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Learning Science and Generalized Anxiety Disorder (GAD)

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Introduction

The aim of this chapter is to review how learning science is contributing to our understanding of generalized anxiety disorder (GAD). Learning science helps us to understand the etiology and maintenance of several anxiety disorders including GAD. In addition, a number of types of therapy have been developed based upon, or at least congruent with, the results of relevant learning theory and research. For example, exposure therapy is a well investigated and effective part of cognitive-behavioral interventions, fruitfully influenced by the results of research on basic conditioning procedures. Modern learning theories suggest that both enhanced excitatory and inhibitory fear mechanisms as well as fear generalization each play an important role in the pathology of GAD. In addition to this, approaches originating within contextual behavioral science, including Relational Frame Theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001) help us to understand how anxiety can generalize via verbal–symbolic processes, rather than simply formal similarity. In this chapter, we will first review basic associative and operant learning theories before subsequently considering the theoretical and empirical contributions of RFT. In this way, we will build a bridge to the symptomatology of GAD as well as to worry as a core feature of this condition.

Before beginning, we should first provide the following caveat. Although learning theories are well recognized as contributing to our understanding of the processes

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involved in anxiety, research explicitly investigating fear learning in GAD itself is rather rare (Mineka & Oehlberg, 2008). Research findings in this area are often derived from research employing subclinical samples that are high in trait or state anxiety or neuroticism, which renders it difficult to draw unambiguous conclusions regarding the role of learning in GAD. While we describe general learning approaches to anxiety disorders, this chapter will include the results of those relatively few studies directly investigating pathological anxiety learning in individuals with GAD. Also, while RFT research is promising with regard to its conceptualization of verbal–symbolic generalization in anxiety, this work is only starting to empirically model the types of processes hypothesized to be involved in clinical anxiety, including GAD. This modeling research has also tended to mainly involve non-clinical participants. At the same time, however, this research has provided some important pointers that have helped in the understanding of the characteristics of GAD, not least regarding the role of symbolic generalization of fear and avoidance.

Basic Conditioning Theory and Avoidance Learning

A key learning process that is drawn upon to explain the origin of anxiety disorders, such as GAD, is Pavlovian fear conditioning (e.g., Mineka & Zinbarg, 2006). In this paradigm, a neutral stimulus (NS) is paired repeatedly with an unconditioned threat stimulus (US; e.g., electric shock, audible scream, air puff to eye). Consequently, the NS reliably signals an upcoming aversive event, becoming a conditioned stimulus (CS) capable of eliciting a conditioned fear response (CR) while no US is present. The CR is measured by self-report (i.e., valence, arousal), physiological (e.g., skin conductance) and behavioral measures (e.g., freezing). This form of associative learning has been shown to occur not only when explicitly pairing a neutral with a fear eliciting US, but also via observation and instructional learning (Debic & Olsson, 2017; Olsson, Nearing, & Phelps, 2007). In most current experimental research, the preferred design is a differential conditioning procedure, in which one CS (CS+) coincides with the US, while a second CS (CS–) is never followed by the US. In this procedure, conditioning is measured by the degree of difference in fear or avoidance rates produced by the two different CSs (Lonsdorf et al., 2017).

Modern conditioning studies provide a more precise description of the difference between fear and anxiety, which is relevant for the understanding of learning in GAD. More specifically, while fear tends to be defined as an urgent alarm reaction to a real and imminent threat, anxiety can be defined as a more future oriented mood state, directed at potentially threatening upcoming future events (Craske et al., 2009). In addition, while explicit cue conditioning establishes a discrete stimulus as a reliable predictor of a discrete US, context conditioning can also be undertaken, in which a CS is present in a particular context, such as the background color of a computer screen or the ambient smell of the laboratory. Cue and context conditioning have been argued to target different defense responses; from responses to clear imminent threats (e.g., fear, avoidance) on the one hand to responses to more distal and less certain threats (e.g., worrying) on the other. These different types of responses may also recruit two distinct neural substrates (Walker, Toufexis, & Davis, 2003).

Mowrer's (1947) two-stage theory of fear argued that Pavlovian learning constitutes only one aspect of anxiety acquisition. This theory postulated that pathological

anxiety is established as a reaction to a CS paired with a threatening US but that, in addition, the individual subsequently learns that avoiding the CS leads to a direct reduction of fear. The latter is an operant learning process that complements the Pavlovian, or respondent conditioning process, and is relevant in explaining the emergence and maintenance of avoidance behavior associated with anxiety and fear. Despite the enormous impact of this theory on clinical psychology and the resultant development of exposure therapy, Mowrer's two-stage theory has been criticized on the basis that avoidance responses can still arise even in the absence of fear reduction, which should of course lead to extinction of avoidance responding in accordance with the basic principles of the theory (e.g., Mineka & Gino, 1980). Accordingly, more modern associative learning theories have attempted to broaden the Pavlovian-operant perspective with respect to avoidance (Krypotos, Effting, Kindt, & Beckers, 2015; Treanor & Barry, 2017). For example, in safety signal accounts, context cues which are present during the avoidance response become discriminative for avoidance responding as they signal safety. Cognitive processes, such as the private mental rehearsal of the consequences of avoiding or not avoiding a feared stimulus, have also been suggested as causal in the etiology of fear and avoidance (Lovibond, Saunders, Weidemann, & Mitchell, 2008). As we will see further on, modern contextual behavioral approaches to learning may offer a behavioral paradigm within which we may better understand precisely such cognitive activity.

Excitatory Fear Mechanisms and Fear Generalization in GAD

When GAD patients are compared to healthy controls in associative conditioning paradigms, they show heightened response to threat cues in differential and simple conditioning paradigms. Importantly, heightened fear responses are observed during learning (acquisition) and unlearning (extinction) of fear associations to the CS+ as well as to the CS–, and differences observed during extinction are not necessarily accompanied by heightened response during acquisition (Craske et al., 2009; Lissek et al., 2014). Although results such as these suggest that individuals with GAD (and perhaps other anxiety disorders also) might suffer from an overactive excitatory fear system, other models argue that pathological anxiety of this kind is mainly characterized by a failure to inhibit fear responses to safety cues. It has been suggested that individuals with GAD may be more prone to associate threat cues with neutral cues but, even more importantly, they may not be able to suppress their anxiety response to safe, non-threatening information. Overgeneralization of conditioned fear has been discussed as a crucial feature of GAD, and, although the literature is inconclusive regarding fear generalization in GAD (Lissek et al., 2014; Tinoco-Gonzalez et al., 2015; for a review, see Dymond, Dunsmoor, Vervliet, Roche, & Hermans, 2015), it has been speculated that for individuals with GAD anxiety responses generalize more readily to stimuli that resemble the initial CS+. This view dovetails with other theoretical accounts of GAD which focus on the role of dysfunctional cognitive processes that occur when the GAD patient encounters ambiguous stimuli (see Lommen, Engelhard, & van den Hout, 2010). In clinical terms, it has been argued that patients with GAD learn more easily to associate threat cues with neutral cues and show higher anxiety responses to cues which either signal safety or which are like the initial threat cue.

Borkovec's Avoidance Model

In 2004, Borkovec proposed the "Avoidance Model of GAD and worry," which is mainly based on Mowrer's two-factor theory and modern emotional processing theories (Borkovec, Alcaine, & Behar, 2004). Regarding learning principles, Borkovec describes pathological mechanisms in operant terms, suggesting that the verbal process of worrying, seen as a central feature of GAD, is an instrumental avoidance response aimed at suppression of aversive worry-related mental imagery and its somatic and affective symptoms. Importantly, verbal processing may interrupt the emotional processing of the feared stimulus, thus precluding habituation and extinction. There is substantive empirical evidence supporting Borkovec's Avoidance Model (see e.g., Behar, DiMarco, Hekler, Mohlman, & Staples, 2009), and current exposure-based therapies for GAD rely heavily on this theory (see Chapter 10 in current volume). Interestingly, current research on learning and operant processes broadens the perspective of avoidance learning in GAD to aspects of dysfunctional decision-making processes in individuals with GAD. Negative emotional and somatic consequences of imagined future threatening events may not only be avoided by such a linguistic processing style, but as a result, individuals may also have an increased internal representation of upcoming negative events. While healthy individuals learn that their negative expectations about the future ("My husband will be killed in an accident") do not match their current experiences ("My husband is alive"), it has been suggested that individuals with GAD may be less sensitive with respect to learning the inconsistency between their expectations and real experiences, ensuring less diminution of the negative impact of their worries (White et al., 2017).

RFT and GAD

While theorists such as Borkevec acknowledge the role of verbal processing within GAD, and indeed anxiety more generally, one more recent contextual behavioral account implicates verbal responding as a core factor, not just within GAD or even anxiety, but in the development of psychopathology generally (Dymond, Bennet, Boyle, Roche, & Schlund, 2018). In contrast to traditional cognitive accounts of GAD, this behavioral contextual approach is based upon an operant analysis of language itself, and one which has promise for providing new insights into diverse areas of human functioning, both adaptive and maladaptive. This is the modern contextual behavioral account known as RFT (Hayes et al., 2001). In what follows, we introduce this innovative approach and explain how it is being used specifically to investigate the processes underlying psychopathology and novel treatments for anxiety-based clinical conditions.

According to RFT, under normal socialization conditions, humans acquire a type of operant skill referred to as arbitrarily applicable relational responding (AARR). This skill is acquired relatively early on in parent–child interactions, and later in early schooling, and it underpins language and cognition itself, rather than vice versa (see e.g., Cassidy, Roche, Colbert, Stewart, & Grey, 2016). Relational responding is of course common in animal species. For instance, many species can respond to a stimulus based on its physical relationship to another (e.g., picking something physically

bigger or smaller than something else). This is referred to as non-arbitrarily applicable relational responding (NAARR). Humans, however, can additionally learn to relate stimuli regardless of their physical properties and instead based on contextual cues independent of those properties. This is referred to as AARR. The fact that the relational responding is independent of physical properties means that humans can respond to new and derived relations among the stimuli based on the cues involved and without being directly taught to do so. For example, if I tell you that A is bigger than B, then you can derive that B is smaller than A. This relational response is not controlled by the physical properties of A and B but rather the words "bigger" and "smaller." In this sense, the response to B as smaller than A can be described in terms of the application of the arbitrary relation of comparison to the A and B stimuli (i.e., rather than being based on physical properties of A and B).

AARR has three core empirically demonstrable properties. (a) Mutual entailment refers to the bidirectionality of relational responding, such that if A is related to B in a particular context, then a relation from B to A can be derived in that context (e.g., if A < B then B > A). (b) Combinatorial entailment refers to the fact that relations can be combined to derive a new relation. For example, if A is related to B and B to C, then a bidirectional relation between A and C is entailed (e.g., if A < B < C, then A < C and C > A). (c) Transformation of stimulus functions is the phenomenon whereby, if the psychological functions of a stimulus in an arbitrarily applicable relation are changed in some way, then the corresponding functions of related stimuli can change in accordance with the applicable relation in the absence of further training or instruction (e.g., if A < B < C and A is frightening, then C may spontaneously become more frightening than A).

Humans can learn a variety of patterns of AARR including, for example, equivalence (or coordination), opposition, comparison, temporality, hierarchy, analogy, and deixis (or perspective-taking; see e.g., Stewart, 2016). All patterns of AARR are by definition under the control of contextual cues. Some cues (referred to as "relational") specify how stimuli should be related to each other. For example, cues such as "more" and "less" specify a comparative relation. Other ("functional") cues specify which stimulus functions should be transformed based on the relation. For instance, in the phrase "Dogs are more frightening than cats," the cue "more" specifies a relation of comparison between dogs and cats, while the cue "frightening" specifies the functions that should transform (i.e., fear functions).

Once an advanced repertoire of AARR is in place, any stimulus can be related symbolically to any other stimulus, including relations and relational networks (sets of interconnected relations) themselves, and the events involved can thereby have their functions wholly transformed. As such, RFT researchers see AARR as the key functional analytic process underlying the complexity, generativity, and semantic richness of human language and cognition, and have used it to investigate a variety of key repertoires, both public and private, including thinking, self-knowledge, problem-solving, and rule-following (see, e.g., Hayes et al., 2001) with the aim of facilitating prediction and influence in these important domains. Indeed, over the past 20 years, RFT research has expanded rapidly into a variety of areas, both basic and applied. One such area is psychopathology.

As a result of AARR, we humans can adapt our behavior in ways unique to our species. For instance, we can relate past events to future ones and derive innovative solutions to problematic states of affairs. However, AARR can also itself result in

maladaptive responding and psychological problems including depression, anxiety, or addiction (see Hayes, Strosahl, & Wilson, 2012; Törneke, Luciano, & Valdivia Salas, 2008). Regarding generalized anxiety, an individual who has had a frightening or traumatic experience may find recalling this event highly aversive as a result of the transformation of the response functions of the words used to describe the event by the now conditioned aversive stimuli established via direct conditioning processes during the traumatic incident itself. AARR can also facilitate contact with purely hypothetical but nevertheless aversive events. For example, a hypothetical future event such as failure in a job can be contacted via temporal relations (e.g., "If I try to innovate then things will go badly wrong"). Although this event has not, and may never, happen, it can nevertheless produce fear and distress via derived relational processes. Indeed, this can explain how people come to fear and avoid completely novel stimuli without prior experience or instruction (e.g., "I won't try that fish because I heard once that it tastes worse than another fish that I don't very much like").

Another concept that can help to explain pathological behavior are "rules." In RFT, a rule is understood as a network of relations that specifies contingent relations between antecedent, behavioral, and consequential events (Kissi et al., 2017). In the same way that a cue can signal the necessity to engage in an avoidance response as a result of direct Pavlovian or operant learning history (e.g., a traumatic event), a rule can control the same avoidance response, but in the absence of a conditioning history that makes such behavior readily predictable by an observer. However, a rule is not in itself detached from this learning history, but is entirely explained by it, coupled with the individual's extensive ability to respond to all events in terms of arbitrarily applicable relations (e.g., "I got hurt badly in a car accident that day I failed to wear my car seat belt, so I am going to *always wear my seat belt in future*").

In technical terms, when a person generates and follows a rule they are responding to the relations between the stimuli contained in those rules, which are in turn controlled by the relevant contextual cues, such as relational words or thoughts of such words (e.g., "worse," "bigger," "sooner"). For example, a person with GAD might tell themselves "I am safe now here at home. If I go to the party then something bad might happen and I'll feel highly anxious, so I'll stay home and relax instead." This rule includes a number of stimuli (I versus others) and events (going to parties; something bad happening; being relaxed versus being anxious) that are related in a particular way. Conditional ("f") and temporal ("Then") stimuli serve as contextual cues and dictate the order of events and indicate the behavior required (staying home) in order to avoid the aversive consequences of going to the party (something bad happening; feeling anxious). The person concerned can check if they are following their self-rule and whether it is working by assessing whether what they are doing is coordinated with the relations involved (i.e., "here I am at home—and I should not feel anxious") and whether or not it has resulted in the consequences specified (i.e., nothing bad having happened; feeling relaxed).

Rule-following has both advantages and disadvantages for humans. It allows us to set and attain goals, to learn from other people's experience, and to anticipate and deal with potential future events (e.g., one can follow the rule "Don't exceed the speed limit in town, it's dangerous" and avoid harm without having to directly contact the events involved). At the same time, however, rule-following can also contribute to human suffering. Studies have shown that rule-following can make people insensitive to changes in environmental contingencies (e.g., Doll, Jacobs, Sanfey, &

Frank, 2009; Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986; Wulfert, Greenway, Farkas, Hayes, & Dougher, 1994) and that this effect may be particularly pronounced in subclinical and clinical populations (Baruch, Kanter, Busch, Richardson, & Barnes-Holmes, 2007; Cella, Dymond, & Cooper, 2009; Dixon, Hayes, & Aban, 2000; McAuliffe, Hughes, & Barnes-Holmes, 2014; Monestes, Villatte, Stewart, & Loas, 2014).

AARR and GAD

Chronic and/or generalized anxiety can be understood to a large extent as the product of AARR transforming an otherwise relatively adaptive response into a maladaptive one. From this perspective, the causes of generalized anxiety include both bio-genetic factors as well as particular fear- or stress-producing experiences and conditioning processes that might augment them. These aspects of the causal background to anxiety are ones that can also be present to some extent in non-verbal animals. However, in humans the capacity for AARR can facilitate significant promulgation, strengthening, and indeed transformative generalization of fear/anxiety responses including facilitation of anxiety disorders such as GAD. Through AARR we can come to fear and practice avoidance of not just stimuli directly involved in or physically similar to those in a fear-producing incident, but also any other stimuli that might be symbolically related (i.e., relationally framed) with those, including emotional and cognitive aspects of our fear/anxiety responding itself. Contributing to this process of debilitating transformation of function, we may engage in the derivation of maladaptive rules that work to promote generalization and augmentation of fear and avoidance responding as well as the "problem-solving like," but ultimately avoidant and practically self-defeating practice of worrying. In effect, the process of private rumination over feared events can exacerbate the aversive functions of those events vis-a-vis the process of transformation of stimulus functions. For example, an individual who privately verbally rehearses the possible consequences of being stuck in an elevator, can literally transform the psychological functions of elevators, and all related stimuli (e.g., pictures of elevators, the word elevator, thoughts of elevators), such that they not only become more aversive, but also that previously non-aversive features of elevators (e.g., their color) now come to produce an exacerbated anxious response.

As presented above, direct learning processes undoubtedly play a role in generalized anxiety. People with GAD often report previous or current experience of traumatic or stressful events (e.g., childhood abuse, bullying, ongoing chronic illness or pain; Roemer, Salters, Raffa, & Orsillo, 2005). In the case of at least some of those who have experienced such events, at least some threat anticipation and avoidance behavior may be a product of Pavlovian conditioning (e.g., other people paired with physical or emotional abuse; hospitals paired with experience of illness) or the relationship between past behavior and its consequences (e.g., avoidance of people to reduce likelihood of bullying; avoidance of the workplace to reduce stressful task load and/or interpersonal encounters). These past experiences may subsequently influence the extent to which other previously not encountered but physically similar individuals or events are avoided in the present. However, we believe these processes alone are not enough to account for GAD. First, not everyone with GAD has a history of trauma, nor does everyone with such a history subsequently develop it. Second, GAD

can involve fear/anxiety with respect to a diverse array of situations, social and otherwise, many of which might bear little or no resemblance to those involved in an originally precipitating fear-eliciting event. Thus, it is important that we confront the fact that while direct conditioning may play a role in GAD, it cannot offer a complete account of the disorder. Furthermore, while emotional processing theories may attempt to extend the conditioning accounts in order to fill the explanatory lacuna, they do so in entirely hypothetical terms appealing to hypothetical private mental processes. What RFT offers is an extended account of the fear and avoidance conditioning processes, but one which appeals only to well-understood processes (AARR) identified in bottom-up laboratory research.

An RFT account suggests that verbal processes (AARR) are critical in the acquisition and maintenance of psychopathological anxiety and avoidance (see Dymond et al., 2018 for a review). More specifically, individuals can come to fear or avoid stimuli based not simply on direct experiences with them, but also on how they are related to other stimuli. There are now several empirical studies demonstrating this phenomenon. For instance, Pavlovian conditioned fear can both transfer to distantly related stimuli via coordinate relations (e.g., Dougher, Augustson, Markham, Greenway, & Wulfert, 1994; Rodriguez-Valverde, Luciano, & Barnes-Holmes, 2009; Vervoort, Vervliet, Bennett, & Baeyens, 2014) and transform the functions of other stimuli via non-coordinate relations (e.g., Bennett, Hermans, Dymond, Vervoort, & Baeyens, 2014; Dougher, Hamilton, Fink, & Harrington, 2007; Roche & Barnes, 1997; Roche, Barnes-Holmes, Smeets, Barnes-Holmes, & McGeady, 2000).

The transformation of stimulus functions effect has been used to model and investigate the symbolic generalization of avoidance from a behavioral perspective (Augustson & Dougher, 1997; Dymond et al., 2011). One relevant early study conducted by Augustson and Dougher (1997) first induced participants to derive coordinate relations among arbitrary stimuli (A1-A2-A3-A4, B1-B1-B3-B4), before subsequently using a differential conditioning paradigm to pair A2 but not B2 with shock, and training an avoidance response to A2 which both removed it from a computer screen and omitted shock. The researchers then tested for the emergence of this threat-avoidance response in other stimuli not presented in the avoidance learning and showed that all participants emitted the avoidance response to both A3 and A4 (in derived coordination with A2) but not to either B3 or B4 (in derived coordination with B2). This is a clear example of an entirely symbolically generated avoidance response, which in the absence of a technical account capable of explaining it, might tempt a researcher to speculate on all manner of hypothetical private processes, thereby leading to untestable hypotheses regarding the emergence of anxiety.

Further studies have extended this effect by demonstrating complex transformations of avoidance through non-coordinate relations. For example, Dymond, Roche, Forsyth, Whelan, and Rhoden (2007, 2008) first established contextual functions of same and opposite in arbitrary stimuli and subsequently induced participants to derive both same and opposite relations in the presence of these cues. More specifically, they used the cues to train arbitrary relations between randomly chosen nonsense words (represented by alphanumerics) as follows: A1-Same-B1, A1-Same-C1, A1-Opposite-B2, A1-Opposite-C2, and then successfully tested for derivation of additional untrained arbitrary relations: B1-Same-C1, B2-Same-C2, B1-Opposite-C2, B2-Opposite-C1. Next, participants were exposed to a differential conditioning task involving aversive stimulation in the presence of B1 but not B2 and in which they

could cancel the aversive stimulation with an avoidance response. Finally, they were tested in extinction for responding in the presence of C1 and C2 and showed avoidance in the presence of C1, derived as the same as B1, but not C2, derived as opposite to B1. These findings thereby showed the transformation of avoidance in accordance with a complex network of both same and opposite relations. Data such as these indicate that RFT constitutes a useful paradigm for modeling the symbolic generalization of fear and anxiety in anxiety conditions. In particular it provides a framework for understanding how such anxious responses can generalize rapidly and extensively through an extended relational network such that events even remotely related to the original fear object can elicit a large anxious response. Indeed, even thoughts of typical escape and avoidance strategies can themselves elicit the response because of their relationship to the very thing they are intended to escape or avoid (see e.g., Hooper, Stewart, Duffy, Freegard, & McHugh, 2012; Stewart et al., 2015).

The RFT paradigm also suggests ways in which particular features of GAD may be modeled and investigated. For example, one issue of particular relevance to clinical anxiety, including GAD, is excessive worry. Individuals with GAD often show "catastrophizing" in which an apparently minor problem might lead to derivation of an extremely negative outcome, far in excess of what might be warranted. RFT can easily explain how worry increases via transformation of function in accordance with relational frames. For instance, in one study, Dougher et al. (2007) employed three arbitrary stimuli, which we will call A, B, and C here for illustrative purposes. When presented with A, B, and C on separate trials, participants were taught to choose from a selection of three further stimuli, the smallest, middle sized, and largest stimulus, where all three stimuli were images of circles. The researchers then used the B stimulus (which had been discriminative for choosing the middle-sized circle) in a differential conditioning procedure, in which it was paired with brief electric shocks. Participants were then exposed to the A, B, and C stimuli in a random sequence without instruction while their skin conductance responses were recorded. The C stimulus, which was in an established relation with a larger circle stimulus, more reliably produced larger skin conductance responses than either the B or A stimuli. This effect is explicable only in terms of the arbitrarily applicable comparison response participants made to the C stimulus, which was identical in size to the A and B stimuli but which was derived as "greater than" these other stimuli and consequently had its fear functions transformed so as to become more frightening/aversive than them. Once again, a response that appears irrational in the absence of a technical historical account of behavior (i.e., greater fear of a C stimulus that has not been directly aversively conditioned than of a B stimulus that has been directly conditioned), becomes explicable in testable ways given an RFT-based explanation. But more importantly in the current context, this study was the first to show how AARR can help explain the process of catastrophizing insofar as it involved a complex and extended verbal response to the B stimulus that resulted in a substantially larger reaction to the C stimulus than might seem warranted (i.e., given the lack of evidence that the latter was threatening).

The foregoing studies suggest that, based on their capacity and indeed propensity to engage in AARR, humans can show fear and avoidance of novel stimuli in the absence of a direct history of reinforcement for doing so (i.e., in the absence of any trauma). In more recent years, derived relations research has also started to examine the phenomenon of combined approach–avoidance contingencies based on the argument that this is a more ecologically valid model of anxiety disorders. To explain, the

behavior characterizing pathological anxiety is not simply avoidance of purely aversive contingencies, since that would be arguably adaptive rather than maladaptive (Hayes, 1976). Instead, pathological behavior is likely better characterized as the frequency of avoidance in situations in which approach and avoidance contingencies compete. For example, a person might avoid all public spaces because, while they desire to go shopping and have social contact, they also wish to minimize feelings of anxiety associated with leaving their safe space at home. In an attempt to examine such phenomena, Gannon, Roche, Kanter, Forsyth, and Linehan (2011) exposed participants to a stimulus equidistant (in terms of the number of intervening derived relations) from both a conditioned avoidance and conditioned approach stimulus. In this paradigm the aversive stimulus predicted electric shock, whereas the appetitive stimulus predicted a monetary reward. Findings were that participants showed longer response latencies in combined approach–avoidance trials in which only one response was possible—to approach or avoid the stimulus. An avoidance response removed the shock but also the cash reward. An approach response involved a brief shock but also a cash reward. Shorter response latencies were observed on trials in which only a shock or monetary consequence were available (participants always avoided the shock and approached the money). This extended response time on conflicted trials was interpreted as evidence of an experienced dilemma, not unlike that experienced by, for example, an agoraphobic individual standing in their house doorway, determined to leave the house, but equally determined not to. It is this conflict which adds a degree of suffering for the already dysfunctional individual.

The models of avoidance discussed so far have all featured fear and avoidance of solely public stimuli. However, much of the problematic avoidance that happens in pathological anxiety is avoidance of private events (i.e., thoughts and emotions). Based on their capacity for AARR, humans develop rules concerning the desirability of particular kinds of private experiences. Sadness or fear, for example, are typically seen as negative and undesirable and therefore to be minimized or avoided. Attempts to control or avoid anxiety and anxiety-provoking thoughts play a central role in pathological anxiety. Invariably, such attempts not only fail but are actually counterproductive, in that they can result in the increased likelihood of the to-be-avoided private event (e.g., Najmi & Wegner, 2008; Wegner, 1994). Empirical investigations into this effect suggest that the reason for this ironic effect in attempted thought suppression is that previously neutral stimuli used as distractors can become associated with the to-be-avoided stimulus and thus act as reminders of this stimulus (e.g., Wenzlaff & Wegner, 1998). Over the last few years a number of RFT studies have added to this work by showing how transformation of functions through derived relations can play a crucial role in this phenomenon because not only distractors, but even stimuli participating in derived relations with distractors, can contribute to failed suppression (Hooper, Saunders, & McHugh, 2010; Stewart et al., 2015).

In the Hooper et al. (2010) study, participants were first induced to derive three separate equivalence relations, each of which involved a derived (rather than directly taught) relation between a real word and a nonsense word. They were then instructed to suppress all thoughts of a target word ("Bear") that was in fact a member of one of the three equivalence relations, and they were shown how they could escape words presented to them on a computer screen by pressing a space bar. During the crucial test, participants escaped not only the to-be-suppressed stimulus "Bear" but also the nonsense word that was indirectly related to it via the equivalence relation. Stewart

et al. (2015) used a similar paradigm to demonstrate that this spontaneous generalization of avoidance to related words could happen not only via derived equivalence or sameness relations but also on the basis of derived non-equivalence (specifically opposition) relations (i.e., participants can avoid words on the basis of what they are semantically opposite to). These studies demonstrate that experiential avoidance can generalize not only through direct association but also via multiple derived relational networks, thereby substantially extending the original avoidance repertoire. As this repertoire extends, the degree of dysfunction increases. These findings justify further investigation among clinical populations such as those with GAD, but early indications are that we have isolated a core behavioral process that can help to explain the apparent irrationality of fears and worries.

Thus far we have presented RFT theory and empirical research on a number of different phenomena characterizing pathological anxiety, including transformation of fear and avoidance functions; catastrophizing; and experiential avoidance of private events. As discussed earlier, one key aspect of pathological anxiety and GAD that involves all of the processes discussed thus far is worrying. Anxious individuals may spend long periods of time lost in thought, cognitively rehearsing potential future problems. From the RFT perspective of course, worrying is relational framing, a behavior under the control of multiple and complex contextual (historical and situational) stimuli. As for any pattern of AARR, the cues that occasion it may themselves be relational and arbitrary in nature. Thus, other than previous verbal behavior (which may be private) little environmental support is necessary to maintain this behavior and control its content. Regarding consequential control, one of the factors that maintains worrying is relational coherence (see e.g., Bordieri, Kellum, Wilson, & Whiteman, 2015; Quinones & Hayes, 2014; Wray, Dougher, Hamilton, & Guinther, 2012). This can be conceptualized broadly as responding relationally in a manner that is consistent with previously acquired patterns of relational responding. During early language training, the child's relational responding is evaluated for coherence and differentially reinforced by the verbal community. With time, the processes involved in this (i.e., the relational responding itself, the evaluation of that responding for coherence, and the reinforcement for coherence) become private and automatic so that the derivation and rehearsal of coherence becomes self-reinforcing.

Apart from providing socially conditioned reinforcement, coherence is also frequently associated with instrumental success. In other words, "figuring things out" facilitates problem-solving. However, as suggested in our earlier discussion of Borkevec's work, worrying is different from other more typical examples of "thinking things through," in that its effective function is not primarily to facilitate problem-solving (in fact it tends to interfere with it; Lyubomirsky & Tkach, 2004) but to minimize or avoid the experience of anxiety. More specifically, worrying may function to reduce anxiety about the focus of one's worries because by worrying one is at least engaging with the problem at some level and in a "problem-solving-like" manner. This reduces feelings of uncertainty about the future (see e.g., Dugas & Robichaud, 2007; Quinones & Hayes, 2014) and provides a reinforcing sense of coherence. At the same time it does not increase the anxiety of dealing with associated problems in the moments they occur, because by worrying one is also not actually engaged in directly dealing with the problems that are the source of the worry. People with GAD often endorse positive evaluations of the functionality of worry in helping avoidance of other emotional distress (Borkovec, Hazlett-Stevens, & Diaz, 1999). Nevertheless,

as with other forms of experiential avoidance, worrying does not facilitate improved outcomes overall, especially in the longer term, but instead tends to produce increasingly negatively biased thoughts, negative problem orientation, inhibition of operant behavior, diminished concentration, higher stress, and increased problems (e.g., Lyubomirsky & Tkach, 2004). In addition, while perhaps seeing the utility of worrying as a short-term avoidance tactic, individuals with GAD also come to see worry itself as dangerous and uncontrollable (Wells, 2002; Wells & Carter, 2001). Again, this is readily understood from an RFT perspective as a product of the bidirectional and reflexive nature of the process of transformation of functions via derived relations. For example, GAD sufferers may come to derive bidirectional relations between their worrying and such labels as "futile," "self-defeating," "incapacitating," and "part of the problem." As a result, there is negative transformation of the functions of their ongoing patterns of worrying so that this behavior itself may become anxiety-provoking, thus serving to heighten their anxiety even further.

Finally, in addition to providing a theoretical and empirical approach to understanding pathological anxiety, RFT researchers have also conducted basic investigations of therapeutic processes that may be relevant in treating this condition. A number of these have focused on the phenomenon of "cognitive defusion," a core element within acceptance and commitment therapy (ACT; Hayes et al., 2012). ACT, which shares philosophical roots with RFT as a form of contextual behavioral science, aims to promote acceptance rather than avoidance of private experiences (i.e., thoughts and emotions) in the service of living a values-oriented life, and has already been successfully applied to pathological anxiety and GAD among various other forms of psychopathology (e.g., Brown et al., 2011; Forman, Herbert, Moitra, Yeomans, & Geller, 2007; Roemer et al., 2005; Roemer, Orsillo, & Salters-Pedneault, 2009; Zettle, 2003).

Cognitive defusion is a technique intended to result in a reduction in the transformation of stimulus functions through AARR (e.g., Assaz, Roche, Kanter, & Oshiro, 2018; Blackledge, 2007, 2015). Several different ACT exercises are used to achieve this end. One simple example is an exercise in which a word or phrase is repeated over and over again until conventionally dominant verbal functions (e.g., meaning and verbal control) are temporarily displaced in terms of influence by other functions (e.g., sound). This and other types of defusion exercises are employed to undermine maladaptive elicited or evoked functions (e.g., avoidance) that might otherwise pertain when particular words or phrases (e.g., death, anxiety, etc.) are present under conventional circumstances. Cognitive defusion may be of particular relevance for the treatment of GAD in particular. Borkovec and colleagues have highlighted that what is particularly problematic for individuals with GAD is their reactions to their reactions (e.g., Borkovec et al., 1999). That is, they worry about (i.e., engage in AARR with regard to) their initial cognitive and emotional reactions, prompting further distress or worry through transformation of function. Based on this reflexive and augmentative process, individuals with GAD may find their emotional responses particularly aversive and overwhelming (Mennin, Heimberg, Turk, & Fresco, 2002). Fear of negative emotions in general, and not just of anxiety, may be a predictor of anxiety disorders including GAD (Roemer et al., 2005; Williams, Chambless, & Ahrens, 1997). Data from RFT studies already reviewed suggest that AARR might play a key role in this process by allowing transformation of functions through relational framing of fear-inducing stimuli, including one's own (negatively evaluated)

reactions. Cognitive defusion exercises operate to reduce or limit such problematic transformations of function—in this case, of overextended avoidance or discriminative functions.

A number of basic RFT studies have tested this concept under controlled laboratory conditions. One such study is Luciano et al. (2014) who showed that a cognitive defusion intervention could reduce experimentally induced generalized avoidance. This study used a paradigm similar to that described earlier in which participants were first trained and tested for the formation of derived equivalence relations and subsequently showed transfer of avoidance functions through equivalence. Following this, all members of the "defusion" intervention group were trained in taking perspective on thoughts rather than acting on them (i.e., thus "changing the context" within which AARR occurs, a key method by which defusion may be facilitated), while controls simply received motivational instructions. Subsequently, all members of the defusion group showed a complete suppression of avoidance responding for stimuli that might otherwise be predicted to occasion avoidance, including ones eliciting fear responding, while less than half of controls did. These results support the utility of cognitive defusion as a procedure for undermining problematic avoidance such as is seen in pathological anxiety.

Conclusion

Learning theories have fruitfully influenced our understanding and treatment of anxiety disorders. For GAD, several general as well as disorder-specific processes have been described in fear learning within associative and operant learning paradigms. Many previous accounts have tried to explain GAD in terms of direct learning processes alone. However, such accounts are arguably too simple to explain key features of GAD such as extensive generalization of fear and avoidance, catastrophization, and worrying. Borkovec's (1994) account that worrying is an avoidance response which undermines needed emotional processing has received empirical support and has been influential regarding current exposure-based therapies. However, this theory can be criticized for its lack of technical specificity about key explanatory phenomena such as "emotional processing," which make it difficult to test or verify in a truly bottom-up fashion. In contrast, modern contextual behavioral science in the form of RFT greatly augments previous analyses by highlighting AARR as the key technical process underlying language, and showing how this process can facilitate extensive generalization of experience through transfer and transformation of function. We discussed how these processes might give rise to several characteristics of pathological anxiety generally as well as to features more specific to GAD. One particularly prominent feature of GAD is the response of worrying, which seems to be part of an instrumental avoidance response, but which produces several negative outcomes including prevention of habituation to negative emotional and somatic reactions to worries about future events, and interfering with engagement in valued activities. Apart from allowing investigation of the origins of psychopathology, contextual behavioral psychology has also begun to contribute to examining potential therapeutic methods such as cognitive defusion. To the extent to which conditions such as GAD are based on AARR, methods such as this that target the problematic patterns of AARR may be therapeutically useful, but research is needed to determine their potential (see e.g., Assaz et al., 2018; Dymond, Roche, & Bennett, 2013).

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