Core Mechanisms of Cognitive Behavioral Therapy for Anxiety and Depression: A Review

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KEYWORDS

• Anxiety • Depression • Mechanisms • Mediators • CBT • Review • Cognitive • Behavioral

KEY POINTS

- Fear extinction is the type of learning that takes place during cognitive behavioral therapy (CBT) for anxiety.
- Inhibitory learning is a process by which fear extinction takes place.
- Cognitive change largely mediates CBT for depression in whatever manner it is achieved (through cognitive restructuring, behavioral activation, and so forth).

In this article, the authors seek to summarize the core mechanisms of cognitive behavioral therapies (CBTs). Core mechanisms of CBT include the specific psychological factors responsible for symptom improvement with therapy. The authors do not discuss nonspecific factors that can also be therapeutic, such as expectancy, credibility, and therapeutic alliance.[1] In addition, they do not cover neural mechanisms of change in this article. It is difficult to separate psychological and neural mechanisms because they may measure the same processes at different levels of analysis. However, work is underway to further delineate the role of the limbic system and the prefrontal cortex as explanatory mechanisms of psychological mediators of CBT.[2–8] The authors first briefly define CBT and mediators of change. Next, they discuss core

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mechanisms of change in CBT for anxiety and related disorders, including extinction and threat reappraisal. Finally, they cover cognitive change as the most researched mediator of CBT for depression.

CBTs are a family of treatments that share a common focus on affect, behaviors, and cognitions. For the purpose of this article, the authors simply refer to the entire group of interventions as CBT. Meta-analyses of randomized controlled trials show CBT is effective for anxiety[9–14] and depression.[15,16] Unfortunately, a substantial minority of patients do not respond to CBT. For example, in several studies nonresponse rates for panic disorder, obsessive-compulsive disorder, and social anxiety disorder were 36%, 38%, and 49%, respectively.[17–20] Treatment development guidelines state that improving interventions requires a better understanding of the change process.[21,22] Thus, CBT researchers are seeking to identify core mechanisms of change (treatment mediators) in an effort to develop effective augmentation strategies or new interventions.[23–25]

Mediators are variables that can explain why or how a treatment works, and they are measured at least at pretreatment and posttreatment. Early analysis strategies (**Fig. 1**) suggested mediation if (1) the treatment-affected outcome (path *a*), (2) the mediator-affected outcome (path *b*), and (3) while controlling for the mediator (paths *a* and *b*), the effect of treatment on outcome was reduced or eliminated.[26]

However, with only these limited criteria for mediation, there were many false positives.[27] Over time, several more mediation criteria were proposed.[28,29] A more comprehensive strategy was suggested by Kazdin.[30] In addition to showing statistical mediation, the following 7 additional criteria were recommended: (1) mediators should be selected guided by theory, (2) potential mediators must be measured in treatment studies, (3) temporal precedence must be established (change in the proposed mediator must occur before change in outcome), (4) more than one mediator should be measured in each study to establish specificity, (5) the design of the study should be sufficient to evaluate mediators, (6) multiple different studies must show similar evidence, (7) the mediator should be directly manipulated to provide converging evidence. These criteria add confidence in the causal relationship between the independent variable (treatment), the mediator, and the dependent variable (outcome measures). Many more recent studies meet criteria 1 through 6. However, studies meeting criteria 7 remain limited.[31] These criteria are not without limitations. For example, if mediators need to be theory driven (criteria 1), the strength of the literature depends on the strength of the theory. Thus, if the actual mechanism of change is not theorized or measured, it will remain undetected with this approach. Nevertheless, this approach has been fruitful to date.

Many mediators of CBT have been proposed (eg, self-efficacy,[32] emotional processing theory fear network modification[33]). However, most can be roughly collapsed into either behavioral[34] or cognitive[35] processes. The behavioral perspective began primarily as a method (exposure) that evolved into an explanation (extinction learning) beginning with Dr Joseph Wolpe's work with cats.[34,36–39] The cognitive perspective of Dr Aaron T. Beck and colleagues[35] focused on changes in thinking as an explanation

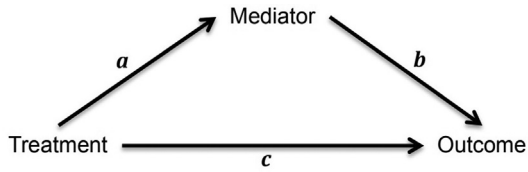

Fig. 1. Baron and Kenny suggested mediation when (1) the treatment affected outcome (*path a*), (2) the mediator affected outcome (*path b*), and (3) while controlling for the mediator (*paths a and b*), the effect of treatment on outcome was reduced or eliminated.

for symptom improvement regardless of the method (eg, cognitive restructuring, behavioral experiments).[40,41] In later discussion, the authors discuss each of these in turn. However, the division of the 2 may be artificial. For example, Hofmann[42] suggested that extinction learning may be cognitively mediated by changes in harm expectancies.

ANXIETY DISORDERS: THE BEHAVIORAL PERSPECTIVE: FEAR EXTINCTION

In this section, the authors discuss the most researched mechanism of change in CBT for anxiety and related disorders.[43] More specifically, they discuss fear extinction as a model for exposure therapy for the treatment of anxiety and related disorders. In this model, anxiety disorders may be acquired via Pavlovian classical conditioning and maintained through operant conditioning (avoidance with negative reinforcement).[44] For example, a soldier may survive a nearby explosion while riding in a Humvee. In this example, the Humvee is the neutral stimulus, the explosion is the unconditioned stimulus (US), and fear is the unconditioned response. This pairing can result in the Humvee becoming a conditioned stimulus (CS) that also causes fear (conditioned response). If the soldier avoids the thoughts, images, and other reminders, this relationship between the Humvee stimulus and fear can persist. One advantage of this model is that it can be tested experimentally in animals and humans. The subject can undergo acquisition (pairing of the CS and aversive US), extinction (repeatedly presenting the CS without the US), and a test phase (presenting the CS again in a different context to test generalization and maintenance of gains). This research led to many important findings on optimal fear extinction parameters[45,46] and reasons for relapse.[38,39]

Although fear extinction is frequently referred to as a mechanism of fear reduction, it is not the final level of analysis. Two major theories on how fear extinction operates include habituation and inhibitory learning.[38,47–50] Habituation refers to the process of automated fear reduction in response to prolonged exposure to a feared stimulus. Although habituation may be operating during extinction, far more research has come from the inhibitory learning literature.[38,51] This theory describes the process of extinction and emerged from findings that exposure therapy does not appear to erase the fear memory, but rather competes with it.[39,52,53] After successful exposure therapy, many patients experience a return of fear. This return suggests that the fear memory was never entirely erased. There are 4 primary categories of return of fear including spontaneous recovery, renewal, reinstatement, and rapid reacquisition.[38,39] Spontaneous recovery is the return of fear that occurs with the passage of time. Renewal is a return of fear that is brought on by a shift in context that is different from the extinction context. Reinstatement can occur when the patient experiences another US that brings back the association between the CS and US. Finally, rapid reacquisition occurs if the CS and US are parried again after extinction (the fear response is learned much faster than if they had never previously been paired). Interestingly, each of these can be addressed by modifying the exposure protocol.[50] The authors discuss a summary of these modifications in later discussion. First, they cover a summary of research on extinction in anxiety disorders.

Research shows that participants with anxiety disorders respond differently during fear acquisition and extinction. Overall, they show greater and more generalized fear responses during acquisition, and they are more resistant to extinction.[6,54,55] Duits and colleagues[55] examined 44 studies in their meta-analysis of classical fear conditioning in the anxiety disorders. Results showed increased fear responses among anxiety patients to conditioned safety cues (CS−) during fear acquisition. Increased

responses to safety cues suggest that they may have a tendency to overgeneralize fear learning. In addition, they showed greater fear responses to the CS+ during extinction indicative of reduced or delayed extinction of the fear response. Other studies show that the level of extinction in a pretreatment assessment predicts the level of improvement in CBT for anxiety disorders.[7,56] Lueken and colleagues[7] examined neural correlates of fear conditioning and extinction before and after CBT for panic disorder. They found that altered safety signal processing demonstrates individual differences that determine the effectiveness of CBT. Interestingly, successful CBT also appears to improve extinction parameters in anxiety patients. Posttreatment, anxiety disorder patients show a better response to extinction, possibly associated with increased prefrontal cortex activity and better coupling between the amygdala, insula, and the anterior cingulate cortex.[6–8]

As stated, research on extinction as a mechanism of change produced several augmentation suggestions to improve CBT for anxiety disorders.[50,57] These suggestions include the following: (1) maximize the mismatch between the expected and actual outcome (expectancy violation),[58] (2) fade use of safety behaviors (safety signals),[59] (3) combine multiple fear stimuli (deepened extinction), (4) occasionally pair the fear stimulus with an aversive outcome (occasional reinforcement),[60] (5) vary the stimuli including intertrial intervals (variability),[61] (6) conduct exposure in multiple contexts,[61–63] (7) label the emotional content (affect labeling),[64] (8) sleep after extinction,[65] (9) deliver exposure during sleep,[66] (10) combine the feared stimulus with a neutral stimulus during extinction (novelty outcome),[67] (11) combine feared stimulus with less aversive outcome (US devaluation),[68] (12) use retrieval cues,[69,70] (13) induce positive mood before extinction,[71] (14) engage in physical exercise before extinction,[72,73] (15) expose a novel context before or after extinction,[74–76] (16) activate the fear memory briefly before extinction training (reconsolidation).[77,78] This list is not exhaustive and does not cover pharmacologic enhancement of fear extinction.[79–86] For a recent review of these strategies in OCD, see Jacoby and Abramowitz.[87] However, this research is still emerging. For many of these strategies, there is preclinical evidence that they facilitate or enhance consolidation of extinction learning, but whether these strategies indeed enhance CBT outcome needs further investigation.

ANXIETY DISORDERS: THE COGNITIVE PERSPECTIVE: THREAT REAPPRAISAL MEDIATION HYPOTHESIS

The cognitive perspective can be divided among automatic and conscious cognitive processes. The relationship between the 2 is described as the “horse and rider” metaphor.[88,89] The horse refers to the automatic processes (attention bias, approach bias, interpretive bias, and so forth) and is the subject of cognitive bias modification research. The work in this area is relatively new and shows promising but at times conflicting results.[90–94] Thus, for the purpose of the current article, the authors focus on “the rider.” The rider here refers to the more volitional conscious cognitive misappraisal activity that is modified through cognitive or behavioral methods. The 2 most common cognitive errors from this perspective are likelihood and cost overestimations of threat.[40] Patients with anxiety disorders tend to overestimate how likely a negative outcome will be (I will be anxious in every social situation; people will always notice; they will always assume I am incompetent). They also overestimate how bad the outcome will be (cost: if a person thinks I am incompetent, this means all people will think I’m incompetent and I will die alone). These faulty threat appraisals then lead to avoidance or escape that maintains the disorder.[35] CBT seeks to target these faulty threat appraisals through exposure and cognitive restructuring. The overarching

goal is threat reappraisal and resulting symptom improvement (reduced anxiety). Thus, threat reappraisal is a proposed mediator for the efficacy of CBT in anxiety disorders.[42]

In an effort to summarize this literature, the authors conducted a systematic review that identified 25 studies that examined the threat reappraisal mediation hypothesis in panic disorder, social anxiety disorder, obsessive-compulsive disorder, posttraumatic stress disorder, acute stress disorder, specific phobia, and one study with a mixed population.[31] The authors included studies that (1) investigated the threat reappraisal mediation hypothesis, (2) included adults with and anxiety disorder, and (3) included a longitudinal design. First, results showed that 56% of the studies investigated statistical mediation, and all but one of those (13 of 14 studies) demonstrated either a significant mediated pathway or a reduction of the strength of the relation between treatment and anxiety reduction after controlling for threat reappraisal. Second, 28% of the studies demonstrated evidence for a causal relation between CBT and threat reappraisal. Third, 28% of the studies examined whether threat reappraisal caused anxiety reduction, and all but one of those (6 of 7 studies) demonstrated that threat reappraisal resulted in subsequent reductions in anxiety. Finally, 44% of the studies controlled for one or more plausible alternative mediators, and 9 of 11 studies observed significant relations between threat reappraisal and anxiety reduction after controlling for one or more plausible alternative mediators. Thus, there was strong evidence of the association between threat reappraisal and symptom reduction. However, there was less evidence that threat reappraisal *caused* symptom reduction - particularly in OCD. [95] For example, Woody and colleagues[95] found evidence of statistical mediation, that CBT caused threat reappraisal, and the effect was specific. However, they also showed that threat reappraisal did not cause anxiety reduction.

Based on this literature, recommendations for CBT for anxiety disorders include enhancing threat reappraisal through several methods. Patients are expected to make their threat predictions explicit (both likelihood and cost estimations). They are then encouraged to attend to and evaluate these predictions during and after exposure trials. Thus, they are guided to attend to their core threats, evaluate them, and then summarize what is learned in an effort to enhance the threat reappraisal.

ANXIETY DISORDERS: CURRENT TRENDS

Until this point, the authors have largely discussed mechanisms of fear reduction. Understandably, patients approach them for exactly this purpose. However, many studies show that not every person has a steady decline in anxiety (either within or across sessions). Nevertheless, this often does not negatively impact long-term success. For example, extinction data show that the amount of fear reduction during extinction training does not always predict the amount of fear at retest.[96–98] Similarly, the amount of fear reduction during exposure therapy does not always predict the amount of fear at follow-up.[99–101] Therefore, the focus on fear as the primary target shifted to a focus on function and adaptive value guided behavior regardless of anxiety or mood. Resulting treatments include mindfulness-based approaches and acceptance and commitment therapy.[102,103] There is debate whether this should be considered a “new wave” of CBT or simply the continued refocus away from immediate anxiety reduction in favor of long-term improved quality of life.[104] Hofmann and colleagues[105] reviewed the literature and suggested that the new approaches are similar in efficacy to CBT and that these new therapies are consistent with the CBT approach.

There is some debate on whether the authors should even measure fear during treatment sessions because this sends a message that it must be dangerous.[87] However, it would difficult to convince a patient that they do not intend to reduce the very symptom they are presenting with for treatment. Rather, one way of presenting this rationale is to say that, at least during the course of treatment, the goal is not to win the war but rather to stop fighting. However, an important follow-up is to state that when one stops fighting during the course of treatment, the war eventually ceases (and the patient has achieved his treatment goals). Similarly, with anxiety, once one no longer finds anxiety threatening, it too eventually goes away. This second part of the message is often neglected in clinical and research settings.

DEPRESSION: COGNITIVE MECHANISMS

Cognitions figure prominently in the research and treatment literature for depression. Not surprisingly, cognitive change is the most researched mediator of CBT for depression. Beck[106] first developed a comprehensive theory of the cause and maintaining factors for major depression. Central to the theory was the role of inaccurate beliefs and maladaptive information processing (repetitive negative thinking). The cognitive model suggests that when these errors in thinking are corrected (cognitive change) that depression lessens and the likelihood of relapse is reduced. Interestingly, early studies suggested both antidepressants and CBT produced similar levels of cognitive change. However, careful follow-up studies and analysis showed that cognitive changes precede symptom improvement in CBT but not in the medication conditions.[107–110] For example, DeRubeis and colleagues[110] randomized outpatients with major depression to CBT or pharmacotherapy and measured cognitions and symptoms at pretreatment, mid treatment, and at posttreatment (week 12). They found that changes from pretreatment to mid treatment on cognitive measures (the Automatic Thoughts Questionnaire, Dysfunctional Attitudes Scale, and the Hopelessness Scale) significantly predicted change in depression from mid treatment to posttreatment. Cognitive change also predicts lower relapse rates.[111–114] Teasdale and colleagues[112] examined how cognitive therapy prevented relapse among 158 patients with residual depression. They found that relapse was reduced by reductions in absolute, dichotomous thinking styles. In an attempt to further determine the specificity of cognitive change, Jacobson and colleagues[115] conducted a dismantling study randomizing patients to behavioral activation alone, behavioral activation plus modification of automatic thoughts, or behavioral activation with modification of both automatic thoughts and schemas. Overall, they found the 3 treatments were equally efficacious. Their data also suggested that cognitive change was important but not differentially affected by the different treatments as one might expect. Thus, cognitive change is important in CBT for depression in whatever manner it is achieved. Finally, research on “sudden gains” in depression further supports the role of cognitive change as a mediator. Sudden gains refers to a relatively sudden drop in depressive symptoms during CBT (an average drop of 11 points on the Beck Depression Inventory that occurs between sessions 4 and 8 in approximately 30%–50% of patients).[116–120] Importantly, Tang and colleagues[116,118] found that cognitive change predicted sudden gains. In 2 studies, they found more cognitive change in the sessions preceding sudden gains relative to other control sessions in the same patients.

SUMMARY

There have been great strides in the development of effective treatments for anxiety and depression. However, a substantial minority of patients do not respond or do

not fully recover. Recommendations in the field are to identify mechanisms of change to guide the search for augmentation strategies or the development of future CBT. The most evidence in the anxiety disorders currently is for mediation described by fear extinction and threat reappraisal. Interestingly, these 2 theories are not incompatible and may represent differences in levels of analysis. The same can be said for research on brain mechanisms. Across anxiety and depression, there is agreement that the limbic system and prefrontal cortex are intricately involved in the process of change. The most researched psychological mechanism in CBT for depression is cognitive change. Cognitive change is observed in both antidepressant and CBT interventions. It is also observed in both cognitive (cognitive restructuring) and behavioral (behavioral activation) therapies. Overall, cognitive change is important in CBT for both anxiety and depression in whatever manner it is achieved. It may be that cognitive change is important, and one of the best ways to convince someone to change their mind is through giving them experience (exposure/behavioral experiments). Thus, exposure and behavioral interventions may be very good cognitive therapy.

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