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Prolonged exposure therapy for post-traumatic stress disorder: a review of evidence and dissemination

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Post-traumatic stress disorder (PTSD) is a highly prevalent, often chronic and disabling psychiatric disorder that is associated with significant adverse health and life consequences. Fortunately, there is compelling evidence that cognitive–behavioral therapies, notably exposure therapies, are effective in reducing PTSD symptomology relative to waiting list and active control conditions. Prolonged exposure is a specific exposure therapy program that is considered a first-line evidence-based treatment for PTSD. Unfortunately, barriers to treatment dissemination prevent the majority of individuals with PTSD from receiving evidence-based treatment. Strategies to increase the availability of treatment and boost the efficiency of exposure therapy are now being examined.

Keywords: CBT • dissemination • exposure • PTSD • trauma

This article describes the current status of treatment efficacy for post-traumatic stress disorder (PTSD) and highlights the most important issues related to developing and delivering effective care to those in need. We first briefly discuss the phenomenology and epidemiology of PTSD, and then provide a conceptual framework for understanding the etiology and treatment of PTSD. To this end, we will review relevant principles of learning theory and discuss Foa and Kozak's emotional processing theory [1,2] to explain the mechanisms of exposure-based treatments that are involved in ameliorating PTSD symptoms. We will focus on reviewing evidence for prolonged exposure (PE), a specific exposure therapy program for the treatment of PTSD that has been supported by the greatest number of studies to date. Next, we will present an overview of PE, including a detailed description of the key components of treatment. Finally, we will outline major barriers to the effective dissemination of evidence-based treatment and discuss the most promising strategies for circumventing these barriers.

Phenomenology & epidemiology of PTSD

An event is considered potentially traumatizing if it is unpredictable, uncontrollable and involves a severe or catastrophic violation of fundamental beliefs and expectations about safety, physical integrity, trust and justice [3]. Examples of potentially traumatizing events (PTEs) include direct life threats, physical injury, observing violence or extreme suffering, and sexual assault. Although PTEs are extraordinary, they are not rare. More than half of all US adults (51% of women and 60% of men) are exposed to at least one PTE during their lifetime [4]. Despite the ubiquity of exposure to PTEs, most individuals follow a trajectory of naturally recovery [5]. However, a salient and often silent minority do not recover and go on to develop chronic PTSD [6,7].

According to the National Comorbidity Survey, the lifetime prevalence rate of PTSD is 8% [4]. A more recent epidemiological study found lifetime prevalence rates of 3.4% in men and 8.5% in women [8]. Certain groups are at greater risk for developing PTSD: service members exposed to a war zone [9], individuals with severe mental illness [10], emergency medical technicians, police, firefighters, and members of communities or geographical regions affected by natural and man-made disasters [11]. For example, a reanalysis of the National Vietnam Veterans Readjustment Study found lifetime prevalence rates of 18.7% for war-related PTSD [12]. Similarly, recent research has shown that 16.6% of military personnel returning

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from Iraq or Afghanistan screen positive for PTSD [13]. Rates of PTSD among women exposed to sexual assault have been estimated at 36% [14]. Thus, disseminating empirically supported prevention and treatment programs is especially critical for these at-risk groups.

Post-traumatic stress disorder is characterized by intrusive re-experiencing symptoms, avoidance behaviors and elevated arousal [15]. In the absence of effective treatment, PTSD can become a chronic and disabling disorder that is frequently comorbid with major depression, other anxiety disorders and substance abuse disorders [4], and is associated with low quality of life [16,17]. Therefore, it is encouraging that effective interventions have been developed that can reduce the incidence of chronic PTSD.

Our understanding of the processes that govern the development and treatment of PTSD has been heavily influenced by emotional processing theory [1,2]. Together with models of extinction learning, emotional processing theory provides a theoretical framework for understanding the psychopathology of PTSD and the mechanisms underlying the most effective treatment approaches. There are many other theories of PTSD, including cognitive theory [18], schema theories (for example, see Horowitz, 1986 [19]), and multiple representation theories [20,21]. In this article, we briefly describe basic extinction models of pathological anxiety, then provide an overview of emotional processing theory as it pertains to PTSD. We focus on emotional processing theory because it incorporates the role of extinction processes, as well as the role of negative cognitions that typify PTSD. A comprehensive account of other theoretical models of PTSD can be found elsewhere [22].

Extinction theories of exposure therapy

Behavioral models of PTSD highlight the role of Pavlovian conditioning in fear acquisition. Accordingly, the mechanism underlying exposure therapy in the treatment of chronic PTSD has been linked to the process of extinction. A basic assumption of the Pavlovian model is that associative learning underlies both the development and treatment of excessive fear. In the application of this model to PTSD, the traumatic event is considered an unconditioned stimulus (US), which has become associated with a variety of non-threatening conditioned stimuli (CS; e.g., smells, sights, sounds and people). When an association between a neutral stimuli and the traumatic event is formed in memory, later exposure to the neutral event will activate the representation of the trauma, triggering a fear response, including re-experiencing symptoms, physiological reactivity and avoidance behavior.

In contrast to fear acquisition, extinction learning occurs through repeatedly presenting a CS in the absence of the US, which results in a reliable decrease in fear responding to the CS due to changes in CS–US expectancy [23,24] (for a review of cognitive processes, see [25]). Exposure therapy for PTSD is based on the principles of fear learning and shares procedural similarities with extinction training. Treatment involves repeatedly confronting feared thoughts, images, objects, situations or activities in the absence of the expected negative outcome, in order to reduce pathological fear, anxiety and other symptoms. Exposure therapy for PTSD typically involves 'imaginal' exposure to the patient's memory of the trauma, as well as '*in vivo*' exposure, or real-life exposure, to various reminders of the trauma. As emotional processing theory suggests, fear activation alone is not sufficient for therapeutic change. Information that is incompatible with the fear structure (i.e., that disconfirms the CS–US expectancies) must be incorporated into memory in order for corrective learning to occur.

Many modern learning theories of fear acquisition [26,27] also recognize the role of cognitive processes, such as the controllability and predictability of the traumatic event, and better account for observational and informational fear learning, as well as directly experienced events, than the simple Pavlovian model [28]. Furthermore, it is now recognized that exposure is not an 'unlearning' or 'forgetting' of feared associations. Rather, it involves new inhibitory learning and the formation of new inhibitory associations that disrupt the CS–US expectancy [29,30]. The original fear memory (CS–US) now competes with the extinction memory (CS–no-US) to influence the behavioral response. The outcome of this competition is highly dependent on environmental conditions and is sensitive to changes in temporal and physical context.

Thus, even following successful exposure therapy, the fear response may return in contexts where the corrected memory is not activated to inhibit the original fear memory. Return of fear observations confirm the integrity of the original fear network [31] and are often regarded as experimental models for clinical relapse [32,33]. Accordingly, memory for extinction is viewed as new and fragile inhibitory learning, directly competing against a strong, excitatory fear memory. Corrective learning is generally well retained following exposure therapy for PTSD, as evidenced by low rates of post-treatment relapse [34]. However, an important clinical issue for the treatment of PTSD is understanding how treatment can strengthen new learning efficiently to promote durable treatment effects. Conducting exposures repeatedly and in multiple contexts is a standard treatment procedure that is designed to reduce renewal effects. Additional strategies of strengthening the associations learned during exposure therapy will be discussed in the following section, including paradigms (e.g., introducing pharmacological agents) to enhance memory consolidation of the learning that occurs during exposure therapy.

Emotional processing theory

Emotional processing theory proposes that fear is represented in memory as a cognitive structure that includes information about the fear stimuli, the fear responses and their meaning [1,2]. For example, a veteran with PTSD may have a fear structure that includes representations of stimuli such as loud sudden noises, and representations of responses such as rapid heartbeat and muscle tension. Of particular importance is the meaning assigned to the stimuli, such as the meaning of a loud noise as 'dangerous' or the meaning of rapid heartbeat and muscle tension as 'I am afraid'. The stimuli, responses and their meaning are inter-related within the fear structure such that inputs matching any one part of the

structure will activate the entire structure. Thus, hearing a car backfire will activate the veteran's fear structure, including the meaning associated with this representation ('danger') and the behavioral and physiological fear responses.

Foa and Kozak described the distinguishing features of normal and pathological fear structures [2]. Following the previous example, the veteran's fear structure may be considered normal if it is restricted to settings that are actually dangerous, such as an active war zone. In this situation, activation of the fear structure will prompt adaptive responses, such as readying a weapon and monitoring for enemy threats. By contrast, the fear structure can be considered pathological if it is activated by objectively safe stimuli, such as fireworks or thunderstorms. In other words, a pathological fear structure is characterized by erroneous associations that lead to overgeneralization of fear responding to objectively safe situations and stimuli, as well as excessive fear responding. Emotional processing theory proposes that in order to successfully reduce pathological fear, treatment must first activate the fear structure, and second provide new information that is incompatible with the existing pathological fear structure. As described later, exposure therapy effectively accomplishes both of these objectives. The fear structure is activated by helping the client to approach the feared situation (in real life or in imagination). Once activated in a safe setting, corrective learning occurs through integration of information that disconfirms the feared outcomes. Following successful exposure treatment, there are two fear structures (one pathological and one normal), either of which may be retrieved and activated depending on their associative strength with the contextual cues.

The application of emotional processing theory to PTSD [35] helps to account for natural recovery following trauma, the development and maintenance of PTSD, and for the treatment of PTSD. Natural recovery occurs when the fear structure is repeatedly activated in the absence of feared consequences. As such, individuals who revisit the memory of the trauma, engage with trauma-related thoughts and feelings, share the experience and reactions with others, and approach reminders of the trauma in daily life will successfully recover from a traumatic event [36]. By contrast, individuals who avoid engaging with the traumatic memory and avoid trauma-related stimuli are at risk for PTSD because avoidance thwarts opportunities to obtain corrective information that would disconfirm feared consequences.

Successful treatment of PTSD, therefore, involves repeated exposure to trauma-related stimuli. This exposure accomplishes a number of therapeutic goals. First, activating the fear structure in the absence of feared outcomes corrects exaggerated probability estimates of harm. Second, repeated retelling of the trauma memory helps to organize the narrative in memory and also helps to strengthen the distinction between remembering the trauma and the experience of the trauma, which alters the associations between the traumatic memory and threat meaning. Third, exposure to the trauma memory helps individuals reevaluate negative trauma-related cognitions about themselves and the world (e.g., 'I am totally incompetent' and 'the world is completely dangerous') that are thought to be at the core of the fear structure for PTSD [37]. Prolonged exposure is an effective treatment for PTSD, based on the tenets of emotional processing theory, which accomplishes each of these therapeutic aims. The procedures used in prolonged exposure to promote fear activation and modification of erroneous cognitions are explained in detail in the following section.

Prolonged exposure therapy

Exposure therapy refers to a general strategy for reducing excessive or unrealistic anxiety through confronting anxiety-provoking or avoided thoughts, situations, activities and people that are not realistically threatening. There are several variants of exposure therapy, including imaginal exposure, *in vivo* exposure, systematic desensitization and flooding. Interoceptive exposure, which involves the deliberate induction of physiological symptoms that mimic anxiety, is primarily used in the treatment of panic disorder [38] and will not be discussed here.

Prolonged exposure is a specific exposure therapy program that has been the subject of considerable research in the treatment of PTSD. PE is comprised of three main components: first, *in vivo* exposure to trauma reminders, typically as homework; second, imaginal exposure to the memory of the traumatic event, both in session and as homework; and third, processing of imaginal exposure, as well as two minor components: psychoeducation about the nature of trauma and trauma reactions, including a clear rationale for the use of exposure therapy, and training in controlled breathing.

Treatment overview

The current PE program for treatment of PTSD consists of between eight and 15 individual 90-min sessions. In the first meeting, the clinician provides a detailed rationale for exposure therapy and explains that PTSD is maintained by two key factors. The first factor is avoidance of thoughts and images related to the trauma and avoidance of trauma reminders. The clinician explains that although avoidance is effective in reducing anxiety in the short term, it maintains PTSD by preventing opportunities to emotionally process and integrate the trauma memory. The second factor is the unhelpful and often erroneous beliefs that have developed in the wake of the trauma. For example, many trauma survivors hold the distorted belief that the world is extremely dangerous and that the survivor himself or herself is completely incompetent. Therefore, PE aims to alter distorted beliefs by providing opportunities to obtain corrective information that disconfirms these beliefs via experientially learning (i.e., exposure).

In the first session, the clinician and patient must determine which trauma to focus on during imaginal exposure. For patients who have a history of multiple traumas, this 'index trauma' is selected by determining which event is currently causing the greatest distress and dysfunction. Often, this will be the event that is associated with the most frequent and upsetting re-experiencing symptoms. The index trauma is selected during either the initial evaluation of the patient or the first session as part of the trauma history interview. Finally, the first session also involves teaching patients a slow-breathing relaxation technique that they are encouraged to practice on a daily basis as homework.

The second session involves an in-depth discussion of common reactions to trauma, which provides the patient with a framework for understanding their symptoms. Specifically, reviewing common reactions can help the patient to realize that their difficulties are recognized as PTSD symptoms, that the therapist is familiar with these symptoms and that PE is geared towards alleviating these symptoms. Next, the clinician introduces *in vivo* exposure and works with the patient to construct a hierarchy by listing and rank ordering previously avoided situations based on how distressed the patient would be if he or she confronted the situation. After creating the *in vivo* hierarchy, specific *in vivo* assignments are selected for homework. During each *in vivo* exercise, the patient is instructed to remain in the situation for 45–60 min or until his or her anxiety decreases by at least 50%.

In the third session, the clinician presents a detailed rationale for imaginal exposure, and then spends the majority of the session conducting imaginal exposure (~45 min). The exposure is immediately followed by 15–20 min of post-exposure 'processing', which includes discussion of the patient's experiences during the imaginal exposure and focuses on the lessons learned from the experience. Imaginal exposure is conducted in each subsequent session. Patients are also instructed to listen to an audio recording of the imaginal exposure each day as part of their weekly homework.

The remainder of treatment (sessions 4–10) follows a standard agenda that begins with reviewing the preceding week's homework. Homework exposure exercises for the coming week are assigned at the end of the session. During the final treatment session, the clinician and patient review progress, discuss lessons learned and make a plan for how the patient can maintain the gains made during treatment. By the end of treatment, the patient has often shifted their approach to managing PTSD symptoms from avoidance, which maintains fear, to confrontation of trauma reminders, which promotes recovery and mastery.

Key component: in vivo *exposure*

In vivo exposure refers to real-life confrontation with feared stimuli. Trauma survivors often avoid places, people and objects that remind them of the trauma. While exposure to objectively unsafe situations is neither appropriate nor therapeutic, *in vivo* exposure to feared situations for which there is a low probability of actual harm is very beneficial in the treatment of PTSD. For example, a veteran whose military truck was hit with an explosive device while in Iraq may avoid driving. A reasonable goal of *in vivo* exposure would be to help the patient resume driving. The first step in implementing *in vivo* exposure is to develop a list of feared situations, rank ordered by their level of expected distress (this is referred to as an exposure 'hierarchy'). The patient and the clinician collaborate in generating a list of situations that the patient currently either avoids or endures with great discomfort. For each situation on the list, the patient then assigns a subjective units of distress (SUDS) rating ranging from 0 to 100 as a means of rank ordering the situations. A SUDS of 0 indicates no distress or anxiety at all, whereas a SUDS of 100 indicates the most distressed a person has ever been. A well-constructed hierarchy includes a range of items spanning from ones that generate moderate anxiety to those that generate the most anxiety a patient can imagine. *In vivo* exposure is generally conducted in a stepwise fashion, beginning with situations that are moderately fear-provoking before moving up the hierarchy to more challenging situations. This graduated approach helps patients build confidence and self-efficacy through early success experiences and is widely considered more palatable to patients than beginning with the most feared situations on the hierarchy.

The duration of exposure to the feared situation is an important factor in treating PTSD. The exposure must last long enough for corrective learning to occur (i.e., for the patient to associate the feared stimulus with safety). A duration of 30 and 60 min appears to be sufficient for good outcomes [39]. Although within-session reductions in fear are no longer considered critical for improvement [36], habituation of fear may be important for patients who hold erroneous beliefs about the consequences of anxiety (e.g., that it will be unbearable or will last forever). Antony and Swinson provide additional guidelines on how to conduct effective exposures [40].

Patients are instructed to start doing exposures on their own between sessions at the start of therapy. In contrast to exposure therapy for other anxiety disorders, *in vivo* exposures for PTSD are rarely conducted during sessions. One reason for this is practical: the types of situations that are typically feared by patients with PTSD cannot easily be accessed or simulated within a clinician's office. A second reason is that conducting exposures independently for homework helps to minimize patients' tendency to discount success experiences that occur during in-session exposures. Third, exposure should occur wherever the patient's anxiety 'lives', in order to promote generalization and attenuate the risk of contextual renewal (i.e., exposure to the CS in a different context than extinction elicits the extinguished fear response).

Evidence for the benefit of clinician assistance with exposure in other anxiety disorders is mixed. Öst, Salkovskis and Hellström found that clinician-guided exposure was superior to self-guided exposure for spider phobias [41], whereas a study by Marks and colleagues with OCD patients yielded the reverse conclusion [42]. Owing to the wide variety of feared situations typically observed in PTSD, there are practical considerations that limit the therapist's ability to provide guided exposure. In light of these limitations, the most prudent approach is to supplement self-guided exposure by enlisting others, such as the patient's partner, friends or family members, as needed. Including others can decrease the level of expected distress associated with an exposure exercise and is therefore a helpful strategy to modify difficulty of the *in vivo* assignment. Clinician assistance with *in vivo* exposures is warranted if the patient is persistently having difficulty completing assignments independently. In such cases, the clinician should accompany the patient, if possible, in order to demonstrate the process of exposure, help to troubleshoot any obstacles that arise and lend support. However, as clinician presence may serve as a 'safety behavior' for the patient, it is essential for the patient to realize that they can face feared situations and effectively manage their anxiety on their own.

Safety behaviors refer to any behavior used during exposure to reduced anxiety (e.g., the presence of another person, medications or reassurance seeking). These behaviors (or mental processes) may interfere with successful exposure therapy because patients who use safety behavior during an exposure mistakenly attribute the absence of feared outcomes to the use of the safety behavior. The availability of safety behaviors has been shown to be detrimental to exposure therapy among phobic samples [43], whereas explicit instruction to withdraw safety behaviors has been demonstrated to improve treatment outcomes [44]. Assessing for safety behaviors and instructing patients to withdraw from using them is already standard protocol in PE [45]. Although there is ample evidence that the use of safety behavior can interfere with the progress of exposure therapy [46,47], there are also some data to suggest that permitting some use of safety behaviors, especially in the early stages of exposure therapy, can be facilitative in the treatment of specific phobias [48]. Further work is needed to examine therapeutic uses of safety behavior in the treatment of PTSD.

How does in vivo *exposure promote recovery from PTSD?*

Mirroring the process of natural recovery, *in vivo* exposure promotes recovery through activation of the fear structure and the correction of erroneous probability estimates of harm. Intentionally approaching reminders of the trauma presents patients with information that disconfirms the pathological elements of the fear structure, thereby reducing PTSD symptoms. *In vivo* exposure gives patients the opportunity to test feared consequences and incorporate more realistic information through experiential learning. *In vivo* exposure also provides opportunities for habituation as patients learn that when they remain in the feared situation for long enough, their anxiety will decrease on its own. Approaching and remaining in feared situations prevents negative reinforcement of avoidance behaviors, which are a key maintaining factor in PTSD. Successfully approaching feared situations can also help patients to shift negative beliefs about themselves by promoting a sense of mastery and courage. Indeed, a greater reduction in thoughts of incompetence and the level of danger in the world has been associated with a greater reduction in PTSD symptoms [49].

Several studies have demonstrated the efficacy of *in vivo* exposure in the treatment of PTSD. A crossover study by Richards, Lovell and Marks evaluated the relative contributions of *in vivo* exposure and imaginal exposure and found that phobic avoidance was significantly reduced after four 60-min sessions of *in vivo* exposure plus homework [50]. A randomized controlled study of *in vivo* exposure with and without cognitive restructuring (CR) found significant improvement among those assigned to a five-session *in vivo* exposure protocol compared with those assigned to a relaxation condition [42]. Both exposure alone and CR alone were superior to relaxation; there was no additional benefit for combining exposure and CR. Most recently, a randomized study among earthquake survivors showed that a single session of self-directed *in vivo* exposure lead to significant reductions in PTSD symptoms compared with a waiting-list control [51].

Key component: imaginal exposure

As noted earlier, in imaginal exposure the patient imagines himself or herself reliving the traumatic experience. The imaginal scene typically includes a detailed description of the traumatic event, including the associated thoughts, feelings and physical sensations. Revisiting the traumatic experience helps the patient to emotionally process and organize his or her traumatic memory. After providing a thorough rationale for the use of imaginal exposure in ameliorating PTSD symptoms, the clinician instructs the patient to close his or her eyes and describe out loud what happened during the trauma, while visualizing the event as vividly as possible. In order to facilitate emotional engagement, the patient may be asked to use the present tense when describing the thoughts, emotions and sensory experiences that occurred during the traumatic event. Imaginal exposure is continued for a prolonged period (usually 30–45 min) and includes multiple repetitions of the memory if necessary. Once begun, imaginal exposure is typically conducted in each subsequent treatment session, as well as between sessions as homework by listening to an audio recording of the imaginal exposure on a daily basis.

How does imaginal exposure promote recovery from PTSD?

There are several ways in which imaginal exposure is thought to foster therapeutic change in PTSD. First, like *in vivo* exposure, imaginal exposure promotes extinction of conditioned fear reactions (i.e., habituation), thus reducing anxiety previously associated with the trauma memory and correcting the patient's erroneous belief that anxiety will persist indefinitely in the absence of avoidance or escape. Patients learn that they can tolerate their distress and that having anxiety does not result in 'going crazy' or 'losing control'. This corrective learning alters negative perceptions regarding lacking self-efficacy and self-control. Second, the process of deliberately approaching the trauma memory prevents negative reinforcement of avoidance strategies. Avoidance of trauma memories and related reminders leads to an immediate decrease in distress. Although temporary, this decrease in distress reinforces the avoidance behaviors that maintain PTSD. Thus, by approaching, rather than avoiding, the trauma memory, imaginal exposure removes the primary barrier to emotional processing. Third, repeated imaginal reliving of the trauma promotes differentiation between remembering the trauma and being retraumatized. Patients with PTSD often report that thinking about the trauma makes them feel as if it is happening to them again at that moment. Through repeated revisiting of the trauma in a safe, therapeutic environment, imaginal exposure helps to strengthen the discrimination between cognitive representations of threat (e.g., memories of the trauma) and actual threat. Fourth, repeated revisiting of the trauma memory helps patients to organize the traumatic memory into a more coherent narrative, which is associated with symptom improvement [52]. Fifth, imaginal exposure promotes differentiation between the traumatic experience and similar stimuli that have become associated with trauma. This differentiation helps patients to view the trauma as a specific

occurrence, thereby disconfirming the perception that the world is entirely dangerous and the perception that they are unable to cope with stress (being incompetent).

A number of studies have demonstrated the efficacy of imaginal exposure without *in vivo* exposure in the treatment of PTSD. For example, there are several studies that found imaginal exposure to be effective among male Vietnam veterans with PTSD [53–55] mixed-trauma civilians [56–58], and refugees and survivors of torture [59,60].

Key component: processing

Processing occurs immediately following the imaginal exposure and involves discussing the experience of revisiting the trauma memory, with a focus on new learning and changed beliefs or perspectives. In general, processing is less structured than other components of PE. Following the imaginal exposure, clinicians should first provide positive feedback and acknowledge the patient's courage and willingness to approach painful memories. Having monitored the patient's SUDS ratings periodically (~every 5 min) during the imaginal exposure, clinicians may comment on any habituation that was observed either within or between sessions. Open-ended questions allow patients to express their thoughts and feelings about the imaginal exposure experience, and discuss any insights that seem particularly important or meaningful.

There are two studies that provide indirect evidence for the importance of processing to treatment outcomes. The first is a study by Bryant and colleagues that found that adding CR to exposure therapy led to superior outcomes compared with exposure therapy without CR [61]. The exposure therapy program examined in this study included both *in vivo* and imaginal exposure, but importantly, processing was excluded in order to maximize the distinction between treatment conditions. Unsurprisingly, the effect size of the exposure condition was lower than that typically observed in studies of exposure that include a processing component [36]. In terms of the study aims, the methodology does not provide a true test of the utility of adding CR to the most effective exposure therapy program, although it does demonstrate that adding CR to a diminished version of exposure therapy is beneficial.

The importance of processing was also highlighted in a study by Sloan and Telch that examined *in vivo* exposure with claustrophobic patients with and without 'guided threat reappraisal' [43]. Patients in the guided threat reappraisal condition were instructed to focus on information relevant to the validity of the perceived threat and to verbalize the disconfirmatory information obtained during the exposure. Patients in this condition had significantly better outcomes than patients who were instructed to engage in a demanding cognitive load distraction task during the exposure. This suggests that processing the exposure by articulating the disconfirmation helps patients attend to the lack of feared consequences that occurs during exposure, and facilitates treatment outcome by promoting the elaboration of the corrective learning. Together, these two studies reinforce the importance of processing imaginal exposure in the treatment of PTSD.

How does processing promote recovery from PTSD?

Processing the imaginal exposure allows patients to articulate and integrate new information and insights into their memory. By explicitly focusing on details that are central to the erroneous cognitions that are maintaining the patient's PTSD, processing helps patients to recognize unrealistic thoughts and beliefs, thereby promoting a more realistic perspective. Indeed, the study by Sloan and Telch suggests that procedures that help patients attend to the information that disconfirms their erroneous beliefs facilitate treatment outcome [43]. Attending to patterns observed in the patient's SUDS ratings, either within or between sessions, encourages the patient to consider the meaning of habituation and adjust their beliefs about the consequences of approaching feared stimuli. Highlighting the patient's courage and ability to approach the traumatic memory and remain emotionally engaged during the revisiting helps to enhance the patient's sense of self-control and personal competence. In summary, processing is an integral component of PE because it helps to foster the elaboration and consolidation of the new learning that occurs during imaginal exposure.

Evidence-based interventions for PTSD

Almost all evidence-based psychological interventions for PTSD involve some discussion of, or exposure to, trauma-related stimuli [62]. Cognitive–behavioral therapy (CBT) refers to a set of treatment approaches that includes exposure techniques, as well as CR and anxiety management. As a family of treatment approaches, CBT has been deemed the treatment approach of choice in clinical practice guidelines for PTSD [63,64,201,202]. Specific evidence-based treatments for PTSD include cognitive therapy [42,65], stress inoculation therapy [62,66], relaxation [42,67], eye movement desensitization and reprocessing [67,68], and supportive counseling [66,69].

Several specific CBTs for PTSD have received empirical support, including PE, cognitive processing therapy [70], cognitive therapy [65], and stress inoculation therapy [62]. Eye movement desensitization retraining for PTSD has also been evaluated [68]. Of these, PE has been studied most broadly and extensively. We therefore focus on the evidence for the efficacy of PE, but also acknowledge that other CBTs have also demonstrated efficacy for PTSD in a smaller number of studies. Treatments that are comprised of imaginal exposure, but referred to as 'CBT', 'exposure-based' or 'trauma-focused' treatment can be considered variants of the PE program. Thus, for ease of review, these treatments will be discussed together.

Evidence for the efficacy of prolonged exposure

To date, there have been 25 randomized controlled trials indicating that PE is effective in reducing the array of PTSD symptoms [61,71–78]. Exposure therapy is effective for acute and chronic PTSD [64,79] and gains are generally maintained at follow-ups of 1 year or longer [80]. Furthermore, PE has been consistently associated with rapid change and maintenance of large effect sizes over time [67,81].

Studies have demonstrated that PE leads to significantly greater pre- to post-treatment reductions in PTSD symptomology when compared with a waiting-list control [55,62,66,68,81–83], supportive counseling [34,56], relaxation [42,58,67] and treatment as usual [53,54,84,85].

A recent meta-analysis found a large effect size for PE compared with the control condition at post-treatment and at follow-up (Hedges's g = 1.08), but no systematic differences between PE and other active treatments [86]. There are several other meta-analyses that have examined the efficacy of exposure therapy in general, but have not examined PE specifically. For example, a large meta-analysis by Bradley and colleagues found that exposure therapy was far more effective than wait-list control (effect size of comparison: 1.11–1.53) or supportive therapy (effect size of comparison: 0.83–1.01) [87]. Meta-analyses have also found that exposure therapy is associated with lower dropout rates than pharmacotherapy, and that CBT is equally effective as selective serotonin-reuptake inhibitors in the short term [88], although long-term data are sparse. Other meta-analyses focusing on the efficacy of specific treatments for PTSD have shown that exposure therapy is more effective than 'non-trauma-focused' treatments or wait-list/control at reducing PTSD symptoms, but have not found significant differences in outcomes among trauma-focused therapies [89–91].

Do additional intervention techniques increase the efficacy of PE?

Some experts have suggested that treatment programs that include multiple techniques will be more efficacious than any single treatment approach in reducing the wide range of symptoms that characterize PTSD [92]. Accordingly, most evidence-based treatment programs for PTSD include several techniques such as exposure, relaxation, CR and modeling [93]. A number of studies have compared PE with other evidence-based treatments. For example, Foa and colleagues compared PE combined with stress inoculation training (SIT) with PE and SIT alone [62]. Contrary to prediction, all three treatments performed equally well on most measures, although PE alone yielded larger effect sizes on severity of PTSD, depression and anxiety at post-treatment and follow-up.

A similarly designed study comparing PE alone, PE plus CR and wait-list also failed to find significant differences between the active treatments [82]. Furthermore, there is evidence that patients with severe trauma-related cognitions fare slightly worse when treated with PE plus CR than in PE alone. These findings are consistent with previous reports [42,94], and suggest that combining separately efficacious treatments (e.g., PE/CR or PE/SIT) does not enhance treatment outcome for PTSD. An exception to this conclusion is Bryant and colleagues' finding that adding CR to exposure therapy did improve outcome [61]. However, as discussed earlier, the study design precludes conclusions about PE because processing was intentionally excluded from the exposure condition.

Although most studies comparing PE with other evidence-based treatments have failed to find significant differences in treatment outcomes, it should be noted that most have lacked sufficient power to detect the small differences in effect size that would be expected when comparing two effective evidence-based treatments [34]. Thus, although a large body of research supports the efficacy of PE, it is not known whether PE leads to significantly greater improvements than other evidence-based treatments or whether additional treatment techniques may be identified that can augment the therapeutic effects of PE.

Summary of the evidence

The evidence in support of the efficacy of PE is extensive and robust. PE has been supported by the greatest number of studies, in a wide range of trauma populations, across a number of diverse cultures and by multiple research groups. No studies comparing PE with a different treatment have found evidence that another treatment approach is more effective than PE in reducing the symptoms of PTSD. Furthermore, studies examining combination treatments (e.g., PE vs PE plus SIT or CR) have failed to find superiority of the combination treatments.

Thus, there is clearly sufficient scientific evidence to justify the widespread routine use of PE to target PTSD whenever possible. Indeed, the International Society for Traumatic Stress Practice Guidelines specifically recommend the use of PE in the treatment of PTSD [64]. Similarly, the recent comprehensive review and committee report from the Institute of Medicine of the National Academies stated that "the evidence is sufficient to conclude the efficacy of exposure therapies in the treatment of PTSD" [95]. No such statement was made for any other treatment approach. This conclusion is also consistent with practice guidelines published by the American Psychiatric Association [96], and the Departments of Veterans Affairs and Defense [202].

Dissemination of PE

Regrettably, most people who suffer from PTSD do not receive appropriate treatment [4,97]. The stigma of PTSD remains a significant barrier to effective care. Feelings of shame are often associated with PTSD [98] and can serve to discourage treatment seeking [99]. For example, studies among military personnel have found that many are unwilling to seek treatment and believe that admitting to a psychological problem would be highly stigmatizing [100] and could potentially damage their military career [101]. Despite these barriers to seeking treatment, the number of individuals accessing care far exceeds the number of trained clinicians available to meet this need. At present, the availability of professionals who are trained in evidence-based treatments for PTSD is woefully limited [102,103]. Furthermore, several studies have shown that, when given the option, individuals generally prefer exposure therapy over other types of treatment. For example, studies have shown that PE is the preferred treatment over medication (among women exposed to trauma [104] and among women with PTSD [105]), and over other types of psychotherapy such as CBT and eye movement desensitization and reprocessing (in analog samples of undergraduates [106]). Further research examining treatment acceptability in clinical samples is needed to enable a better understanding of the low rates of treatment seeking and to inform dissemination strategies.

Fortunately, there is growing evidence that evidence-based treatments can be effectively disseminated. While much of this research has focused on PE, dissemination studies have also examined other evidence-based treatments. For example, research by Gillespie, Duffy, Hackmann and Clark showed that community therapists who received intensive training in cognitive therapy for PTSD and ongoing supervision were able to effectively administer treatment

in an open trial for PTSD [107]. Similarly, a study by Neuner and colleagues showed that a manualized exposure treatment called narrative exposure therapy could be effectively delivered to refugees in southern Uganda by lay counselors chosen from within the refugee community [108]. While acknowledging these promising results, we focus on the dissemination of PE. Furthermore, a particular emphasis on the dissemination of PE appears to be warranted, given the evidence reviewed previously, which demonstrates the consistency with which PE has been supported.

Recently, both the Department of Defense and the Department of Veterans Affairs (VA) initiated rollouts of two evidence-based treatments for PTSD: PE and cognitive processing therapy [109]. The aim of this program was to provide the VA with permanent capacity to train and supervise their mental health practitioners in the delivery of evidence-based treatments for PTSD in a fully self-sufficient manner, without the need for ongoing outside instruction. In 2009 alone, a total of 968 clinicians were trained to provide PE within the VA system, and an additional 269 were trained outside of the VA in coordination with the VA rollout. Despite these important training initiatives, effective dissemination of exposure therapy for PTSD remains a significant challenge. Exposure therapy is still not widely available or routinely employed outside of specialty clinics and research settings.

Another strategy for increasing the availability of evidence-based treatment is to train community clinicians in the implementation of PE. Research has shown that community-based clinicians can effectively implement PE for PTSD when provided with intensive training and ongoing expert supervision [82]. Although effective, this dissemination strategy is time intensive and limited by the availability of experts to provide extended supervision. An alternative approach is to use a 'train the trainers' model of increasing the number of centers with local expertise that can assist in the training and supervision of new clinicians. For example, following an intensive PE workshop provided by experts, a subgroup of newly trained clinicians is identified to become future trainers and supervisors and to receive weekly supervision by a PE expert for a series of training cases. The future trainers then participate in a second intense PE training workshop before beginning to provide supervision to other clinicians who have completed the basic PE training. Preliminary evaluations suggest that training-based dissemination can be effective, but it is labor intensive and limited by the availability of experts.

Expert commentary

The current wars in Iraq and Afghanistan, the worldwide threat of terrorism and the recent large-scale natural disasters have left millions suffering from PTSD and other post-traumatic disturbances. As a result, trauma and its sequelae have been brought to the fore in the academic community as well as in the media. There is currently an unprecedented level of awareness of PTSD and great recognition of the urgent need to develop and widely disseminate effective prevention and treatment strategies.

Efficacious treatments for PTSD are available, but there is room for further improvement. A significant minority of patients discontinue treatment (20.6% [110]), or remain somewhat symptomatic [62]. One strategy commonly used in clinical practice to enhance efficacy is to extend treatment [82]. Although extending treatment for partial responders appears to be an effective method of enhancing outcomes, this strategy requires increased time and costs. Thus, we need to develop ways of making treatments more effective and efficient.

Furthermore, even optimally efficacious treatments are of limited value if the majority of patients who could benefit from these treatments do not have access to them. Given the enormous public health and societal costs associated with chronic PTSD [17], efficiency of care delivery and the dissemination of evidence-based practices present some of the greatest challenges for the field. The need for widely available evidence-based treatments is more acute in light of the large number of returning military personnel suffering from PTSD. At present, the majority of therapists do not use evidence-based treatments for PTSD, primarily owing to a lack of training.

Widespread dissemination of evidence-based treatments will require substantial commitment from multiple systems (e.g., graduate programs, professional organizations and healthcare delivery systems). Recently, there is evidence that top-down dissemination strategies effectively train large number of mental health professional to deliver evidence-based treatments for PTSD (e.g., VA roll-out). While large-scale training-based dissemination may be effective, it is also costly, labor intensive and limited by the availability of experts. Future research will therefore need to address the relative merits of different dissemination models, including those that take advantage of advances in communication technology. There is a great need to develop a science for dissemination, including evidence-based methodology to develop, implement and maintain evidence-based treatment delivery systems.

Five-year view

In the next 5 years, we expect to witness a growth of rigorous clinical research that will broaden and deepen our understanding of the etiology and treatment of PTSD. This research will advance our theoretical understanding of the psychological and psychobiological mechanisms that underlie the development of PTSD and recovery from trauma. The impact of traumatic stress is now being studied at genetic, neurobiological, cognitive, behavioral and sociocultural levels [111,112]. At the same time, increasingly sophisticated research designs and analytic methods are being developed that will allow us to answer previously unanswerable questions. Integrating these new findings will advance our knowledge of how trauma affects processes within and between these levels of analysis and thereby promote a more comprehensive understanding of PTSD. At the same time, we will continue to see treatment innovations that will allow us to treat PTSD more effectively and efficiently through translational research and increased collaboration between basic and applied clinical research. As the consensus that PE and other evidence-based treatments for PTSD should be the first line of treatment increases, as articulated in practice guidelines, greater research and clinical efforts will be channeled towards establishing methods for effectively disseminating these treatments. This includes identifying strategies to increase and maintain the availability of effective treatment and reducing barriers for therapists in learning and

implementing evidence-based treatment. This research will also inform our understanding of which specific treatment(s) should be targeted for dissemination.

In terms of clinical research, we expect that the growing interest in examining novel strategies to enhance the efficacy and efficiency of evidence-based treatments will continue to expand. We have already seen encouraging results from studies investigating the use of pharmacological agents as adjuncts to exposure therapy. The use of D-cycloserine (DCS) to enhance the mechanisms that underlie exposure therapy has been shown to reduce the number of sessions needed to achieve clinically significant gains in six of eight controlled trials to date (specific phobia [113], social anxiety disorder [25,114], panic disorder [115], obsessive–compulsive disorder [116,117]; however, see specific phobia [118] and obsessive–compulsive disorder [119]), with medium-to-large effect sizes across studies [118]. Unfortunately, no data are currently available on the effects of DCS on exposure therapy for PTSD, although two large-scale trials of DCS augmentation of exposure-based treatment for combat-related PTSD are currently underway. Methylene blue (MB) is another pharmacological agent being tested as an adjunct to exposure therapy for anxiety disorders. The hypothesized mechanism by which MB facilitates therapeutic gains in treatment is conceptually and methodologically different to that of DCS. However, both pharmacological agents are thought to facilitate treatment by promoting memory consolidation of the inhibitory learning that occurs during exposure therapy. Enhancement of PE with MB is currently being investigated in a large-scale randomized controlled trial for PTSD.

We expect to see continued research aimed at developing treatment delivery methods that capitalize on technological advances. For example, one strategy that is currently being examined is the use of virtual reality (VR) to deliver PE. Using realistic virtual recreations of patients' traumatic experiences may enhance outcomes by facilitating activation of the fear (emotional) cognitive structures, which we know to be an important factor for successful emotional processing [120,121]. In addition, VR may be especially beneficial for patients who have persistent difficulty engaging in imaginal exposure. At present, there is some preliminary evidence for the efficacy of delivering PE using VR [122,123], but more research is needed to determine whether VR can ameliorate PTSD symptoms more effectively or efficiently than standard PE. Issues related to the cost–effectiveness of using VR to deliver exposure therapy will also need to be addressed.

Finally, we will also see further development and testing of computer- and internet-based treatments for PTSD. Much of the interest in these novel treatment delivery modalities stems from their potential to increase the cost–effectiveness of treatment and reduce financial and logistical barriers to seeking care. There is encouraging initial support for the efficacy of internet-based exposure treatment of PTSD [124–128], and preliminary evidence suggests that the effects are maintained for up to 1.5 years post-treatment [129].

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Key issues

- A substantial minority of individuals who experience a traumatic event will go on to develop chronic post-traumatic stress disorder (PTSD).
- Based on the tenets of emotional processing theory, prolonged exposure is an evidence-based treatment for PTSD that involves *in vivo* exposure (approaching feared stimuli and situations), imaginal exposure (repeated revisiting of the traumatic memory in imagination) and processing (articulating and elaborating on corrective learning).
- Considerable evidence indicates that several cognitive–behavioral therapies are effective in treating PTSD relative to waiting-list and active control conditions. Of these, prolonged exposure has been supported by the greatest number of studies and is considered a first-line treatment for PTSD.
- Few individuals with PTSD receive evidence-based treatment due to stigma, lack of resources and lack of trained clinicians. More effective treatment dissemination methods are clearly needed.
- Promising new research is now examining novel treatment delivery modalities (e.g., virtual reality, computer- and internet-based treatment programs) and strategies to enhance the mechanisms underlying exposure therapy through adjunctive pharmacology.

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