

Cognitive Restructuring Before Versus After Exposure: Effect on Expectancy and Outcome in Individuals With Claustrophobia

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Abstract

Maximizing the discrepancy between expected and actual outcomes during exposure (i.e., expectancy violation) is thought to optimize inhibitory learning. The current study examined Craske et al.'s suggestion that engaging in cognitive restructuring (CR) before exposure prematurely reduces expectancy and mitigates outcomes. Participants ($N=93$) with claustrophobia were randomly assigned to either 15 minutes of CR before exposure (*CR Before*) or 15 minutes of CR after exposure (*CR After*). Although the *CR Before* condition experienced greater expectancy reduction before exposure than the *CR After* condition, both groups experienced similar overall expectancy reduction by the end of the intervention. Groups experienced similar gains, with large significant improvement at posttreatment and follow-up. Results suggest that both cognitive therapy and exposure therapy lead to expectancy reduction, but that the order of these interventions does not impact outcome. Clinicaltrials.org registration #NCT03628105.

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Keywords

expectancy, expectancy violation, exposure therapy, cognitive restructuring, inhibitory learning model, cognitive behavior therapy

Inhibitory learning is defined as the extinction of a behavioral response through repeated presentations of a conditioned stimulus (CS) in the absence of an unconditioned stimulus (US, CS-noUS). As part of the inhibitory learning model, Craske et al. (2008) propose that the crux of exposure therapy is the development of new inhibitory nonthreat associations (CS-noUS) that compete with existing fear responses (CS-US, e.g., cognitions, avoidance, physiological reactions, Bouton, 1993). One approach proposed to optimize inhibitory learning during exposure is called *expectancy violation* (CS-noUS, Rescorla & Wagner, 1972). In order to violate expectancies, clinicians design an exposure that maximizes the discrepancy between one's expected feared outcome and the actual outcome of exposure, and consolidate new learning by highlighting that the expected feared outcome did not occur or was not as bad as expected (Craske et al., 2014). To our knowledge, Deacon et al. (2013) are the only researchers to examine the impact of expectancy violation on outcome from the perspective of the inhibitory learning model. However, Deacon et al.'s results are confounded by a greater dose of treatment in the condition meant to violate expectancies (i.e., 8–20 trials) than the standard condition (i.e., 3 trials).

The inhibitory learning model and associated constructs such as expectancy violation are often presented as novel theoretical and empirical approaches to exposure therapy. However, it is important to acknowledge the rich history that incorporates the principles of inhibitory learning into exposure therapy (e.g., Foa et al., 2006; Rachman, 1974). Craske et al. (2008, 2014) are not the first to suggest that the reduction of expectancies plays a large role in learning new responses (e.g., Boddez et al., 2013; Rachman, 1994). Indeed, challenging a client's conviction in their catastrophic belief (i.e., expectancy) through exposure is a guiding principle in an effective one-session treatment developed 30 years ago for specific phobias (Davis et al., 2012).

Craske et al. (2014) offer one novel element related to expectancy violation that is yet to be tested. They propose that engaging in cognitive interventions meant to reduce belief in the expected feared outcome may mitigate gains, and therefore should be avoided before or during exposure. Interestingly, avoiding cognitive interventions before exposure is contrary to what often happens in clinical practice. Generally, exposure alone versus exposure with cognitive interventions demonstrate similar treatment gains

for anxiety disorders (Podina et al., 2019). When used in combination, manualized protocols (e.g., Barlow & Craske, 2007) often introduce cognitive interventions prior to exposure. Moreover, clinicians may recommend engaging in cognitive interventions before or during exposure practice to provide the courage needed to face the exposure exercise and resist premature escape (e.g., Antony et al., 2006, p. 105). Research has yet to examine the effect of engaging in CR before exposure on exposure-related outcomes.

Purpose of the Study

The purpose of the present study was to test Craske et al.'s (2014) suggestion that cognitive interventions before exposure reduce expectancy level (i.e., how much one believes that a feared outcome will occur during exposure from 0% to 100%) and result in poorer outcomes compared to conducting exposure using their postexposure consolidation method.

Experimental Design

Participants were randomly assigned to one of two groups: (1) the *Cognitive Restructuring (CR) Before* condition: engaging in 15 minutes of CR before one session of exposure and a filler task after exposure, or (2) the *CR After* condition: engaging in the filler task before exposure and 15 minutes of CR after one session of exposure. The *CR Before* condition completed a thought record before exposure adapted from *Mind Over Mood* (Greenberger & Padesky, 2016). Participants challenged at least one of their expected feared outcomes (e.g., "I might suffocate," "I might become trapped") by searching for evidence for and against these feared outcomes (e.g., existing knowledge, previous experience) as they relate to general claustrophobic situations. The *CR After* condition engaged in an exercise after exposure using Craske et al.'s (2014) consolidation questions, which included (1) identifying whether the expected feared outcomes occurred (Yes, No), (2) describing how the participant knew whether their expected feared outcomes had occurred, and (3) reflecting on what the participant learned about their expected feared outcomes through exposure. A 15-minute filler task involving partial completion of the Minnesota Multiphasic Personality Inventory, 2nd edition (MMPI-2, Butcher et al., 1989) was used to control for the time spent in CR before or after exposure, and to compare the effect of CR to no CR intervention (i.e., filler task) before exposure on expectancy. Based on specifications from a number of previous studies (e.g., Deacon et al., 2010), exposure consisted of six 5-minute exposure trials in a claustrophobic wood chamber. The exposure hierarchy included lying down in the chamber with (1) the door open, (2) the

door closed, (3) the door closed and latched, (4) the door closed and latched, wearing face mask, (5) the door closed and latched, wearing face mask and scarf around neck, and (6) the door closed and latched, wearing face mask, scarf around neck, and handcuffs. For each exposure trial, the participant was encouraged to face their fear by selecting the most difficult exposure exercise that they were willing to try. All interventions (i.e., psychoeducation, CR, and exposure) were guided by the principal investigator.

Hypotheses

Hypothesis 1—cognitive interventions before exposure (i.e., psychoeducation, CR) will significantly reduce expectancy level before exposure. Craske et al. (2014) distinguish psychoeducation from CR before exposure by including psychoeducation in their inhibitory learning exposure sessions. It is possible that psychoeducation, like CR before exposure, may also have an impact on expectancy. Hypothesis 2—the *CR Before* and *CR After* conditions will both experience significant intervention gains from pretreatment to post-treatment with gains maintained at follow-up. However, the *CR After* condition will improve more than the *CR Before* condition at posttreatment due to the lack of CR before exposure in the *CR After* condition. Hypothesis 3—expectancy will decrease uniformly across groups throughout the course of the intervention, but expectancy will be greater in the *CR After* condition than the *CR Before* condition due to the lack of CR before exposure in the *CR After* condition.

Method

Participants

See Figure 1 for a description of participant flow. Eligibility criteria included (1) current age between 17 and 65 years old, (2) English language proficiency, (3) a significant fear of enclosed spaces, as determined by a three-step screening process (see Procedure), (4) none of the following current (past month) comorbid diagnoses: panic disorder, agoraphobia, severe major depressive disorder, manic or hypomanic episode, severe alcohol or substance use disorder, psychosis, or claustrophobic fear due to posttraumatic stress disorder, (5) no significant suicidal or homicidal ideation in the past 6 months, (6) no engagement in CR or exposure in the past 12 months for anxiety-related problems, (7) no changes to psychotropic medication in the past 3 months, (8) no use of benzodiazepine medications more frequently than once per week over the past 3 months,¹ (9) no self-reported medical condition that contraindicates

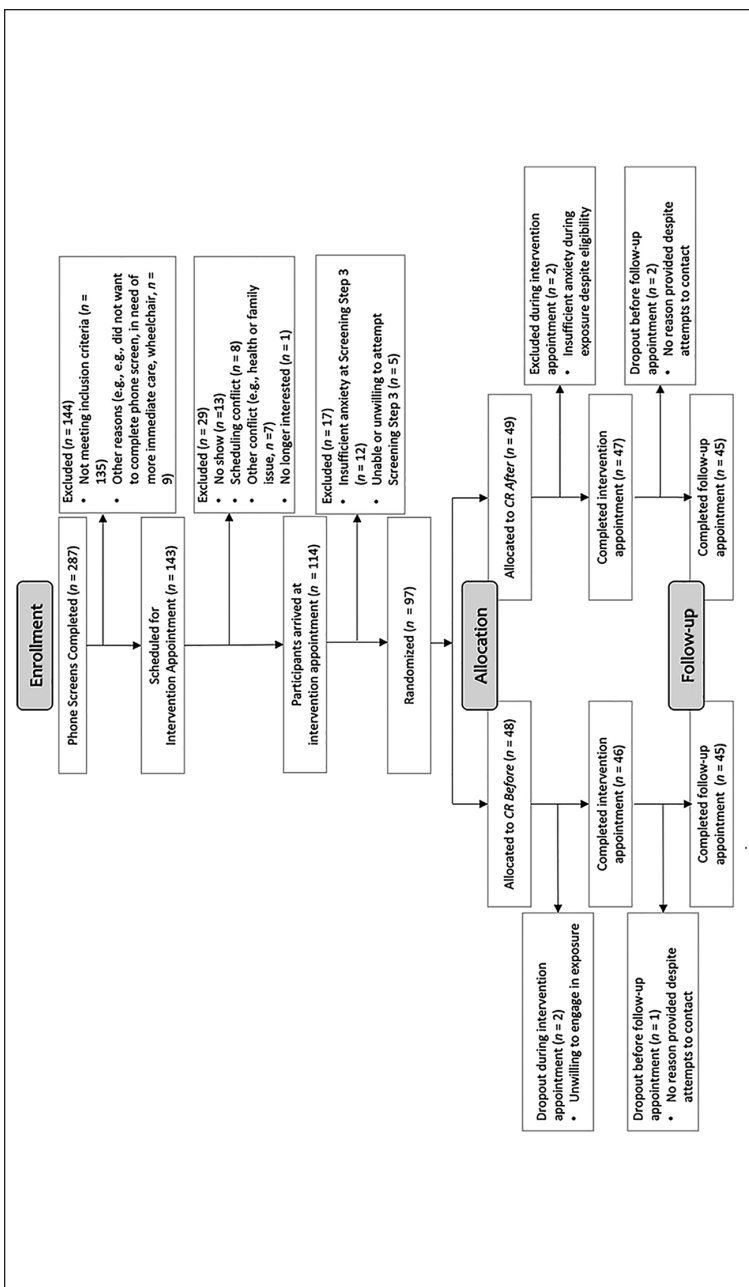


Figure 1. Participant flow.
 Note. CR = cognitive restructuring.

heightened emotions or arousal (e.g., heart condition), (10) height less than 6'5" and weight less than 250 pounds to accommodate the claustrophobic chamber. Five participants had a comorbid diagnosis of mild ($n = 1$) or moderate ($n = 4$) major depressive disorder.

An a priori power analysis indicated a need for 41 participants per group for the repeated measures analysis of variance (ANOVA): group by time interaction on expected feared outcome (Hypothesis 1), small effect size ($\eta_p^2 = .02$), $\alpha = .05$, power = .80, two groups, three measurements (Time 1, Time 2, Time 3), correlation of .5, sphericity of 1. Expected feared outcome was chosen as the outcome measure for the power analysis as it was the only novel dependent variable created for the current study and therefore was expected to produce the smallest effect size of various primary and secondary outcome measures. Participants were recruited from the Greater Toronto Area via online advertising (e.g., Kijiji) and flyers posted on university campuses and in the community. The recruitment advertisement asked potential participants whether they were afraid of small spaces and offered the opportunity to "learn strategies to reduce claustrophobic fear." The final sample of participants who either completed the study or dropped out before the follow-up appointment (*CR Before* condition = 1, *CR After* condition = 2) included 93 participants aged 17 to 62 years. No significant differences existed between groups on baseline demographics ($p > .05$, see Table 1). All participants provided informed consent. The study was approved by the Institutional Review Board and registered at clinicaltrials.org (#NCT03628105).

Measures

Diagnostic Assessment Research Tool (DART). The DART is a semistructured diagnostic interview designed to assess diagnoses from the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, American Psychiatric Association, 2013) in research and clinical settings. Psychometric validation of the DART has demonstrated good construct, convergent, and discriminant validity for a wide range of diagnoses, including specific phobia (Schneider et al., 2021). A second coder trained in the DART listened to 22 (24.4% of completed participants) recorded eligible phone screens to determine interrater reliability of specific phobia (enclosed spaces). The percent agreement was 81.8% (18/22). Cohen's Kappa (κ) = .62, $p = .002$ (95% CI [0.31, 0.93], Landis & Koch, 1977; McCabe et al., 2017).

Depression Anxiety Stress Scales (21-item version, DASS-21). The DASS-21 is a self-report measure created to measure past-week emotional states of depression, anxiety, and psychological tension and stress. The DASS-21 was used

Table 1. Baseline Demographics for the CR Before and CR After Conditions.

Variable	CR before	CR after
Age (years)	32.89 (1.92)	35.32 (2.24)
Gender (woman)	31 (67.4%)	37 (78.7%)
Specific phobia (enclosed spaces) diagnosis		
All criteria endorsed	28 (60.9%)	18 (39.1%)
All criteria except Criterion F endorsed	21 (44.7%)	26 (55.3%)
Screening Step 3		
Peak fear	75.02 (16.39)	78.32 (12.21)
Duration (seconds)	75.05 (46.18)	71.21 (47.81)
Race/Ethnicity		
White/European	20 (43.5%)	18 (38.3%)
Asian	17 (37.0%)	19 (40.4%)
Black	3 (6.5%)	4 (8.5%)
Hispanic/Latin American	2 (4.3%)	5 (10.6%)
Biracial/multiracial	4 (8.7%)	3 (6.4%)
DASS-21		
Depression	11.19 (12.44)	8.72 (8.83)
Anxiety	14.17 (11.04)	12.81 (8.92)
Stress	17.08 (10.92)	15.66 (9.68)
CEQ		
Expectancy	-0.00 (2.43)	-0.03 (2.87)
Credibility	0.36 (2.57)	-0.30 (2.74)

Note. Data are means (SD) or numbers (%). Analyses were conducted using all participants ($N = 93$). No significant differences were found between groups ($p > .05$). DASS-21 = Depression, Anxiety Stress Scales; CEQ = Credibility/Expectancy Questionnaire.

to ensure similar baseline ratings between conditions. Items are rated on a 4-point scale ranging from 0 (*did not apply at all*) to 3 (*applied to me very much*). When scoring the DASS-21, items in each scale are first summed and then doubled to align with the 43-item version (Lovibond & Lovibond, 1995). The DASS-21 demonstrates good convergent and discriminant validity as well as internal consistency, with Cronbach's α ranging from .87 to .94 in clinical and non-clinical samples (Antony et al., 1998). In the present study, Cronbach's α ranged from .81 to .92.

Credibility/Expectancy Questionnaire (CEQ). The CEQ is a 6-item self-report questionnaire developed to measure one's belief about a treatment's credibility (e.g., how logical and successful the therapy seems) and expectancy (e.g., how much one feels that the therapy will reduce symptoms). The CEQ was

used to ensure similar baseline ratings for exposure therapy between conditions. Scores are standardized before summation. Psychometric evaluation in a variety of clinical samples (e.g., generalized anxiety) has suggested support for the two-factor structure, good internal consistency (Cronbach's α ranging from .79 to .86), and good test-retest reliability (r ranging from .75 to .82, Devilly & Borkovec, 2000). In the current study, Cronbach's α ranged from .82 to .86.

Claustrophobia Questionnaire (CLQ). The CLQ is a 26-item self-report questionnaire designed to assess severity of claustrophobic anxiety in situations eliciting fear of suffocation (e.g., "swimming while wearing a nose plug") and fear of restriction (e.g., "handcuffed for 15 minutes"). The CLQ total score served as a self-report intervention outcome measure administered at pretreatment, posttreatment, and follow-up. CLQ items are rated on a 5-point scale ranging from 0 (*not at all anxious*) to 4 (*extremely anxious*). The CLQ has excellent internal consistency (Cronbach's α ranging from .92 to .95; Radomsky et al., 2001, 2006) and excellent test-retest reliability ($r = .89$, Radomsky et al., 2001; $r = .88$, Radomsky et al., 2006), and good convergent and discriminant validity. The CLQ total score has predicted anxiety-related cognitions, distress ratings, and body sensations (Radomsky et al., 2001). In the current study, Cronbach's α ranged from .91 to .96.

Behavioral Approach Test (BAT). Adapted from Deacon et al. (2010), this study included an eight-step BAT administered at pretreatment, posttreatment, and follow-up. Each of the following eight steps lasted a maximum of 30 seconds: (1) lying down in an unzipped sleeping bag, (2) zipping sleeping bag to waist with hands inside the bag, (3) zipping sleeping bag to neck with hands inside the bag, (4) placing white surgical mask over one's mouth, (5) putting on hand cuffs, (6) placing blanket over body including face, (7) placing second blanket over body including face, (8) placing third blanket over body including face. Steps were cumulative, such that steps 4 through 8 were completed while remaining completely zipped up in the sleeping bag. Participants were asked to push themselves to face their fear by completing as many steps as possible. The BAT was discontinued when a participant was unable or unwilling to complete a step. Following each step, participants were asked to verbally rate the highest level of fear experienced from 0% (*no fear*) to 100% (*extreme fear*). An index of peak fear was calculated for pretreatment, posttreatment, and follow-up BATs by using the fear ratings at the step of each time point corresponding to the final step completed at pretreatment (e.g., if the final step completed at pretreatment was step 4, then step 4 peak fear at pretreatment, posttreatment, and follow-up was used as the index). An index

of behavioral approach was calculated by determining whether a participant refused the step (0 points), attempted the step (remained in step for 0–29 seconds, 1 point), or completed the step (remained in step for 30 seconds, 2 points) and summing the total number of points (i.e., /16) accrued during the BAT.

Expected feared outcomes. Two expected feared outcomes were used for the current study given evidence that claustrophobic cognitions fall into two main categories (Radomsky et al., 2001): (1) a suffocation feared outcome, “I might suffocate” and (2) a restriction feared outcome, “I might become trapped.”² Expected feared outcomes were linked to a specific exposure exercise and duration (Craske et al., 2014). That is, participants identified the (1) specific exercise on the exposure hierarchy that was most likely to lead to their expected feared outcome and (2) the predicted duration needed in this specific exercise for the expected feared outcome to occur. For example, a participant might select “I might suffocate” if I “lie down in the chamber with the door closed” (exposure exercise) for “3 minutes and 20 seconds” (duration). Participants verbally rated how strongly they believed their expected feared outcomes would occur from 0% (*not at all*) to 100% (*completely*) at nine time points (See Figure 2).

Procedure

The study took place in the Anxiety Research and Treatment Laboratory at Ryerson University in Toronto, Ontario. The study included three parts: (1) a phone screen to determine preliminary eligibility, (2) an intervention appointment involving a pretreatment assessment, intervention, and posttreatment assessment, and (3) a 1-month follow-up assessment (see Figure 2). All communication with participants throughout these three components followed a scripted protocol (available upon request). Participants were recruited, enrolled, tested, and assigned to interventions by the principal investigator between August 2018 and November 2019. Participants were paid between \$40 and \$60 CAD for completion of the study (i.e., the incentive was increased part way through the project to improve recruitment efforts).

Three step screening process. For Screening Step 1, eligible participants needed to report at least moderate fear (≥ 2 out of 4) when imagining lying down in small dark chamber without windows for several minutes (adapted question from Radomsky et al., 2001). For Screening Step 2, eligible participants needed to endorse DSM-5 criteria for specific phobia (enclosed spaces), with the exception of Criterion F (i.e., “the fear, anxiety, or avoidance causes

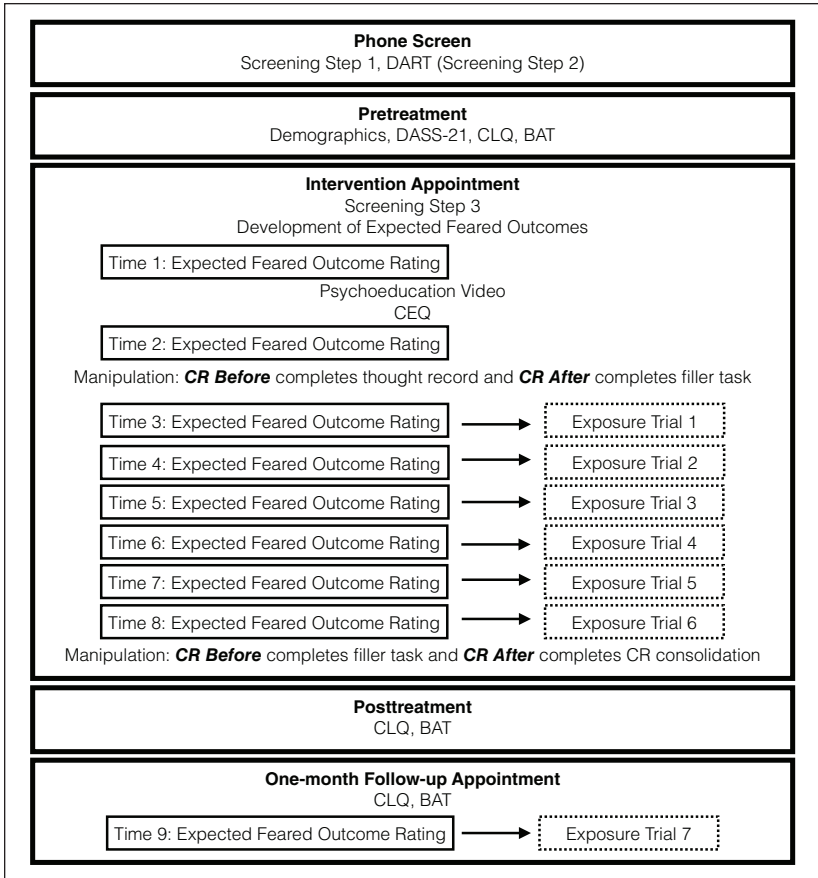


Figure 2. Visual representation of procedure.

Note. DASS-21 = Depression Anxiety Stress Scales; CLQ = Claustrophobia Questionnaire; CGCQ = Claustrophobia General Cognition Questionnaire; BAT = Behavioral Approach Test; CR = cognitive restructuring.

clinically significant distress or impairment in social, occupational, or other important areas of functioning,” American Psychiatric Association, 2013, p. 197). Criterion F was deemed optional to increase recruitment feasibility in recognition that accommodation in one’s lifestyle may mitigate functional impairment for some individuals (e.g., successful avoidance of enclosed spaces reduces frequency of fear, see Table 1). For Screening Step 3, eligible participants needed to demonstrate sufficient fear and/or avoidance of the

claustrophobic chamber as demonstrated by either (1) an inability to remain in the chamber for 2 minutes or (2) at least 50 out of 100 peak fear while in the chamber.

Randomization procedure. Following Screening Step 3, eligible participants were randomly assigned to either the *CR Before* or *CR After* conditions. A preset simple randomization sequence using <https://randomizer.org> was created by a colleague not involved in the study for 96 participants (assuming a 15% dropout rate) using one unique set and a number range of 1 to 2 (*CR Before* and *CR After* conditions respectively). Allocation concealment was used for the principal investigator and participants until eligibility was confirmed following Screening Step 3.

Statistical Analyses

Data were screened for missing data and outliers prior to conducting analyses. Hypotheses 1 and 2 were analyzed through a series of mixed 2 (*CR Before* condition, *CR After* condition) by 3 (Time 1/pre-treatment, Time 2/post-treatment, Time 3/follow-up) analyses of variance (ANOVA) examining the effect of group and time on expected feared outcomes (i.e., suffocation, restriction) and intervention gains (i.e., CLQ, BAT peak fear and approach). Time 1, Time 2, and Time 3 represented expected feared outcome ratings taken (1) before psychoeducation, (2) after psychoeducation/before the thought record versus filler task manipulation, and (3) after the thought record versus filler task manipulation respectively (see Figure 2). Pre-treatment, post-treatment, and follow-up represented CLQ and BAT peak fear and approach ratings. Analyses were conducted using (1) participants who completed the study or dropped out before follow-up for expected feared outcome analyses, as all data for Hypothesis 1 were collected during the intervention appointment ($N=93$, *CR Before* condition $n=46$, *CR After* condition $n=47$), (2) completed participants for Hypothesis 2 CLQ analyses and Hypothesis 3 expected feared outcome analyses, as dropouts did not have follow-up data ($n=90$, *CR Before* condition= 45 , *CR After* condition= 45), and (3) a subset of completed participants for BAT peak fear and approach analyses ($n=88$, *CR Before* condition= 43 , *CR After* condition= 45) due to errors in protocol (see Missing Data).

Prior to conducting mixed ANOVAs, parametric assumptions (i.e., normality, homogeneity of variance, sphericity) were explored. If the assumption of normality was violated for any of the mixed ANOVAs, multilevel models (MLM) using full-information maximum likelihood estimation (i.e.,

maximum likelihood) were also run as they only require normally distributed residuals and linear relationships, making it a robust alternative to mixed ANOVA (Quené & van Den Bergh, 2004). All MLM and nonparametric analyses demonstrated the same pattern of results as mixed ANOVA, as such only mixed ANOVA results are reported. All F tests were deemed robust under the violation of homogeneity of variance despite large variance ratios between the *CR Before* and *CR After* conditions, because groups were either equal in size (i.e., CLQ) or differed in size by only 1 to 2 participants (i.e., expected feared outcomes, BAT peak fear and approach, Blanca et al., 2018). When the assumption of sphericity was violated, degrees of freedom were corrected using a Greenhouse Geisser adjustment when its estimate was $<.75$ and a Huynh-Feldt adjustment when the Greenhouse Geisser estimate was $>.75$ (Field, 2013) to make F tests robust under this violation.

When a significant main effect of time was found, repeated contrasts were used to examine the difference between (1) Time 1/pre-treatment and Time 2/post-treatment, and (2) Time 2/post-treatment and Time 3/follow-up using a Bonferroni correction of $p = .05/2 = .025$. When a significant group by time interaction was found, simple effects analyses were used to examine the difference between groups at Time 1/pre-treatment, Time 2/post-treatment, and Time 3/follow-up using a Bonferroni correction of $p = .05/3 = .017$.

Hypothesis 3 was analyzed using MLM regressions exploring whether linear time, quadratic time, group, the time by group interaction, or the quadratic time by group interaction predicted expected feared outcomes (i.e., suffocation, restriction). Time was coded such that the intercept represented the grand mean of expected feared outcomes at the first time point (Time 3, after the preexposure thought record vs. filler task manipulation/before the first exposure trial). Model estimates of linear time represented the projected trajectory (i.e., slope of the regression line) in expected feared outcomes at Time 3, whereas model estimates of quadratic time represented the change in expected feared outcome trajectories over time. Larger positive (versus negative) estimates indicated a more rapid increase (versus decrease) in slope. For example, a positive linear time effect and a negative quadratic time effect would indicate that participants are predicted to have an initial projected decrease in expected feared outcomes at Time 3 that steadily attenuates (i.e., reverses) over time. Group was effect-coded (*CR Before* condition = -1 , *CR After* condition = 1), whereby the intercept represented the estimated grand mean across all groups at the first time point (Time 3). A positive estimate of group indicated that the *CR After* condition was greater than the *CR Before* condition at Time 3, whereas a negative model estimate indicated that the *CR Before* condition was greater than the *CR After* condition at Time 3. A significant group by time interaction demonstrated that the group trajectories

differed at Time 3. A significant group by quadratic time interaction indicated that groups' trajectories changed at different rates. For each model, adjusted interclass correlations (ICC) and conditional R^2 values were calculated.

Results

Missing Data

A total of 17 questionnaire items were missing at random across all participants ($N=93$; Little's Missing Completely at Random, $p < .05$) and replaced using Estimation Maximization. Two participants were removed from all BAT peak fear and approach analyses due to an error in protocol ($n=88$, *CR Before* condition=43, *CR After* condition=45). Seven participants for BAT peak fear analyses (*CR Before* condition=3, *CR After* condition=4) completed (1) fewer steps at posttreatment and follow-up than at pretreatment ($n=1$) or (2) fewer steps at follow-up than at pretreatment and posttreatment ($n=6$). To account for the likely regression among these participants (i.e., potential inability or unwillingness to face their fear to the same extent at posttreatment or follow-up) in analyses, the worst-case scenario peak fear score (i.e., 100/100) was imputed for these missing data points. No significant differences in results were found between excluding these seven participants from analyses and imputing worst-case scenario peak fear scores (i.e., 100/100). Follow-up intervention gain outcome scores (i.e., CLQ, BAT peak fear and approach) were missing not at random for three participants (3.2%, 3/93, *CR Before* condition=1, *CR After* condition=2) who dropped out before the follow-up appointment. The completed sample of participants (CLQ: $n=90$; BAT peak fear and approach: $n=88$) for any follow-up analyses was deemed appropriate given the negligible impact of the missing data. A best-worst- and worst-best-case scenario sensitivity analysis demonstrated that inclusion of these participants would not have impacted interpretation even in the event of extreme scores (Jakobsen et al., 2017).

Hypothesis 1: Cognitive Interventions Before Exposure on Expected Feared Outcomes

Suffocation feared outcome results demonstrated a significant main effect of time, $F(1.94, 176.09)=41.96$, $p < .001$, $\eta_p^2=.32$, main effect of group, $F(1, 91)=5.24$, $p=.024$, $\eta_p^2=.06$, and group by time interaction, $F(1.94, 176.09)=7.85$, $p=.001$, $\eta_p^2=.08$. Using Bonferroni correction ($.05/2=.025$), repeated contrasts of time demonstrated that suffocation feared outcome ratings were significantly greater at Time 1 than Time 2, $F(1, 91)=18.81$,

$p < .001$, $r = .41$, and at Time 2 than Time 3, $F(1, 91) = 29.39$, $p < .001$, $r = .49$. Using Bonferroni correction ($.05/3 = .017$), simple effects analyses revealed no significant difference between groups at Time 1 ($p = .283$) or Time 2 ($p = .166$). However, the *CR After* condition demonstrated significantly greater suffocation feared outcome ratings at Time 3 compared to the *CR Before* condition, $F(1, 91) = 12.84$, $p = .001$, $r = .35$.

Restriction feared outcome results demonstrated a significant main effect of time, $F(1.73, 157.56) = 40.86$, $p < .001$, $\eta_p^2 = .31$, main effect of group, $F(1, 91) = 9.05$, $p = .003$, $\eta_p^2 = .09$, and group by time interaction, $F(1.73, 157.56) = 9.97$, $p < .001$, $\eta_p^2 = .10$. Using Bonferroni correction ($.05/2 = .025$), repeated contrasts of time demonstrated that restriction feared outcome ratings were significantly greater at Time 1 than Time 2, $F(1, 91) = 22.59$, $p < .001$, $r = .45$, and at Time 2 than Time 3, $F(1, 91) = 29.98$, $p < .001$, $r = .50$. Using Bonferroni correction ($.05/3 = .017$), simple effects analyses revealed no significant differences at Time 1 ($p = .050$) or Time 2 ($p = .256$). The *CR After* condition demonstrated significantly greater restriction feared outcome ratings at Time 3 compared to the *CR Before* condition, $F(1, 91) = 17.10$, $p < .001$, $r = .40$. See Table 2 and Figure 3 for expected feared outcomes.

Hypothesis 2: Intervention-Related Gains

CLQ results demonstrated a significant main effect of time, $F(2, 176) = 148.77$, $p < .001$, $\eta_p^2 = .63$, but no main effect of group ($p = .975$, $\eta_p^2 < .01$) or group by time interaction ($p = .205$, $\eta_p^2 = .02$). Using Bonferroni correction ($.05/2 = .025$), repeated contrasts of time demonstrated that CLQ scores decreased significantly from pretreatment to posttreatment, $F(1, 88) = 234.11$, $p < .001$, $r = .85$, but not from posttreatment to follow-up ($p = .693$).

BAT peak fear results demonstrated a significant main effect of time, $F(1.74, 149.20) = 100.65$, $p < .001$, $\eta_p^2 = .54$, but no main effect of group ($p = .66$, $\eta_p^2 < .01$) or group by time interaction ($p = .095$, $\eta_p^2 = .03$). Using Bonferroni correction ($.05/2 = .025$), repeated contrasts of time demonstrated that BAT peak fear decreased significantly from pretreatment to posttreatment, $F(1, 86) = 183.84$, $p < .001$, $r = .83$, and increased significantly from posttreatment to follow-up, $F(1, 86) = 19.74$, $p < .001$, $r = .43$. Given this significant increase from posttreatment to follow-up, an additional simple contrast between pretreatment and follow-up was run using another Bonferroni adjustment ($.05/3 = .017$) to confirm that overall gains were achieved, $F(1, 86) = 75.53$, $p < .001$, $r = .68$.

BAT approach results demonstrated a significant main effect of time, $F(1.73, 148.67) = 17.70$, $p < .001$, $\eta_p^2 = .17$, but no main effect of group ($p = .093$, $\eta_p^2 = .03$) or group by time interaction ($p = .699$, $\eta_p^2 < .01$). Using

Table 2. Means and Standard Deviations of Expected Feared Outcomes Throughout Study.

Time	Suffocation		Restriction	
	CR before	CR after	CR before	CR after
1	73.59 (22.25)	78.72 (23.58)	85.22 (18.32)	91.70 (12.65)
2	64.02 (26.53)	71.23 (23.19)	75.76 (24.59)	81.38 (22.86)
3 ^a	48.98 (26.32)	68.19 (25.40)	56.26 (30.88)	79.79 (23.57)
4	31.85 (30.27)	56.70 (32.22)	41.09 (35.05)	64.26 (33.12)
5	25.15 (28.53)	37.02 (30.97)	39.78 (35.29)	49.68 (38.44)
6	19.17 (23.52)	28.13 (32.24)	26.15 (31.02)	42.06 (37.29)
7	14.02 (22.43)	23.66 (29.91)	21.57 (30.26)	36.51 (36.75)
8	11.41 (18.90)	16.94 (27.02)	17.87 (28.63)	29.91 (35.33)
9 ^b	22.02 (26.08)	24.98 (26.35)	31.76 (31.67)	36.93 (32.59)

Note. Standard deviations are presented in brackets. Unless otherwise specified, means and standard deviations are based on all participants ($N=93$). Time represents expected feared outcome ratings: 1 = before psychoeducation, 2 = after psychoeducation/before the preexposure thought record versus filler task manipulation, 3 = after the preexposure thought record versus filler task manipulation/before the first exposure trial, 4–8 = before the remaining five exposure trials during the intervention appointment; 9 = before the exposure trial during the follow-up appointment. CR = cognitive restructuring.

^aThere is a significant difference between the CR Before and CR After conditions at Time 3 for both expected feared outcomes.

^bMeans and standard deviations at Time 9 based on sample of completed participants ($n=90$) as dropouts did not have follow-up data.

Bonferroni correction ($.05/2 = .025$), repeated contrasts of time demonstrated that BAT approach increased significantly from pretreatment to posttreatment, $F(1, 86) = 32.68$, $p < .001$, $r = .52$, and decreased significantly from posttreatment to follow-up, $F(1, 86) = 6.67$, $p = .012$, $r = .23$. Given this significant decrease from posttreatment to follow-up, an additional simple contrast between pretreatment and follow-up was run using another Bonferroni adjustment ($.05/3 = .017$) to confirm that overall gains were achieved, $F(1, 86) = 10.98$, $p = .001$, $r = .34$. See Table 3 and Figure 4 for intervention-related gains.

Hypothesis 3: Change in Expected Feared Outcomes Throughout the Intervention

The MLM models examining suffocation and restriction feared outcomes both displayed main effects of linear time, quadratic time, and effect-coded group. First, suffocation feared outcome scores were projected to decrease by

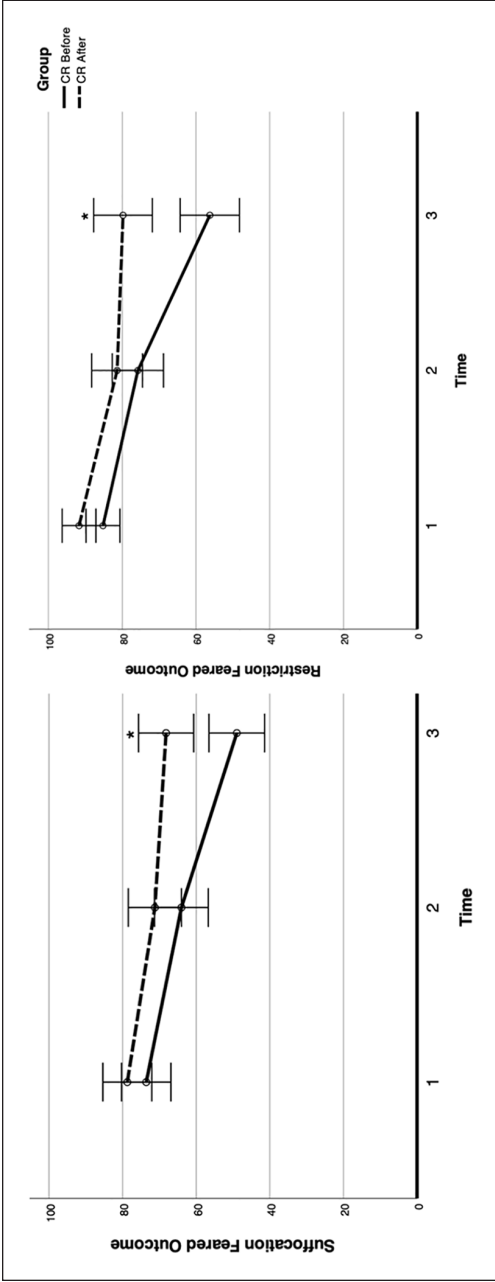


Figure 3. Estimated marginal means for expected feared outcomes.

Note. There were no significant differences between groups at Time 1 or Time 2. Asterisk indicates a significant difference between groups at Time 3. Error bars represent 95% Confidence Interval. Time represents expected feared outcome ratings: 1 = before psychoeducation, 2 = after psychoeducation/before the preexposure thought record versus filler task manipulation, 3 = after the preexposure thought record versus filler task manipulation. ANOVA = analysis of variance; CR = cognitive restructuring.

Table 3. Means and Standard Deviations for Treatment Gains.

Time	CLQ		BAT			
	CR before	CR after	Peak fear		Approach	
			CR before	CR after	CR before	CR after
Pre	64.26 (17.38)	62.91 (15.34)	72.65 (26.09)	66.49 (32.11)	14.67 (2.25)	13.82 (3.02)
Post	40.59 (19.99)	38.93 (20.88)	21.05 (31.70)	26.62 (31.71)	15.65 (1.51)	15.02 (2.37)
FU	38.65 (20.56)	42.01 (21.23)	31.70 (32.80)	39.38 (36.23)	15.52 (1.82)	14.51 (3.06)

Note. Standard deviations are presented in brackets. Means and standard deviations are based on completed participants ($n=90$) for CLQ and a subset of completed participants ($n=88$) for BAT peak fear and approach. CR = cognitive restructuring; CLQ = Claustrophobia Questionnaire; BAT = Behavioral Approach Test; Pre = pretreatment; Post = posttreatment; FU = follow-up.

an estimated amount of 17.88 ($SE=1.28$, $p<.001$) between time points, attenuated by 1.92 ($SE=.20$, $p<.001$) per time point beyond Time 3. Restriction feared outcome scores were projected to decrease by 16.71 ($SE=1.52$, $p<.001$) between time points, attenuated by 1.78 ($SE=.24$, $p<.001$) per time point beyond Time 3. Second, the *CR After* condition had significantly higher scores than the *CR Before* condition at Time 3 right before beginning the first exposure trial for the suffocation feared outcome ($B=10.91$, $SE=2.72$, $p<.001$) and restriction feared outcome ($B=12.08$, $SE=3.27$, $p<.001$, see Time 3 means and standard deviations in Table 2). No interaction effects were found between group and linear time or group and quadratic time for suffocation feared outcome or restriction feared outcome ($p>.05$). See Table 4 and Figure 5.

Discussion

The purpose of the current study was to examine Craske et al.'s (2014) hypothesis that engaging in cognitive interventions before exposure prematurely reduces expectancy and mitigates outcomes. Supporting Craske et al.'s prediction, Hypothesis 1 results showed that cognitive interventions reduce expectancy. Specifically, psychoeducation resulted in a 7% to 10% significant decrease in expectancy across conditions (i.e., Time 1–Time 2, see Table 2). The *CR Before* condition, which involved completing a thought record before exposure, resulted in an additional 15% to 20% significant

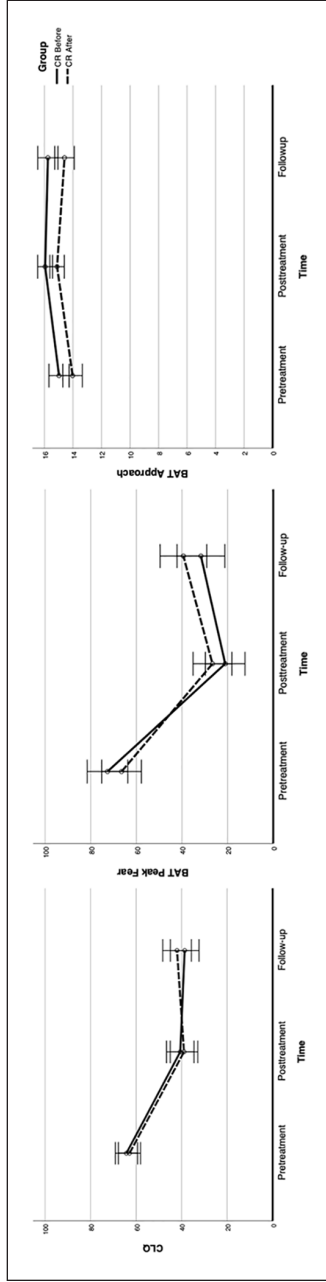


Figure 4. Estimated marginal means for treatment gains.
Note. There were no significant differences between groups at pretreatment, posttreatment, or follow-up. Error bars represent 95% Confidence Interval. BAT = Behavioral Approach Test; CR = cognitive restructuring; ANOVA = analysis of variance.

Table 4. MLM Statistics for Change Over Time in Expected Feared Outcomes.

Level and predictor	Expected feared outcome	
	Suffocation	Restriction
Level 1 (within)		
Intercept	59.70 (2.72)***	68.10 (3.27)***
Time effect	-17.88 (1.28)***	-16.71 (1.52)***
Time ² effect	1.96 (0.20)***	1.78 (0.24)***
Time × Group	-1.59 (1.28)	-1.49 (1.52)
Time ² × Group	0.00 (0.20)	0.02 (0.24)
Level 2 (between)		
Group effect	10.91 (2.72)***	12.08 (3.27)***
Variance components		
Participant intercept variance	425.3***	620.8***
Residual variance	316.9	450.7
Adjusted ICC	.57	.58
-2 log likelihood (FIML)	-2,813.3	-2,925.2
Conditional R ²	.68	.66

Note. Level 1 and 2 data are *B* (*SE*). Analyses conducted using completed participants (*n* = 90). Loadings are unstandardized. Random effect significance was estimated using likelihood ratio tests. MLM = multilevel modeling.

****p* < .001.

decrease in expectancy (Time 2–Time 3, see Table 2). However, the *CR After* condition, which involved completing the filler task before exposure, did not result in a significant decrease between Time 2 and Time 3.

Contrary to Craske et al.'s prediction, Hypothesis 2 results showed that engaging in CR before exposure did not lead to poorer intervention-related gains. Both groups experienced similar, statistically large reduction in symptoms of claustrophobic fear (CLQ) and peak fear on the BAT despite differing patterns of expectancy reduction before exposure. Specifically, participants experienced a 23% significant reduction in claustrophobic fear (i.e., CLQ) and a 40% to 52% significant reduction in peak fear on the BAT from pretreatment to posttreatment (see Table 3), with no significant differences between groups at posttreatment. Gains were maintained at follow-up for claustrophobic fear. Although peak fear on the BAT significantly increased from posttreatment to follow-up, participants still experienced an overall significant decrease in fear levels by the end of the study (i.e., from pretreatment to follow-up). Moreover, a slight return of fear frequently occurs with the passage of time (i.e., spontaneous recovery) or a return to original context

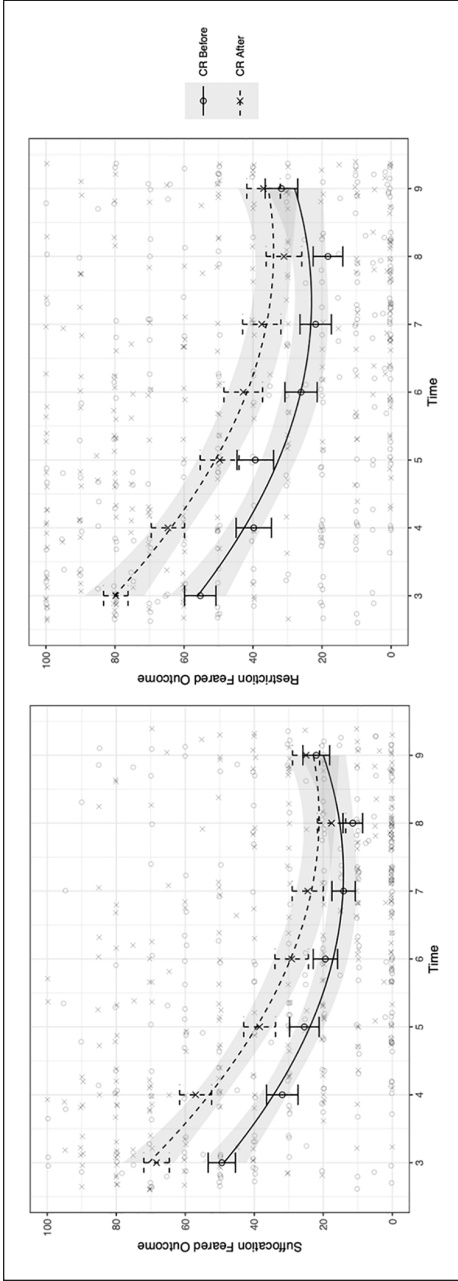


Figure 5. Change in expected feared outcomes from Time 3 to Time 9.

Note. Error bars represent 95% Confidence Interval. Individual data points are offset from each time to reduce overplotting. Time represents expected feared outcome ratings; 3 = after the preexposure thought record versus filler task manipulation/before the first exposure trial, 4–8 = before the remaining five exposure trials during the intervention appointment; 9 = before the exposure trial during the follow-up appointment. CR = cognitive restructuring.

(i.e., renewal, Bjork & Bjork, 2006), especially given the lack of formal exposure practice between posttreatment and follow-up.

Despite a statistically significant increase in behavioral approach from pretreatment to follow-up, this improvement may not be meaningful. Groups increased by less than one full step (2 points) on the BAT from pretreatment to follow-up (*CR Before* condition = 0.85 increase, *CR After* condition = 0.69 increase). Examination of Figure 4 suggests that a ceiling effect occurred for the measure of BAT approach. Indeed, 88.7% ($n = 86$) of participants completed at least five BAT steps at pretreatment with 56.7% ($n = 55$) completing all eight steps at pretreatment. Deacon et al. (2010), who used a similar BAT protocol, also experienced a ceiling effect with 84.8% of participants completing all eight steps at pretreatment. Future studies should pilot the BAT to ensure that it is sufficiently difficult for the population of interest. Potential solutions to the ceiling effect include (1) excluding participants who complete a certain number of steps on the BAT at pretreatment (e.g., Öst et al., 2001) or (2) ensuring certain elevated baseline levels of claustrophobic fear on validated self-reported measures of claustrophobic severity (e.g., CLQ).

Finally, to bridge the gap between greater expectancy reduction for individuals who engaged in CR before exposure and the lack of differences between groups in intervention-related gains, expectancy ratings were explored across time. Although participants in the *CR After* condition had greater expected feared outcome scores than participants in the *CR Before* condition at Time 3, both groups had similar quadratic trajectories over time. Interpretation of these results is perhaps facilitated through examination of Table 2 and Figure 5. Although the *CR Before* condition began the first exposure trial at an expectancy level approximately 15% to 20% lower than the *CR After* condition due to completing a thought record before exposure, the *CR After* condition demonstrated a similar amount of expectancy reduction to the *CR Before* condition by the end of exposure and postexposure consolidation (Time 3–Time 8). Indeed, examination of error bars in Figure 5 appear to suggest a similar level of belief in expected feared outcomes by the end of the intervention appointment (Time 8) and at follow-up (Time 9).

Therefore, while cognitive interventions may “reduce the expectancy of a negative outcome before exposure and thereby lessen the mismatch between initial expectancy and actual outcome,” they do not appear to be “deleterious to inhibitory learning when employed prior to, or during, exposures” (Craske et al., 2014, p. 12) as originally proposed. This is perhaps unsurprising given that various CBT components often display “uniform efficacy” (Podina et al., 2019, p. 7). Moreover, cognitive interventions and exposure address similar mechanisms of change, namely adaptations in maladaptive beliefs (e.g.,

probability overestimation, negative valence, Podina et al., 2019). Indeed, Clark (1995) postulated that “all therapies work by altering dysfunctional cognitions, either directly or indirectly” (p. 158). According to the inhibitory learning model, change is thought to occur through the introduction of information that is incongruent with the original CS-US association. In the current study, it seems as though the *CR Before* condition began incorporating incongruent information (CS-noUS) through a thought record and continued this process throughout exposure. In contrast, the *CR After* condition began incorporating incongruent information (CS-noUS) throughout exposure and continued this process through postexposure consolidation. Regardless of the underlying reason for the lack of statistically significant differences between groups, results suggest that clinicians need not be overly concerned about mitigating outcomes by incorporating cognitive interventions before or during exposure. However, this does not mean that the placement of cognitive interventions in exposure is unimportant. Rather, it may be necessary to ask for whom the addition or intentional placement of cognitive interventions before exposure may be helpful. This decision may depend on other processes such as client reluctance to engage in exposure, client preference, perceived treatment credibility, or self-efficacy.

The importance of expectancy in learning (Boddez et al., 2013; Rachman, 1974) and in theories of exposure (Davis et al., 2012; Foa et al., 2006; Rachman, 1994) is well-established. The similar amount of expectancy reduction across groups by the end of the study could suggest that the better predictor of outcome is the overall amount of expectancy reduction throughout the intervention, rather than the level of expectancy before beginning exposure. However, testing this prediction may prove difficult. Craske et al. (2008) acknowledged the challenge of designing experimental research to test whether greater overall expectancy violation leads to better outcomes, as violation of expectancies may rely heavily on a greater dose of exposure (e.g., greater duration or number of sessions needed to violate expectancies). Indeed, Deacon et al.'s (2013) results were confounded by the greater dose of treatment in the expectancy violation condition. Moreover, just as empirical results from other exposure models have failed to find a consistent empirical relationship between indices of learning and outcome (e.g., habituation, Rupp et al., 2017; match-mismatch of fear, Rachman, 1994), Craske et al. (2008) caution that verbal reports of expectancy may simply be an index of performance during exposure rather than a sign of true inhibitory learning. As such, designs that explore the process of expectancy reduction over time using repeated measurement and multilevel modeling may be better at evaluating exposure than direct experimental comparisons between conditions (i.e., expectancy violation vs. treatment-as-usual).

Limitations

The current study had a number of limitations. First, the current study did not necessarily measure inhibitory learning. Indices of inhibitory learning are lacking for exposure-based practice as exposure therapy only serves as a proxy of classical conditioning (e.g., Benito et al., 2018; Carpenter et al., 2019). In the current study, intervention outcome measures were considered an index of inhibitory learning based on Craske et al.'s (2008) statement that "the most informative and critical test of exposure therapy is posttreatment or follow-up assessment, when the inhibitory learning acquired during exposure will shape the expression of fear" (p. 12). However, posttreatment or follow-up fear expression seem similar to the index of between-session habituation highlighted in emotional processing theory (EPT, Foa et al., 2006) which has not reliably predicted emotional processing (see Craske et al., 2008 for review). Second, challenging expected feared outcomes as they relate to general claustrophobic situations during the thought record may have resulted in less overall impact on outcomes compared to using the thought record to challenge expected feared outcomes as they relate to the claustrophobic chamber specifically. However, this approach was chosen intentionally as participants did not have any existing knowledge or previous experience in the claustrophobic chamber, potentially mitigating the opportunity for client-directed discovery. Results demonstrated that this general approach to CR before exposure still managed to reduce expected feared outcome ratings tied to specific claustrophobic chamber exposure exercises. Third, approximately half (50.6%) of participants did not endorse clinically significant impairment or distress (Criterion F) which may limit generalizability to a clinical sample. However, baseline average scores on the CLQ for individuals endorsing all specific phobia criteria ($M=70.07$, $SD=15.02$) and individuals endorsing all specific phobia criteria except Criterion F ($M=57.46$, $SD=15.18$) were more than double scores found in a sample of healthy controls from a community ($M=28.9$, $SD=19.4$) and a sample of healthy undergraduate students ($M=24.64$, $SD=14.44$, Radomsky et al., 2001) indicating that the current sample demonstrated a level of claustrophobic severity well above analog samples. Fourth, the average CLQ total score at posttreatment and follow-up (Table 3) was well above normative CLQ scores for healthy controls (i.e., between 24 and 29 points, Radomsky et al., 2001, 2006) indicating that the participants in the current study did not return to a nonclinical level of claustrophobic fear by the end of the study. This likely suggests that additional intervention is needed to achieve clinically significant gains. However, effective one-session treatment for specific phobias has a mean treatment time of 2.1 hours (range 1.0–3.0 hours) indicating that the amount of intervention

provided was close to the recommended dose (Davis et al., 2012). Fifth, experimental demand may have biased participant's behavior throughout the study (e.g., learning that they would receive CR before or after one session of exposure during the informed consent process). We attempted to mitigate experimental demand by communicating that all participants received the same dose and quality of intervention. Sixth, it is possible that experimenter bias influenced results given that the principal investigator completed all of the testing. However, procedures were put in place to mitigate bias including following a scripted protocol, remaining blind to intervention condition until after Screening Step 3, and avoiding data analysis until completing recruitment.

Conclusion

While both cognitive interventions and exposure reduce expectancy, the current study demonstrated that cognitive interventions before exposure do not mitigate gains in an intervention for claustrophobia. As such, clinicians can incorporate cognitive interventions and exposure in an order that is tailored to the case conceptualization of the client. However, the rich history of inhibitory learning and expectancy in exposure demonstrate the importance of challenging a client's conviction in their expected feared outcome through the introduction of competing information (e.g., CS-noUS, Davis et al., 2012; Foa et al., 2006; Rachman, 1974).

There is still a need to better understand the mechanisms underlying the efficacy of exposure therapy. Although the recommendation to avoid cognitive interventions prior to exposure was not supported as a way to optimize inhibitory learning, results from the current study suggest that the overall amount of expectancy reduction throughout an intervention may be an important predictor of outcome.

Authors' Note

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Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Martin Antony has published a number of books on cognitive and behavioral treatments for specific phobias and other anxiety related disorders, and regularly presents workshops on related topics. Kirstyn Krause and Naomi Koerner have no conflicts of interest to declare.

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Notes

1. Four participants reported infrequent (e.g., “twice per year”) use of prescribed benzodiazepines. Eligible participants with a prescription of benzodiazepines refrained from taking this medication within 24 hours of both in-person appointments.
2. In addition, each participant identified a “personal feared outcome” to ensure a tailored approach to treatment in the event that suffocation or restriction were not applicable to the participant. These results were not included in the original manuscript as the pattern of results found for personal feared outcome was the same as that found for suffocation and restriction feared outcomes.

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