Implications of a New Theory of Disuse for the Treatment of Emotional Disorders

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In this review, we conceptualize exposure-based treatment as a learning experience. With this approach, optimizing treatment is a matter of optimizing memory for new learning. Given that perspective, we discuss the implications of a "new theory of disuse," proposed by Bjork and Bjork (1992) to capture the storage and retrieval dynamics that characterize human memory. The theory distinguishes between the storage strength and retrieval strength of learned representations and provides a framework from which we derive a number of manipulations that have the potential to improve the long-term effectiveness of cognitive behavioral therapy. Implications for treatment of specific fears are described in detail, with additional discussion regarding treatment for other emotional disorders.

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In the current health care climate, mental health professionals are increasingly being asked to maximize effectiveness of interventions while minimizing cost. Exposure (i.e., repeated, systematic confrontation with a feared stimulus) has been established as the treatment of choice for clinical fear states (e.g., Barlow, 1988). Nonetheless, there is room for further improvement in treatment outcome, particularly in the long term. That is, despite the general appearance of maintenance of treatment gains after cognitive behavioral therapy for anxiety disorders (e.g., Clark et al., 1994; Craske, Brown, & Barlow, 1991; Heimberg, Salzman, Holt, & Blendell, 1993; Öst, 1996), close examination shows that treatment maintenance may not be as strong as first thought. The phenomenon of return of fear to discrete stimuli, following initial reduction of fear, is a relatively common occurrence in specific phobias, agoraphobia, and performance anxieties (for recent reviews, see Craske, in press; Rachman, 1989). Also, whereas 85% of patients with obsessive compulsive disorder maintain their gains 1–3 years after behavioral treatment, close to 50% require further therapy (Öst, 1989). In addition, Brown and Barlow (1995) followed the progress of patients for 2 years after completion of cognitive behavioral treatment for panic disorder and found that the long-term consequences of treatment were not impressive. Despite highly effective outcomes immediately after treatment, only 20.6% of the individuals studied satisfied several criteria for long-term treatment effectiveness: (a) no panic attacks and little or no anxiety about panic both 3 and 24 months after treatment, (b) no panic attacks in the second year following treatment completion, and (c) no additional treatment for panic disorder during the 2-year period. This study is unique in its use of longitudinal follow-up, which may account for the relatively low percentage of cases with successful long-term outcomes as compared to the usual documented effectiveness of this treatment.

Recent theories about exposure suggest that what is learned is a new meaning of a previously feared stimulus. Habituation, extinction, and cognitive processes have all been implicated as mechanisms by which such learning takes place (see Craske & Rowe, 1997, for a recent review). We hypothesize that one way of improving long-term outcomes is to increase the retrievability of the learning that takes place during exposure-based treatment. Long-term memory is generally conceptualized as

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permanent, and which representations are most accessible at a given point in time is governed by competition and by environmental, interpersonal, and body-state cues. Potentially, an examination of exposure therapy in relation to such dynamics may provide insights for enhancing the long-term effectiveness of treatment. Our goal in this article is to apply the tenets of a particular theory of memory—namely, the "new theory of disuse" proposed by Bjork and Bjork (1992)—to learning that takes place during exposure therapy.

Application of the human learning and memory literature to fear reduction necessitates certain assumptions—that learning takes place during exposure therapy, that learned information must be retrieved at a later time for a treated individual to respond nonfearfully to a previously fear-provoking stimulus, and that at least some of the same principles that apply to learning and memory for nonemotional material also apply to emotional material. These assumptions are compatible with other explanations of fear reduction, such as extinction. Therefore, it is reasonable to suggest that techniques that maximize other types of learning and retrieval may be applied to exposure-based treatments.

THE NEW THEORY OF DISUSE

Bjork and Bjork (1992) outlined their "new theory of disuse" to unify, or make sense of, some "peculiarities" of human memory. Among those peculiarities are that (a) a remarkable capacity for storing information is coupled with a highly fallible retrieval process, (b) what is accessible in memory is heavily cue dependent, (c) retrieving information from memory is a dynamic process that alters the subsequent state of the system, and (d) with the passage of time, memory "regresses"—that is, earlier memory representations tend to become more accessible than newer competing representations.

A starting point for the theory is the observation that information in memory, such as the names of friends or prior home phone numbers, no matter how well learned and instantly recallable during some earlier phase of one's life, becomes nonrecallable with a long enough period of disuse. It is easy to demonstrate by measures such as recognition or relearning, however, that such information remains in memory—at nearly full strength. What is lost is *access* to memory representations, not the representations per se. In contrast to Thorndike's (1914) original "law of disuse," which asserted that without continued access memory representations decay, the *new* theory of disuse asserts that without continued access to memory representations those representations eventually become nonretrievable.

The aforementioned observation points to the need to distinguish between the momentary ease of access to memory representations and some more permanent measure of the stored strength of that representation. In the new theory of disuse, the former is referred to as *retrieval strength* and the latter, *storage strength*. Such a distinction is hardly new. It corresponds, for example, to Hull's (1943) distinction between *momentary reaction potential* and *habit strength* and to Estes's (1955) distinction between *response strength* and *habit strength*. What is new about the theory are assumptions about how storage and retrieval strengths of a memory representation are increased and decreased by study and retrieval events, as a function of the current levels of those two strengths. The following are the basic assumptions of the theory.

(a) Any memory representation is characterized by two strengths: storage strength, which denotes how well learned, or interassociated, that representation is with other representations in memory, and retrieval strength, which denotes how accessible, or activated, that representation is regarding the cue or cues guiding retrieval. Recall probability is solely a function of current retrieval strength.

(b) Both study and retrieval (test) events increase storage and retrieval strengths, but retrieval processes, provided they are successful, are the more potent events. Storage strength, once accumulated, is never lost. On the storage side, then, there is no limit to the capacity of human memory. There is, however, a limit on retrieval capacity. Competitive processes limit the memory representations (responses) that are accessible given a retrieval cue or configuration of cues.

(c) Increments in storage strength are a decreasing function of current storage strength; that is, the higher the current level of storage strength, the less there is to gain. Increments in storage strength are also a decreasing function of current retrieval strength, which is an important and much less obvious assumption of the theory. The more a memory representation is currently accessible or activated, the less its storage strength can be increased by a study or test event.

(d) Increments in retrieval strength are a decreasing function of current retrieval strength but an increasing function of current storage strength. Decrements in retrieval strength, resulting from the study or retrieval of other memory representations associated with a given cue or set of cues, are an increasing function of current retrieval strength but a decreasing function of current storage strength. Importantly, then, storage strength acts to enhance the gain and retard the loss of retrieval strength.

In summary, storage strength is a latent, but powerful, variable. It is not reflected in the current probability of responding, which is solely a function of current retrieval strength, but it determines the rate of forgetting and the speed of acquisition. That is, storage strength determines the rate at which retrieval strength is lost during a retention interval and the rate at which retrieval strength is gained during learning. Storage strength, summed across the stored representations in memory, is an unlimited, permanent capacity; it is structured around meaning and relationships, and it increases continuously as more is learned.

Retrieval strength, on the other hand, accounts completely for the probability of recall at any given moment and is limited. The retrieval process is "erratic, highly fallible, and heavily cue-dependent" (Bjork & Bjork, 1992, p. 36). Retrieval itself is a dynamic process. When information is retrieved, that information gains retrieval strength, making it more retrievable in the future. Simultaneously, other information that shares retrieval cues with the retrieved information loses retrieval strength, making it less retrievable in the future.

Bjork and Bjork (1992) place the competition for retrieval strength at the level of retrieval cues. Such retrieval cues are assumed to consist of environmental, interpersonal, and mood or body-state stimuli, real or imagined, that have been associated with a given to-be-remembered item in the past. For a memory representation to be accessible, one or more cues associated with that representation must be reinstated, physically or imaginally. Whether a given memory representation actually determines the behavioral response to a cue or set of cues depends, however, not only on the absolute strength and recency of its association to the cue or cues guiding retrieval but also on the strength or recency of the association of other memory representations to the cue or cues in question. That is, the likelihood that a given memory representation controls the behavioral response in a given setting is assumed to depend on its relative as well as absolute retrieval strength in the face of the cues that comprise that setting.

Bjork (1989) argues that such a system, with a permanent memory store coupled with forgetting in the form of a loss of retrieval access, is adaptive for a number of reasons:

(a) Because the old material becomes nonretrievable (by virtue of learning the new material), that material becomes noninterfering in the recall of the new material; (b) the old material, however, remains in memory, is apparently at full strength from a recognition standpoint, and is, therefore, familiar and identifiable when it reoccurs; and (c) the old material is not only recognizable but also, apparently, relearnable in the sense that it becomes fully accessible in memory when presented again as to-be-learned material. (p. 322)

Home phone numbers illustrate the argument well. When asked for one's home phone number, it would not be useful to remember the entire list of one's numbers from childhood onward. Rather, it is preferable that only one number come to mind (i.e., be retrievable), which is generally what happens. Given that one's old phone numbers remain in memory, however, they may be retrievable given that certain cues are reinstated, such as returning to one's previous residence; they will tend to be readily recognized and identified when presented; and they can be relearned rapidly, should the need arise.

Relationship of the New Theory of Disuse to Other Theories

Current thinking about the learning that takes place during exposure treatment is that new memories are developed that compete with intact older memories. Bouton and colleagues (e.g., Bouton, 1993; Bouton & Swartzentruber, 1991) demonstrate that the excitatory meaning of an association between a conditioned stimulus (CS; e.g., a tone) and an unconditioned stimulus (US; e.g., shock) is not eliminated during extinction. Rather, an additional inhibitory meaning is acquired (i.e., under certain conditions, the tone is not followed by shock). Bouton (1991) believes this additional acquisition creates ambiguity in the meaning of the CS, and which meaning is later expressed depends on (or is "disambiguated by") context. For example, an animal may expect a tone to be followed by shock and may, therefore, express fear upon hearing the tone, unless the tone occurs in the context where the animal previously learned that the tone is not followed by shock. A number of well-established phenomena in animal learning provide additional evidence for the continued presence of original fear associations after apparent extinction of those associations. Such phenomena include reinstatement, renewal, reacquisition, spontaneous recovery, and disinhibition (Bouton, 1988; Bouton & Swartzentruber, 1991). *Reinstatement* occurs when an extinguished pairing between CS and US is revived by presentation of the US alone. *Renewal* describes a return of fearful responding to CS when returned to the conditioning context after extinction in a different context. *Reacquisition,* or relearning of a pairing between CS and US, is evidence for the continuing presence of the original fearful pairing in that relearning is more rapid than initial learning when background cues signal previous conditioning (and slower when cues signal extinction). *Spontaneous recovery* is a return of previously extinguished responding to a CS with the passage of time, and *disinhibition* refers to recovery when a distractor is presented just prior to testing response to the CS (the latter two concepts are from Pavlov, 1927, cited in Bouton, 1988; Bouton and Swartzentruber, 1991).

The emotional processing theory (Lang, 1979; Rachman, 1980) as elaborated by Foa and Kozak (1986) posited that exposure "disintegrated" original fear memories, or the "fear structure," which is the representation of a feared item in memory. They suggested that, through short-term physiological habituation, the stimulus and fear response are dissociated. This dissociation, in turn, was thought to lead to cognitive change, including lessened perception of harm and decreased negativity. Thus, the original set of fearful associations among stimuli, responses, and meanings could be dismantled. In light of the work of Bouton and others, however, Foa and McNally (1996) recently suggested that the result of therapy is a new, nonpathological fear structure that "overrides" the intact, pathological fear structure

Brewin (1989) has put forth similar ideas. He argues that both failures of generalization and relapse after treatment are evidence that new memories, formed as a result of therapy, alter the accessibility of older memories, as opposed to replacing or erasing them. He proposes there exist two major cognitive systems, which differ primarily in their conscious accessibility and, therefore, in their potential for modification. "Verbally accessible knowledge" is available at a conscious level. This system is accessed with effort and is changeable, as through cognitive behavioral therapy. "Situationally accessible knowledge," on the other hand, is not consciously available but is activated without intent or awareness by contextual cues. He states that

> *in clinical settings it is hardly ever possible to create new experiences that perfectly match original learning experiences. Thus, original situational memories are unlikely to be changed, but new memories can be created that share enough of their contextual features to be preferentially accessed in future* [*sic*]. (p. 387)

The new theory of disuse is consistent with these theories. In the new theory of disuse, storage strength, once accumulated, is hypothesized to be permanent. There is substantial evidence for this proposition, dating back to the work of McGeoch (1932) and other learning theorists, whose work discredited the notion that memory representations decay or are erased. Also consistent with other learning theories is the notion that access to representations in memory depends on contextual cues.

Foa and McNally (1996) articulated the need for "research . . . to focus on developing procedures that promote accessibility of new structures and promote inhibition of old ones" (p. 340). We propose that the new theory of disuse provides a theoretical framework for guiding such research. Given its assumptions about how storage strength and retrieval strength are increased and decreased by study and retrieval events, the new theory of disuse provides specific predictions about the relative accessibility of new and old learning as a function of the current levels of both strengths.

At a somewhat more specific level, we see several other benefits of the new theory of disuse as a framework for guiding treatment research. One such benefit is that it is a framework that does not require a commitment to any particular process model as to how learning takes place. In applying Bouton's theory, for example, something like classical extinction is assumed to be the mechanism of change during exposure-based treatment (which it may well be in many cases), whereas applying the new theory of disuse does not require a commitment to such an assumption. Another potential benefit is that responses/retrievals are viewed as learning events. Theories that focus on encoding tend not to contain a mechanism by which a response itself promotes learning; rather, learning is assumed to depend only on the pairing of an event with reinforcement, punishment, and so forth.

A final benefit is that learned behaviors are double indexed in memory. That is, behaviors are assumed to have both a current retrieval strength and a dissociable long-term storage strength. Such double indexing provides a mechanism to explain why a single event, such as the elicitation of a nonadaptive fearful response after treatment, can have such a profound impact. The continued presence of storage strength for the fearful response accelerates the reacquisition of retrieval strength for the fearful behavior. To the extent that the fearful response becomes more retrievable, the nonfearful response is displaced because of the global limit on retrieval strength. Thus, a single event can profoundly effect the retrievability of the nonfear response.

Application of the New Theory of Disuse to Fear Treatment

We propose that exposure-based treatment of fear generates new memories that compete with intact fear memories. During treatment, the storage strength of the old fear representation is unchanged (or slightly increased to the extent that fear is elicited early in treatment) but its retrieval strength decreases as the competing representation gains strength. Both storage and retrieval strengths of the nonfear representation increase during treatment. As described above, context has an important influence on the relative accessibility of competing representations. Thus, successfully treating fear would involve identifying cues that elicit or make more likely a fearful reaction and developing additional associations to those same cues. An implication of the presence of both old and new memories after treatment is that, even after successful treatment, old memories remain in the background, rendering the individual vulnerable to reexperiencing fear given the right retrieval context or with passage of time. We hypothesize, however, that the long-term effectiveness of treatment can be enhanced by actively preventing the reemergence of old fear memories.

In application of the new theory of disuse to fear treatment, the relevant to-be-remembered information is an association between a stimulus (the previously feared stimulus, e.g., a snake) and response (lack of fear). Information that is connected in memory to the pairing of a snake with fear (i.e., the retrieval cues) might include (a) descriptive information, such as scales, a long narrow shape, colors, patterns, and coiling; (b) information about the meaning of a snake, such as danger, biting, and venom; and (c) contextual information (including time), such as a hot summer day as a child when the patient witnessed someone being bit by a rattlesnake (see Glenberg, 1979). During treatment, a nonfearful response is established in relation to the snake. A different set of descriptive, semantic, and contextual information makes up the retrieval cues for treatment learning. Suppose, for example, that the treatment snake was large and solid brown, seen as friendly, cool, and smooth by the patient, and that treatment took place on a fall day in a treatment room and on a nearby lawn. Cues that depend on the patient's mood or body state will tend to differ as well, if for no other reason than that the patient is older during treatment than during initial fear learning. At the end of treatment, retrieval of fearful or nonfearful feelings will depend on the retrieval cues that are present. The goal of treatment, then, is not only to establish a new association between snakes and lack of fear but also to maximize the retrievability of this new, nonfearful association.

Memory phenomena, such as the observation that, among competing memory representations, earlier learned representations will tend to become more accessible over time, are easily explainable by the new theory of disuse. As applied to therapy, the theory provides an explanation for the common problem of return of fear or the partial or complete reemergence of a fear that previously has been diminished. To date, factors associated with the return of fear include treatment intensity, elevated heart rate, distraction during treatment, and initial level of fear (Rachman, 1989). Such findings, however, are not robust and lack a cohesive theoretical framework. According to the new theory of disuse, at the end of (apparently) successful treatment, nonfearful associations to the critical stimulus will tend to have higher retrieval strength (by virtue of recency), but fearful associations to the stimulus will tend to retain greater storage strength (by being older and therefore based on more pairings).[1] Without retrieval opportunities, the retrieval strength of both types of associative responses will decrease over time. Because storage strength slows the loss of retrieval strength, however, the older association will lose retrieval strength at a slower rate. Hence, eventually, the retrieval strength of the older fearful association will exceed the retrieval strength of the newer nonfearful association.

Returning to the example of fear of snakes, the theory predicts that after treatment the new memory of lack of fear of snakes frequently will be more retrievable than the old fear memory. But the fear of snakes has likely persisted longer than the length of treatment and is based on multiple learning experiences. Consequently, the storage strength of the old fear memory is likely to be stronger than that of the new memory of treatment. Because snake encounters are generally not common occurrences, some time may pass before the person again encounters a snake. During that period of disuse, retrieval strengths of the old and new memories decrease but retrieval strength of the old memory decreases at a slower rate because it is associated with greater storage strength. Thus, at the next encounter, retrieval strength of the old fear may be greater than of the new nonfear, causing the person to react fearfully.

SPECIFIC TECHNIQUES FOR THE PREVENTION OF THE RETURN OF FEAR

Application of the Bjork and Bjork (1992) "new theory of disuse" to fear reduction also leads to a number of specific predictions and goals. Within this model, the task of exposure therapy is to optimize the learning and retention of nonfearful associations to fear-provoking stimuli. To achieve that goal, treatment must be structured in a way that maximizes not only the end-of-treatment retrieval strength of nonfearful responses but also, especially, their storage strength. Without underlying storage strength, high retrieval strength creates an illusion of treatment success: Very low fear at the end of treatment will be accompanied, according to the theory, by a rapid return of fear after treatment. It is storage strength that will support nonfearful responding in the long term.

Optimizing storage strength of nonfearful associations requires, however, structuring treatment conditions in ways that may seem unintuitive to both patient and therapist. In particular, certain difficulties for the patient need to be introduced during treatment, because the growth of storage strength is assumed to be a negatively accelerated function of current retrieval strength. That is, high current retrieval strength retards the growth of storage strength. It is necessary, therefore, to avoid treatment conditions that might seem, superficially, to speed the patient's progress, such as massing exposure trials, keeping constant the conditions of exposure, and so forth. Conversely, to maximize long-term effectiveness of treatment, it is necessary to introduce difficult retrievals of nonfearful responses and other manipulations to enhance the growth of storage strength. In the sections below we discuss in more detail specific manipulations of the conditions of treatment.

Timing of Treatment Sessions

One possibility for enhancing long-term gains of treatment involves manipulating the timing of treatment sessions (see, e.g., Schmidt & Bjork, 1992). Empirically, the ideal "spacing interval," that is, the temporal spacing of learning episodes, has been shown to differ as a function of the final "retention interval," that is, the postlearning interval over which the information must be maintained before testing (see, e.g., Glenberg and Lehmann, 1980). If the retention interval is short, closely spaced (massed) learning episodes tend to yield somewhat better performance than do learning episodes that are spaced farther apart (distributed), but if the retention interval is long, distributed learning episodes tend to yield better retention—often *much* better retention—than do massed episodes. The latter result, often referred to as the "spacing effect," is one of the oldest and most reliable of findings in the history of controlled research on human memory.

The new theory of disuse provides a natural account of the observed interaction of spacing and retention intervals. The advantage of massed learning episodes at short retention intervals arises, according to the theory, because massed learning episodes foster more rapid growth of retrieval strength than do spaced episodes (where retrieval strength can be lost between successive episodes). If retention is tested after sufficiently short intervals, the higher level of retrieval strength resulting from massed learning episodes will yield somewhat better performance. Spaced learning episodes, on the other hand, yield a higher level of storage strength than do massed episodes, because, as discussed above, increments in storage strength are a negatively accelerated function of current retrieval strength. Partial forgetting between learning episodes creates, in effect, additional opportunities for learning. The greater storage strength resulting from spaced episodes will in turn slow the loss of retrieval strength, resulting in better performance at long retention intervals.

In the case of therapy, the retention interval (i.e., one's posttreatment lifetime) is long relative to the intervals between treatment sessions across the therapeutic intervention. Thus, increasing the interval between sessions should be beneficial. Further, difficult retrievals, provided they succeed, are valuable learning tools. Hence, structuring sessions so that partial forgetting takes place between sessions should be most helpful. The challenge, however, is to create a schedule that creates increasingly difficult *successful* retrievals of nonfearful responses; simply challenging the patient will not be productive as a learning event if the patient is unable to meet that challenge.

Based on research by Landauer and Bjork (1978) and others, it appears that the optimal schedule is what Bjork (1988) has referred to as "expanding retrieval practice." After the initial presentation, information should be retrieved at a short interval, then a somewhat longer interval, then a still longer interval, and so forth. Ideally, each interval should be of a length that allows for maximum difficulty in retrieval—given the current retrieval strength—without rendering retrieval impossible. Each retrieval, apparently, acts as a learning event, increasing storage strength as well as retrieval strength, which permits successful retrieval at a still longer interval. Such a schedule appears to have advantages over both massed retrieval practice and spaced retrieval practice. Somewhat analogous findings have been obtained in motor-learning research, where the systematic "fading" of feedback enhances performance (for a discussion, see Schmidt and Bjork, 1992).

Regarding emotional learning, spacing of treatment (or extinction) has been investigated in nonprimates and primates. Nonprimate studies have examined the effect of scheduling extinction trials, but none have examined expanding intertrial intervals. Here we present examples of this research but not an exhaustive review. Baum, Andrus, and Jacobs (1990) carried out extinction of a "conditioned emotional response" (suppression of licking related to conditioning of light with shock) on three schedules (18 trials of 10 s, 6 trials of 30 s, and 1 trial of 180 s). Extinction was slower for the massed condition (1 trial of 180 s), and massed extinction led to more spontaneous recovery (return of fear). The most spaced condition (18 trials of 10 s) was nonsignificantly better than the other spaced condition. The superiority of spaced trials has been replicated (e.g., Terry & Anthony, 1980). Contrary to these results, however, several studies (e.g., Bankart and Elliott, 1974; Birch, 1965; Martasian, Smith, Neill, & Rieg, 1992) found no difference between massed and distributed schedules in extinction. We found no nonprimate study that showed better performance with massed as compared to spaced trials. Most important, none have compared the effects of an expanding interval between extinction trials.

Sentiments in clinical psychology are mixed about timing of treatment sessions. Foa, Jameson, Turner, and Payne (1980) preferred massed treatment because it reduced the likelihood of accidental exposure and, therefore, reduced the likelihood of reinforced avoidance during treatment, which is undoubtedly an important consideration. Others argue that massed treatment has the advantage of "getting it over with," or expediting treatment. In contrast, massed treatment may be too demanding, leading to greater attrition (Barlow, 1988; Lang & Craske, 1998).

Most studies have compared massed versus *evenly* spaced schedules and have found no difference between the two (agoraphobia and simple phobia, Chambless, 1990; assertiveness training, Berah, 1981; dental anxiety, Ning & Liddell, 1991; math anxiety, Richardson & Suinn, 1973; obsessive-compulsive disorder, Emmelkamp, van Linden van den Heuvell, Rüphan, & Sanderman, 1989; phobia, Grey, Rachman, & Sartory, 1981; spider phobia, Lanyon, Manosevitz, & Imber, 1968; stuttering, Saint-Laurent & Ladouceur, 1987; test anxiety, Hall & Hinkle, 1972; Suinn & Hall, 1970). Results from the two studies that demonstrated a difference between massed and evenly spaced schedules are conflicting. Furthermore, neither included follow-up assessment. Ramsay, Barends, Breuker, and Kruseman (1966) structured their massed practice as 40 min of treatment on each of 2 days, which were spaced 4 days apart. Their spaced practice included 20-min sessions on 4 consecutive days. The spaced schedule was superior for desensitization for simple phobia. The massed schedule in this study, however, provided more opportunity for forgetting (because of the 4-day break), thus blurring the distinction. Foa et al. (1980) found a massed schedule to be superior on measures of avoidance and anxiety for one group of agoraphobics, while massed and spaced schedules did not differ in their other group. These researchers defined massed treatment as daily sessions and spaced treatment as weekly sessions. Unfortunately, their crossover design did not allow for long-term follow-up, which is when the superiority of spaced treatment would be expected.

The studies comparing massed and spaced schedules have a number of limitations. Most important, none tested the usefulness of the expanding spaced schedule. Massed and spaced schedules are only defined in relation to each other within each study. Thus, a "massed" schedule may have been defined as having meetings as frequently as daily or as infrequently as twice a week, whereas a "spaced" schedule involved meetings once or twice a week. Further limitations include that only three involved a follow-up, many relied on self-report as the sole type of measure, and generally there were no controls on the total time of exposure.

The benefit of an expanding spaced schedule has been shown with motor and verbal learning (for reviews, see Bjork, 1988; Schmidt & Bjork, 1992) and with patients with memory disorders (Schacter, Rich, & Stampp, 1985). Two studies have compared massed and expanding spaced schedules for treatment of fear. Rowe and Craske (1998a) demonstrated the advantage of an expanding spaced schedule as compared to a massed schedule in a spider-fearful sample. As predicted, fear reduced more quickly in the massed group but was followed by return of fear. In contrast, return of fear was not apparent for the expanding spaced group. Lang and Craske (1998), on the other hand, did not find a difference in return of fear between the two groups. It is questionable, however, if this was an adequate test of the manipulation because of a floor effect: Study groups received nearly 4 hours of direct exposure, and there was no detectable return of fear between the end of treatment and follow-up 1 month later. Further work in this area is clearly warranted. First, the findings should be extended to clinically fearful populations. Second, operationalizing the expanding spaced schedule will require identifying optimal intertrial and follow-up intervals. The goal is for fear to return partially, but not completely, between exposures, that is, for some forgetting of the new learning to occur without treatment learning becoming inaccessible.

Variation of Treatment

A second treatment manipulation suggested by Schmidt and Bjork (1992) is to vary the to-be-learned task. Such a manipulation should increase generalizability and retrievability of learning. Varying the task to be learned increases difficulty and provides practice in novel situations, which is useful both because it pairs more cues with a nonfearful response and because it forces one to generalize a technique learned in a previous situation to a new situation. The concept of variation can be applied to the feared stimulus (e.g., multiple different snakes) and to the treatment context (e.g., range of settings, different internal states).

The benefit of variation may be attributed to three factors. First, variation increases retrieval difficulty because retrieval strength is diminished to the extent that cues that were available during prior learning events are no longer available. Second, variation pairs learned information with more retrieval cues, which ultimately leads to easier retrieval (Bjork, 1988), because cues associated with new learning are more likely to be present in a situation where retrieval is required. Returning to the fear-of-snakes example, variation could be used to associate lack of fear with a number of different-looking snakes (stimulus cues) and with varied settings, indoors and out (contextual cues). In contrast, treatment with one snake in a single location leads to a much narrower set of associated cues, thus limiting retrievability.

Third, varying the task causes the person performing the task to generate and apply a rule that captures the invariance among tasks or leads to a broadly applicable coping strategy. For example, encountering a snake without fear depends on reasonable estimations of harmlessness, mastery behaviors, and limited physiological arousal. By application of these general strategies across varied tasks throughout treatment, treatment becomes more like the task of coping with snakes as they naturally occur. Without variation, the patient learns to retrieve a nonfearful association only in relation to the single snake in a specific setting. Schmidt and Bjork (1992) see variation of treatment as an example of transfer-appropriate processing because the task at learning (encountering a novel snake in a novel situation) matches the performance task (naturalistic encounter with snakes).

The benefit of varying the to-be-learned task has been demonstrated with both motor and verbal learning tasks (see Schmidt & Bjork, 1992, for review). No such manipulation was found in the nonprimate fear literature. Two recent investigations with fearful college students employed this manipulation: Exposure to a varied stimulus (a number of different spiders), as compared to constant exposure (a single spider), led to better maintenance of treatment gains at follow-up (Rowe & Craske, 1998b). Similarly, exposure of students who were afraid to heights to varied stimuli and contexts (multiple heights), as compared to a single stimulus and context (one high location), led to better performance 1 month after treatment (Lang & Craske, 1998). The benefit of variation remains to be tested in a clinical sample, although in practice variation is often incorporated into exposure. Future work also should address whether variation of the stimulus or of the context is more important and what amount of variation is necessary for the manipulation to be maximally effective.

Overlearning and Repeated Learning

A third specific suggestion for improvement of long-term treatment efficacy involves "overlearning" and "repeated learning." According to Bjork and Bjork (1992),

> *it is a time-honored result in both the human and animal literature that additional learning trials given after perfect performance is achieved (overlearning), or additional relearning sessions where performance is brought back to the original criterion (repeated learning) act to slow the rate of subsequent forgetting. (p. 46)*

This impression is supported by a recent meta-analysis of the literature on overlearning. Driskell, Willis, and Copper (1992) reported that overlearning consistently results in greater retention. Their analysis suggested a direct positive relationship between the amount of overlearning and retention. In that analysis, the effect of overlearning was somewhat stronger for cognitive tasks than for physical tasks. Driskell et al. also emphasized the importance of repeated learning. Their analysis showed that the benefit of overlearning dropped by half within 3 weeks and may disappear within 5–6 weeks. They therefore suggested the need for "refresher training" at 3-week intervals. They did not, however, review the effect of such refreshers on long-term retention.

Driskell et al. (1992) account for the effects of overlearning by suggesting that "increased repetition represents a greater degree of learning . . . and . . . allows further feedback to be received on the correctness of response" (p. 620). Bjork and Bjork (1992) argue that the benefit of overlearning and repeated learning is attributable to continued increase in storage strength, albeit at a decreasing rate once retrieval strength is at a maximum level. The resulting greater storage strength retards the later decline in retrieval strength.

Clinically, overlearning is operationalized by continuing exposure beyond the point at which a minimum level of fear is reported. Repeated learning could be accomplished, for example, by administering booster exposure sessions. Typically, this happens only when patients have become fearful once again, as it is difficult to convince someone who is doing well to return for additional treatment. Because of the importance of retrieval as a learning tool, however, it is important to administer the booster before treatment learning can no longer be retrieved, that is, before complete return of fear has occurred.

The concept of overlearning has been tested in behavioral therapy in humans. The area in which it has been most extensively considered is in the treatment of enuresis in children. Houts, Peterson, and Whelan (1986) operationalized overlearning as an additional challenge after children had reached the criterion for the end of treatment. Namely, after the children had achieved 14 consecutive dry nights, those in the overlearning group drank 16 oz of water before bed and worked to achieve another 14 consecutive dry nights. This manipulation reduced relapse significantly.

Overlearning also has been examined in exposure-based treatment for anxiety disorders. Rachman and Lopatka (1988) included an overlearning condition that consisted of an additional 15 min of nonfearful modeling after reported fear had been reduced to zero. This manipulation did not, however, lead to less return of fear at follow-up 4 weeks later. One potential problem with the operationalization of overlearning is highlighted by this study. That is, overlearning may be easily confounded with massed learning. Massed learning creates a familiarity with the to-be-learned information, which in turn may lead to a false sense of knowing the information (Bjork, 1994). Another potential problem relates to the amount of overlearning. In the Rachman and Lopatka study, those who received exposure until they reported no fear received an average of 22 min of exposure, while the overlearning group received 36 min of exposure on average. This may represent an insufficient amount of overlearning. Driskell et al. (1992) found that 50% overlearning (defined as half again the amount of learning to reach criterion) led to an effect size of 0.222. The effect size increased to 0.413 with 100% overlearning (double the time to criterion performance) and to 0.630 at 200% overlearning. They concluded that there must be at least 50% overlearning to have an appreciable effect but that 100% overlearning is preferable. Thus, the Rachman and Lopatka study may not be a fair test of the overlearning concept. This issue should be carefully addressed in subsequent clinical studies of overlearning.

Repeated learning has been included in relapse prevention interventions. For example, Hiss, Foa, and Kozak (1994) described, as one part of a relapse prevention program, the use of follow-up telephone contacts to review the patients' use of maintenance techniques. These contacts were spread across the 3 months following treatment. The total relapse prevention program was shown to be effective in comparison to a treatment that was shown to be credible but not specifically effective for anxiety. Because their relapse prevention program contained a number of components in addition to the follow-up contacts, dismantling research is needed to determine the effect of maintenance contacts alone and what should be included in such contacts. In addition, it remains to be determined whether such contacts foster relearning by encouraging increased practice of treatment techniques or whether patients must see the therapist in person to operationalize relearning.

Recent work suggests that relearning (i.e., booster sessions) may be administered in a massed, rather than a spaced, fashion, without the typical rapid retention loss that characterizes massing of original learning episodes. Bjork and Fritz (1994), working with a quantitative version of the new theory of disuse, noticed that the theory predicted the typical interaction of spacing interval and retention interval for original learning (better performance during learning given massed presentations; better long-term performance given spaced presentations) but that the theory predicted a somewhat different pattern for relearning. Massed relearning still produced somewhat more rapid reacquisition during training, compared to spaced relearning, but also retained that advantage over a much longer retention interval.

That massed relearning may not have the same long-term disadvantage characteristic of massed original learning, though at first a surprising implication of the theory, has a straightforward interpretation. Because storage strength, once accumulated, is assumed to be permanent, the storage strength that results from original learning is assumed to carry over to the relearning phase. The disadvantage massed practice would typically have in terms of the accumulation of storage strength during training is therefore ameliorated. Recently, to test that prediction of the new theory of disuse, Schneider and Lane (1997) examined the original learning and relearning of arithmetic facts under massed and spaced conditions. Consistent with the theory, spacing of original learning fostered long-term retention, but there was no significant difference in long-term retention following massed or spaced relearning.

Such findings, if generalizable to treatment settings, have very important clinical implications. On the one hand, they suggest that it may be feasible to provide patients with a single massed booster session, rather than multiple sessions, which would have multiple practical advantages. On the other hand, such findings also suggest that a single massed episode of fear-inducing experiences might reinstate fearful responding in a dramatic way, undoing much of the progress achieved by treatment.

Manipulating Contextual Cues

Bouton (1988) has suggested that

> *one way to prevent reinstatement is to extinguish fear of the CS in a context that also predicts the US. These observations may imply that exposure therapy would be slow, but perhaps more successful in the long run, if it were conducted in a frightening context. (p. 140)*

In other words, Bouton suggests that treatment will be more successful if fear-provoking contextual cues are present during treatment. More generally stated, it is important to target not only the nature of the association with the CS (i.e., adding the inhibitory path between the CS and US) but also the context, which gates the inhibitory association.

This manipulation is also readily derived from Bjork and Bjork's (1992) new theory of disuse. In that model, retrieval of either fearful or nonfearful pairing depends on retrieval strength, which is determined by retrieval cues. By conducting treatment in the presence of fear-provoking cues, those cues, which previously would have contributed to retrieval strength of the fearful association, may be paired with the nonfearful response. Only retrieval cues associated with the treatment (insofar as they are the only ones paired with the nonfearful association) would aid in the retrieval of nonfearful associations at a later point in time. It should be emphasized that these cues include not only situational/contextual cues but also internal sensations. The presence of a greater number of retrieval cues in *in vivo* exposure may explain the advantage of that medium over imaginal exposure (Foa & Kozak, 1986).

Minimizing Disuse

As reviewed above, Bjork and Bjork's (1992) new theory of disuse predicts that, with lack of use, retrieval strength decreases over time. This statement should serve as a warning to clinicians. Without continued practice, treatment gains are predicted to dissipate over time. Öst (1989) described a maintenance program, which included scheduled practice over 6 months following treatment. Those in the program were provided with forms to be sent to the therapist every 2 weeks for the first 6 weeks and every 4 weeks thereafter. Upon receiving the forms, the therapist made a brief contact to review maintenance practices. Öst described a positive response to the program among patients and believed that it improved long-term outcome; however, the program was not systematically tested against a comparison group. Clearly, it would be of great value to establish the effectiveness of such a program as compared to no maintenance and to supportive contact with the therapist over an equal period.

EXTENSION TO OTHER EMOTIONAL DISORDERS

As mentioned above, one strength of the new theory of disuse is that it does not rely on assumptions about the process by which learning takes place. Rather, its principles can be applied to any learned information. Thus, application of these principles to other emotional disorders is relatively straightforward. The goal of treatment within this framework is to generate new learning that will compete with older learning and to structure learning in such a way that the new information will "win" the competition or be preferentially retrieved later. To accomplish this, the following three questions should be answered:

(a) What is the older, maladaptive learning that is being targeted in treatment?
(b) What are the retrieval cues with which the older learning is associated?
(c) What is the new, adaptive information to be learned during treatment?

In answering these questions, the therapist identifies maladaptive thoughts or behavior, determines the triggers for those thoughts or behavior, and selects alternative thoughts or behavior to be learned during treatment. From that point, the strategies outlined above (i.e., timing of sessions, variation, overlearning, repeated learning, manipulation of contextual cues, and minimization of disuse) can be applied.

As an example, consider a man who presents for treatment of depression. The older, maladaptive learning manifests in a core belief such as "I am inadequate," which leads to a range of depressive symptoms. This belief is triggered by the patient's perception of being criticized, particularly by figures of authority. For example, when his boss gives him anything less than glowing feedback about his work, he automatically thinks "I am stupid, I'll probably be fired," despite years of successful career advancement. In this case, the goal of therapy is for the patient to learn an alternative belief, "I am adequate." For purposes of this example, we assume that the first skill to be taught is cognitive restructuring. Based on the new theory of disuse, frequent sessions and regular homework should occur early in treatment. If there are not multiple occasions each day when the belief "I am inadequate" arises, homework of imagining hypothetical situations can be implemented to activate such beliefs and therefore to allow regular and frequent practice of cognitive restructuring. Once skills of restructuring have been at least partially mastered, breaks from cognitive restructuring of this core negative belief can be scheduled to allow partial forgetting to occur. A new skill, such as problem solving, could be introduced during these breaks from cognitive restructuring. Furthermore, returns to cognitive restructuring provide a break in problem solving so that partial forgetting can occur in relation to that skill as well. Eventually, as treatment sessions are scheduled farther and farther apart, the skills of cognitive restructuring and problem solving both are retrieved with some effort each time. If naturalistic situations do not present enough variability, hypothetical situations, role plays, or behavioral experiments can be designed to facilitate practice of skills across a range of situations. For example, the depressed patient described above may have ample opportunity to practice cognitive restructuring at work but have limited his life in such a way that there are few other areas in which people express pleasure or displeasure with him. Other situations, such as sending a meal back at a restaurant or refusing to attend a social event, will be essential. Overlearning may be incorporated into the treatment by continuing practices in each situation after the patient consistently activates belief in self-adequacy. According to Driskell et al. (1992), overlearning should be continued for a period of time equal to that of initial learning. Overlearning may be best operationalized in relation to specific situations. For example, if restructuring of negative self-evaluations that are induced by being asked to rewrite a memo is successful only after five rehearsals, then overlearning would mean rehearsing the same situation five additional times. Encouragement and careful explanation of the rationale for overlearning may help patient motivation during this phase. Finally, booster sessions consisting of practice of each skill learned in treatment should enhance long-term retrieval of the newly learned treatment information and skills. Boosters may be scheduled every few months and involve lengthy and intense role plays, imaginal rehearsals, or practices of cognitive restructuring.

The same strategies may be applied to cognitive behavioral treatments for Axis II disorders. For example, cognitive behavioral treatment for avoidant personality disorder often includes anxiety management and social skills training. Initially, therapy could focus intensely on relaxation training. Once the patient is able to implement relaxation skills across a range of situations, treatment focus can shift to cognitive restructuring with continued, but increasingly infrequent, relaxation practice. Similarly, once the cognitive restructuring skill has been at least partially mastered, focus may shift to social skills. Overlearning and booster sessions are likely to be especially useful with this population, given the chronic nature of the target symptoms.

CONCLUDING COMMENTS

Bjork and Bjork's (1992) new theory of disuse has much to offer to treatment of emotional disorders. In general, this theory suggests that attention should be paid to the cues that are associated with treatment learning and to the total amount of new learning that takes place during treatment. In addition, Bjork and Bjork emphasize that learning must be actively maintained to prevent loss of new learning due to disuse; studies of relapse and return of fear suggest that this is a realistic concern. Specific strategies to accomplish this end include an expanding spaced schedule of treatment, variation of aspects of the treatment stimulus and situation, overlearning and relearning, minimizing the impact of disuse, and careful attention to retrieval cues. Whereas the expanding spaced schedule does not appear to be regularly used in clinical practice, others, such as variation and boosters, are often used in some form but not consistently or systematically. We feel that more could be done to maximize the effect of such strategies. For example, in most clinical settings, there is variation across tasks—a height phobic patient might complete exposures on both stairwells and balconies—but not within task—the patients proceed up a hierarchy in a very orderly fashion in both settings. One potential treatment plan, which incorporates these strategies for treatment of a specific phobia, is outlined in Figure 1. Further research to clarify the best ways to operationalize these strategies is warranted.

As a final comment, it is perhaps worth mentioning that applying the new theory of disuse to the treatment

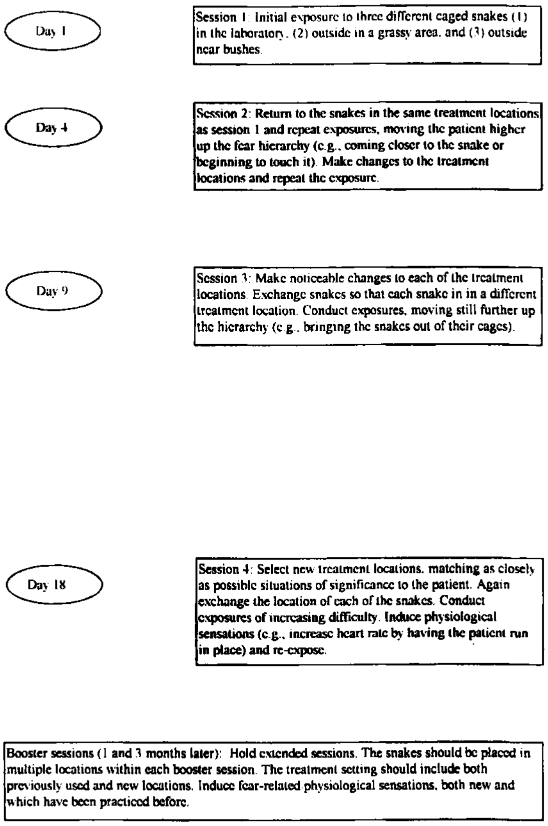

Figure 1. A sample treatment plan, employing strategies to increase long-term retention of treatment learning.

reminds us of the importance of an old distinction in psychology, namely, the distinction between learning and performance. What we see during training (or treatment) is *performance*, which may be a quite imperfect indicator of whether the more permanent changes that constitute *learning* have or have not taken place, as indexed by long-term retention and transfer. Conditions that result in rapid improvements during training may not support retention in the long term, and conversely, conditions that appear to create difficulties for the learner and slow the apparent rate of acquisition may prove optimal as measured by long-term retention and transfer.

Drawing on such findings, Bjork (1994, in press), Christina and Bjork (1991), and Schmidt and Bjork (1992) warned individuals responsible for training and instruction that they can be easily misled by performance during training. A similar warning seems appropriate for clinical practitioners and scientists: What one sees during treatment sessions is the product of the current retrieval strengths of desirable and undesirable associations, relative to the cues present in the treatment context; what one does not see are the relative storage strengths of competing desirable and undesirable associations, relative to the cues characteristic of a patient's real-world environment.

NOTE

1. For the purposes of this discussion, we have used a simplified model of fear learning. Acquisition of fear can be extremely rapid and depend on very few trials. The idea that there is a predisposition to acquire certain fears has received considerable empirical support (e.g., Cook & Mineka, 1989). This preparedness idea is not directly addressed in the new theory of disuse, which focuses primarily on nonemotional learning. It may be hypothesized, however, that rapid increase in storage strength may accompany rapid acquisition.

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