CHAPTER 4

Behavioral Techniques to Reduce Relapse
After Exposure Therapy
Applications of Studies of Experimental Extinction

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Pavlovian phenomena have long served as models for the etiology, treatment, and relapse from treatment of diverse disorders (e.g., phobias, addictions). Here we briefly review Pavlovian conditioning models of anxiety disorders, experimental extinction models of exposure therapy, and recovery from extinction models of relapse following exposure therapy. We then focus on how research on experimental extinction has led to the development of specific behavioral techniques to reduce recovery from extinction and hence relapse from exposure therapy. These techniques include conducting extinction treatment in multiple contexts, giving a massive amount of extinction, increasing the time between extinction trials and between extinction sessions, administering extinction in the presence of a second excitor, and testing in the presence of a retrieval cue from extinction. It is concluded that these behavioral techniques, all of which were discovered in the experimental laboratory, are potent and important tools to be considered by psychotherapists trying to make their patients less susceptible to relapse.

The pioneering work of Pavlov (1927) laid the groundwork for the development of many successful models of select psychopathologies. Pavlovian phenomena have subsequently served as models of the etiology, treatment, and relapse of numerous disorders. In this chapter we briefly review some of these roles of Pavlovian conditioning in modeling behavioral/mental disorders, and then focus on how the empirical study of extinction has resulted in the development of behavioral techniques that are applicable by clinicians who are trying to decrease relapse after exposure therapy. We will recurrently use fear and anxiety disorders as examples of how Pavlovian conditioning has been used as a model; however, these are only a few of the disorders for which these Pavlovian techniques are useful in preventing relapse after exposure therapy.

EARLY ASSOCIATIVE ACCOUNTS
OF THE ETIOLOGY OF
PSYCHOPATHOLOGY

Pavlov's (1927) discovery of so-called experimental neurosis represents one of the first known experimental demonstrations of learned emotional responses, and it constitutes the first associative model for the etiology of anxiety disorders. Pavlov and his colleagues showed how different environmental manipulations provoked learned emotional responses in dogs. In one exemplar study (Shenger-Krestinikova, 1921, cited in Pavlov, 1927), they showed that, after their subjects mastered a two-stimulus visual discrimination (i.e., training the subjects to respond to one of two visual stimuli for reinforcement), making this discrimination gradually more difficult
In a Pavlovian learning paradigm, two stimuli are paired; one of them elicits responding prior to any specific treatment (i.e., an unconditioned stimulus [US] that elicits an unconditioned response [UR]), and the other does not initially evoke the response in question (i.e., a neutral stimulus). However, when the stimuli are presented contiguously, the once neutral stimulus begins evoking a response [usually] similar to those evoked by the US. In other words, the neutral stimulus becomes a conditioned stimulus (CS) and begins eliciting a conditioned response (CR). This simple associative account of the acquisition of fear and phobias is exemplified by Watson and Rayner's (1920) demonstration of an infant's learned fear response to a rat after the rat was paired with a loud noise. Here the rat served as a neutral stimulus that did not initially evoke a fear response by the infant. However, when the presentation of the rat (i.e., the CS) was followed by a stimulus that initially evoked a fear response (i.e., the loud noise, which served as the US), the infant seemingly associated them and began emitting conditioned fear responses upon presentation of the rat, similar to those evoked by the US. Generalizing from this demonstration, Watson and Rayner suggested that "It is probable that many of the phobias in psychopathology are true conditioned emotional reactions." (p. 14). This simple conditioning model served as the foundation for more modern associative accounts of the etiology of fear and anxiety disorders, which has been expanded to include factors that can account for individual differences in associative learning, including personality/temperament factors, experiential factors, and evolutionary variables (e.g., Mineka & Oehlberg, 2008; Mineka & Sutton, 2006; Mineka & Zinbarg, 2006).

EXPERIMENTAL EXTINCTION AS A MODEL OF EXPOSURE THERAPY

After an association between a CS and a US has been formed through contiguous activation of the mental representation of these stimuli, repeated presentations of the CS in the absence of the US decreases the conditioned responding it elicits. This manipulation is one of the most widely studied phenomena of associative learning and is referred to as experimental extinction (Pavlov, 1927; for reviews, see Delamater, 2004; Rescorla, 2001). In addition to the importance of the empirical study of extinction for assessment of general theories of associative learning (e.g., Gallistel & Gibbon, 2000; Rescorla & Wagner, 1972; Stout & Miller, 2007; Wagner, 1981), extinction has also been pivotal as an associative model of exposure therapies (e.g., Bouton, 2000; Bouton & Nelson, 1998; Hofmann, 2008). In exposure therapy for a specific phobia, the phobic object is considered a CS, which, if repeatedly presented without the aversive stimulus (i.e., the US) loses its potential to elicit a fear response. This associative model has received extensive attention from researchers and, as a result, today exposure therapy is one of the best empirically supported treatments for specific phobias and other anxiety disorders (Chambless et al., 1996; Chambless & Ollendick, 2001).

Despite the success of extinction in decreasing conditioned responding, evidence indicates that extinction does not erase the original association between a CS and a US as some associative models have proposed (e.g., Rescorla & Wagner, 1972). Instead, experimental extinction is assumed to result in the formation of an inhibitory-like association (for reviews, see Bouton, 1993, 2000,
XTINCTION AS A SURE THERAPY

When testing occurs in the CS in the absence of activation of the US, extinction is assumed to wipe out the original association between a CS and a US has been pivotal as an exposure therapy is one of the most supported treatments for anxiety disorders, which has served as the foundation of associative accounts of the etiology disorders, which has cluded factors that can differ in associative personality/temperament factors, and evolutionary (Oehlberg, 2008; Mineka & Zinbarg, 2006).

SOME ASSOCIATIVE MODELS OF RELAPSE AFTER EXPOSURE TREATMENT

Several associative phenomena have been widely cited to support the new-learning (as opposite to erasure) account of extinction, and most of them also serve as evidence of the susceptibility of extinction to recovery. For example, postextinction presentations of the US often induce partial recovery of the extinguished CR (reinstatement; e.g., Bouton & Bolles, 1979b; Rescorla & Heth, 1975), and retraining of an extinguished cue is usually faster than training a novel cue (rapid reacquisition; e.g., Napier, Macrae, & Kehoe, 1992; Pavlov, 1927; Ricker & Bouton, 1996). More widely studied, a long delay between extinction treatment and testing has been seen to provoke partial recovery of the extinguished CR (spontaneous recovery; e.g., Brooks & Bouton, 1993; Pavlov, 1927), and partial recovery of the extinguished CR also occurs when testing takes place outside the extinction context (renewal; e.g., Bouton & Bolles, 1979a; Bouton & King, 1983; Bouton & Ricker, 1994). Given their similarities with relapse situations outside the laboratory (where relapse often occurs in a context different from the one used during treatment and often after a period of time has elapsed since the end of treatment), spontaneous recovery and renewal will be reviewed in more detail.

There are three types of renewal that differ based on the contexts in which acquisition, extinction, and testing take place. ABA renewal is the recovery of an extinguished CR when subjects are tested in the acquisition context (A) after extinction treatment in a different context (B; e.g., Bouton & King, 1983). ABC renewal is the recovery of an extinguished CR that occurs when acquisition (Context A), extinction (Context B), and testing (Context C) all take place in different contexts (e.g., Bouton & Bolles, 1979a). AAC renewal is the recovery of an extinguished CR when acquisition and extinction occur in the same context but testing occurs in a different context, which is associatively neutral (C; Bouton & Ricker, 1994). Most evidence suggests that ABA and ABC renewal result in more recovery from extinction than AAC renewal, which is sometimes completely ineffectual (e.g., Laborda, Witnauer, & Miller, in press; Rescorla, 2008; Tamai & Nakajima, 2006; Thomas, Larsen, & Ayres, 2003; Üngör & Lachnit, 2008).

There are several theoretical accounts to explain why renewal of extinguished responses occurs when testing takes place outside the context of extinction. For example, according to Pearce’s (1987) configural model, subjects do not process stimuli elementally; rather, they process the entire perceptual field as a single configural stimulus. Generalization occurs between configured stimuli to the extent that they are similar. In this framework, ABA renewal occurs because the target cue and the acquisition context are processed as a single configured cue that acquires an excitatory association with the US during acquisition treatment. Then, because the target cue provides similarity between configural units representing the acquisition and extinction trials, some of the strength of the excitatory configured cue generalizes to the extinction configured cue (i.e., the target and extinction contexts), creating a situation in which this second configuration develops an inhibitory association with the US (because of the unfulfilled expectancy of US occurrence). When testing occurs in the acquisition context, the excitatory strength of the configured cue formed by the target cue and the acquisition context is only partially reduced by the generalization of inhibition from
the compound formed by the extinction context and the target cue, thereby producing a recovery of responding. Pearce's model anticipates ABC renewal due to the inhibitory properties of the configured extinction cue (composed of the target cue and extinction context) not fully generalizing to the test situation, due to the absence of the extinction context at test. According to the Rescorla and Wagner (1972) model, during acquisition training in Context A both the target cue and the context acquire elemental excitatory associations with the US. Then, when subjects receive extinction training in a different context, the CS predicts the US and its absence causes the extinction context to develop an inhibitory relationship with the US. Importantly, summation of the excitation from the target cue with inhibition from the extinction context results in little stimulus control of behavior in the extinction context. Moreover, the inhibitory-like status of the extinction context protects the CS for further extinction (e.g., Lovibond, Davis, & O'Flaherty, 2000; McConnell & Miller, 2010; Rescorla, 2003). When subjects are tested back in the acquisition context, its excitatory association summates with the remaining excitatory association of the target cue provoking ABA renewal. Similarly, ABC renewal is anticipated because of the absence of the inhibitory status of Context B when testing in Context C, thereby allowing for more excitation relative to the ABB control group. The ABB group exhibits low responding presumably because at test it is under the influence of the inhibitory Context B. As stated elsewhere (Laborda et al., in press), although the comparator hypothesis (Stout & Miller, 2007) does not account for renewal (i.e., ABB < ABC; ABB < ABA; AAA < AAC) because it lacks of a rule to allow summation between the testing context and the target stimulus, there is no reason to think that such summation does not actually take place. The implementation of such summation rule would permit SOCR to predict renewal in a way similar to that of Rescorla and Wagner.

From another perspective, Bouton's (1993, 1994, 1997) retrieval model suggests that recovery from extinction occurs for two reasons: First, extinction learning is akin to inhibition learning, that is, learning when an outcome will not occur, and memories that support inhibitory learning are thought to be more labile than excitatory memories. Second, extinction learning involves the creation of ambiguity (because it contradicts the previously acquired knowledge concerning reinforcement of the cue), and ambiguity presumably fosters context-specific encoding of the extinction information as a means of resolving the ambiguity. That is, when two types of inconsistent information (i.e., reinforcement and nonreinforcement of a cue) are sequentially acquired, retrieval of the second-learned information depends on the spatial (renewal) and temporal (spontaneous recovery) test context matching that of the second-learned treatment (i.e., extinction). Thus, moving outside the context of second learning (i.e., the extinction context) should cause a failure to retrieve the second-learned information because it is inhibitory (in the case of extinction) and because it was coded as context specific due to its ambiguity (in contrast to the unambiguous first-learned memory; i.e., according to Bouton's model, ambiguous memories do not transfer well between contexts). These mechanisms con­jointly account for ABA and ABC renewal. Rosas and colleagues (Rosas, Callejas-Aguilera, Ramos-Alvarez, & Abad, 2006) recently revised the second mechanism of Bouton's (1993, 1994, 1997) retrieval model. For them it is not ambiguity that makes second-learned information become context specific, but any manipulation that makes organisms to pay attention to the context (e.g., ambiguity, previous experience focusing on the context, instructions to pay attention to the context, informational value of the context, and the salience of the context relative to the target cue). According to Rosas and his colleagues, in the case of ABA and ABC renewal, the ambiguity experienced during extinction treatment (i.e., the CS acquiring a second meaning) makes subjects attend to the context, thereby encoding the extinction information as specific to the extinction context. When testing occurs in the acquisition context or a neutral context, extinction learning does not generalize to test because it was encoded as an “exception” occurring in the extinction context, thereby producing renewal. In general, Bouton's approach has been successful
in predicting several recovery phenomena and related data. For example, it accounts for AAC renewal being weaker than ABA and 'ABC renewal by noting that initial acquisition should interfere with the extinction context becoming a conditioned inhibitor for the AAC condition, but not the ABC or ABA conditions.

Like renewal, there are several theoretical accounts to explain why spontaneous recovery occurs. For example, Skinner (1950) proposed that acquisition cues, such as handling of the experimental subjects, were not properly extinguished and those cues provoke the recovery of extinguished CRs at a delayed test. Robbins (1990) proposed another account in which a loss of attention to the CS during extinction wanes over a retention interval, thereby producing spontaneous recovery (but see Bouton & Peck, 1992, for difficulties with this account). More recently, Devenport (1998) used a temporal weighting rule to explain spontaneous recovery. This theory states that events are weighted differently depending on their recency. Recent events are given more weight in determining behavior than remote events. But as time elapses between extinction treatment and testing, the subject weights the acquisition and extinction phases more evenly. Thus, for an experimental group in which a long delay has been imposed between the extinction treatment and testing, subjects give relatively more weight to what was learned before extinction treatment (i.e., a high level of responding) than if no retention interval was imposed. Bouton (1993; 2010) proposed a related account in which spontaneous recovery occurs because changes of the so-called temporal context can produce similar effects to those produced by changes in physical contexts (i.e., renewal). For Bouton, renewal and spontaneous recovery are examples of the same phenomenon. In this framework, like renewal, spontaneous recovery is due to some combination of two factors. First, inhibitory-like information (extinction) does not generalize as well as excitation (from acquisition) to the time of test when testing is appreciably delayed. Also, second-learned information (extinction in this case) is temporally more context dependent than first-learned information (acquisition in this case), making second-learned information less likely to transfer to a different temporal context. Rescorla (2005) suggested that the former was the major factor responsible for spontaneous recovery from extinction. But Sissons and Miller (2009) identified a lack of equivalence between Rescorla’s inhibitory information and his excitatory information. With this corrected (i.e., using the same number of trials in both phases of the experiment, using Pavlovian conditioned inhibition treatments in each phase as the nonreinforced treatment, and using a nontarget excitor for inhibition training to decrease the possibility of indirectly diminishing the inhibitory status of the stimulus trained as an inhibitor when nonreinforcing the target excitor in phase 2), Sissons and Miller’s data suggested that extinction being the second-learned information contributes more to spontaneous recovery than does the inhibitory-like nature of extinction.

In addition to the vast number of reports of recovery of extinguished CRs in, the (nonhuman) animal learning literature, these phenomena have also been observed in humans. For example, Vila and Rosas (2001; see also García-Gutiérrez & Rosas, 2003; Rosas & Callejas-Aguilera, 2006; Rosas, Vila, Lugo, & Lopez, 2001) reported recovery phenomena in a human contingency learning task. Using a fictitious story relating a medicine (cue) with a deleterious side effect (outcome), they demonstrated acquisition of an excitatory relationship between the medicine and the side effect, extinction of this association, and then recovery of it when testing occurred in a context different than the extinction context (i.e., renewal) or when a retention interval was imposed between extinction and testing (i.e., spontaneous recovery). Similarly, Van Gucht, Vansteenwegen, Beckers, and Van den Bergh (2008) showed that chocolate cravings are susceptible to relapse when tested in the acquisition context after extinction in another context (i.e., ABA renewal). In a related line of research, Vansteenwegen et al. (2005; see also Effting & Kindt, 2007; Vansteenwegen et al., 2006; Vansteenwegen et al., 2007) reported recovery phenomena in a human fear-conditioning preparation. Using a differential conditioning paradigm, a picture of a face (i.e., the CS) was
paired with a loud aversive noise (i.e., the US). After training this association in one context and extinguishing it in another, returning subjects to the acquisition context to test responding to the CS resulted in renewal of the extinguished CRs, compared with a group in which all phases took place in the same context.

In more applied situations, these extinction and the recovery phenomena have been replicated when social drinkers (Collins & Brandon, 2002; but see MacKillop & Lisman, 2008; Stasiewicz, Brandon, & Bradizza, 2007) and arachnophobic students (Mineka, Mystkowski, Hladek, & Rodriguez, 1999; Mystkowski, Craske, & Echiverri, 2002; Rodriguez, Craske, Mineka, & Hladek, 1999) were used as participants. For example, Collins and Brandon (2002) reported a recovery of extinguished reactivity of the urge to drink and extinguished salivatory responses to alcohol-related cues in undergraduate social drinkers. In this study all participants received extinction of alcohol-related cues (e.g., a beer can) in one context, decreasing salivation and urge to drink. Participants tested in a different context showed renewal of the extinguished CRs relative to participants tested in the extinction context. As previously mentioned, similar results have been found with subclinical participants. As an illustration, Mystkowski et al. (2002) confirmed previous findings of recovery of extinguished fear responses in arachnophobic undergraduates (Mineka et al., 1999; Rodriguez et al., 1999). In this research, all participants received an exposure session in one context and were tested 1 week later in the same and a different context. An important feature of this study is that both contexts were fully counterbalanced real-world settings. Self-report data showed that fear was much higher when testing occurred in a context different from the one used during the extinction session, thereby extending the renewal and spontaneous recovery literature to phobic participants.

**BEHAVIORAL TECHNIQUES TO REDUCE RECOVERY AFTER EXTINCTION**

The evidence summarized earlier is clear in suggesting that neither experimental extinction nor exposure therapy erases memories. Rather, they establish inhibitory-like associations that are more context dependent than the original excitatory association (e.g., Bouton, 1993). Relapse after exposure therapy is one of the greatest problems confronting psychotherapy. However, research concerning experimental extinction has identified some ways to prevent, or at least attenuate, the recovery of extinguished CRs. Recently, Boschen, Neumann, and Waters (2009, p. 97; see also Rachman, 1978) proposed 10 recommendations for preventing relapse after successful exposure treatment of anxiety-related disorders: (1) Extend the duration of exposure sessions past the point of habituation (i.e., past the point in which anxiety is no longer reported in a given exposure session); (2) Increase the overall number of sessions, continuing past successful extinction of the anxiety response across sessions (i.e., past the point in which anxiety is no longer reported at the beginning of the next therapy session); (3) Use massed exposure sessions with short durations between sessions; (4) Encourage patients to relinquish distraction techniques, and do not train patients in using these as part of treatment (i.e., during exposure treatment the anxiety-eliciting stimulus must be attended to; anxiety diminution could be reduced if patients are actively avoiding the situation); (5) Utilize an assortment of fear stimuli during exposure; (6) Conduct exposure in a variety of different environments and contexts; (7) Ensure that exposure tasks are sufficient to elicit anxiety, but do not place excessive demand on the patient; (8) Homework tasks should be used to consolidate treatment and reduce probability of relapse; (9) Where possible, prior to reencountering the phobic stimulus, patients should attempt to recall (mentally reinstate) the treatment context; (10) Cognitive restructuring should be used to assist patients to recognize, reevaluate, and restructure associations between their phobic stimulus and negative outcomes. Most of these recommendations were directly or indirectly derived from experimental extinction research. Although this list is suggestive, most of the procedures have not yet been well researched, thereby raising doubts concerning which ones really work and under what conditions, if any, they are effective.
BEHAVIORAL TECHNIQUES TO REDUCE RELAPSE

Another promising area of research on behavioral techniques to prevent relapse is the study of pharmaceutical cognitive enhancers. For example, the use of d-cycloserine (DCS), a partial agonist of NMDA receptors, has been shown with non-human subjects to enhance extinction of freezing conditioned responses (Ledgerwood, Richardson, & Crannery, 2003), fear-potentiated startle (Walker, Ressler, Lu, & Davis, 2002), conditioned taste aversion (Davenport & Houpt, 2009), and cocaine-induced conditioned place preference (Thanos, Bermeo, Wang, & Volkow, 2009). Also, the use of DCS with humans has been reported to enhance the effects of exposure therapies on social phobia (Guastella et al., 2008; Hofmann et al., 2006), acrophobia (Ressler et al., 2004), and some cases of obsessive-compulsive disorder (Kushner et al., 2007). Adding to this body of data, there is also evidence of DCS attenuating reinstatement of extinguished fear CRs (Ledgerwood, Richardson, & Crannery, 2004) and extinguished cocaine-induced conditioned place preference (Paolone, Botreau, & Stewart, 2009). However, these successes are tempered by reported failures of DCS to enhance extinction of arachnophobia (Guastella, Dadds, Lovibond, Mitchell, & Richardson, 2007), human electrodermal responses (Guastella, Lovibond, Dadds, Mitchell, & Richardson, 2007), and some cases of exposure therapy for obsessive-compulsive disorder (Storch et al., 2007). Of more central interest here is that DCS has failed to prevent renewal of extinguished conditioned fear suppression (Bouton, Vurbic, & Woods, 2008; Woods & Bouton, 2006), and rapid reacquisition of extinguished freezing conditioned responses (Ledgerwood, Richardson, & Crannery, 2005) in rats. There is clearly a need to extend research on the effects of pharmaceutical cognitive enhancers on extinction and recovery situations; however, extended discussion of this area of investigation is beyond the scope of the present review.

Next we review some behavioral techniques, discovered and extensively studied in the experimental laboratory, that have been shown to be robust and potentially useful tools to be considered by psychotherapists trying to make their treatments less susceptible to relapse.

Massive Extinction

Denniston, Chang, and Miller (2003) compared the effects of moderate and massive extinction training in attenuating ABC and ABA renewal, using rats as subjects in a conditioned lick suppression paradigm. After a white noise (i.e., CS) was paired with a footshock (i.e., US) in one context (A), subjects received moderate (160) or massive (800) amounts of extinction trials in a second context (B). Notably, 160 extinction trials have been shown to be sufficient to eliminate conditioned suppression in their preparation. When subjects were later tested for conditioned fear responses in a neutral context (C), Experiment 1; see Fig. 4.1A) and in the acquisition context (Experiment 2; see Fig. 4.1B), those that received a massive number of extinction trials showed attenuated renewal of the extinguished responses compared with subjects that received only a moderate number of extinction trials. These positive results were recently replicated in a similar experimental situation (Laborda & Miller, 2010). However, Thomas, Vurbic, and Novak (2009), Rauhut, Thomas, and Ayres (2001), and Tamai and Nakajima (2000) failed to see reduction in ABA renewal with increasing number of extinction trials, but their large number of trials (144, 100, and 112, respectively) were decidedly less than in the studies that obtained reduced renewal (800 and 810). This suggests that insufficient extinction might account for the failures to obtain this effect. It should be noted that Tamai and Nakajima successfully reduced AAC renewal with only 112 extinction trials, which is in concordance with the evidence suggesting that this type of renewal is weaker than ABA and ABC renewal. Foa et al. (2005; see also Gillihan and Foa, this volume, chapter 2) observed reduced relapse with humans treated for posttraumatic stress disorder when prolonged exposure was used. Prolonged exposure can be viewed as having a similar effect as many extinction trials because both treatments increase time spent in the presence of the CS. Future research should determine whether massive extinction can prevent other recovery situations and whether these results can be replicated using a variety of experimental paradigms and subjects.
Extinction in Multiple Contexts

Bouton (1991) suggested that another possible manipulation to reduce recovery after extinction could be to conduct extinction treatment in several contexts. He reasoned that if an association is extinguished in multiple contexts, the greater number of features present in multiple extinction contexts than in a single extinction context may help to generalize extinction learning to contexts other than those used for extinction treatment. In line with this operational suggestion, Gunther, Denniston, and Miller (1998) evaluated the effect of extinction treatment in

Figure 4.1 Panel A: Mean log time to complete 5 cumulative seconds of licking in the presence of the target conditioned stimulus in a neutral context (C). Brackets represent standard error of the mean. Higher scores indicate more conditioned suppression. No extinction (A-C) = group that received no extinction trials and was tested in a neutral but familiar context (C); Moderate extinction (ABC) = group that received a moderate number of extinction trials (160) and was tested in a neutral but familiar context (C); Massive extinction (ABC) = group that received a massive number of extinction trials (800) and was tested in a neutral but familiar context (C); Moderate extinction (ABB) = group that received a moderate number of extinction trials (160) and was tested in the extinction context (B). See text for further explanation. (From J. C. Denniston, R. C. Chang, & R. R. Miller, 2003 Experiment 1, *Learning and Motivation, 34*, 68–86.) Panel B: Mean log time to complete 5 cumulative seconds of licking in the presence of the target conditioned stimulus in the acquisition context (A). Brackets represent standard error of the mean. Higher scores indicate more conditioned suppression. No extinction (A-A) = group that received no extinction trials; Moderate extinction (ABA) = group that received a moderate number of extinction trials (160) in a context different from the one used for both acquisition and testing; Massive extinction (ABA) = group that received a massive number of extinction trials (800) in a context different from the one used for both acquisition and testing; Moderate extinction (AAA) = group that received a moderate number of extinction trials (160) in the acquisition context. See text for further explanation. (From J. C. Denniston, R. C. Chang, & R. R. Miller. 2003. Experiment 2. *Learning and Motivation, 34*, 68–86).
multiple contexts on ABC renewal, using rats as subjects in a conditioned lick suppression paradigm. After a white noise (i.e., CS) and a mild shock (i.e., US) were paired in one context, subjects received extinction trials in one or three different contexts (all different from that of conditioning and that of testing). As depicted in Figure 4.2, rats that received extinction treatment in three different contexts showed less renewal of the extinguished CR when tested in an associatively neutral context (i.e., ABC renewal) than rats that received the same amount of extinction treatment but in only one context. Gunther et al. went a step further and also presented data delineating the situations in which this technique can be effective in attenuating renewal. In their Experiment 2, they found that the number of contexts in which acquisition took place limited the effectiveness of extinction in multiple contexts. As depicted in Figure 4.3, the effect of extinction in multiple contexts decreasing ABC renewal was eliminated when the number of contexts used during acquisition and extinction were equated. This finding has implications for the treatment of patients who have suffered multiple traumas (e.g., war combatants and victims of multiple abuses) or consume drugs in different places and situations (e.g., smokers and drinkers). For these people, extinction in multiple contexts could prove hard to implement because of the number of extinction contexts that would be necessary to compensate for the multiple acquisition contexts.

To date, Gunther et al.'s (1998, Experiment 1) results have been replicated several times and in a number of different situations (e.g., Bandarian Balooch & Neumann, 2011; Chaudhri, Sahuque, & Janak, 2008; Chelonis, Calton, Hart, & Schachtman, 1999; Glautier & Elgueta, 2009; Laborda & Miller, 2010; Neumann, 2006; Pineda & Miller, 2004; Thomas et al., 2009; Vansteenwegen et al., 2007; but see Betancourt et al., 2008; Bouton, Garcia-Gutiérrez, Zilski, & Moody, 2006; Neumann, Lipp, & Cory, 2007, in the presence of the standard error of the mean, group that received no extinction (ABC) = group that received extinction trials in one or three contexts, and group that received extinction trials (800) and a moderate number of extinction trials (162) across three different contexts. Acquisition-1 / Extinction-3 = group that received acquisition in one context and a moderate number of extinction trials (162) across three different contexts. Acquisition-3 / Extinction-3 = group that received the same amount of acquisition but in three different contexts and a moderate number of extinction trials (162) also across three different contexts. See text for further explanation. (From L. M. Gunther, J. C. Denniston, & R. R. Miller. 1998. Experiment 1. Behaviour Research and Therapy, 36, 75–91).
for negative results). For example, Chelonis et al. (1999) reported successful prevention of ABA renewal in a conditioned taste aversion preparation with rats as subjects. After a single pairing of sucrose (i.e., CS) with lithium chloride (i.e., US) in one context, subjects received extinction trials in one or three new contexts. The results indicated that extinction in only one context was more prone to renewal than when the same amount of extinction was administered in multiple contexts. Neumann extended the previous results to ABA and ABC renewal situations in a conditioned suppression task with humans as subjects. Moreover, two studies found reduced renewal from similar manipulations in arachnophobic participants. Vansteenwegen et al. (2007) reported successful attenuation of renewal of fear responses after extinction in multiple contexts. They exposed arachnophobic participants to a videotaped spider in one or three different locations within a house. When tested with the videotaped spider in a novel location of the house (i.e., an A[BCD]E-like design), participants who received exposure of a videotaped spider in only one location displayed more renewal of the extinguished CRs than participants who received the same amount of exposure to the videotaped spider in three different locations in the house. Finally, Rowe and Craske (1998b) showed attenuated return of fear using an interesting manipulation analogous to the extinction in multiple contexts procedure. The authors exposed arachnophobic participants to one or three different tarantulas during extinction treatment. When tested 3 weeks later, participants who were exposed to three different tarantulas during treatment showed less return of fear than participants that were exposed to only one type of tarantula. These results further support the view that extinction in the presence of multiple features can facilitate generalization of extinction learning to new situations.

Overall, extinction treatment in multiple contexts, at least with some parameters, has been found to be an effective way to reduce relapse of extinguished CRs after context shifts (i.e., renewal) and delayed testing (i.e., spontaneous recovery). Future research should test the effectiveness of this manipulation in reducing relapse caused by other factors (e.g., reinstatement, rapid reacquisition), evaluate possible theoretical explanations of these results, and test its effectiveness in more clinical settings.

### Massive Extinction in Multiple Contexts

Thomas et al. (2009) recently reported that there is a summation of the effects of extinction in multiple contexts and large number of extinction trials in reducing renewal of extinguished CRs in conditioned bar press suppression preparation. After pairing the momentary absence of an otherwise present white noise (i.e., the CS) with a footshock (i.e., the US), rats received 36 or 144 extinction trials in Context A. Orthogonal to this manipulation of number of extinction trials, subjects received extinction in either one or three different contexts with the total number of extinction trials held constant (Experiment 2). The results suggested that extinction in multiple contexts was effective in attenuating renewal when subjects were tested in the acquisition context (i.e., A[BCD]A). A treatment resulted in less renewal than did A[BBB]A treatment, but only when a large number of extinction trials were administered. Thus, extinction in multiple contexts and massive extinction do appear to summate at least in some circumstances. This may offer an explanation for why some researchers have failed to observe reduced renewal after extinction in multiple contexts. For example, Bouton et al. (2006) gave 12 extinction trials compared to Gunther et al.’s (1998) 160 trials.

Extending Thomas et al.’s (2009) results, Laborda and Miller (2010) have reported a similar summative effect of extinction in multiple contexts and massive extinction when a more naturalistic relapse situation was used. In therapeutic situations, relapse often occurs when subjects are exposed to the fearful stimulus in a context different than the one in which treatment took place, and after some time has elapsed since the last exposure session. In other words, relapse often occurs after a delayed context shift, which can be thought of as a situation in which the renewal effect summates with the spontaneous recovery of extinguished responses. Similar additive effects of context change and retention...
Multiple Contexts

He reported that there are effects of extinction in the number of extinction trials on spontaneous suppression. Absence of the cue (i.e., the CS ± US), rats received 36 extinction trials. In the acquisition context A, Orthogonal extinction trials were attenuating renewal in the acquisition context A orthogonally to extinction trials in multiple contexts. This may explain why some researchers have found that extinction in a single context is not as effective as extinction in multiple contexts. For example, Laborda and Miller extended these findings to a conditioned lick suppression situation. Their Experiment 2 tested the effectiveness of massive extinction, extinction in multiple contexts, and both manipulations together in reducing relapse after a delayed context shift. As indicated in Figure 4.4, the results suggested that extinction in multiple contexts alone and massive extinction alone decreased this strong recovery of extinguished CRs, but only marginally. However, when massive extinction trials (810) took place in three different contexts, the recovery of extinguished CRs was radically attenuated.

Although more research would be useful in understanding the underlying mechanisms of these techniques, the data available today strongly suggest that these conjoint behavioral manipulations are effective tools to attenuate relapse after successful extinction treatments.

Retrieval Cues from Extinction

Another technique that has been proposed to reduce relapse is through the use of extinction cues (ECs, e.g., Brooks & Bouton, 1993). Typically, extinction cues (also known as retrieval cues for extinction) are stimuli that are presented shortly before the target CS on most CS extinction trials. Then at test, the EC is presented again just prior to the CS, which reduces responding (relative to, for example, a group in which no EC is presented at test) in a situation in which renewal would otherwise be expected (Brooks & Bouton, 1994; see Fig. 4.5). In other words, ECs are presented during most extinction trials and, when subjects are tested for responding to the extinguished CS in the presence of the EC, recovery phenomena are usually reduced. During extinction, the EC is typically not presented on all extinction trials in order to prevent it from becoming a conditioned inhibitor, which would protect the excitatory target CS from extinction (e.g., McConnell & Miller, 2010), or the subject from processing the EC and the target cue as a single configured cue. Beside those demonstrations in appetitive preparations (Brooks, 2000; Brooks & Bouton, 1993, 1994; Brooks & Bowker, 2001), there are reports of the effectiveness of ECs attenuating spontaneous recovery of alcohol tolerance (Brooks, Vaughn, Freeman, & Woods, 2004), conditioned taste aversion (Brooks, Palmatier, Garcia, & Johnson, 1999), and directed swimming in a navigation task (Prados, Manteiga, & Sansa, 2003). Recently, Brooks (unpublished data) found that EC-alone presentations during the retention interval further attenuated spontaneous recovery. He speculated that this effect arises from the EC-alone trials extinguishing the EC's second-order conditioned excitatory properties acquired by its having been paired with the target CS during extinction treatment.
In addition to the aforementioned demonstrations of ECs decreasing recovery of extinguished CRs with non-human subjects, similar effects have been reported with humans as participants. Dibbets, Havermans, and Arntz (2008) reported attenuated ABA renewal in a human fear-conditioning preparation. Participants received extinction trials with an EC and were then tested on the extinguished cue with or without the EC. Participants tested in the acquisition context with the EC present showed less recovery of US expectancy ratings than participants who were tested without the EC. Similar results were reported by Vansteenwegen et al. (2006), in which renewal of conditioned electrodermal responses and of expectancy ratings were attenuated when testing occurred in the presence of an EC. In a few instances the effectiveness of ECs to reduce recovery of extinguished CRs has been examined with subclinical and clinical samples. Collins and Brandon (2002) observed that a reduction in stimulus-induced alcohol craving in social drinkers produced by exposure therapy was more resistant to relapse when testing occurred in the presence of ECs, thereby extending the effect to clinical situations.

In an interesting extension of the EC concept, Mystkowski, Craske, Echiverri, and Labus (2006) presented self-report data in which a verbal instruction to recall the context of treatment (what they called "mental reinstatement") successfully diminished the return of fear after a context change (i.e., renewal), in arachnophobic participants. Thus, mental reinstatement of the circumstances of extinction may serve in place of or in addition to reinstatement of physical ECs.

The evidence strongly supports the effectiveness of ECs in attenuating recovery of extinguished conditioned responses in different preparations and populations. Future research should focus on the mechanisms behind the success of ECs. Brooks (unpublished data) has argued that ECs differ mechanistically from both occasion setting (for properties, see Holland, 1992; Miller & Oberling, 1998) and conditioned inhibition, but the actual mechanism is still unclear. Likely, multiple processes drive effective ECs in clinical settings because the procedure that produces ECs resembles those commonly used to produce conditioned inhibition, occasion setting, and configural learning.

**Extinction in the Presence of a Second Excitor**

Another possible manipulation to prevent relapse that is consistent with almost all theories of learning is to conduct extinction of the fear-evoking target cue in the presence of a second fear-evoking cue. This should produce deeper (i.e., a greater degree of) extinction, which should, more arguable, attenuate recovery of extinguished responses. This expectation has been confirmed several times (e.g., Rescorla, 2000, 2006; Thomas & Ayres, 2004; but see Pineño,
The effectiveness of ECs to reduce relapse when testing elements following extinction trials with compound stimuli, but because of the lack of the appropriate comparisons (i.e., one in which the experimental groups are compared with groups tested in the extinction context), it remains unknown if better extinction could be obtained outside a renewal design (for further discussion, see Urcelay, Lipatova, & Miller, 2009).

Despite the positive results just reviewed, there is evidence that extinction in the presence of an additional excitor is limited by generalization decrement. Urcelay, Lipatova, et al. (2009) observed enhanced extinction due to this manipulation, but its effects were almost completely obscured by generalization decrement going from elemental training to compound extinction and from compound extinction to elemental testing. That is, despite the deepened extinction effect induced by the added excitor, almost no benefit was observed at test due to repeatedly changing the target by adding elements (going from acquisition to extinction) or subtracting elements (going from extinction to test). Presumably, the subjects configured the two CSs as a single cue during extinction, which limited the amount of generalization of learning that could occur between phases (i.e., perceiving the individual CS of training and testing as a component of the compound CS at extinction). This is consistent with work by Pearce and Wilson (1991) who also found a large generalization decrement effect such that extinction with a concurrent excitor actually resulted in less response decrement than elemental extinction. Moreover, conditioned taste aversion experiments with rats (e.g., Píneiro et al., 2007) and fear-conditioning experiments with humans to date have so far failed to find enhanced extinction in the presence of a second excitor (Lovibond et al., 2000; Vervliet, Vansteenwegen, Hermans, & Eelen, 2007). To reduce configuring, Urcelay, Lipatova, et al. (2009) used cues with asynchronous onsets (a 15-s target that onset 5 s before a 10-s concurrent excitor) and of different modalities. These two manipulations collectively did result in a modest but significant reduction of ABC renewal in subjects that were extinguished in the presence of a companion conditioned excitor (see Fig. 4.6). More specifically, the use of cues with asynchronous onsets and different sensory modalities reduced generalization decrement when testing elements following extinction trials with compound stimuli, thus supporting the view that the previous failures to find such an effect were due to generalization decrement.

Collectively, we see that extinction in the presence of other conditioned excitors has produced mixed results with respect to attenuating recovery phenomena. The results suggest that concurrent extinction of more than one excitor decreases relapse only slightly (e.g., Urcelay, Lipatova, et al., 2009). Experiments that appear to have yielded a large effect have lacked desirable experimental controls (e.g., Rescorla, 2006; Thomas & Ayres, 2004). In conclusion, the
available data suggest only modest benefits of this technique in reducing relapse.

**Spaced Training in Extinction**

Urcelay, Wheeler, and Miller (2009) showed that spaced extinction trials produce more enduring extinction than do massed extinction trials. In their study, rats that received extinction with 6-s intertrial intervals showed renewal (Experiment 2, Fig. 4.7) and spontaneous recovery (Experiment 3, Fig. 4.8), whereas this recovery was attenuated in subjects that received extinction with 600-s intertrial intervals (a result recently extended to a situation in which ABC renewal and spontaneous recovery summates; Laborda, Miguez, & Miller, 2011). This is consistent with evidence that spaced acquisition trials are more effective than massed acquisition trials (e.g., Barela, 1999; Barnet, Grahame, & Miller, 1995; Humphreys, 1940) and the view that extinction involves learning (i.e., acquisition) of a new association. Urcelay, Wheeler, et al.’s results suggest that spacing exposure trials can be an effective means of attenuating relapse after exposure treatments.

In a related study using an appetitive preparation, Moody, Sunsay, and Bouton (2006) found that spacing the extinction trials was effective in decreasing recovery in a reinstatement design (Experiment 5b); however, they found no benefit of spacing the extinction trials in preventing spontaneous recovery. Bjork and Bjork (1992, 2006) suggested that an expanding spaced schedule is more effective in producing robust...
consistent with evidence that extinction trials are more effective on trials (e.g., Barela, 1999; Miller, 1995; Humphreys, that extinction involves) a new association. al.'s results suggest that an extinction method can be an effective means after exposure treatments. using an appetitive prosay, and Bouton (2006) extinction trials was effective in a reinstatement model; however, they found that extinction trials in pre-recovery. Bjork and Bjork I that an expanding spaced active in producing robust extinction than trials spaced evenly. In this schedule, extinction trials are first massed and then gradually spaced out. This is meant to produce fast extinction with the massed trials and robust extinction with the spaced trials. This idea has received support from human verbal learning studies (e.g., Fritz, Morris, Nolan, & Singleton, 2007; Landauer & Bjork, 1978), but there is also evidence that this expanding extinction procedure is not more effective than uniformly spaced extinction when subjects are tested in a renewal or spontaneous recovery situation (e.g., Karpicke & Roediger, 2007; Orinstein, Urcelay, & Miller, 2010). Orinstein et al. observed faster extinction with this procedure, but they did not observe a difference at test between the expanding schedule and a uniform-spaced schedule in an ABA renewal design in a human contingency learning task. However, the fact that extinction proceeded faster with the expanding schedule may still be beneficial for reducing drop-out rates in therapy, even if the end result is the same.

Additional support for a beneficial effect of spacing extinction trials on behavior during extinction learning has been reported using operant techniques with snails (Sangha, Scheibenstock, Morrow, & Lukowiak, 2003) and using conditioned taste aversion preparations with rats (Westbrook, Smith, & Charnock, 1985). However, there are also reports of massed extinction trials supporting better extinction than spaced extinction trials (Cain, Blouin, & Barad, 2003; Moody et al., 2006; Rescorla & Durlach, 1987). Likely, parametric differences in CS duration as well as trial spacing are responsible for these discrepancies. Notably, data originating from tests administered in the extinction context very soon after extinction treatment (as is often done when researchers assess the consequences of extinction treatment) are neither informative nor particularly relevant to exposure therapy because they only identify the final level of behavioral control, which reflects not only associative extinction but also labile non-associative endogenous and exogenous states immediately created by the extinction trials (Rescorla, 2004). Such data are not predictive of recovery after context changes or long retention intervals.

Together these results suggest that there are likely benefits of spacing extinction trials, but much more research is needed to delimit the scope and mechanisms of this manipulation.

**Spaced Extinction Sessions**

As discussed earlier, spacing extinction trials has been found to be of some benefit in preventing recovery from extinction. This suggests that spacing the extinction sessions might also support better extinction and/or promote less recovery. To test this prediction, Tsao and Craske (2000; also see Rowe & Craske, 1998a) compared massed sessions (i.e., four exposure sessions in a single day), uniform-spaced sessions (i.e., four exposure sessions with one every 5 days), and expanding-spaced sessions (i.e., four exposure sessions over a 16-day period, in an expanding schedule [days 1, 2, 6, and 16]) of exposure.
therapy on reducing return of fear with anxious public speakers. Contrary to the author’s expectations, all three groups of participants showed similar reduction of fear at post treatment, a result consistent with Orinstein et al.’s (2010) results when using expanding and uniformly spaced intertrial intervals in a human contingency learning task. However, as hypothesized by Tsao and Craske, when the participants were tested 1 month later, the massed condition showed the greatest fear recovery. The uniform- and expanding-spaced extinction sessions both attenuated return of the fear response relative to the massed session condition, but they did not differ between themselves (for negative results of a similar manipulation, see Lang & Craske, 2000). More recently, Laborda et al. (2011) reported a series of three fear-conditioning experiments in which the benefit of spacing extinction trials and of spacing extinction sessions was evaluated, using rats as experimental subjects in a preparation in which renewal and spontaneous recovery summated. In brief, they found that the recovery of an extinguished association after a delayed context shift was reduced by spacing the extinction trials (600-s intertrial intervals vs. 6-s intertrial intervals; extending the results reported by Urcelay, Wheeler, et al., 2009) and by spacing the extinction sessions (7-d intersession intervals vs. 10-m intersession intervals). Moreover, simultaneously spacing the extinction trials and spacing the extinction sessions were shown to further attenuate strong recovery encouraged by a combination of renewal and spontaneous recovery. According to Bouton’s (1993, 2010) account, it is possible that, when using spaced sessions (or even spaced intertrial intervals), we are actually conducting extinction in multiple “temporal” contexts, which would put any benefit in reducing recovery here on common ground with the reduction in recovery observed following extinction in multiple physical contexts.

**Extinction in a Context as Similar as Possible to That of the Precipitating Conditioning Event**

Laborda et al. (in press) demonstrated that the weaker recovery of responding observed with AAC renewal relative to ABC renewal is due to extinction treatment in the acquisition context strengthening the association between the target cue and the excitatory acquisition context. Presumably, extinction in the acquisition context facilitates reduction of conditioned responding by not only reducing the effective CS-outcome association but also by increasing the expected background rate of outcome occurrence, which is mediated by CS-training context and training context-outcome associations (see Laborda et al., in press for details). This manipulation is essentially extinction of the target cue in the presence of an additional excitor, which in this case is the acquisition context. Extinguishing the acquisition context or overshadowing the target-context association with another cue presented during extinction both reduced initial extinction and increased AAC renewal. This provides a theoretical basis for the empirically supported view that exposure therapy in a context similar to that of the precipitating conditioning event often is more effective than when it occurs in a neutral context (Massad & Hulsey, 2006). Deeper extinction and less recovery can be expected when the extinction context is more similar to the acquisition context.

**Unconditioned Stimuli Presentations During Extinction**

Considerable research has found that the unpaired presentations of USs during extinction treatment can enhance extinction and its resistance to recovery. As shown in Figure 4.9, Rauhut et al. (2001) attenuated renewal by presenting explicitly unpaired USs interspersed among the CS-alone trials of extinction treatment in contrast to administering only CS-alone trials. This created the conditions for combining extinction to the CS and habituation to the US (details of their data indicate that the treatment did not constitute inhibitory training of the target). Alternatively, Bouton, Rosengard, Achenbach, Peck, and Brooks (1993) have suggested that the unsignaled USs make the context of extinction more similar to that of acquisition, which, as proposed in the previous section, could attenuate relapse. In related research, Bouton, Woods,
Behavioral Techniques to Reduce Relapse

The Acquisition-Extinction Interval

A somewhat controversial variable of interest is the acquisition-to-extinction interval. Myers, Ressler, and Davis (2006) reported less reinstatement, renewal, and spontaneous recovery when this interval was very short relative to if it was long, a set of results that Myers et al. discussed in terms of the possible neural mechanisms underlying extinction at various intervals.

These data can also be interpreted within a behavioral framework based in Bouton's (1997) context theory. As previously discussed, if the context is defined by spatial and temporal cues, then one can think of a long retention interval as inducing a new temporal context to create a renewal-like situation. That is, imposing a long retention interval between acquisition and extinction and between extinction and testing causes the temporal context to be equivalent to an ABC-like renewal design. A short acquisition-to-extinction interval, however, is analogous to an AAC-like renewal design. As previously mentioned, AAC renewal tends to be much weaker than ABA or ABC renewal. Thus, Myers et al.'s data can be accounted for as an instance of AAC treatment producing poor renewal compared to a strong ABC renewal effect. However, this finding is controversial, because there are many reported failures to confirm this effect (e.g., Alvarez, Johnson, & Grillon, 2007; Huff, Hernandez, Blanding, & LaBar, 2009; Kim & Richardson, 2009; Maren & Chang, 2006; Schiller et al., 2008; Woods & Bouton, 2008). Although there is no agreed-upon reason for the discrepant findings, it is likely related to how each researcher defines "long" and "short" when deciding upon parameters for the retention interval and is a function of the acquisition-to-test interval relative to other intervals rather than an absolute time. In brief, decreased recovery given short acquisition-to-extinction intervals is highly constrained by the temporal parameters used.

A series of experiments recently reported by Johnson, Escobar, and Kimble (2010) began...
clarifying the scope of the benefit of immediate extinction. They found that a short acquisition-to-extinction interval decreased spontaneous recovery of extinguished fear responses in rats when the extinction-to-test interval was relatively long (a 3-d interval in Experiment 1 and a 7-d interval in Experiment 2), and increased recovery when the extinction-to-test interval was relatively short (a 2-d interval in Experiment 2), suggesting that it is an interaction between the acquisition-to-extinction and the extinction-to-test intervals which determines the long-term effects of extinction.

CONCLUSIONS AND FINAL REMARKS: DEEPENING EXTINCTION AND/OR LINKING EXTINCTION AND TEST CONTEXTS

Pavlov's early studies (1927) and subsequent findings have been used to both understand acquired behavior and model human psychopathology. Research in the animal and human laboratory has found that Pavlovian conditioning provides a useful model of select mental disorders (e.g., anxiety, addictions) and some forms of cognitive-behavioral therapy. The study of experimental extinction has been fundamental for the development and success of exposure therapy. Unfortunately, despite extinction treatments and exposure therapies often immediately decreasing undesired behaviors, recovery and relapse commonly occur (e.g., Bouton, 2000). To decrease the possibility of recovery after successful extinction treatments, behavioral techniques have been developed based on associative models that speak to relapse prevention after exposure therapy. In the present chapter, we have reviewed these contemporary behavioral techniques to decrease recovery from extinction. Bouton, Woods, Moody, Sunsay, and Garcia-Gutiérrez (2006) suggested that these techniques could be divided in two categories: techniques designed to deepen extinction learning, and techniques designed to enhance similarity between the context of extinction and the context of testing (i.e., linking or 'bridging' the extinction and test contexts). Dividing these strategies into these two categories appears inviting. However, upon careful inspection it becomes clear that almost none of them fit exclusively into just one of these two categories. We instead suggest that these techniques can be categorized as deepening extinction, linking the extinction and test contexts, both, or none of the above, with most of the techniques likely belonging in part to both categories. Using a massive number of extinction trials and extinguishing the target cue with a second conditioned excitor can be considered exemplars of techniques that deepen extinction learning and clearly do not "bridge" the extinction and test contexts. The use of retrieval cues from extinction is the only technique that can be categorized as purely "bridging" the extinction and test contexts. In this technique a component of the extinction context is explicitly presented at test. Extinction in multiple contexts can be thought of as increasing the total number of contextual features associated with extinction, thereby increasing the possibility of generalizing extinction learning to other contexts. But an alternative account of any reduction in recovery from extinction following extinction in multiple contexts is that renewal in each new extinction context may increase fear during extinction, thereby facilitating deeper extinction (Rescorla, 2001; but see Bouton, Garcia-Gutiérrez, et al., 2006). Spaced extinction trials and sessions might reduce recovery of extinguished CRs because each trial and session can be considered as occurring in different "temporal" contexts, and in this way working as extinction in multiple "temporal" contexts. But spaced training has been showed to improve learning during acquisition (e.g., Barela, 1999) and extinction (e.g., Westbrook et al., 1985); consequently, we could think of these techniques as deepening extinction by enhancing the inhibitory-like learning that occurs during extinction. US-alone presentations interspersed during extinction treatment can be characterized as improving extinction learning because these US presentations either make the extinction context excitatory, thereby creating the conditions for explicitly unpaired conditioned inhibition training of the target cue (which is usually
categories appears now carefully inspection but none of them fit these two categories. The techniques can be considered as deepening extinction, linking extinction contexts, both, or none of the techniques likely categories. Using extinction trials and extinction with a second considered exemplars of extinction learning. The extinction and test interval cues from extinction can be categorized extinction and test: a component of the extinction presented at test. Texts can be thought of containing multiple contexts, thereby f generalizing extinction contexts. But an alternation in recovery from extinction in multiple contexts can each result in extinction, extinction (Rescorla, García-Gutiérrez, et al., 1999) and sessions might be considered exemplars of extinction. Deepening extinction in multiple contexts is potentially more useful to clinicians than manipulations that depend on interventions at the time of extinction in multiple contexts. Those interventions in which the critical manipulation takes place during the extinction trials (e.g., massive extinction) is clearly effective in attenuating relapse. In our view, a more useful distinction is to think of behavioral interventions occurring at the time of extinction or at the time of testing. Those interventions in which the critical manipulation takes place during the extinction trials (e.g., massive extinction in multiple contexts) are potentially more useful to clinicians than manipulations that depend on interventions at the time of testing (e.g., extinction cues) because the clinician can more readily control what occurs during therapy than what occurs at the moment of potential relapse.

Despite our tentative conclusions, the results reviewed in this chapter strongly suggest that more research is needed concerning the parameters that optimize these techniques and their underlying mechanisms. Lastly, additional research evaluating the translation of these laboratory techniques to clinical settings is essential so that they can be used to enhance psychotherapy.

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