EXPECTANCY VIOLATION DURING EXPOSURE THERAPY: A RANDOMIZED CONTROLLED TRIAL

Jennifer L. Buchholz

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Approved by:

Jonathan S. Abramowitz

Anna Bardone-Cone

Donald H. Baucom

David L. Penn

Keith Payne

ABSTRACT

Jennifer L. Buchholz: Expectancy Violation During Exposure Therapy: A Randomized Controlled Trial
(Under the direction of Jonathan S. Abramowitz)

Despite empirical support for the efficacy of exposure-based cognitive-behavioral therapy (CBT) for anxiety-related disorders, many individuals do not respond to this intervention or experience a return of fear after treatment. Inhibitory learning theory has informed novel approaches to exposure therapy that aim to improve both short- and long-term outcomes. One exposure optimization strategy is to maximize expectancy violation (i.e., the difference between expected outcomes and actual outcomes), which is thought to strengthen inhibitory (i.e., non-threat) associations and enhance long-term fear extinction. In practice, exposure therapy is often preceded by cognitive restructuring, which is designed to lessen the magnitude of harm expectancies. According to inhibitory learning theory, this technique may restrict the discrepancy between expected outcomes and actual outcomes, thus reducing the potency of exposure therapy and limiting the durability of treatment gains. Although theoretically plausible, this hypothesis had not previously been empirically investigated. Accordingly, the present study examined the effects of the timing of cognitive techniques during exposure-based CBT by randomly assigning 45 participants with spider phobia to one of three intervention conditions: (a) cognitive restructuring before exposure (CR-EXP), (b) exposure before cognitive restructuring (EXP-CR), and (c) stress management (SM) control. No significant outcome differences were detected between CR-EXP and EXP-CR conditions on measures of fear, avoidance, or spider-related cognitions. There were also no group differences in expectancy change, surprise, or treatment

acceptability and adherence. Clinical implications, study limitations, and future directions are discussed regarding the timing of cognitive restructuring in conjunction with exposure therapy.

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LIST OF ABBREVIATIONS

ADIS-5	Anxiety Disorders Interview Schedule for DSM-5
ANOVA	Analysis of variance
BAT	Behavioral Approach Task
CBT	Cognitive-behavioral therapy
CR-EXP	Cognitive restructuring before exposure
EPT	Emotional processing theory
EXP-CR	Exposure before cognitive restructuring
FSQ	Fear of Spiders Questionnaire
ILT	Inhibitory learning theory
PTSD	Posttraumatic stress disorder
SBQ	Spider Phobia Beliefs Questionnaire
SM	Stress management
TAAS	Treatment acceptability and adherence scale

LIST OF SYMBOLS

α	Cronbach's alpha
F	F-statistic
n	Number of cases in subsample
N	Total number of cases
η_p^2	Partial eta squared
t	t-statistic
p	Probability value
r	Pearson correlation coefficient

INTRODUCTION

Anxiety-related disorders have a lifetime prevalence of up to 33.7% and affect nearly 40 million adults in the United States each year (Bandelow & Michaelis, 2015; Kessler et al., 2005). They are associated with significant disability, reduced quality of life, and functional impairment in educational, social, and occupational domains (Rapaport et al., 2005). Despite considerable heterogeneity in symptom presentation, cognitive-behavioral therapy (CBT), which targets unhelpful cognitions (e.g., threat overestimation) and behaviors (e.g., avoidance), is the first-line treatment for anxiety-related disorders (Abramowitz et al., 2019; Arch & Craske, 2009). Meta-analytic findings suggest that exposure therapy, which involves guided, systematic, and repeated engagement with feared stimuli without the use of safety behaviors, reassurance, or compulsive rituals, is an essential element of CBT for anxiety (Kaczkurkin & Foa, 2015). Indeed, evidence from numerous clinical trials supports the transdiagnostic efficacy and effectiveness of exposure therapy (Deacon & Abramowitz, 2004).

Despite strong empirical support for the intervention, however, not everyone who receives exposure-based CBT experiences lasting benefits. Specifically, approximately 15% of individuals who recieve exposure therapy for specific phobia do not experience significant clinical improvement (Wolitzky-Taylor et al., 2008), and as many as 50% of patients show at least partial relapse after a course of treatment (Craske & Mystkowski, 2006). These limitations have motivated researchers and clinicians to identify strategies that maximize both short- and long-term exposure therapy outcomes.

As argued by Abramowitz (2013), knowledge of the principles of fear extinction is central to effective implementation of exposure therapy. Fear extinction refers to a decline in the conditioned anxiety response associated with a fear-eliciting stimulus. Although it is known that repeated confrontation with a fear-eliciting stimulus facilitates the extinction process in both animals and humans (Eelen & Vervliet, 2006), efforts to identify the precise mechanisms that underly fear extinction during exposure therapy are ongoing. Evidence of cognitive, behavioral, and physiological changes that occur during fear extinction can translate to innovative approaches that improve the effectiveness of treatment for anxiety-related disorders (Craske et al., 2008). Two leading theories seek to explain fear extinction during exposure therapy: emotional processing theory and inhibitory learning theory.

Emotional processing theory (EPT; Foa et al., 2006; Foa & Kozak, 1986; Foa & McNally, 1996; Rachman, 1980) was traditionally the prevailing model for explaining the changes that occur during exposure therapy (Abramowitz et al., 2011; Jacoby & Abramowitz, 2016). According to EPT, exposure to a feared stimulus activates a "fear structure" that is contained in memory (e.g., *spiders are dangerous*), and repeated confrontation of that stimulus provides information that is incompatible with the fear structure (e.g., *spiders are generally harmless*). This inconsistent information is thought to become integrated via a process of "corrective learning," in which non-threat associations replace fear-based associations (Foa & Kozak, 1986; Foa et al., 2006; Foa & McNally, 1996). Habituation, or decreased response to a stimulus after repeated activation (Groves & Thompson, 1970), is central to EPT and considered to be indicative of learning during exposure therapy (Foa & Kozak, 1986). Foa and colleagues emphasize the importance of within-session habituation and between-session habituation for long-term learning and the maintenance of exposure therapy gains over time.

EPT and principles of habituation have historically informed the delivery of exposure therapy in several important ways (Jacoby & Abramowitz, 2016). First, when providing the rationale for the intervention, therapists who adhere to principles of EPT explain to patients that repeated exposure leads to fear reduction within each session and between sessions. Patients therefore expect to experience a decrease in fear during each session and anticipate starting each treatment session with less fear than they felt in previous sessions. Second, the duration of an exposure session is determined by evidence of habituation (i.e., exposures are terminated when habituation occurs). Patients therefore continue to confront feared stimuli until the intensity of their initial fear response diminishes considerably (e.g., according to subjective units of distress; SUDS). Third, exposure begins with moderately fear-provoking stimuli and progresses gradually to more intense stimuli (i.e., up an exposure hierarchy). For example, an individual with spider phobia might start by looking at photos of spiders, then watch videos of spiders, and eventually confront a live spider.

Although decades of research on exposure therapy from an EPT perspective points to its effectiveness for many individuals (Abramowitz et al., 2011), the available body of evidence does not provide consistent support for the principles of EPT (Craske et al., 2008; Rupp et al., 2017). Specifically, although fear often declines from the beginning to the end of an exposure trial (e.g., Grayson et al., 1982; Grey et al., 1981), relatively little is known about the extent to which emphasizing habituation during exposure therapy facilitates the long-term retention of treatment gains. Some studies have documented symptom improvement in the absence of habituation (Rachman et al., 1986; Rowe & Craske, 1998; Tsao & Craske, 2000), casting doubt on the assumption that habituation is necessary for effective treatment. Clinically, the emphasis on habituation can have negative consequences (Jacoby & Abramowitz, 2016). For example,

when therapists rely on fear reduction during exposure as an index of treatment effectiveness, they may inadvertently imply that anxiety is dangerous, and that treatment is only successful when anxiety decreases within and between sessions. This is inconsistent with the treatment objective of teaching patients to confront their fears even when they feel anxious (Abramowitz & Arch, 2014).

Another important limitation of EPT is that the theory does not adequately account for spontaneous recovery (i.e., return of fear after a lapse of time since exposure), renewal (i.e., return of fear after a change in context), or reinstatement (i.e., partial return of fear after representation of the feared stimulus, which all may occur even after a successful course of exposure therapy (e.g., Rachman, 1989). Given these theoretical shortcomings of EPT and inconsistent support for its role in exposure therapy, Craske and colleagues (2008) proposed an inhibitory learning framework for understanding the mechanisms of fear extinction.

Inhibitory learning theory (ILT; Lang et al., 1999; Myers & Davis, 2007) posits that fear-based associations (e.g., *if I approach a spider it will attack me*) are not *replaced*, but rather *inhibited,* by newly acquired non-threatening associations (e.g., *when I approached the spider it did not move*). According to ILT, the original association acquired during fear acquisition (i.e., fear-based) remains in memory during fear extinction and competes with new, inhibitory (safety-based) associations when a stimulus is repeatedly presented in the absence of aversive consequences. It follows that after a successful course of exposure therapy, a feared stimulus remains associated with both its original (fear-based) meaning and its newly acquired inhibitory (safety-based) meaning. The presence of this inhibitory pathway is supported by research on the neurobiology of fear extinction (Sotres-Bayon et al., 2006).

The simultaneous existence of both original and inhibitory associations after fear

extinction explains spontaneous recovery, renewal, and reinstatement, because fear associations do not disappear and can therefore re-emerge even without necessarily being re-learned via fear acquisition. For example, an individual who was treated for spider phobia may experience a return of their fear of spiders, even after an apparently successful trial of exposure therapy and without having an adverse experience with a spider following treatment. Craske and colleagues (2008, 2014) explain that inhibitory learning is vulnerable to time and context and conceptualize return of fear as weakened access to inhibitory associations. This phenomenon may occur after the passage of time or if the fear-eliciting stimulus is encountered in a new context (e.g., a spider is found at home rather than at the clinic). Successful extinction, therefore, occurs when new associations are robust enough to consistently inhibit the original associations across time and multiple contexts.

Relative to EPT-based approaches that emphasize habituation during exposure trials, techniques derived from ILT prioritize shifts in harm attributions (i.e., beliefs about the likelihood and severity of an adverse outcome), even if anxiety remains elevated throughout exposure trials. This perspective is supported by research indicating that fear reduction during exposure does not predict the level of fear expressed at follow-up (Baker et al., 2010; Culver et al., 2011; Kircanski et al., 2012). Consequently, the overarching aim of exposure therapy from an inhibitory learning perspective is to help individuals build and strengthen non-threat associations in order to enhance their retrieval during and long after completion of exposure therapy. Put simply, whereas EPT emphasizes fear reduction, ILT emphasizes safety learning.

Return of fear, conceptualized by ILT as weakened access to inhibitory associations, is experienced clinically as treatment non-response or relapse. Accordingly, ILT can inform the development of novel therapeutic techniques that strengthen inhibitory associations, and in turn,

buffer against return of fear and promote the maintenance of treatment gains. Craske and colleagues (2008, 2014) have been at the forefront of these efforts to close the gap between the science of extinction and clinical practice. They specifically highlight *expectancy violation* as an essential process that promotes long-term fear extinction.

Expectancy violation refers to the discrepancy between an individual's anticipated outcome and the actual outcome (Craske et al., 2014). This construct is conceptually important to exposure therapy because research suggests that durable learning occurs when there is a "mismatch" between one's prediction and what actually occurs (Bouton, 2004; Rescorla & Wagner, 1972). For example, an individual may expect a negative outcome in response to a feared stimulus (e.g., *the spider will bite me*). Exposure therapy can be engineered to disconfirm such an expectancy and teach the individual new information (e.g., *the spider walked away from me when I confronted it*). Maximizing the difference between expectation and outcome, according to ILT, strengthens inhibitory associations and enables them to robustly compete with original (fear-based) associations to inhibit the return of fear. Exposure therapy that is designed to optimize expectancy violation is therefore thought to promote successful short- and long-term exposure therapy outcomes.

Despite the conceptual importance of expectancy violation, only a small body of research to date has empirically examined this hypothesized mechanism of exposure therapy. One consistent finding in support of ILT is that expectancy violation occurs during exposure therapy (i.e., fear-based predictions decrease in magnitude over the course of treatment). Findings are mixed, however, with regard to the effect of expectancy violation on therapy outcomes.

To date, one study has found empirical support for the practice of terminating exposure trials when expectancies have significantly changed (as recommended by Craske et al., 2014),

rather than when habituation occurs. Deacon and colleagues (2013) randomly assigned participants with elevated anxiety sensitivity (i.e., fear of anxiety-related physiological sensations) to one of four single-session exposure interventions: (a) three 60-second interoceptive exposure trials (using hyperventilation) separated by rest periods of controlled breathing (i.e., to allow physiological arousal to return to baseline), (b) three 60-second interoceptive exposure trials without rest, (c) "intensive" 60-second interoceptive trials without rest that continued until participants' likelihood ratings of feared consequences (e.g., heart attack) had significantly lessened, or (d) expressive writing (non-exposure control group). Compared to the other three conditions, the intensive interoceptive exposure group had significantly greater reductions in anxiety sensitivity and a behavioral measure of anxiety (i.e., fearful responding to a straw breathing task) at post-treatment. This indicates that exposure therapy that is designed to maximize expectancy violation leads to better outcomes relative to traditionally structured exposure trials.

Although these findings point to the role of expectancy violation in facilitating fear extinction, an important limitation of Deacon and colleagues (2013) is that the intensive group received more trials of exposure than the other groups. Therefore, the relative contributions of expectancy violation and exposure duration remain somewhat unclear. Overall, this study highlighted the potential relevance of expectancy violation to exposure therapy outcome and the need for research paradigms designed to control for the effect of exposure duration and isolate the effects of expectancy violation.

A subsequent study measured expectancy violation as a mechanism of change in exposure therapy for posttraumatic stress disorder (PTSD; De Kleine et al., 2017). Unlike the randomized controlled experimental design implemented by Deacon and colleagues (2013), all

participants in this study received the same brief exposure therapy intervention and reported harm expectancies before and throughout treatment. De Kleine and colleagues found that harm expectancy ratings significantly decreased within and between exposure sessions, underscoring expectancy violation as a process that occurs during exposure therapy. Contrary to ILT-based hypotheses, however, expectancy violation was not significantly related to PTSD symptom change.

It is important to note that this study relied on participants' self-reported expectancies, suggesting that expectancy violation, as measured in this study, reflects explicit shifts in cognition. These cognitive changes do often occur during treatment; indeed, some researchers have characterized exposure therapy as a cognitive intervention that explicitly changes threat overestimations (e.g., Hofmann, 2008). Extinction according to ILT, however, also involves implicit learning processes in which new (safety) associations inhibit old (fear) associations. Accordingly, study designs that experimentally manipulate the presentation of non-threat information are well suited to capture both explicit and implicit expectancy violation.

To date, only one study has employed an experimental design to measure the effect of expectancy violation without relying on explicit, self-reported cognitions. Scheveneels and colleagues (2019) empirically examined the implication of ILT that providing safety information prior to exposure restricts the possible discrepancy between expected outcome and actual outcome, thus attenuating extinction. The researchers employed a fear conditioning paradigm to test this hypothesis in a non-clinical sample. During the fear acquisition phase, all participants were presented with two geometric shapes—one paired with an uncomfortable shock and one paired with the absence of a shock. Immediately after this phase, participants who were randomly assigned to the experimental group were given didactic information about the low

probability of the occurrence of an electric shock during the extinction phase, whereas participants in the control group did not receive this information. No shocks were administered during the extinction phase. The researchers hypothesized that, consistent with ILT, the experimental group would display higher return of fear compared to the control group due to expectancy reduction prior to the extinction phase.

Scheveneels and colleagues (2019) found that providing safety information prior to exposure led to lower expectancies, and the control group experienced a steeper decline in harm expectancies relative to the experimental group (i.e., implying greater expectancy violation in the group that was not given safety information). Contrary to hypotheses, however, participants in the experimental group (i.e., who received safety information prior to extinction) had lower average return of fear, suggesting that receiving information about the low probability of an electric shock actually strengthened the effects of fear extinction.

This study has some important caveats that underscore the need for additional research on ILT. First, while fear conditioning paradigms approximate the real-world experience of fear learning and exposure therapy, there are important differences between laboratory and clinical settings (e.g., symptom heterogeneity and severity, therapist involvement). Moreover, participants in the experimental condition may have perceived the safety information about the low probability of an electric shock as factual, given that the paradigm was presumably programmed by study personnel. This differs considerably from the clinical exposure therapy context, in which the therapist may provide psychoeducation about the low likelihood of a feared outcome (e.g., *most tarantulas are not dangerous to humans*) but does not control the outcome (e.g., the spider's behavior). Thus, although laboratory studies with healthy volunteers are an important first step in understanding the mechanisms of fear acquisition and extinction, studies

with clinical samples and experimental paradigms that maximize ecological validity are warranted.

In practice, therapists often use cognitive restructuring before exposure to lessen the patient's probability overestimations and perceived negative valence of a feared outcome (Abramowitz et al., 2019). Cognitive restructuring involves Socratic questioning (e.g., Froján-Parga et al., 2011), a method of guided discovery in which the therapist asks a series of questions to help the patient identify and challenge maladaptive thoughts and beliefs (Beck & Dozois, 2010; Clark, 2013). This exercise is thought to motivate and prepare patients for the challenging task of facing their fears, and therapists may find that exposures are more palatable when the patient is less convinced of the likelihood of an adverse outcome. When working with individuals with anxiety-related disorders, therapists often ask patients to challenge their fear-based predictions by providing evidence that supports and refutes them, generating alternative possible outcomes, identifying negative attention biases, and considering what they would tell a friend in a similar situation. The explicit goal of cognitive interventions is to help patients identify and correct distorted cognitions to, in turn, reduce their fear prior to confronting a feared stimulus.

Despite the ubiquity of cognitive restructuring as a pre-exposure intervention, ILT and its implications for the critical role of expectancy violation have raised questions about the utility of this technique (Craske et al., 2014; Weisman & Rodebaugh, 2018). Specifically, the premise that extinction learning is enhanced by the discrepancy between expectancy and experience implies that strategies that reduce expectancy prior to exposure (e.g., cognitive techniques) attenuate extinction learning. Counterintuitively, aversive predictions that are strongly held prior to an exposure trial (e.g., *I am 99% positive the spider will kill me*) may promote fear extinction by

leaving a great deal of room for expectancy violation (e.g., *the spider didn't cause any harm*). Cognitive restructuring exercises designed to lessen probability overestimations prior to exposure may therefore weaken inhibitory learning and increase the likelihood of return of fear. Conversely, the use of cognitive restructuring *after* exposure to consolidate learning may potentiate the intervention. Despite the theoretical plausibility of this hypothesis, however, it has not previously been empirically tested.

The current study empirically examined the hypothesis that postponing cognitive restructuring until after exposure enhances immediate and long-term outcomes of exposure therapy for spider phobia, relative to using cognitive restructuring before exposure. Adults with spider phobia were recruited and randomly assigned to one of three one-session intervention conditions: (a) cognitive restructuring before exposure (CR-EXP), (b) exposure before cognitive restructuring (EXP-CR), and (c) stress management (a comparison condition that involves neither exposure nor cognitive restructuring; SM). Immediate and long-term outcomes were assessed via cognitive and behavioral indices of spider phobia.

Exposure processes were also examined and compared across groups. In order to test the theory that postponing cognitive restructuring until after exposure enhances expectancy violation, expectancy ratings were collected before and after the exposure portion of the intervention. Surprise, a conceptually related construct thought to be the affective experience associated with expectancy violation (Craske et al., 2014), was also measured. Given research on learning and memory suggesting that surprise enhances learning and memory retention (e.g., Brod et al., 2018), the feeling of surprise when fear-based predictions are disconfirmed by exposure may amplify fear extinction. Treatment acceptability and adherence were also measured to examine the impact of the timing of cognitive techniques on participants'

perceptions and willingness to engage with the treatment. Building upon previous research, the proposed study aimed to test the following hypotheses regarding the effect of treatment condition on outcomes, expectancy violation, surprise, and treatment acceptability and adherence.

Given the demonstrated efficacy of in-vivo exposure therapy for specific phobia in adults (Choy et al., 2007), it was predicted that the CR-EXP and EXP-CR interventions would result in a greater reduction in spider fear, avoidance, and threat-based cognitions relative to the SM group at both post-treatment and follow-up. Based on implications of ILT, it was also predicted that the EXP-CR group would demonstrate greater reduction in spider fear, avoidance, and threat-based cognitions than the CR-EXP group at post-treatment and follow-up.

It was predicted that change in harm expectancies from pre- to post-exposure would be significantly greater in the EXP-CR group relative to the CR-EXP group. It was also predicted that post-exposure surprise would be rated more highly among individuals in the EXP-CR group relative to the CR-EXP group. Finally, it was predicted that treatment acceptability and adherence would be rated more highly for CR-EXP participants, relative to EXP-CR participants, given the presumed value of cognitive restructuring in preparing individuals to confront feared stimuli.

MATERIAL AND METHODS

Participants

A sample of 51 adults with a DSM-5 diagnosis of specific phobia of spiders participated in this study. The target enrollment was 90 adults; however, recruitment efforts were halted in March 2020 due to the COVID-19 pandemic and associated precautions that precluded in-vivo assessment and treatment sessions. Of note, a previous study of a one-session intervention for spider phobia (Hellström & Öst, 1995) assigned 10-11 participants to each

condition, suggesting a precedent for the limited sample size of the present study (i.e., 15 participants per condition). The majority of participants (82.4%, *n* = 42) identified as female; eight participants identified as male, and one participant identified as gender non-binary. The sample had a mean age of 29.94 years (*SD* = 13.89). Most participants (74.5%, *n* = 38) self-identified as White, 17.6% (*n* = 9) self-identified as Black or African American, 3.9% (*n* = 2) self-identified as Asian, and 3.9% (*n* = 2) self-identified with another racial background. Regarding ethnic background, one participant (2.0%) self-identified as Hispanic/Latinx.

Participants were recruited from the University of North Carolina at Chapel Hill (UNC) and surrounding community. Recruitment methods included flyers, e-mail listserv advertisements, and UNC's Undergraduate Psychology Research Participant Pool. Study advertisements included a brief study description and listed a UNC email address (spiderstudy@unc.edu) for potential participants to express interest in learning more about the study. Participants were screened via telephone by the principal investigator for basic eligibility and willingness to confront a tarantula during the assessment and/or treatment phase. Individuals who met eligibility criteria and confirmed an interest in participating were invited to an in-person appointment to (a) confirm eligibility criteria and (b) provide informed consent before participating in the study. Eligibility criteria included (a) at least 18 years of age, (b) English fluency, and (c) presence of specific phobia of spiders according to DSM-5 diagnostic criteria. Participants were deemed ineligible if they did not meet the above inclusion criteria or (a) were allergic to spiders, (b) were experiencing current psychosis, mania, or substance abuse, or (c) successfully completed 10 of 13 possible steps on a behavioral approach task during the pre-treatment appointment (to ensure that participants were indeed spider phobic at pre-treatment; see primary outcome measures). Regarding incentives, participants who enrolled in the study

during or after February 2020 received $20 compensation for completing the follow-up assessment, which was prorated for individuals who discontinued participation prior to follow-up.

Measures

Anxiety Disorders Interview Schedule for DSM-5 (ADIS-5; Brown & Barlow, 2014). The ADIS-5 is a semi-structured standardized clinical interview that assesses current anxiety-related diagnoses according to DSM-5 criteria. The specific phobia module was administered to all participants during the telephone screening to determine the presence of spider phobia. This module assesses specific symptoms including interference and distress, which are rated separately on a 0 (*none*) to 8 (*very severe*) scale. To be considered eligible to participate, individuals must have endorsed a score of 4 (*moderate fear/sometimes avoids*) on either the interference or distress item, indicating clinically significant fear.

Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995). The FSQ is an 18-item self-report measure of spider phobia. Participants rated their agreement with each statement (e.g., "If I saw a spider now, I would think it will harm me") on a scale of 0 (*totally disagree*) to 7 (*totally agree*), with higher scores indicating greater spider fear. The FSQ has shown high internal consistency, high test-retest reliability, and adequate convergent validity in previous work (Szymanski & O'Donohue 1995), as well as sensitivity to therapeutic change with behavioral therapy (Muris & Merckelbach, 1996). The FSQ was administered at pre-treatment, post-treatment, and follow-up. Internal consistency was excellent in the current sample (α_{Pre} = 0.93, α_{Post} = 0.96, $\alpha_{Follow\text{-}up}$ = 0.97).

Tarantula Behavioral Approach Task (Tarantula BAT; Blakey et al., 2018). A Tarantula BAT (see Appendix B) served as the behavioral outcome variable in this study. The

BAT includes 13 rank-ordered steps ranging from "stand at the opposite end of a room containing a tarantula enclosed in a covered terrarium" to "allow tarantula to crawl up your arm." Participant must have performed a BAT step for 5 full seconds for the step to count as completed. The highest step completed for each participant was recorded at pre-treatment, post-treatment, and follow-up. As noted previously, participants who reached the 10^{th} BAT step at pre-treatment (i.e., touched the spider) were excluded from participation.

Spider Phobia Beliefs Questionnaire (SBQ; Arntz et al., 1993). The SBQ comprises 48 items measuring dysfunctional beliefs (e.g., "When there is a spider in my vicinity, I believe that the spider is deadly") on visual analogue scales from 0 (not at all) to 100 (completely). Higher scores correspond to greater spider fear and/or unrealistic beliefs. The SBQ was administered at pre-treatment, post-treatment, and follow-up. Internal consistency was excellent in the current sample ($\alpha_{Pre} = 0.97$, $\alpha_{Post} = 0.98$, $\alpha_{Follow\text{-}up} = 0.98$).

Harm Expectancy. Immediately prior to beginning the exposure and immediately following the exposure, participants in the CR-EXP and EXP-CR groups were asked to verbally report how strongly they believed that their idiographic negative harm prediction (i.e., their primary phobic belief) would occur, using a scale of 0 (*0% certain it will occur*) to 100 (*100% certain it will occur*). Pre-exposure and post-exposure expectancy ratings were recorded by study therapists.

Surprise. Immediately after completing the in-vivo exposure, participants in the CR-EXP and EXP-CR groups were asked the following three questions: 1. You said that you were most afraid that _____ would happen during the exposure. How surprised were you by what actually happened? (0-100%). 2. You said that you thought you could manage your feelings at ___ out of 10. How surprised were you by how you actually managed them? (0-100%). 3. You

said that you thought you could only manage this exposure for ____ minutes. How surprised were you by how long you actually confronted the spider? (0-100%). Responses were recorded by study therapists.

Treatment Acceptability and Adherence Scale (TAAS; Milosevic, Levy, Alcolado, & Radomsky, 2015). The TAAS is a 10-item self-report measure of treatment acceptability and adherence. Participants rate each statement (e.g., "If I participated in this treatment, I would be able to adhere to its requirements") on a 1 (*disagree strongly*) to 7 (*agree strongly*) scale. Six items are reverse-scored such that possible total scores range from 10 to 70, with higher scores indicating greater treatment acceptability and adherence. The TAAS was administered at the post-treatment assessment. Although the TAAS has exhibited sound psychometric properties in both clinical and non-clinical samples (Milosevic, Levy, Alcolado, & Radomsky, 2015), internal consistency was questionable in the current sample ($\alpha = 0.66$).

Demographics Form. Participants completed a basic demographics questionnaire at the pre-treatment appointment, in which they self-disclosed their gender identity, age, race, and ethnicity.

Procedure

Treatment setting and providers. Data were collected in the Anxiety and Stress Disorders Laboratory at UNC between January 2018 and April 2020. Four clinical psychology graduate students served as therapists on this study. All therapists were trained on the three treatment protocols by the principal investigator. All treatment sessions were recorded for supervision and therapists received feedback from the principal investigator after every session. The principal investigator was supervised by a licensed clinical psychologist with expertise in exposure therapy for anxiety-related disorders. This clinical trial was approved by the

university's Institutional Review Board and was registered at http://www.clinicaltrials.gov (NCT03410264).

Phobic stimuli. Two docile, non-poisonous tarantulas were used in this study. All participants interacted with a tarantula during the pre-treatment, post-treatment, and follow-up assessments, and a tarantula was used for the exposure intervention for participants in the CR-EXP and EXP-CR groups. Tarantulas were housed in separate terrariums, which were hidden from view when not in use.

There are several factors that supported testing study hypotheses in the context of spider phobia. First, spider phobia is common relative to other anxiety-related disorders (e.g., Oosterink et al., 2009). Second, findings from this study are qualitatively comparable to previous inhibitory learning research using spiders as exposure stimuli (e.g., Blakey et al., 2018; Shiban et al., 2015). Finally, although many manualized anxiety treatments recommend more than three exposure sessions (e.g., Abramowitz et al., 2019; Barlow, 2007), the efficacy of one session of exposure therapy for specific phobia has been established (Zlomke & Davis, 2008). Therefore, the one-session intervention employed in the current study maximized ecological validity as it was conducted in the context of spider phobia.

Study timeline. The proposed study involved two study appointments, totaling approximately 141 minutes: (1) a 30-minute in-person pre-treatment assessment, followed by a 60-minute treatment session, followed by a 15-minute post-treatment assessment, and (2) a 36-minute follow-up assessment appointment one month later. The study participant flow and assessment schedule are presented in Figure 1 and Table 1, respectively.

Pre-treatment procedures. Participants initiated contact with the principal investigator via email as described previously to schedule an initial phone screening. Participants that

appeared eligible after the phone screen were scheduled for an in-person appointment. Participants were given a detailed description of the study by a trained undergraduate research assistant and provided informed consent. Consenting participants completed the demographics form, FSQ, and SBQ via Qualtrics, a secure online survey development tool, with the tarantulas stored out of sight. After completing the self-report measures, participants participated in the Tarantula BAT. The hypothesis- and condition-blind assessor presented a 13-item list of tasks involving the tarantula that each participant was asked to complete. Participants were told that although they would be asked to complete progressively more difficult tasks, they could refuse any task and discontinue the BAT at any time. Participants who completed more than 10 of the 13 BAT steps at pre-treatment were excluded from participating in the rest of the study. The highest BAT step completed was recorded as the pre-treatment BAT Steps value. After all pre-treatment procedures were completed, the participant met their therapist for the initiation of the treatment session.

Treatment procedures. All 45 eligible participants received one 60-minute intervention session. Figure 2 displays the CONSORT participant flow diagram. All participants who were randomized to a treatment condition completed the one-session intervention (CR-EXP $n = 15$; EXP-CR $n = 15$; SM $n = 15$). Five participants were lost to follow-up—two in the EXP-CR group and three in the SM group. The five participants who were lost to follow-up did not significantly differ from the study completers on any baseline measure (all ps $> .05$).

Following introductions and a brief rapport-building conversation, the therapist provided an explanation of the cognitive-behavioral model of spider phobia (Abramowitz, Whiteside, & Deacon, 2019). The therapist emphasized maladaptive thought processes and behavioral patterns, as well as illustrated the ways in which avoidance and safety behaviors interfere with

overcoming spider phobia. To minimize the effects of psychoeducation on harm expectancies (see Scheveneels et al., 2019), participants were not given any safety information about the (low) objective likelihood of an adverse event occurring in the presence of the spider. After participants reported that they understood the general idea of spider phobia, participants were randomized to one of three treatment conditions: CR-EXP, EXP-CR, or SM.

Consenting participants were randomized by Microsoft Excel's random number generator function (implemented by principal investigator) to one of three study conditions: CR-EXP, EXP-CR, or SM. Study procedures were identical in CR-EXP and EXP-CR condition except for the order of component delivery. The SM intervention did not include cognitive restructuring or exposure components (see "Treatment procedures," below). The therapist alone viewed the allocated study condition by temporarily lifting the concealment specific to the participant after completing the standardized psychoeducation portion of the intervention.

Participants assigned to the CR-EXP condition were told: "Today, we will be using two strategies: thought challenging and exposure, which are designed to help you change the thinking and behaving patterns that contribute to spider phobia." Participants assigned to the EXP-CR condition were told: "Today, we will be using two strategies: exposure and thought challenging, which are designed to help you change the thinking and behaving patterns that contribute to spider phobia." The language used in CR-EXP and EXP-CR treatment rationales to describe cognitive restructuring and exposure interventions were identical but delivered in reverse order. Participants assigned to the SM condition were told: "Today, we will be using stress management skills, which are designed to help you better cope with stressors that contribute to spider phobia."

All participants in CR-EXP and EXP-CR groups received a 15-minute cognitive

restructuring intervention, adapted from Antony and colleagues (1995). The therapist first explained three common "thinking mistakes" that contribute to spider phobia—likelihood overestimation, severity overestimation, and distress tolerance underestimation—and described the process for correcting these mistakes. The therapist then used a thought challenging form to help the participant identify their negative thoughts and interpretations, rate the likelihood and severity of their feared outcomes, and generate predictions about their ability to manage their own distress. The participant next was prompted to challenge their predictions by providing evidence that supports and refutes them, generating alternative possible outcomes, identifying negative attention biases, and considering what they would tell a friend in a similar situation. Finally, the therapist prompted the participant to provide modified ratings about the likelihood of their feared negative outcome, the severity of their feared negative outcome, and their ability to manage their own distress related to the phobic situation.

All individuals in CR-EXP and EXP-CR conditions participated in a 30-minute in-vivo exposure task with the treatment tarantula. The therapist brought the tarantula into the treatment room immediately prior to beginning the exposure. During the exposure, the therapist and participant sat on the floor by the terrarium, and the therapist encouraged the participant to approach, touch, and handle the spider, without forcing the participant to do anything they refused to do. The therapist was trained to be careful not to encourage the participant to change their beliefs during the exposure, ensuring that the exposure component of the intervention did not include explicit cognitive techniques. Instead, the therapist narrated the behaviors of the participant and tarantula and asked the patient to describe how they were feeling (both physiologically and emotionally). Liberal praise and encouragement were provided throughout

the exposure, and the therapist refrained from providing reassurance about the non-threatening nature of the tarantula.

All participants in the SM group participated in a 45-minute discussion of stress management skills, based on Abramowitz (2012). The therapist first asked the participant open-ended questions about general life stress and coping and provided psychoeducation about physical, mental, and behavioral responses to stress. The therapist then shared information about elements of a healthy lifestyle, such as nutrition, exercise, and sleep, and solicited reflections from the participant about their own lifestyle patterns and areas for improvement. Participants were encouraged to ask questions and provide examples throughout the discussion.

In accordance with guidelines published by the Treatment Fidelity Workgroup of the National Institutes of Health Behavior Change Consortium (Bellg et al., 2004), several methodological strategies were used to enhance and monitor the reliability and validity of the study's intervention. Based on the application of these guidelines by Blakey and colleagues (2018), this involved incorporating multiple specific recommendations during study design, therapist training, treatment delivery, and treatment skills enactment (see Appendix A).

In addition, three hypothesis- and condition-blind undergraduate research assistants double-coded 27% (n = 12) of the recorded treatment tapes, in accordance with Lombard and colleagues' (2002) recommendations to evaluate a minimum 10% of treatment units. Session recordings were randomly selected by a random number generator (http://www.random.org), with the condition that an equal number of tapes be coded for each treatment condition. Three different study therapists were represented across coded sessions. Thirteen items assessing general therapeutic skills were derived from the Beck Cognitive Therapy Scale (Young & Beck, 1980). Twenty-four additional items assessing treatment content were derived from the study

treatment manuals. All items were rated on a 0 (*poor*) to 6 (*excellent*) scale, or marked as "not applicable" (i.e., specific component was not delivered). Fidelity coders were trained by the principal investigator. All coders demonstrated 100% simple agreement with nominal items and a difference score of ≤ 1 for continuous ratings compared with the principal investigator's fidelity ratings of three session recordings (one for each condition) before coding tapes independently. Interrater reliability of the current study's fidelity coders was excellent (95.9% of items rated identically; agreement on 702 of 732 coded items). Therapists received ratings of 6 on nearly all items (96.8%; *excellent*).

Fidelity coding also provided evidence for the independence (i.e., absence of "contamination") of each therapy component (e.g., cognitive restructuring and exposure) and confirmed that excessive reassurance was not provided to participants by study therapists. Specifically, for all reviewed sessions (100%; $n = 12$), all coders responded "no" to the items "Did the therapist verbally challenge the participant's beliefs during the exposure?" and "Did the therapist provide excessive reassurance about the safety of the spider?" No elements of cognitive restructuring or exposure were identified in any of the SM session recordings.

Participants completed the FSQ and SBQ at post-treatment with the assessment tarantula out of view. Behavioral data (BAT performance) was obtained as in the pre-treatment assessment with a hypothesis- and condition-blind assessor. The assessor then scheduled the follow-up visit for one month later.

Participants completed the FSQ, SBQ, and Tarantula BAT as in the pre-treatment and post-treatment assessments. They were debriefed, offered referral information, and compensated. Individuals in the SM group were contacted by the principal investigator after completing the follow-up assessment and offered a free, one-hour session of CBT for spider phobia as part of

the UNC Anxiety Clinic (i.e., not as part of study procedures). A side-by-side comparison of assessments and interventions for each treatment condition is presented in Table 4.

Data analytic strategy

Treatment outcome analyses. All 45 eligible participants completed treatment and were included in analyses. In order to examine group differences in spider phobia symptom changes from pre-treatment to post-treatment and follow-up, three separate 3 (condition) x 3 (time) mixed model ANOVAs were conducted with FSQ, BAT, and SBQ scores as individual dependent variables. Planned contrasts were performed to test each individual hypothesis.

Clinically significant improvement. Criteria to identify patients who achieve clinically significant and reliable improvement on the FSQ were based on the methodology suggested by Jacobson and Truax (1991). Specially, we identified the number of participants in each group who achieved (a) post-treatment and follow-up scores within the non-phobic distribution of FSQ and (b) reliable change from pre-treatment to post-treatment and follow-up. Participants who demonstrated both clinically significant and reliable change were considered to be "recovered." In accordance with Ost and colleagues (1998), clinically significant improvement for behavioral approach was defined as a post-treatment cut-off score of 10 or more (i.e., the participant touched the spider), and reliable change was defined as a minimum of two points (i.e., steps) improvement.

Exposure process analyses. A 2 (condition) x 2 (time) repeated measures ANOVA was conducted to examine group differences (CR-EXP and EXP-CR) in expectancy change from pre- to post-exposure, and follow-up independent sample t-tests were conducted to examine mean differences in expectancy change, pre-exposure expectancy ratings, and post-exposure expectancy ratings. Three independent samples t-tests were conducted to examine group

differences (CR-EXP and EXP-CR) on the three self-report measures of surprise. A one-way ANOVA was conducted to examine group differences (CR-EXP, EXP-CR, and SM) in treatment acceptability and adherence.

RESULTS

Effects of Treatment on Spider Phobia Symptom Measures

Fear of spiders (FSQ). Table 2 displays the pre-treatment, post-treatment, and follow-up mean scores on the FSQ by treatment condition. From pre- to post-treatment, FSQ scores decreased by 52% in the CR-EXP group, 51% in the EXP-CR group, and 21% in the SM group. From pre-treatment to follow-up, FSQ scores decreased by 63% in the CR-EXP group, 53% in the EXP-CR group, and 28% in the SM group.

A 3 (condition) x 3 (time) mixed model ANOVA indicated that relative to participants who received SM, participants had significantly larger overall decreases in FSQ scores in the CR-EXP group, $F(2, 75) = 6.76$, $p < .01$, $\eta_p^2 = .15$ and EXP-CR group, $F(2, 75) = 4.58$, $p < .05$, $\eta_p^2 = .12$. There were no significant overall differences, however, between the CR-EXP and EXP-CR groups, $F(2, 75) = 0.37$, $p = .69$, $\eta_p^2 = .01$. Planned contrasts revealed that, relative to the SM group, FSQ scores decreased significantly more from pre- to post-treatment in the CR-EXP group, $t(75) = -3.21$, $p < .01$, and in the EXP-CR group, $t(75) = -2.87$, $p < .01$. Similarly, relative to SM, FSQ scores decreased significantly more from pre-treatment to follow-up in the CR-EXP group, $t(75) = -3.12$, $p < .01$, and in the EXP-CR group, $t(75) = -2.20$, $p < .05$. There were no significant differences in FSQ scores between the CR-EXP and EXP-CR groups from pre- to post-treatment, $t(75) = -0.34$, $p = .74$, or from pre-treatment to follow-up, $t(75) = -0.85$, $p = .40$. Figure 4 provides a graphical depiction of the change in FSQ scores by condition over time.

Behavioral approach (BAT steps). The mean number of BAT steps completed by participants in each group at each assessment point are also displayed in Table 2. From pre- to post-treatment, the number of steps completed increased by 58% in the CR-EXP group, 35% in the EXP-CR group, and 14% in the SM group. From pre-treatment to follow-up, the number of steps completed increased by 67% in the CR-EXP group, 43% in the EXP-CR group, and 29% in the SM group.

A 3 (condition) x 3 (time) mixed model ANOVA indicated that relative to participants who received SM, participants had significantly larger overall increases in BAT steps in the CR-EXP group, $F(2, 76) = 9.35$, $p < .001$, $\eta_p^2 = .20$, and EXP-CR group, $F(2, 76) = 3.81$, $p < .05$., $\eta_p^2 = .09$. There were no significant overall differences, however, between treatment effects of CR-EXP and EXP-CR, $F(2, 76) = 1.25$, $p = .29$, $\eta_p^2 = .03$. Planned contrasts revealed that, relative to the SM group, BAT steps increased significantly more from pre- to post-treatment in the CR-EXP group, $t(76) = 3.98$, $p < .001$, and in the EXP-CR group, $t(76) = 2.62$, $p < .05$. Relative to SM, BAT steps increased significantly more from pre-treatment to follow-up among participants in the CR-EXP group, $t(76) = 3.34$, $p < .05$, though this difference did not reach significance for the EXP-CR group, $t(76) = 1.96$, $p = .05$.

There were no significant differences in BAT steps completed between the CR-EXP and EXP-CR groups from pre- to post-treatment, $t(76) = 1.36$, $p = .18$, or from pre-treatment to follow-up, $t(76) = 1.35$, $p = .18$. Figure 5 provides a graphical depiction of the change in BAT scores by condition over time.

Clinically significant improvement. Table 3 presents the frequencies of participants in each group who achieved clinically significant and reliable change, as well as those who achieved both (i.e., recovery). As can be seen, recovery according to the FSQ was achieved for

two participants in the CR-EXP group (13%), three in the EXP-CR group (20%), and none in the SM group at post-treatment. At follow-up, recovery was achieved for two participants in the CR-EXP group (13%), one in the EXP-CR group (7%), and one in the SM group (7%).

Recovery on the BAT at post-treatment was observed for seven participants in the CR-EXP group (47%), five in the EXP-CR group (33%), and none in the SM group (0%). Recovery at follow-up was observed for eight participants in the CR-EXP group (53%), six in the EXP-CR group (40%), and none in the SM group.

Effects of Treatment on Beliefs About Spiders (SBQ)

Group mean scores on the SBQ at each assessment point are shown in Table 2. From pre- to post-treatment, SBQ scores decreased by 69% in the CR-EXP group, 61% in the EXP-CR group, and 26% in the SM group. From pre-treatment to follow-up, SBQ scores decreased by 66% in the CR-EXP group, 61% in the EXP-CR group, and 31% in the SM group.

A 3 (condition) x 3 (time) mixed model ANOVA indicated that relative to participants who received SM, participants had significantly larger overall decreases in SBQ scores in the CR-EXP group, $F(2, 79) = 9.55$, $p < .001$, $\eta_p^2 = .19$, and EXP-CR group, $F(2, 79) = 4.18$, $p < .05$, $\eta_p^2 = .10$. There were no significant overall differences, however, between treatment effects of CR-EXP and EXP-CR, $F(2, 79) = 1.13$, $p = .33$, $\eta_p^2 = .03$. Planned contrasts revealed that, relative to the SM group, SBQ scores decreased significantly more from pre- to post-treatment in the CR-EXP group, $t(79) = -4.11$, $p < .001$, and in the EXP-CR group, (79) = -2.79, $p < .01$. Relative to SM, SBQ scores decreased significantly more from pre-treatment to follow-up among participants in the CR-EXP group, $t(79) = -3.28$, $p < .01$, although this difference did not reach significance in the EXP-CR group, $t(79) = -1.98$, $p = .05$.

There were no significant differences in SBQ scores between the CR-EXP and EXP-CR groups from pre- to post-treatment, $t(79) = -1.32$, $p = .19$, or from pre-treatment to follow-up, $t(79) = -1.27$, $p = .21$. Figure 6 provides a graphical depiction of the change in SBQ scores by condition over time.

Exposure Process Variables

Expectancy change. Table 4 presents mean harm expectancy ratings at pre- and post-exposure for the CR-EXP and EXP-CR groups. A 2 (condition) x 2 (time) repeated measures ANOVA revealed a significant main effect of time, indicating overall change in harm expectancies (i.e., expectancy violation) from pre-exposure to post-exposure, $F(1, 27) = 19.42$, $p < .001$, $\eta_p^2 = .42$. The time x condition interaction, however, was not significant, $F(1, 27) = .033$, $p = .857$, $\eta_p^2 = .001$.

A follow-up independent samples t-test did not detect a significant mean difference in expectancy change (e.g., difference in perceived likelihood of feared outcome between pre-exposure and post-exposure) between participants in the CR-EXP condition and EXP-CR condition, $t(28) = .036$, $p = .972$. There was also no significant mean difference in pre-exposure expectancy ratings between participants in the CR-EXP condition and EXP-CR condition, $t(28) = -1.89$, $p = .417$. There was, however, a significant mean difference in post-exposure expectancy ratings between participants in the CR-EXP condition and EXP-CR condition, such that the EXP-CR group evidenced greater post-exposure harm expectancies relative to the CR-EXP group, $t(27) = -2.58$, $p < .001$. Figure 6 provides a graphical depiction of the change in harm expectancies.

Surprise. Table 4 also presents the mean post-exposure surprise ratings for the CR-EXP and EXP-CR groups. Independent samples t-tests did not detect any significant differences in

ratings between these groups (all *p*s > .05). The first and second questions (surprise about what happened during the exposure and how well the participant managed their feelings) were significantly correlated with expectancy change (*r*s = .37 and .50, respectively, *p*s < .05), whereas the correlation between the third surprise question (surprise about how long the participant confronted the spider) and expectancy change did not reach statistical significance (*r* = .35, *p* = .06).

Treatment acceptability and adherence (TAAS). Finally, Table 4 shows the group mean scores on the TAAS. A one-way ANOVA was used to examine the effect of treatment condition on TAAS ratings across the three conditions. Results indicated no significant mean differences, $F(2, 41) = 3.17$, $p > .05$, $\eta_p^2 = .13$.

DISCUSSION

As ILT gains recognition as the leading framework for understanding the process of fear extinction during exposure therapy, empirical research is essential to understanding the ways in which theory translates to practice. One hypothesized clinical implication of ILT is that cognitive restructuring may be deleterious when delivered prior to exposure due to its interference with expectancy violation (Craske et al, 2014). This hypothesis is directly relevant to clinical practice, given that many traditional exposure-based CBT protocols for anxiety-related disorders include cognitive restructuring before exposure to lessen the patient's probability overestimation and prepare them for the challenging task of facing their fears (e.g., Barlow, 2014). In order to address this concern clinically, Craske and colleagues (2014) recommended postponing cognitive restructuring until *after* exposure to consolidate inhibitory learning rather than decreasing its potency. Although theoretically sound, this recommendation has not been empirically substantiated with a randomized controlled trial comparing the two approaches—

cognitive restructuring before exposure, and exposure before cognitive restructuring. Accordingly, the current study was designed to examine the effects of the timing of cognitive restructuring on both short- and long-term outcomes of exposure-based CBT for spider phobia.

Our first hypothesis—that CR-EXP and EXP-CR groups would both demonstrate a greater reduction in spider phobia symptoms and cognitions relative to the SM group at post-treatment and follow-up—was supported by several analyses. Self-reported spider fears, as measured by the FSQ, decreased significantly more in both exposure-based CBT groups relative to the SM control group, and this effect was present at both post-treatment and follow-up. Both exposure-based CBT improved by more than 50% on this measure, compared with the SM group that experienced less than a 30% average improvement. These findings are consistent with previous research suggesting that one session of exposure therapy is efficacious for specific phobia and superior to non-exposure control interventions (Zlomke & Davis, 2008).

The effect of treatment condition was also significant for behavioral approach (BAT steps) and spider beliefs (SBQ) at post-treatment, such that the CR-EXP and EXP-CR groups both evidenced greater improvements than the SM group. Findings were mixed for both measures, however, at follow-up. Specifically, changes in behavioral approach and spider beliefs were larger in the CR-EXP group than the SM group, yet the differences between EXP-CR and SM groups were non-significant. Although this may be explained by the smaller relative change in the EXP-CR group, given that the differences trended towards significance ($ps < .06$), it is likely that larger sample sizes would have revealed significant differences. Moreover, visual inspection of the means suggests that the pattern was driven, at least in part, by continued improvement among individuals in the SM group from post-treatment to follow-up across all outcome measures.

Although unexpected, this improvement may have resulted from practice effects of the BAT. The BAT was designed purely as an assessment tool, yet our clinical observations suggested that it served as a brief exposure exercise for some participants. Indeed, for participants in the SM group, the BAT administered during the follow-up assessment was their third interaction with the tarantula, and this repeated confrontation may have led to the unintended side effects of fear reduction, increased approach, and cognitive change. It is also possible that the coping skills and healthy lifestyle suggestions provided in the SM intervention were helpful to participants for managing their spider phobia symptoms.

Our ILT-derived hypothesis—that the EXP-CR group would demonstrate greater changes in spider phobia symptoms and cognitions than the CR-EXP group—was not supported at post-treatment or follow-up. That is, there were no significant differences in the degree of improvement when cognitive restructuring was delivered before or after exposure; the intervention was effective regardless of the timing of cognitive restructuring. Participants in both CR-EXP and EXP-CR groups evidenced considerable improvements in self-report and behavioral measures of spider phobia from pre-treatment to post-treatment. Moreover, although ILT suggests that maximizing expectancy violation inhibits the return of fear, both CR-EXP and EXP-CR groups maintained their fear reduction between post-treatment and follow-up. These data are therefore inconsistent with theoretical work suggesting that the use of cognitive techniques prior to exposure therapy increases vulnerability to return of fear and attenuates treatment outcome.

The strong efficacy of both exposure-based CBT interventions reflects the substantial body of literature supporting the therapeutic value of direct confrontation with feared stimuli. Indeed, the symptom reduction and cognitive change that occurred after just one treatment

session align with previous research on the efficacy of brief interventions for specific phobia (Choy et al., 2007). Our findings are also consistent with those of previous empirical examinations of theoretical models of exposure therapy (e.g., Blakey at al., 2018; Jacoby et al., 2019; Twohig et al., 2018) that suggest that the efficacy of exposure therapy is both difficult to improve upon and difficult to undermine.

Despite the promise of brief interventions for anxiety-related disorders, our analyses of clinically significant and reliable change highlighted the limitations of our one-session intervention. Although both of the active treatment groups performed better than the control (i.e., SM) group, few participants across all conditions achieved recovery (i.e., both clinically significant and reliable change). Of note, recovery rates were higher among participants who received either exposure-based intervention when measured behaviorally rather than by self-report. Given the possibility of self-report bias in the assessment of spider fear, the BAT may have been a more accurate representation of functional improvement. On the other hand, the BAT was administered by a research assistant, and thus subject to social desirability bias. This bias may have also been present among self-report questionnaires, yet likely played a larger role during the BAT because of the direct interaction between the research assistant and participant. The presence of the research assistant may also have provided a sense of safety for participants (see Helbig-Lang & Petermann, 2010). As such, participants' willingness to approach the tarantula in the presence of a research assistant may not have reflected their behavior outside of the laboratory.

Our hypothesis that expectancy violation would be larger in the EXP-CR group relative to the CR-EXP group was also not supported. Consistent with previous research (Deacon et al., 2013; De Kleine et al., 2017; Scheveneels et al., 2019), harm expectancy ratings decreased over

the course of exposure therapy. Contrary to our prediction, however, there was no time x condition interaction. These findings suggest that, inconsistent with the implications of ILT, postponing cognitive restructuring until after exposure does not lead to a larger change in harm expectancies. In other words, it does not appear that using cognitive restructuring before exposure therapy attenuates safety learning.

Further comparison of group expectancy ratings, however, yielded interesting findings. Whereas the mean difference scores were nearly identical between groups, expectancy scores before exposure tended to be lower for participants in the CR-EXP group (who received cognitive restructuring prior to providing ratings) relative to those in the EXP-CR group (who did not). Although this difference did not quite reach statistical significance, the trend suggests that in the CR-EXP group, the cognitive intervention changed beliefs about the likelihood of an adverse event when confronting the spider. Rather than restricting the magnitude of expectancy violation as suggested by ILT, however, the cognitive intervention appeared to *promote* lower expectancy ratings at the end of exposure. That is, although the magnitude of change was comparable between groups, negative expectancies after exposure were rated lower when cognitive restructuring was delivered before exposure. Future research with larger samples and larger doses of exposure therapy (e.g., three sessions; Blakey et al., 2018) is needed to confirm the stability of these findings.

Our hypothesis that surprise would be optimized when cognitive restructuring was delayed until after exposure was also not supported. The absence of group differences in ratings of surprise parallels our findings regarding expectancy violation, given that surprise and expectancy violation are theorized to be closely related (Craske et al., 2014). Our results also

support self-reported surprise as a viable correlate of expectancy violation, as we found moderate to large correlations between all three surprise questions and expectancy violation.

Taken together, our findings regarding expectancy violation and surprise challenge the premise that these processes can be manipulated by the timing of cognitive restructuring during exposure-based CBT. Expectancies changed over the course of the intervention, and participants reported feeling surprised by what happened, how well they managed their emotions, and for how long they confronted the spider. The magnitude of these changes did not, however, differ by treatment condition. This indicates that exposure itself is enough to substantially shift beliefs about threat, regardless of the individual's beliefs prior to confronting feared stimuli.

We also found, contrary to hypotheses, that treatment acceptability and adherence ratings were not significantly different between CR-EXP and EXP-CR participants. This finding challenges the presumed value of cognitive restructuring in preparing individuals to confront feared stimuli. Although the use of cognitive techniques before exposure therapy is common practice among clinicians, our data suggest that this intervention is unnecessary as a preparatory measure to promote treatment acceptability and adherence. Our findings parallel research suggesting that preparatory treatments for trauma-focused, evidence-based psychotherapies do not enhance treatment outcomes or engagement. For example, a recent study (Dedert et al., 2020) found that "preparatory interventions" that included cognitive restructuring skills did not improve completion rates of cognitive processing therapy or prolonged exposure therapy for PTSD. It may be the case that therapist assumptions and reservations about exposure (e.g., Meyer et al., 2014), rather than empirical evidence about predictors of treatment acceptability and adherence, have been driving the use of cognitive techniques prior to introducing feared stimuli. Interestingly, there were also no differences in treatment acceptability and adherence

ratings between CBT-based exposure groups and the SM control group. This suggests that despite the discomfort of confronting a live tarantula, participants did not find exposure-based CBT to be less acceptable than the SM intervention. Caution is recommended when interpreting these findings, however, due to the questionable internal consistency of the TAAS in the current sample.

The present study had several strengths that constitute novel contributions to the existing literature on ILT-based approaches for the treatment of anxiety-related disorders. This randomized controlled trial was the first to test the effects of the timing of cognitive restructuring in a clinical sample of individuals with spider phobia. The inclusion of an active comparison group enhanced the rigor of the study, and multi-modal assessment procedures at pre-treatment, post-treatment, and one-month follow-up captured both immediate and long-term effects of each intervention. Moreover, expectancy violation was examined via both experimental manipulation (i.e., by measuring the effect of treatment condition) and subjective expectancy and surprise ratings. This extends the work of researchers who collected self-report expectancy ratings (e.g., De Kleine et al., 2017; Deacon et al., 2013; Scheveneels et al., 2019) yet did not utilize an experimental manipulation or measure surprise. Although researchers have referred to expectancy violation and surprise as interchangeable constructs (e.g., Abramowitz & Arch, 2014; Craske et al., 2014), the degree of surprise after exposure had not previously been examined as a therapy process variable. The design of this trial maximized both internal and ecological validity, which resulted in findings that are both scientifically sound and directly applicable to clinical practice.

At the same time, findings from this study should be considered within the context of several limitations. First, the relatively small sample sizes in each treatment condition may have

limited our power to detect statistically significant differences, particularly given the efficacy of both exposure-based CBT conditions relative to SM. Future research would benefit from larger samples to test ILT-based hypotheses. Second, our sample lacked diversity with respect to demographic variables (e.g., race, ethnicity, gender). Participants who identified as Black or African American, Asian, and/or Hispanic/Latinx were underrepresented, perpetuating the problem of inequity and exclusion in anxiety-related disorders research. Given the underrepresentation of individuals with these identities in clinical trials and evidence-based treatment programs (e.g., Williams, Beckmann-Mendez, & Turkheimer, 2013; Chavira et al., 2014; Ching & Williams, 2019), it is imperative that future trials implement evidence-based strategies (e.g., Williams, Beckmann-Mendez, & Turkheimer) to recruit diverse samples.

Third, the specific contexts of the present study may have limited the generalizability of findings. Hypotheses were tested in the context of spider phobia, and findings may not translate to other specific phobias or anxiety-related disorders. In addition, all study therapists received comprehensive training in all three treatment conditions and referred to detailed manuals while delivering treatment. These circumstances do not reflect the heterogeneity of outpatient hospital programs and community clinics. Moreover, all therapists participated in experiential training to become accustomed to the study tarantulas, with the goal of handling the tarantulas without observable avoidance or fear responses. Research suggests that this is a feasible way to prepare therapists to deliver effective exposure therapy (Frank et al., 2020), yet is not a typical intervention for clinicians who treat anxiety-related disorders. Taken together, the therapists who delivered treatment for the present study are unlikely to be a representative sample of mental health providers in the community.

Fourth, although several outcome and process variables implicated in ILT were assessed at multiple time points, there are many important factors that were not measured as part of the current study. For example, it remains unknown how participants spent their time between post-treatment and follow up. Given the importance of exposure to feared stimuli outside of the treatment session (Huppert, Roth Ledley, & Foa, 2006), the degree to which participants continued confronting spider-related content after leaving the laboratory likely affected the maintenance of their gains over the one-month follow-up period. Further, although surprise and expectancy change were not different between CR-EXP and EXP-CR conditions, there may have been unexamined processes that differed between conditions and would have offered insight into the nuances of fear extinction.

Relatedly, the present study did not capture individual-level factors that may predict better adherence and treatment response to one approach relative to another. This area of research is critical for understanding how to improve outcomes for individuals who do not experience symptom reduction after a course of exposure therapy (Wolitzky-Taylor et al., 2008) or show partial to full relapse after treatment (Craske & Mystkowski, 2006). It is important to note that the present study tested only one implication of ILT, rather than comparing ILT-based exposure therapy to an EPT-based approach. As such, our findings do not undermine the ILT as a whole, but rather call into question the clinical utility of delaying cognitive restructuring to maximize expectancy violation.

One final consideration is our use of self-report ratings of harm expectancies and surprise, which may not adequately map on to the neurobiological processes involved with inhibitory learning. Future research that includes physiological measures of emotional arousal may help capture the complexities of this construct. For example, a recent study (Willems &

Vervliet, 2021) correlated skin conductance with expectancy violation, establishing a link between the electrodermal response and this process. Facial action coding has proven useful in detecting surprise in research participants (e.g., Noordewier & van Dijk, 2019), and fundamental frequency of voice that has been examined in couple therapy research (e.g., Weusthoff, Baucom, & Hahlweg, 2013) may be an informative exposure therapy process variable in future studies. Importantly, surprise may function differently when it is experienced as "good news" rather than "bad news." In the present study, the experience of learning that the spider is safer than expected may be more accurately described as *relief*, rather than surprise. Indeed, some researchers have conceptualized relief as an emotion triggered by the absence of an expected or experienced negative stimulus (e.g., Deutsch et al., 2015), which was likely the process that occurred for participants in the present study. Future research that measures both surprise and relief would provide a more comprehensive picture of the affective experiences associated with inhibitory learning.

In summary, we did not observe the hypothesized benefits of postponing cognitive restructuring until after exposure for either short- or long-term treatment outcomes for spider phobia. Results from this study point to the efficacy of brief, exposure-based CBT interventions for specific phobia, which does not appear to be contingent upon ILT-informed treatment delivery. Additionally, our findings did not support enhanced expectancy violation or surprise when manipulating the order of treatment components, nor did the timing of cognitive restructuring impact treatment acceptability or adherence. Extending these findings to clinical practice, therapists may not need to be concerned with the order of treatment components when delivering CBT for specific phobia.

Table 1

Assessment Schedule.

Measure	Phone Screen	Pre-treatment	Before Exposure (for CR-EXP and EXP-CR)	After Exposure (for CR-EXP and EXP-CR)	Post-treatment	Follow-Up
ADIS-5 specific phobia module	X					
Demographics		X				
BAT		X			X	X
FSQ		X			X	X
SBQ		X			X	X
Negative expectancy			X	X		
Surprise				X		
TAAS					X	X

Table 2

Descriptive Data for Primary Outcome Variables.

	CR-EXP (n = 15)			EXP-CR (n = 15)			SM (n = 15)		
	M	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range
FSQ									
Pre-treatment	84.21	25.15	32-110	79.93	25.09	29-115	91.47	21.44	31-125
Post-treatment	42.79	27.64	3-94	41.14	26.01	10-93	74.80	25.79	11-104
Follow-up	37.07	37.07	2-101	34.62	20.64	2-85	63.67	29.49	14-116
BAT steps									
Pre-treatment	6.87	1.77	4-9	7.60	1.50	5-10	6.33	2.29	1-9
Post-treatment	10.27	2.43	5-13	10.13	2.32	8-13	7.20	2.57	1-9
Follow-up	10.64	2.44	6-13	10.42	2.15	7-13	8.27	1.74	4-11
SBQ									
Pre-treatment	3005.47	1432.75	593-6082	2648.27	1370.27	419-5738	2836.40	1160.60	509-4720
Post-treatment	915.07	708.81	58-2468	1033.40	1148.72	90-4593	2225.13	1220.40	89-4749
Follow-up	1044.33	828.42	35-2870	1147.69	1242.45	193-4496	1916.08	1549.05	51-4795

Note. BAT = Behavioral Approach Test; FSQ = Fear of Spiders Questionnaire; SBQ = Spider Phobia Beliefs Questionnaire; CR-EXP = Cognitive restructuring before exposure condition; EXP-CR = Exposure before cognitive restructuring condition; SM = Stress management control condition.

Table 3

Clinically Significant Change, Reliable Change, and Recovery.

	Clinically Significant Change (Post)	Clinically Significant Change (Follow-Up)	Reliable Change (Post)	Reliable Change (Follow-Up)	Recovery (Post)	Recovery (Follow-Up)
FSQ						
CR-EXP	4 (27%)	5 (33%)	7 (47%)	8 (53%)	2 (13%)	2 (13%)
EXP-CR	4 (27%)	3 (20%)	5 (33%)	6 (40%)	3 (20%)	1 (7%)
SM	1 (7%)	2 (13%)	1 (7%)	3 (20%)	0 (0%)	1 (7%)
BAT						
CR-EXP	8 (53%)	8 (53%)	10 (67%)	13 (87%)	7 (47%)	8 (53%)
EXP-CR	6 (40%)	6 (40%)	10 (67%)	9 (60%)	5 (33%)	6 (40%)
SM	0 (0%)	1 (7%)	5 (33%)	6 (40%)	0 (0%)	0 (0%)

Note. BAT = Behavioral Approach Test; FSQ = Fear of Spiders Questionnaire; SBQ = Spider Phobia Beliefs Questionnaire; CR-EXP = Cognitive restructuring before exposure condition; EXP-CR = Exposure before cognitive restructuring condition; SM = Stress management control condition. Recovered = demonstrated both clinically significant and reliable change.

Table 4

Descriptive Data at Pre-Exposure and Post-Exposure.

	CR-EXP (n = 15)			EXP-CR (n = 15)		
	M	*SD*	Range	*M*	*SD*	Range
Pre-exposure expectancy rating	28.60	24.15	0-70	47.33	29.87	0-95
Post-exposure expectancy rating	4.36	8.25	0-30	23.20	26.13	0-80
Expectancy Change	24.53	21.61	0-70	24.13	37.40	-60-85
Surprise Ratings						
Question 1	62.00	36.88	0-100	60.00	31.57	0-100
Question 2	72.67	31.67	0-100	69.60	35.52	0-100
Question 3	81.33	30.21	0-100	89.00	16.17	50-100
TAAS	59.00	6.21	47-70	58.27	6.46	47-69

Note. Expectancy Change = Pre-exposure expectancy rating - Post-exposure expectancy rating; TAAS = Treatment Acceptability and Adherence Scale; CR-EXP = Cognitive restructuring before exposure condition; EXP-CR = Exposure before cognitive restructuring condition

Figure 1

Participant Flow.

<table>
<tr><th>Appt. #</th><th>Duration</th><th colspan="3">Study phase</th></tr>
<tr><td>-</td><td>15 min</td><td colspan="3">Principal investigator conducted telephone screen to assess initial eligibility</td></tr>
<tr><td rowspan="5">1</td><td>30 min</td><td colspan="3">In-person informed consent and pre-treatment assessment</td></tr>
<tr><td rowspan="3">60 min</td><td colspan="3">Psychoeducation</td></tr>
<tr><td colspan="3">Randomization</td></tr>
<tr><td>CR-EXP
rationale (n = 15)</td><td>EXP-CR
rationale (n = 15)</td><td>SM
rationale (n = 15)</td></tr>
<tr><td>Cognitive Restructuring (15 min)
Exposure Therapy (30 min)</td><td>Exposure Therapy (30 min)
Cognitive Restructuring (15 min)</td><td>Stress Management Skills (45 min total)
Stress Management Skills (45 min total)</td></tr>
<tr><td>15 min</td><td colspan="3">Post-treatment assessment</td></tr>
<tr><td>2</td><td>36 min</td><td colspan="3">Follow-up assessment
Debriefing
Compensation</td></tr>
</table>

Figure 2

CONSORT Flow Diagram.

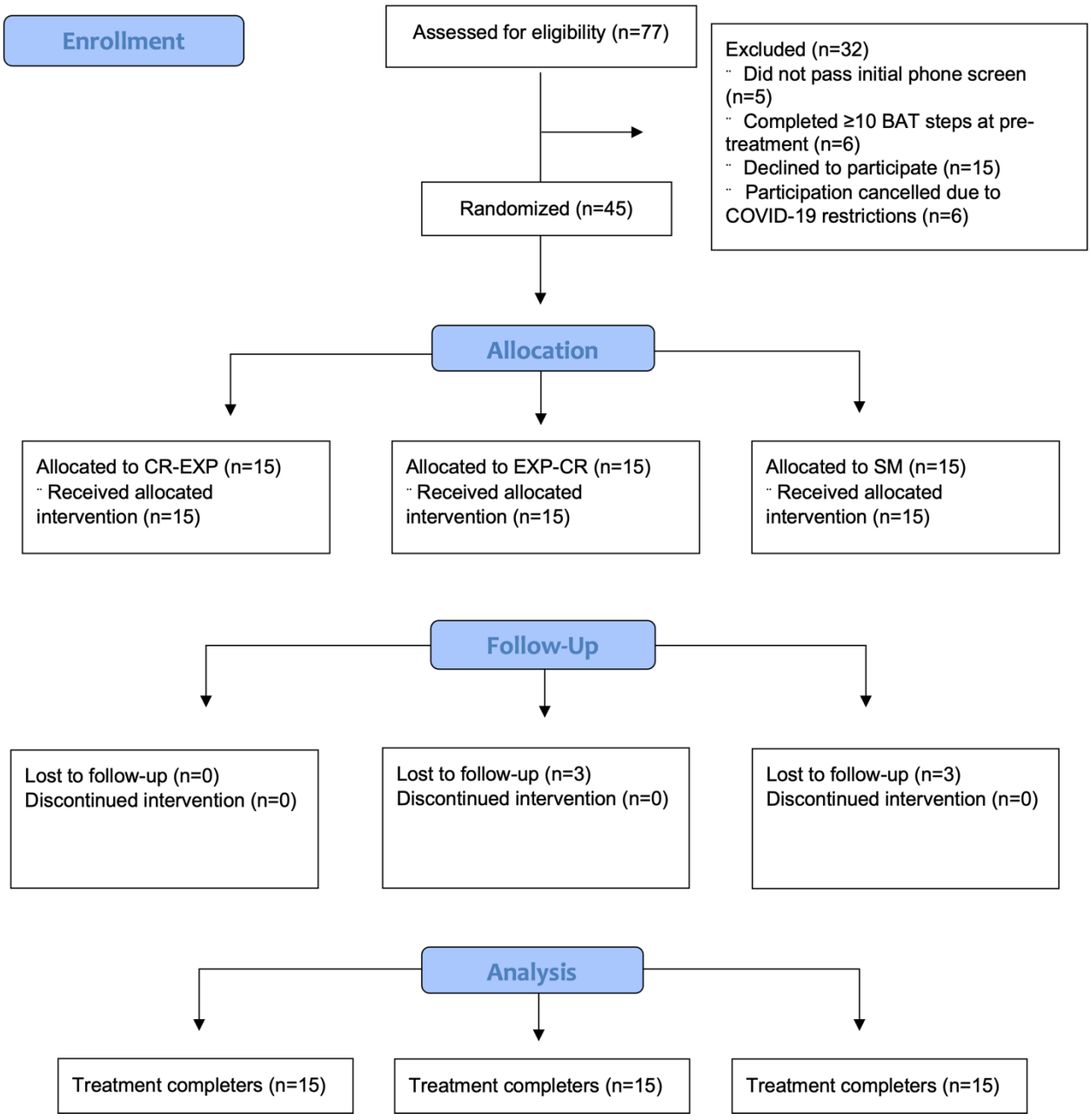


Figure 3

Study Procedures Across Conditions.

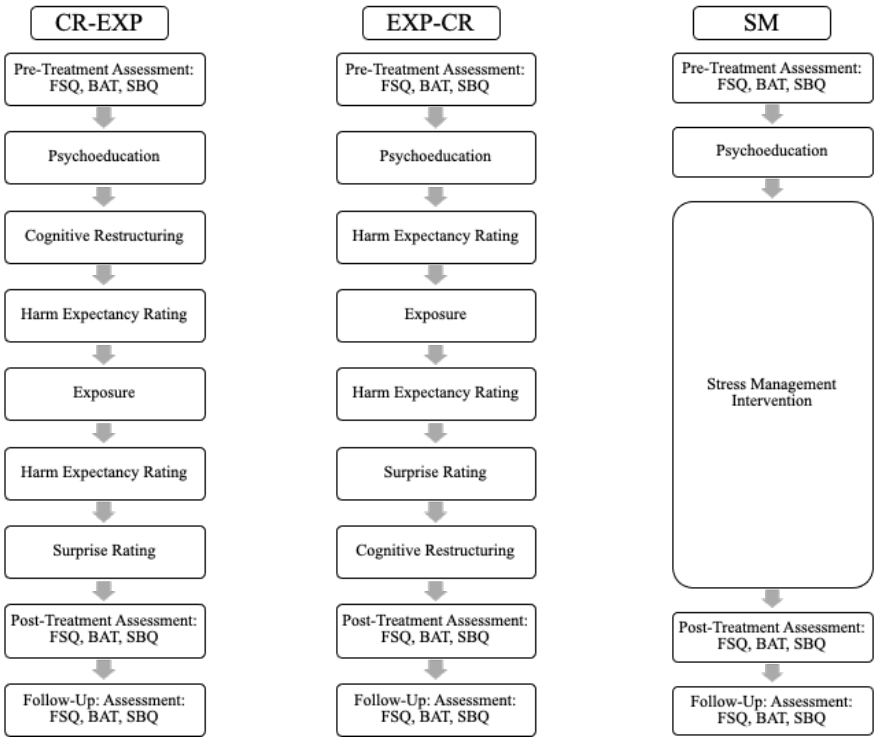


Figure 4

Mean FSQ Scores by Group at Pre-Treatment, Post-Treatment, and Follow-Up.

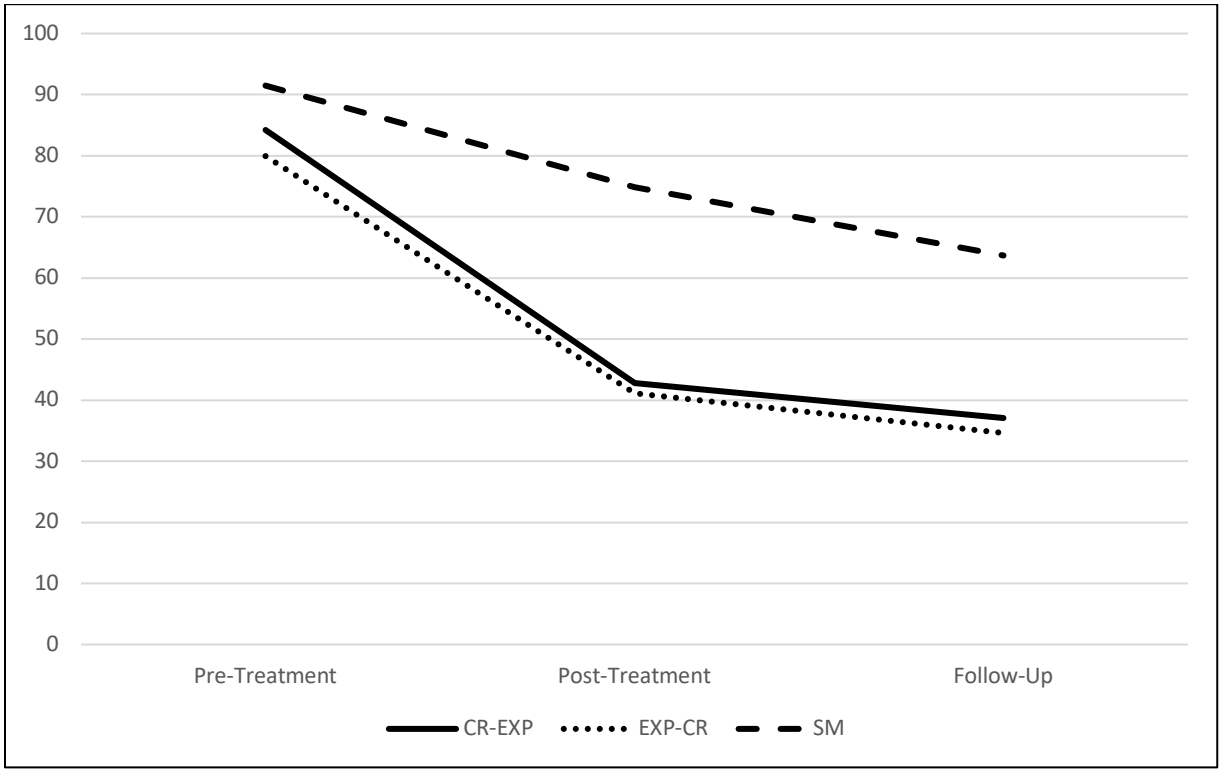


Figure 5

Mean BAT Scores by Group at Pre-Treatment, Post-Treatment, and Follow-Up.

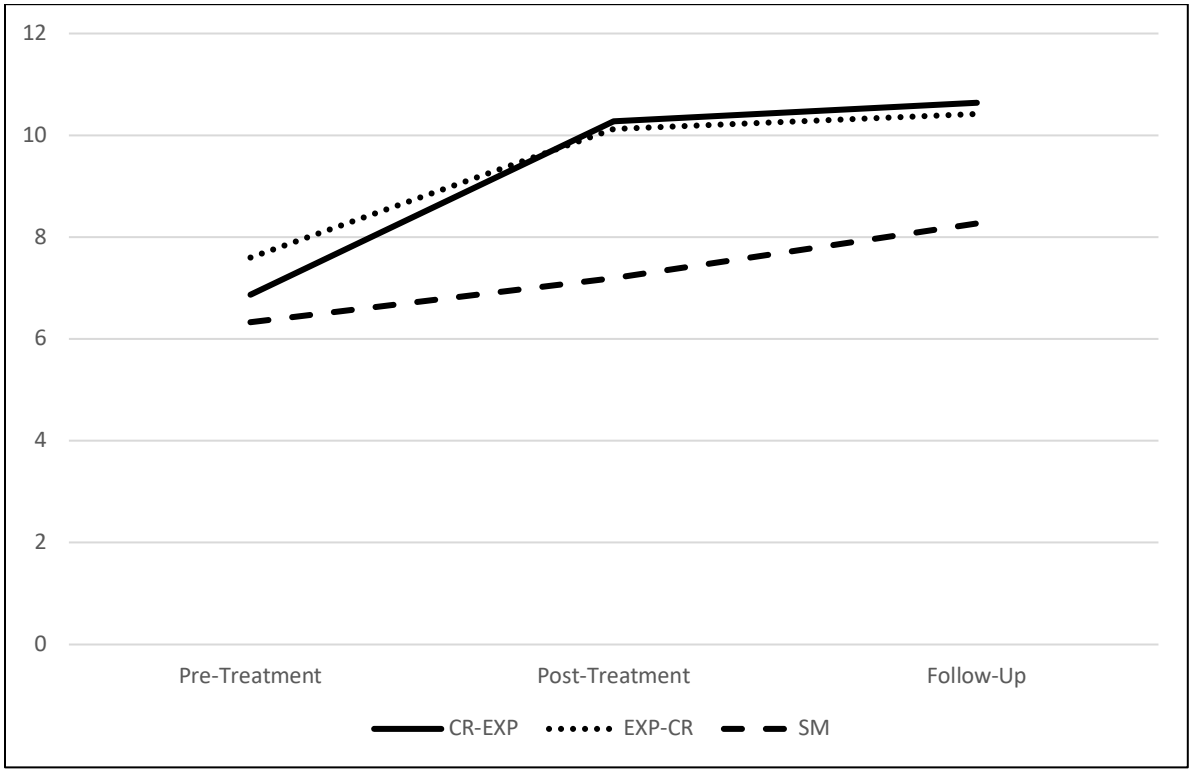


Figure 6

Mean SBQ Scores by Group at Pre-Treatment, Post-Treatment, and Follow-Up.

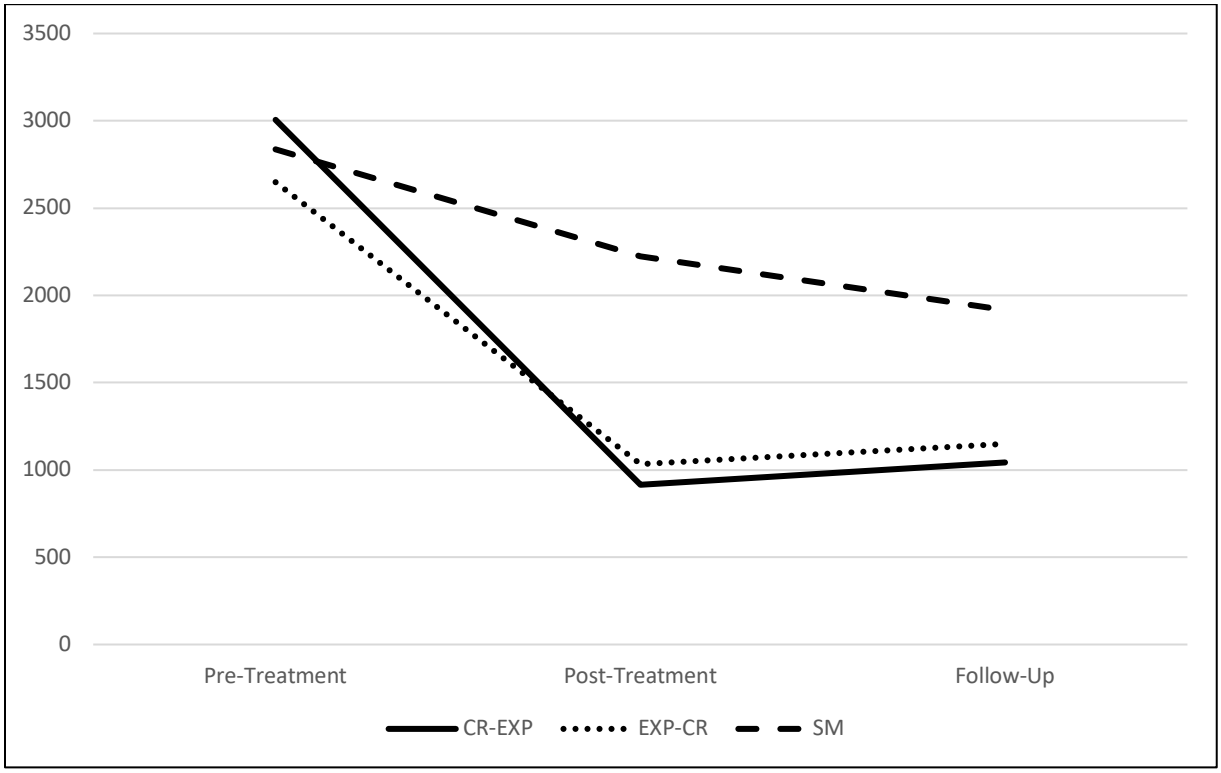
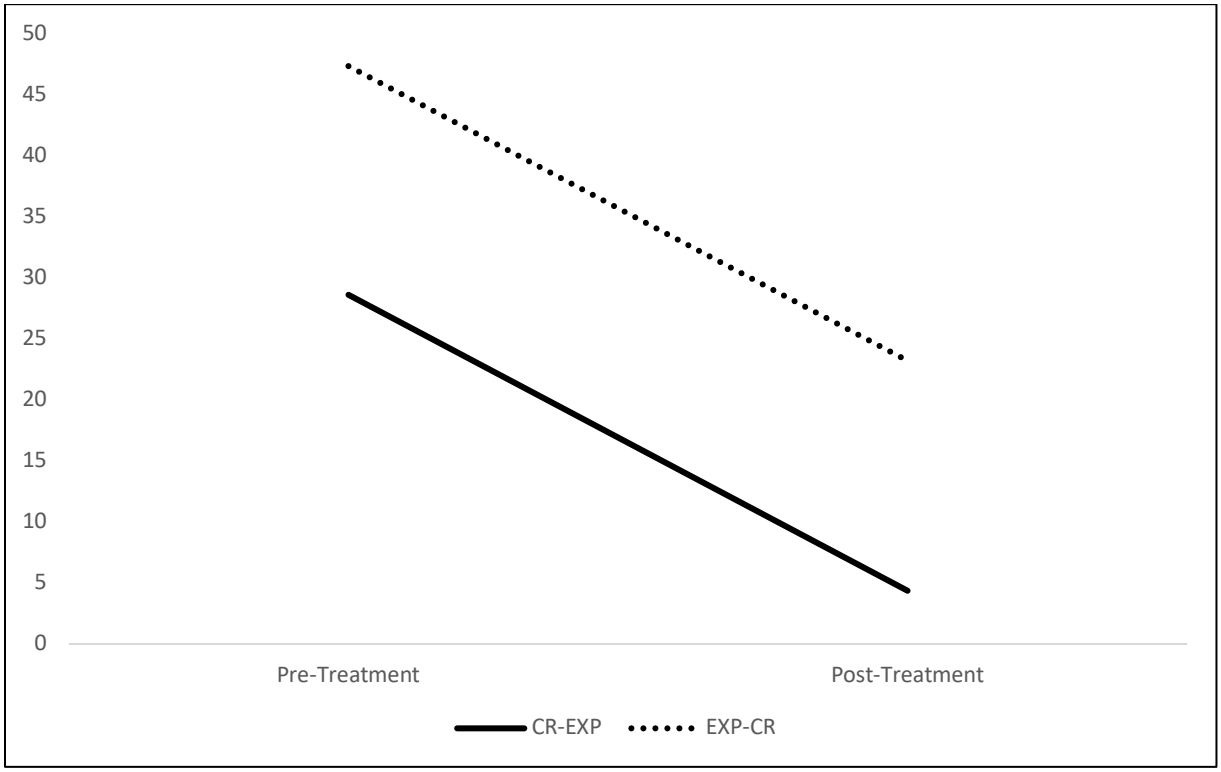


Figure 7

Mean Harm Expectancy Ratings at Pre-Exposure and Post-Exposure.



APPENDIX A: TREATMENT FIDELITY STRATEGIES

Treatment Fidelity Strategies

Recommendations by fidelity domain[1]	Steps taken
Study design	
Ensure same treatment dose within and between conditions	• All participants received 60 minutes of treatment • Providers used a timer to standardize exposure duration for participants in CR-EXP and EXP-CR conditions • Treatment manual psychoeducation text was identical for all conditions and CR-EXP and EXP-CR treatment manuals were identical except for the order of component delivery
Training providers	
Standardize training	• Same clinical trainer (Principal Investigator) trained all treatment providers • Trainer used standardized training materials and curriculum • Treatment providers listened to ≥ 3 sample sessions conducted by clinical trainer or trained providers
Ensure provider skill acquisition	• Trainer observed intervention implementation with pilot participants via audio recordings • Trainer provided written and verbal feedback on recorded intervention implementation
Accommodate provider differences	• Trainer used provider-centered training according to provider's needs, background, and clinical experience
Minimize "drift" in provider skills	• Trainer conducted regular observation of recorded encounters and provide individual supervision • Trainer was accessible for supervision and questions about the intervention outside of regular supervision • Trainer regularly monitored therapist adherence to manual
Delivery of treatment	
Control for provider differences	• Providers delivered all treatment conditions • Analysts coded and compare providers' non-specific skills
Reduce differences within treatment	• Providers used scripted intervention protocol • Trainer regularly monitored therapist adherence to manual

Ensure adherence to treatment protocol	• Trainer conducted regular observation of recorded encounters and monitor therapist adherence to manual • Trainer ensured provider comfort in self-reporting deviations from the treatment manual to the supervisor • Trainer regularly reviewed recordings for errors of content omission and commission • 27% of sessions were randomly selected for fidelity evaluation by independent coders • Fidelity coders who were blind to hypotheses reviewed tapes
Minimize contamination between conditions	• Providers used scripted intervention protocol • Providers delivered condition-specific rationales verbatim • Trainer gave providers a convincing rationale for minimizing contamination between conditions, and reviewed throughout training and supervision • Trainer conducted regular observation of recorded encounters and monitor therapist adherence to manual
Receipt of treatment	
Ensure participant comprehension	• Providers solicited feedback and personal examples of psychoeducational material to demonstrate understanding • Intervention protocol prompted providers to frequently ask if the participant had any questions or wanted any clarification
Enactment of treatment skills	
Ensure participant use of cognitive skills	• Providers used Socratic and open-ended questioning • Providers completed CBT compliance scale after each treatment session
Ensure participant use of behavioral skills	• Providers narrated and encouraged approach behavior throughout exposure sessions • Providers completed CBT compliance scale after each treatment session

APPENDIX B: TARANTULA BAT

Assessor will say: "I have a list of 13 items involving a live tarantula that I will ask you to complete. Each task lasts for five seconds, so I'll need you to hold whatever position you are in for at least five seconds before we can move on to the next one. I would like you to complete as many of the tasks as you are willing, but you may quit this task at any time. Do you have any questions before we begin?" *(Clarify any questions as needed.)* Okay, let's begin. Please: …

1. Stand at opposite side of room from covered tarantula terrarium
2. Stand at opposite side of room from exposed tarantula terrarium
3. Stand halfway across from exposed, closed tarantula terrarium
4. Stand 1 meter across from exposed, closed tarantula terrarium
5. Stand 1 foot from exposed, closed tarantula terrarium
6. Allow assessor to remove terrarium lid
7. Stand over exposed and open terrarium
8. Touch outside walls of the exposed, open terrarium
9. Place hands on inside walls of exposed, open terrarium
10. Touch tarantula inside the open terrarium
11. Touch tarantula in the assessor's hands
12. Hold tarantula in your own hands
13. Allow tarantula to crawl up your arm

The highest step *completed* will be recorded as the BAT value. Participants must hold a position for at least 5 seconds for the step to be considered completed.

Standardized response to reassurance-seeking: Participants will be told during informed consent that both tarantulas used in this study are docile and nonvenomous, but like with any pet, there is no guarantee that the tarantulas will not bite. If participants ask for reassurance (e.g., "is the tarantula safe?" "Will the tarantula bite me?" "Is the tarantula going to hurt me?"), assessors will respond with the following standardized reply:

> "Like I said before, this breed of tarantula is docile and nonvenomous, but like with any pet, there is no guarantee that the tarantulas will behave in a certain way. Like playing with an unfamiliar pet, it is possible for this tarantula to get defensive, but there's no guarantee that this one will. I can't make any promises either way, but I hope that you will still do as many of these steps as you can."

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