidence also suggests that the prefrontal cortex is implicated in the process of anxiety. Trait anxious participants' prefrontal cortex had increased blood oxygen levels during exposure to fear stimuli (Telzer et al., 2008). The prefrontal cortex is a suppressor of the amygdala, which is crucial for the regulation of fear and anxiety. In the same study, negative couplings between the amygdala and ventrolateral prefrontal cortex were found during threat trials. These results showed that amygdala activation could be suppressed by the heightened activity of the ventrolateral prefrontal cortex. However, unlike non-anxious controls, the negative modulation of the ventrolateral prefrontal cortex was significantly weaker in the GAD group. As a result, their amygdala reactivity was significantly greater than the control group during threat trials. In addition, in a study which used a fear generalization task, patients with GAD showed deficient functioning of the ventromedial prefrontal cortex (Greenberg et al., 2013). In another study, reactivity of the right ventrolateral prefrontal cortex was significantly improved during exposure to threat stimuli in response to CBT or fluoxetine treatment (Maslowsky et al., 2010). On the other hand, in a study which compared GAD and generalized social anxiety disorder, patients with GAD had significantly more activation in their middle frontal gyrus than socially anxious participants during an exposure to angry faces (Blair et al., 2008). These findings suggest that not only the increased activity of amygdala but also defective modulation of the prefrontal cortex may contribute to the pathology of GAD (Hariri et al., 2003; Nomura et al., 2004).

The other brain circuit with close connectivity to the amygdala is the anterior cingulate cortex. Compared to the amygdala, the anterior cingulate cortex is involved in the emotion regulation process (Paulus et al., 2010). In line with this hypothesis, the anterior cingulate cortex was significantly associated with cognitive and affective processing of errors (Carter et al., 1998). In emotional conflict trials, patients with GAD failed to engage in premorbid anterior cingulate activation and the decreased activation in the pregenual anterior cingulate area consequentially increased reactivity of the amygdala during threat exposure (Etkin et al., 2010). In an EEG study, researchers also found increased error-related potential in participants with GAD, which reflected heightened activity of the anterior cingulate cortex (Weinberg et al., 2010). Furthermore, greater reactivity in the anterior cingulate cortex during anticipatory threat trials predicted a more positive treatment outcome of 8-week venlafaxine treatment (Nitschke et al., 2009; Whalen et al., 2008). These results show that not only the prefrontal cortex but also anterior cingulate cortex regulates reactivity of amygdala and responses to threat-relevant stimuli.

Findings from these studies indicate that impaired amygdala modulation by the prefrontal cortex and anterior cingulate cortex may contribute to the development and maintenance of GAD. However, considering the small number of studies, replication would be a must for these exploratory findings.

**GAD and Interpersonal Factors**

Interpersonal factors have been consistently linked to GAD, with extensive evidence suggesting that that dysfunctional interpersonal processes contribute to its onset and persistence (Newman and Erickson, 2010). The potential etiological role of interpersonal factors in the onset of GAD has been indicated by research documenting the developmental and familial origins of interpersonal problems. For instance, GAD tends to aggregate in families (Biederman et al., 2006; Kessler et al., 2005) but moderate heritability estimates of GAD imply that environmental influences that operate within familial relationships likely play an important etiological role. In particular, theoretical models of GAD have implicated adverse caregiving experiences during the first few years of life as a factor that may contribute to the onset of generalized anxiety. Bowlby’s attachment theory (1982) has offered an influential theoretical framework for explaining the enduring impact of insecure attachment on individuals’ negative internal working model of self, world and others. More specifically, caregivers’ consistent failure to make themselves available to their infants
and to respond sensitively to infant distress is theorized to lead to a generalized sense of uncertainty that characterizes GAD. Consistent with this perspective, empirical evidence suggests that GAD is associated with a history of attachment problems (Cassidy et al., 2009; Newman et al., 2016) and more extreme adverse experiences such as abuse (Cougle et al., 2010).

Similarly, etiological models of childhood GAD posit that specific forms of maladaptive parenting can lead children to overestimate threat and to undermine their sense of control over self, others, and the environment (Raee, 2001). For instance, symptoms of worry and GAD have been linked to a wide range of maladaptive parental behaviors such as parental rejection (Brown and Whiteside, 2008; Hale et al., 2006; Muris et al., 2000), criticism (Nelemans et al., 2014), control (Wijsbroek et al., 2011), and overprotection (Beesdo et al., 2010; Muris, 2002; Nordahl et al., 2010). These parental behaviors provide children with inadequate or excessive parental support; consequently they limit opportunities for children to develop adaptive coping strategies. In the absence of consistent environmental support and a diminished sense of control over one’s emotions, children may attempt to gain control over self and the environment by adopting a constant state of anxious vigilance. Such attempts may involve perpetual engagement in worries, which may in turn serve to minimize the experience of a sharp shift in affective states (Newman et al., 2013).

Research has also indicated that the family functioning of adults with GAD may be characterized by heightened worries, tension, and discord (Beesdo et al., 2010), particularly within marital relationships (Durham et al., 1997; Whisman et al., 2000; Zinbarg et al., 2007). Furthermore, although individuals with GAD commonly report worries pertaining to family/interpersonal issues (Roemer et al., 1997), they may nonetheless be reluctant to disclose their worries to their family members or to seek familial support (Priest, 2013). According to the growing literature on attentional biases associated with GAD, interpersonal dysfunction among youths and adults with GAD potentially reflects an underlying bias toward threat-relevant social cues (Coles et al., 2007; Mogg et al., 2000; Waters et al., 2008). Recent neuroimaging evidence also suggests that children and youth diagnosed with GAD show heightened amygdala activation in response to facial threat (Monk et al., 2008). As such, GAD may be associated with neurobiologically based hyperreactivity to threat conveyed in social information. Similar patterns of biased interpretation of social cues have been documented at the behavioral level. An experimental study found that GAD analogues demonstrated a tendency to perceive interpersonal hostility (e.g., blaming, attacking) during a brief social interaction task (Erickson and Pincus, 2005). Biased estimation of one’s own contribution to interpersonal interaction was also noted for GAD analogues, with some individuals showing a tendency to overestimate the negative impression they made during an emotional disclosure task, while other GAD analogues failed to recognize the negative impact of their view of their problems does not match that of their significant others.

Given their tendency to process social information in a biased manner, adults with GAD are likely to present with a heterogeneous pattern of interpersonal problems typified by intrusive, exploitable, cold, and nonassertive qualities (Przeworski et al., 2011). Newman et al. (2013) theorized that each type of interpersonal problem reflects maladaptive attempts to preserve a sense of predictability in interpersonal situations. For example, cold interpersonal behaviors may be used as a means to prevent a sense of vulnerability that may result from the possible experience of interpersonal rejection or hostility. Conversely, exploitable or nonassertive behaviors may be used to actively signal non-hostile intent and to ultimately avoid interpersonal conflicts.

Taken together, available evidence suggests that negative interpersonal experiences, cognitive biases, and problematic interpersonal behaviors may be reciprocally related. Furthermore, these factors may operate jointly to maintain the interpersonal dysfunction and symptoms of GAD (Newman and Erickson, 2010). Accumulating evidence also indicates that interpersonal dysfunction of GAD extends to therapeutic relationships and hinders therapeutic progress (Erickson et al., 2015). For example, personality problems that exist at the level of a comorbid personality disorder have been identified as one of the most commonly cited obstacles for treatment of GAD (Szkodny et al., 2014). Additionally, insecure attachment was found to moderate GAD clients’ response to treatment (Newman et al., 2015). Specifically, greater symptom improvement was reported for CBT that included a treatment module designed to address interpersonal problems. Such a finding highlights the role that interpersonal factors play in symptom persistence and response to treatment.

**Therapy Outcome Investigations of GAD**

Consistent with research implicating interpersonal factors in the onset and maintenance of GAD, investigations of CBT incorporating interpersonal-experiential focus (e.g., Interpersonal and Emotional Processing Therapy (I/EP)) have begun to identify the processes by which interpersonal factors maintain GAD and influence individuals’ response to CBT (Newman et al., 2015). However, controlled therapy outcome research of CBT that directly addresses interpersonal processes associated with GAD has only begun recently (Newman et al., 2011). As such, the present review focuses on treatment outcome research of standard CBT protocols that primarily target the intrapersonal anxiety processes. (Readers interested in a detailed review of Interpersonal and Emotional Processing therapy are directed to Erickson et al. (2015).)

**Review of Past Controlled Therapy Outcome Studies of GAD**

Over the past two decades, there has been a near three-fold increase in the number of controlled trials of cognitive behavioral therapy (CBT) for GAD. Extant literature indicates that CBT remains the only empirically supported treatment of GAD and that
CBT should be employed as the first line of treatment of GAD for adults (Cuijpers et al., 2014b) and youth (Higa-McMillan et al., 2016). Furthermore, meta-analyses of treatment outcome research have consistently demonstrated that CBT is superior to waitlist, placebo, and non-directive therapy (Borkovec and Ruscio, 2001; Covin et al., 2008; Cuijpers et al., 2014a, 2014b; Durham et al., 2003; Goncalves and Byrne, 2012) and that treatment gains are maintained at long-term follow-ups (Borkovec and Ruscio, 2001; Ladouceur et al., 2000). CBT designed to target GAD has also been shown to improve symptoms of a range of comorbid conditions, including other anxiety disorders and major depression (Newman et al., 2010). Given the overwhelming empirical support for CBT, a preponderance of research on treatment of GAD has been focused on CBT. As a consequence, there has been limited data on the comparative efficacy of CBT and other treatment options for GAD, such as pharmacological treatment or psychotherapeutic interventions with different theoretical orientations. Due to the small number of studies that directly compared CBT and psychopharmacological treatment, findings have been generally inconclusive regarding their relative efficacy (Crits-Christoph et al., 2011; Cuijpers et al., 2014a, 2014b). Nevertheless, there has been an indication that CBT outperforms pharmacological treatment for youths presenting with GAD (Compton et al., 2014) or GAD co-occurring with other anxiety disorders (Higa-McMillan et al., 2016).

Although the efficacy of CBT has been well-established for GAD, relatively small effect sizes have been reported for CBT as compared to other anxiety disorders (Hofmann and Smits, 2008; Stewart and Chambliss, 2009). Furthermore, only about 50% of individuals who complete CBT for GAD are estimated to demonstrate clinically significant change in their symptoms upon completion of treatment (Borkovec and Whisman, 1996; Fisher and Durham, 1999; Newman et al., 2004). These findings have led to various efforts aimed at enhancing the efficacy of CBT. First, researchers have explored modifying the structural format of traditional CBT to augment its efficacy. These efforts included increasing the amount of session time (Borkovec et al., 2002; Newman et al., 1999), use of dismantling designs to identify active ingredients of CBT (Borkovec et al., 2002) to inform individually tailored treatment approaches (Newman and Fisher, 2013; Newman et al., 2000), and use of adjunctive computer technology to enhance the ecological validity of the intervention (Newman et al., 1999, 2014b). Whereas increasing session time beyond that prescribed for a previous version of CBT (Borkovec and Costello, 1993) did not incrementally improve treatment outcomes (Borkovec et al., 2002), preliminary investigations of minimal CBT interventions involving selective treatment components (LaFreniere and Newman, 2016; Newman and Fisher, 2013) or adjunctive methods designed to increase the generalizability of treatments revealed promising results (Newman et al., 2014b). In particular, efforts to increase the accessibility of treatment using software technology have revealed the unique benefits of ‘momentary intervention’ afforded by the use mobile treatment devices (Newman et al., 2014b). Such ecological momentary intervention methods increase the generalizability of treatment effects as clients gain immediate access to situational relevant instructions for coping with worry and anxiety. Second, there has been a growing interest in identifying the potential moderators of treatment outcome to refine the treatment protocols for individuals who show partial or nonresponse to CBT. Research has identified duration of GAD, the presence of comorbid conditions (e.g., depression), and elevated dominating and intrusive interpersonal problems as factors that may moderate individuals’ response to treatment (Newman et al., 2010, 2017; Newman and Fisher, 2013). In particular, a recent study indicated that longer duration of GAD was associated with a superior response to intensive presentation of distinct components of CBT (e.g., cognitive therapy), whereas shorter duration was related to better response to combined CBT (Newman and Fisher, 2013). Similarly, another study found that intrusive and dominating interpersonal problems predicted better response from a purely behavioral relaxation-based therapy compared to therapies that included cognitive restructuring (Newman et al., 2017). Finally, recent advances in theoretical formulations of GAD have led to the development of CBT protocols that place a differential emphasis on interpersonal, affective, cognitive, and behavioral dysfunction. Although a detailed review of extant theoretical models of GAD and their corresponding treatment approaches is beyond the scope of this chapter, contemporary theories of GAD build upon the Cognitive Avoidance theory of worry (Borkovec et al., 2004) and conceptualize worry as an avoidant strategy (Behar et al., 2009). Most recently, the Contrast Avoidance model of GAD has proposed a novel perspective of the phenomenon of avoidance in GAD (Newman and Llera, 2011). According to the Contrast Avoidance model, individuals with GAD find it highly distressing to experience a sharp affective shift from a euthymic or relaxed state to a negative emotional state. Consequently, individuals with GAD engage in worry in order to avoid a sharp increase in negative emotions and demonstrate a preference for maintaining a chronic yet tolerable level of negative emotional state (Llera and Newman, 2014; Newman and Llera, 2011). Emerging data supporting the Contrast Avoidance model (Llera and Newman, 2014) underscores the underlying fear of affective contrast as a meaningful target of treatment. Additionally, the application of Contrast Avoidance theory to interpersonal and affective processes is an ongoing pursuit, as negative emotional contrast experiences are likely to be influenced by and to exacerbate the interpersonal dysfunction that are associated with GAD (Erickson et al., 2015). In sum, integrating the theoretical advances with innovative approaches to deliver CBT (e.g., personalized intervention) represents an important future direction of research aimed at enhancing the efficacy of CBT for GAD.

### Clinical Descriptions of Cognitive-Behavioral Therapy Techniques

Within a cognitive behavioral theoretical framework, GAD is conceptualized to develop as a result of an anxiety spiral that involves a complex interaction among cognitive, physiological/affective, and avoidant behavioral responses to possible threat (Borkovec and Costello, 1993). Although variability exists across different protocols of CBT for GAD, treatments typically combine cognitive therapy (CT) with behavioral techniques that are designed to enhance the individuals’ flexible coping responses to internal and external anxiety cues. In this section, the following traditional components of CBT are reviewed: psychoeducation, self-monitoring, self-control desensitization, coping skills, and cognitive therapy. Collectively, the above components are broadly aimed at disrupting the cyclical patterns of intrapersonal anxiety processes that contribute to the onset and maintenance of worry.
**Psychoeducation**

Cognitive and behavioral treatments of GAD typically begin with a description of GAD and processes that contribute to the occurrence and persistence of worry. Worry is described as a maladaptive habit that develops as a result of recurrent interactions among cognitive, physiological, and behavioral responses to perceived threat. The notion of worry as a habit is then used to illustrate the point that the strength of this habit will grow weaker if the underlying anxiety spiral is repeatedly interrupted. A comprehensive rationale for a cognitive behavioral approach to treatment provided at the outset of treatment is considered to play an important role in establishing the client’s positive expectations for treatment, treatment credibility, and facilitating commitment to practicing specific skills between sessions. Additionally, client’s initial response to the information and rationale pertaining to different components of CBT may yield information about ways to structure the overall sequence of the treatment.

**Self-monitoring and Early Cue Detection**

Self-monitoring is an essential component of CBT that is designed to enhance clients’ ability to identify their characteristic patterns of worry, including its content, frequency, intensity, duration as well as the context in which worry or anxiety occurred. As treatment progresses, self-monitoring may extend to recording outcomes that one feared would happen. This information, when compared to the outcomes that actually occurred, can be used as evidence to suggest that most feared outcomes are unlikely to occur and that individuals generally possess the ability cope effectively with the small number of negative outcomes that do occur (Borkovec et al., 1999). Therapists may also directly support accurate monitoring of anxiety cues by asking clients to recreate prior worry episodes. Similarly, clients may be guided through the process of creating a detailed account of the experience that do occur (Borkovec et al., 1999). Therapists may also directly support accurate monitoring of anxiety cues by asking clients to recreate prior worry episodes. Similarly, clients may be guided through the process of creating a detailed account of the experience of worrying (e.g., content and sequence of worries, concurrent physiological and behavioral responses to anxiety).

**Stimulus Control Methods**

The initial introduction of self-monitoring techniques may often reveal an extensive list of cues that trigger worries for individuals with GAD. Clients who have learned to worry pervasively in response to various internal or situational triggers present challenges with isolating the specific conditions under which worry is likely to occur. In the presence of poorly discriminated worry cues, stimulus control techniques can be instrumental in weakening and reducing the associations between worry and its triggers (Borkovec et al., 1983a; McGowan and Behar, 2013). Stimulus control involves designating a 30-minute worry period at a time and a location that is not associated with other routine or leisure activities. As clients carry on with the daily self-monitoring, they are instructed to postpone their worries to the worry period, upon detection of their initial worry cues. By ignoring the urge to immediately attend to their worries, they are able to short-circuit worries at an earlier stage before it becomes increasingly difficult to disengage from the process of worrying. If the worry cues persist until the designated worry period, individuals may choose to attend to the worries and use this opportunity to apply specific cognitive or behavioral techniques. Over time, this stimulus-control technique is expected to gradually eliminate diffuse worry-cue connections and to promote secondary improvement in individuals’ use of coping skills.

**Relaxation Methods**

The benefits of relaxation methods in modulating heightened arousal states associated with worry and anxiety have long been recognized (Borkovec et al., 1983a, 1978; Öst, 1987). Indeed, recent evidence continues to document the efficacy of relaxation techniques for GAD (Siev and Chambless, 2007). Likewise, worry has been linked to physiological states characterized by a greater sympathetic activation and diminished parasympathetic influences (Brosschot et al., 2007; Pieper et al., 2010; Stapinski et al., 2010), warranting the implementation of relaxation techniques designed to increase parasympathetic control. Several relaxation techniques have been incorporated into CBT protocols developed for GAD, including diaphragmatic breathing, progressive muscle relaxation (PMR), and applied relaxation (AR).

The underlying principle of diaphragmatic breathing is that slow, paced breathing induces increased parasympathetic influences on the cardiac arousal, resulting in the restoration of calm bodily states (Porges, 2007; Strauss-Blasche et al., 2000). As documented above, it has been suggested that enhanced parasympathetic influences produce a bodily state that is incompatible with that associated with the state of worry (Newman and Borkovec, 2002). The introduction of this technique should include a detailed description of the rationale for the technique along with a clear demonstration that a brief trial of this technique immediately results in a noticeable reduction of physical tension and anxiety. Given the research findings which indicate that individuals with GAD exhibit a dispositional vulnerability for physiological regulation as indexed by low heart rate variability (high stable heart rate), clients are encouraged to make a conscious effort to continuously revert to diaphragmatic breathing patterns in their daily lives.
Progressive muscle relaxation (PMR) is another technique that is commonly used to produce a rapid decrease in bodily tension and a corresponding increase in the state of relaxation. PMR involves repeated, contrastive experience of tension and relaxation induced by systematic tensing and releasing of 16 different muscle groups. Through repeated practice, individuals are expected to be able to recall the state of tension and relaxation and to be able to use this technique to immediately release the momentary experience of tension. PMR has proven to be a particularly useful component of CBT for GAD, as the notion of “letting go” of worry and its internal triggers can be easily illustrated using the practice of releasing muscular tension. Clients are asked to practice this technique at least twice daily.

Applied relaxation (AR) utilizes DB and PMR as strategies to let go of the earliest signs of anxiety cues that are experienced in the clients’ daily lives. Continuous daily monitoring of physical tension and other anxiety cues should thus accompany AR. To generalize the use of AR to daily activities, clients are provided with specific instruction to regularly implement self-monitoring and AR to activities that involve walking and other daily routines. Cue-controlled applied relaxation, in which a specific word is paired with “letting go” of tension and anxiety, is also used as a way to enhance clients’ ability to promptly respond to anxiety cues.

**Self-control Desensitization**

Although internal cues of anxiety may take the form of imagery, individuals with GAD experience worry as a predominantly verbal process and tend to report significantly fewer and more brief involvement of imagery in their worries (Behar et al., 2005; Hirsch et al., 2012). In contrast, when they are in a state of relaxation, individuals with GAD experience an increased activation of imagery (Behar et al., 2005) and demonstrate greater reactivity to emotionally salient imagery (Newman and Llera, 2011). Self-control desensitization (SCD; Goldfried, 1971) is an imagery-based exposure technique that allows clients to experience habituation to anxiety induced by imagery through the use of imaginal rehearsal of coping behaviors in a state of relaxation (Goldfried, 1971).

Prior to SCD, clients construct a simplified hierarchy of situations that may induce a worry response at low, moderate, and high levels. Once the list is developed, PMR is used to begin SCD in a fully relaxed state. PMR is followed by a detailed presentation of the anxiety imagery cue that the therapist and client established prior to the procedure. Clients are asked to imagine remaining in the situation until anxiety cues are detected. Upon detection of anxiety cues, clients are instructed to rapidly shift to imaginal rehearsal and to picture oneself coping skillfully with the anxiety-eliciting situation in a highly detailed manner. Imagery rehearsal continues for an additional 20 seconds after the anxiety cues dissipate. Following this step, clients are instructed to stop visualizing the scene and to focus their attention solely on the experience of relaxation for another 20-second period. Repeated practice is expected to help clients to view effective coping as a plausible response to common anxiety-provoking situations and to increase the likelihood that effective coping will ultimately become a more automatic and habitual response.

**Cognitive Therapy**

The fundamental premise of the cognitive theories of anxiety is that cognitive appraisal of internal and external anxiety cues elicit and sustain negative affective experiences (Newman and Borkovec, 2002). Therefore, CT aims to identify, challenge, and ultimately replace the maladaptive patterns of cognitions that are linked to worries. Extant cognitive behavioral frameworks of GAD have proposed a number of cognitive processes that may be targeted in the context of CT. Broadly, these processes are characterized by biased estimation of threat and one’s capacity for coping (Newman and Borkovec, 2002) and maladaptive beliefs that maintain the worry cycle through various reinforcement mechanisms.

As aforementioned, the essential first step of CT is to enhance the clients’ awareness of cognitive and affective experiences that are associated with worry and anxiety. To help establish the rationale for analyzing thoughts as a meaningful target of treatment, data gathered from self-monitoring is used to illustrate the connection between thoughts and a corresponding increase in anxious affect. During this phase of CT, information is collected on the content of automatic thoughts, imagery, self-talk, and beliefs that pertain to worries. Once clients begin to gain awareness of the patterns of their own interpretations, client and therapist collaboratively engage in objective hypothesis testing to examine the accuracy and logic of these cognitions. Given that individuals with GAD tend to overestimate the likelihood of negative outcomes while underestimating their own ability to effectively cope with adverse circumstances, self-monitoring data can be utilized as objective evidence to test the accuracy of their predictions. Similarly, clients are asked to realistically estimate the probability that their negative predictions will occur, by reflecting on their personal history or by examining relevant data on the actual base rates of such events. Beyond addressing the automatic thoughts that are readily identified by clients, CT also targets the core beliefs that deeply underlie these automatic thoughts. To familiarize clients with the concept of core beliefs, examples of common forms of anxious core beliefs are introduced. Examples include imperative thinking style characterized by a list of how self and others “should” operate, catastrophic thinking that leads one to imagine the worst possible outcomes, and reliance on internal emotional cues to interpret a given situation. The distinct styles of anxious beliefs can be applied to individuals’ own thoughts, beliefs, and interpretations to examine further evidence of cognitive distortions. Therapists’ effective use of nonconfrontational Socratic method plays an important role in supporting the clients’ use of objective and critical strategies to examine potential flaws or biases of their own beliefs. (Erickson and Newman, 2007). Over time, clients are gradually expected to adopt this questioning method to examine the validity of their beliefs. Even when major distortions are not identified, consideration of the benefits and disadvantages of particular anxiety-inducing beliefs may enable clients to arrive at the conclusion to discard these beliefs in favor of more adaptive perspectives.

When clients are able to appreciate the distortions and disadvantages of the thus identified cognitions, therapists and clients explore alternative hypotheses that reflect a more adaptive appraisal of reality. Logical analyses continue during this phase of CT to help correct existing distortions and to model adaptive thought processes. Decatastrophizing is used to reveal faulty logic that
is inherent to catastrophic beliefs by walking clients step-by-step through a series of “what-if” questions. During this process, clients are asked to construct a detailed account of each individual step that is required for the worst-possible outcome to occur. In addition to demonstrating the probability that the series of negative events will occur precisely in the manner they imagined is actually very low, this exercise offers an opportunity to generate alternative possibilities for each step. In a similar technique, individuals’ written statements of their core beliefs are deconstructed to remove any source of ambiguity that may make it difficult to recognize and challenge underlying cognitive distortions with concrete evidence. As part of this exercise, clients practice re-constructing the original statements using more concrete expressions, which provide a basis for generating alternative beliefs that are more realistic and adaptive.

One common form of challenge within CT is clients’ reported difficulties with readily adopting the newly generated perspectives, in place of the core beliefs that are deeply rooted in their habitual patterns of cognitive, emotional, and behavioral functioning. To facilitate a more effective replacement of core beliefs, CT may be complemented by behavioral techniques such as SCD and behavioral experiments. The purpose of SCD used in the context of CT is to supply a repertoire of vivid visual imagery that would make the adaptive alternative perspectives “feel” more plausible to the client. On the other hand, behavioral experiments designed to test the alternative perspectives can provide practice preventing avoidant behaviors and further evidence that can support the new perspective.

**Summary and Implications for Future Therapy Development**

Recent advances in basic research of GAD have led to an improved understanding of GAD and the processes that contribute to its onset and maintenance. Building upon Borkovec and colleagues’ groundbreaking theory of worry as a cognitive avoidance mechanism (‘Cognitive avoidance theory of worry’) (Borkovec, 1994; Borkovec et al., 2004), recent theories have offered important new insights into the pathogenic mechanisms of GAD. First, accumulating research has continued to demonstrate that GAD is characterized by cognitive, affective, and neurobiological hyperreactivity to negative events. Due to this pattern of hyperreactivity, individuals with GAD exhibit a heightened sensitivity to sharp increases in negative emotions (Newman and Llera, 2011). Second, this new insight into the nature of affective dysfunction of GAD has led to a reconceptualization of the function of worry. Specifically, worry represents a form of cognitive avoidance that is motivated by a specific desire to avoid negative emotional contrast. However, the goal of avoiding a negative contrast is achieved at the expense of a constant experience of negative affect. Lastly, the Contrast Avoidance model has provided a theoretical framework that integrates distinct factors (i.e., developmental, constitutional, and interpersonal) that are implicated in the onset and maintenance of GAD. It proposes that the transactional processes linking developmental, constitutional, and interpersonal factors contribute to a fear of negative emotional contrast. Although worry is employed as a strategy to avoid the contrast experience, it inadvertently perpetuates dysfunctional interpersonal processes which may further maintain and exacerbate the symptoms of GAD (Erickson et al., 2016; Newman and Fisher, 2013; Newman and Erickson, 2010).

Theoretical advances that were made in the past two decades have led to a series of efforts aimed at further enhancing the efficacy of CBT for GAD. Notably, research has underscored a need to develop treatment components that specifically target interpersonal and related affective dysfunction within the context of CBT (Borkovec and Newman, 1998). Additionally, the importance of using additive designs to incorporate such new components to existing CBT protocols has been highlighted (Behar et al., 2009; Behar and Borkovec, 2003). To fill this void in treatment options, Newman et al. (2004) took a modular approach to incorporate a new treatment module (Interpersonal and Emotional Processing Therapy (I/EP)) designed to address interpersonal dysfunction and deeper emotional processing into standard CBT (Newman et al., 2004). Investigations of I/EP are ongoing and it is anticipated that research on Contrast Avoidance theory would further inform efforts to enhance the efficacy of I/EP delivered in conjunction with CBT (Erickson et al., 2015). Conceptually, an integration of these theories suggest that contrast avoidance is likely to occur within interpersonal contexts.

This review of the extant literature on Worry and GAD has highlighted important progress made in the last two decades’ research on GAD and its treatment. An improved understanding of the nature of affective, neurobiological, and interpersonal processes that underlie worry and GAD is considered as one of the most significant accomplishments (Newman et al., 2013). Currently, important questions remain regarding application of the theoretical advances to treatment development. Future research may prioritize efforts to develop personalized approaches to intervention and to target underlying fear (e.g., fear of negative emotional shift) of GAD.

**References**


