Exposure Treatment in Multiple Contexts Attenuates Return of Fear via Renewal in High Spider Fearful Individuals

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Abstract

Background and Objectives: Research has demonstrated that after exposure treatment, re-exposure to a previously feared stimulus outside of the treatment context can result in renewal of fear. The current study investigated whether conducting exposure treatment in multiple real-life contexts can attenuate renewal of fear.

Methods: Forty-six moderate to high spider fearful individuals were randomly allocated to groups that received exposure treatment in either one context or three contexts. Follow-up testing was conducted one week and four weeks after exposure in the treatment context or a novel context.

Results: Renewal of fear was found for the single extinction context group when exposed to the feared object in a novel context with self-report of fear, heart rate, and behavioural avoidance. However, renewal of fear was attenuated for the multiple extinction context group. Furthermore, no renewal was found for the control group that was exposed to the feared object in the treatment context.

Limitations: The sample included moderate to high spider fearful participants rather than clients with spider phobia, potentially limiting the generalisability of the findings to clinical populations.

Conclusions: Using multiple extinction contexts in combination with other methods of attenuating renewal (e.g., context similarity) may provide a means to reduce the risk of renewal of fear.

Keywords: exposure therapy, extinction, renewal, return of fear, context

Exposure Treatment in Multiple Contexts Attenuates Return of Fear via ABC Renewal in Humans

Following succesful exposure based treatment of specific phobias, there is a high risk of relapse of anxiety symptoms e (Choy, Fyer, & Lipsitz, 2007; Rachman, 1966; Rose & McGlynn, 1997; Wolpe, 1958). Conditioning research has provided strong evidence that the renewal effect is a underlying mechanism responsible for return of fear (Bouton, 2002). Over three decades of laboratory research with animals (e.g., Bouton, 1988; 1993) and humans (Neuman, Boschen, & Waters, 2008) and clinical-analogue research (e.g., Mineka, Mystkowski, Hladek, & Rodriguez, 1999; Mystkowski, Craske, Echiverri, & Labus, 2006) has concluded that a renewal of fear may occur when a feared stimulus is encountered outside of the treatment context. Therefore, it is required to establish methods that can enhance the generalisability of exposure treatment across contexts and thereby attenuate renewal of fear.

Laboratory-based research with humans (Bandarian-Balooch & Neumann, 2011; Bandarian-Balooch, Neumann, & Boschen, 2012b) and clinical analogue studies (Rowe & Craske, 1998; Shiban et al., 2013; Vansteenwegen et al. 2007) have found that conducting exposure treatment in multiple contexts attenuates renewal of fear when follow up is conducted in novel contexts (synonymous to ABC renewal in laboratory research). Based on the notion that contextual changes include stimulus feature changes (Bouton & Swartzentruber, 1991), Rowe and Craske (1998) conducted exposure treatment with moderate to high spider fearful participants. Modest support was found for the notion that exposure treatment using multiple stimuli (different spiders) enhances the generalisability of exposure treatment.

Vansteenwegen et al. (2007) exposed a sample of spider anxious students to video footage of a spider in multiple filmed contexts (filmed rooms of a house) or one context.

During follow up testing in a novel context, they found a significant renewal of fear as indicated by self-report of fear and skin conductance for the group that was exposed to the video footage of the spider in one filmed context. Moreover, renewal of fear was attenuated for the group that was exposed to the video footage of the spider in multiple filmed contexts.

More recently, Shiban et al. (2013) attenuated renewal of fear in 40 spider phobic individuals using a virtual spider and multiple virtual contexts that differed by background colour (e.g., red vs yellow coloured walls, floor, and ceiling). Although no virtual context change control group was included, self-reported fear and skin-conductance responses revealed significant renewal of fear to a virtual spider was found for those that received exposure treatment in only one virtual context. For those that received exposure treatment in multiple virtual contexts, renewal was attenuated.

The present study aimed to extend the findings reported by Vansteenwegen et al. (2007) and Shiban et al. (2013). Neither study consistently used real-life contextual changes, possibly limiting the applicability of these studies to real-life clinical situations where contexts: a) may vary by multiple sensory cues (e.g., visual, olfactory, and tactile cues), b) may present unique challenges (e.g., handling a spider in the forest may require different skills to handling a spider in a bathroom), c) may vary on the informative value of the present cues (e.g., some spider hunt in dark places and must be approached more cautiously than in the light). Both experience with a task (e.g., Carr & Durand, 1985) and the informative value of contextual cues (e.g., Léon, Abad, & Rosas, 2010) have been found to moderate attention to contextual cues and consequently affect the context dependence of learning

Shiban et al. (2013) did conduct a behavioural avoidance test (BAT) using a real-life contextual change and spider to examine the generalisability of their virtual reality treatment. However, during this test, group differences were limited to behavioural avoidance

(participant-determined distance to the spider) and participants were not instructed to touch the spider, which potentially resulted in ceiling effects on fear renewal. Nevertheless, the single extinction context group was found to be more avoidant of the real-life spider than the multiple extinction context group, showing some evidence of generalisation to real-life contexts and spiders. Additionally, tests for renewal in both Shiban et al. (2013) and Vansteenwegen et al. (2007) were conducted immediately after treatment. Thus, the long-term effects of exposure treatment in multiple real-life contexts using a real-life spider on renewal of fear remain to be determined.

The current study examined whether conducting exposure treatment in multiple real-life contexts with a real-life spider enhances the generalisability of exposure treatment to novel contexts and attenuates renewal of fear. In contrast to previous studies (e.g., Mystkowski et al., 2006), the current study allowed participants to complete any step they were willing at each stage of testing, to enhance the likelihood of observing avoidance. As participants were required to move freely within and between each context, similar to, for instance, Mystkowski et al. (2006), heart rate was used to measure physiological fear.

Participants were randomly allocated to either a control group (BBB), which received treatment in one context (B) and each follow up in the same context (B), a single extinction context group (BEF), which received treatment in one context (B) and each follow up in a novel context (E and F respectively), or a multiple exposure context group (BCDEF), which received treatment in three different contexts (B, C, and D) and each follow up in a different context (E and F respectively). Follow up testing was conducted one week and again four weeks after treatment for all groups. Screening, pre-treatment, and post-treatment tests were conducted in the exposure treatment context for all groups. It was hypothesized that there would be a renewal of fear as indicated by increases in verbal self-report of fear, heart rate,

and avoidance ratings for the BEF group. It was also hypothesised that renewal of fear would be attenuated for the BCDEF group.[1]

Method

Participants

Forty-Six[2] moderate to extremely fearful participants (36 females and 10 males; age: *M* = 26.52, range = 18 - 55, *SD* = 10.15) scoring between 17 and 26 (*M* = 20.04, *SD* = 0.41) on the Spider Phobia Questionnaire (SPQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974) participated for treatment benefits and/or in exchange for partial course credit. Of the sample, 47.83% were Australian/New Zealander, 10.86% European, 26.08% Asian, 6.52% North American, 4.34% African, and 4.34% South American. Recruitment was via website advertisement or mass testing sessions using the SPQ during university classes. Participants were not formally assessed for spider phobia but were screened at pre-treatment assessment. Participants were randomly assigned to the control group, BBB (*n* = 15), single extinction context group, BEF (*n* = 16), or multiple extinction context group, BCDEF (*n* = 15).

Therapist

The principal author served as experimenter under the supervision of the third author who has extensive experience with using exposure therapy to treat anxiety disorders. The principal author conducted this experiment as part of the research component of his clinical psychology training. To ensure consistency in treatment adherence and pace of treatment across participants, the same exposure hierarchy was used for all participants, a treatment

[1] No hypothesis was made for the BBB group as it acted as a control group for the BEF and BCDEF groups.
[2] Fifty-four people were initially screened and three were excluded due to insufficient pre-treatment avoidance/fear (e.g., touched the spider at pre-treatment and reported fear below 70 on a 100 points scale) and five were removed due to psychological or medical conditions.

manual was devised and used at each session, and the researchers frequently discussed adherence to the treatment manual.

Apparatus

The spider was one non-harmful *Nephila plumipes* (Brunet, 1998) (body length approximately 1.5cm, legspan approximately 10cm). The same spider (contained in a box or cage in all contexts) was used throughout the experiment. The five experimental contexts were authentic locations within the university campus. The contexts included a psychological treatment room, a bathroom, an office, a Faraday cage, and an outdoor patio. The contexts were counterbalanced across groups and phases of the experiment. The contexts naturally varied by size, lighting, colour, furniture, background noise, odour, and colour (green, pink, blue, yellow, white) of therapy tools (papers, pencils, and clipboards). The colour, material, and content of the tarantula cage varied in a relevant fashion to fit the contexts (e.g., white plastic bin containing shampoo bottles and toilet paper in the bathroom vs. a glass container with dirt and branches in the outdoor patio).

Description and Prediction Measures. Participants' self-reported fear of spiders was measured at the start of each session using the SPQ (Cronbach's α= .83 to .90; Klorman et al., 1974). Item 23 on the SPQ was altered to fit an Australian sample (Neumann & Longbottom, 2008).The Depression Anxiety and Stress Scales 21-item version (DASS21, Lovibond & Lovibond, 2005) was used to examine comparability across groups in depression, anxiety and stress levels.

Borkovec and Naus's (1972) treatment credibility questionnaire was used to determine whether potential differences in outcome were due to the credibility of a given type of exposure. The self-report Meta-Cognition Questionnaire (Rowe & Craske, 1998) was used to rate (1 = *none* to 7 = *very much*) the extent and permanence of fear reduction, fearfulness if

confronted with a spider in a novel context, and fearfulness if asked to perform the task again in a couple of weeks.

***Dependent variables*.** The BAT was used to measure participant behavioural avoidance of the spider across groups. The participants were informed of the steps included in the 16-step hierarchy and asked to perform the most anxiety-provoking step they were willing. They were given a maximum of 6 min to do this while the therapist was standing out of sight but able to see the participant. Thus, similar to recent clinical-analogue studies (e.g., Elsesser et al., 2013) participants were given the opportunity to approach or avoid the feared object without fixed approach distances. The set BAT distances and steps corresponded to the 16-step exposure hierarchy treatment (see Table 1). Each step performed by the participant subtracted an avoidance point. Thus, the higher the score of the participant on the BAT the more avoidance they showed.

Self-reported fear using the subjective unit of distress ratings (SUDS; Wolpe, 1973) was also used. These ratings were collected during each BAT. The SUDS ratings were used by the participants to rate their current fear levels on a 100 point scale (0 = *no fear*, 25 = *mild fear*, 50 = *moderate fear*, 75 = *severe fear* and 100 = *very severe fear*) before (anticipated SUDS) and during (max SUDS) each BAT.

The physiological measure of fear was participants' heart rate (HR). Heart rate was recorded continuously using an ambulatory monitor (RS8000CX, Polar CIC, Inc.) before and after each BAT. Heart rate signals averaged over one second intervals were transmitted from an electrode belt strapped under the participants' lower rib cage to a wrist receiver unit carried by the experimenter and later uploaded to a computer for analysis. A 5 min HR acclimatization period was provided at the start of each session. Also, a 5 min HR baseline measurement period was provided before each BAT. Heart rate change scores were calculated

by subtracting HR during the BATs from baseline for each session. Positive HR change scores indicated more arousal associated with fear.

Procedure

The procedure consisted of three sessions lasting a maximum of 4 hours. The initial session included 35 min of pre- and post-exposure assessment and 1 hour and 45 min of exposure treatment. The follow up testing sessions one (FU1) and four weeks (FU2) after exposure were 35 min each. Participants were randomly assigned to one of the treatment groups BBB, BEF, or BCDEF where they received a single session graded exposure treatment in one (B) or three contexts (BCD). Follow up BATs were completed in the initial exposure context (BBB group) or in novel contexts (BEF and BCDEF groups).

During pre-treatment assessment, set in the exposure context, participants were asked to provide written consent, complete the Psychological and Medical Treatment History Questionnaire, DASS21, SPQ, and provide their SAM ratings. Subsequently, the Treatment Credibility Questionnaire was completed and participants were taught to use the SUDS scale. Next, the HR equipment was attached and a 5 min acclimatization period and 5 min HR baseline was recorded. Next, the spider was placed 3 m opposite the participant and the participant was asked to perform a self-chosen step on the hierarchy and report their fear level at that distance, providing pre-treatment SUDS, HR, and avoidance data. This final requirement initiated the exposure session.

The exposure was a single session in vivo exposure treatment based on a standard fear hierarchy (Öst, 1989) similar to that used in previous studies on return of fear of spiders (e.g., Mineka et al., 1999). Table 1 shows each step of the exposure hierarchy along with the associated BAT score. The therapist modelled each step and provided encouragement until the participant reported being ready to do the same. Participants rated their maximum fear at

the current step and anticipated fear of the next step of the hierarchy. When a participant's fear during the current step of the hierarchy dropped to 10 or below on the 100 point SUDS scale (corresponding to very low levels of fear) the participant was prompted to perform the step again in the absence of the therapist. Subsequently, they were asked to perform the next step of the hierarchy.

The order of exposure contexts was counterbalanced between exposure and follow up, such that an exposure context for some participants, was used as a follow up context for other participants in the same group. To control total exposure duration and time spent in each context, participants were transferred from one context to the other based on time with 30 min allotted to each context or the step of the hierarchy reached (7 and 12) of the exposure hierarchy. A 2 min transfer period was allotted to each context change. When the 2 min ended, the exposure was resumed.

Treatment was completed when all steps of the hierarchy were completed. Subsequently, participants were given a 5 min resting period with the spider absent to provide the post-treatment baseline HR. Next, participants were asked to again complete the final step of the hierarchy in the absence of the therapist (BAT-post), providing the post-treatment SUDS, HR, and avoidance data. After this, participants completed the Meta-cognition Questionnaire, Credibility Ratings Questionnaire, and were debriefed.

The follow-up dates were set at the same day of the week, exactly one week and four weeks post treatment. Day of testing was only delayed (two days later than the pre-arranged FU2 date) with a participant in the BEF group and another in the BCDEF group. During each follow up, the descriptive measures were completed and participants were asked to complete the highest step of the hierarchy that they could in the absence of the therapist.

Scoring and Statistical Analysis

Mixed model ANOVAs were used for the primary analyses. The dependent variables were the SUDS, HR, and avoidance ratings. For the SUDS ratings, the anticipated and maximum fear ratings showed the same pattern and there were never any significant differences between the measures. Therefore, for brevity, only the maximum SUDS ratings data are presented. The independent variables were treatment type (BBB, BEF and BCDEF) and time (pre, post, FU1 and FU2).

Separate one-way ANOVAs revealed no significant pre-treatment differences between the groups on age, DASS-21, SPQ, treatment and therapist modelling duration, arousal evoked by contexts (compared using HR acclimatization and HR baseline data), and treatment credibility, all Fs < 2.17, ps > .05. Post hoc analyses used t-tests adjusted for Type I error with a Bonferroni correction. For brevity, only statistically significant results are reported. The statistical significance was set at an α-level of .05.

Results

Treatment Results

Separate 3 × 2 (Group × Time) ANOVAs comparing pre-treatment and post-treatment scores revealed a main effect of Time for the SUDS, $F(1, 43) = 787.13$, $p < .001$, $\eta_p^2 = .95$, HR change, $F(1, 43) = 121.30$, $p < .001$, $\eta_p^2 = .74$, and avoidance ratings, $F(1, 43) = 2186.99$, $p < .001$, $\eta_p^2 = .98$. No group main effects or interactions were found. Figures 1, 2, and 3 show the results for the SUDS, HR, and avoidance ratings, respectively. Collectively, it can be seen that all measures of fear significantly reduced from pre to post-treatment. All participants (except one)[3] were able to complete the final step of the hierarchy at post-treatment.

[3] One participant in the BB group was only required to complete step 15 at maximum during post-treatment testing, due having to disrobe to reveal her naked sholder.

Renewal

A series of 3 × 2 (Group × Time) ANOVAs comparing each dependent variable from post-treatment to FU1 and post-treatment to FU2 were conducted. As can be seen in Figures 1, 2, and 3, there was a significant increase in SUDS, HR, and avoidance measures for all groups between post-treatment to subsequent follow up sessions. This increase is likely due to the expected spontaneous recovery effect caused by the delay from post-treatment to follow up. However, of specific interest to renewal testing, the BEF group showed an overall pattern of larger fear than the BBB and BCDEF groups at each follow up. This pattern indicates that renewal of fear was attenuated by conducting exposure treatment in multiple contexts.

SUDS Post-Treatment to FU1 and FU2. Post-treatment to FU1 results (see Figure 1) showed a significant main effect of Time, $F(1, 43) = 63{,}80$, $p < .001$, $\eta_p^2 = .60$, a significant main effect of Group, $F(1, 43) = 9.43$, $p < .001$, $\eta_p^2 = .31$, and a significant Group × Time interaction, $F(2, 43) = 14{,}78$, $p < .001$, $\eta_p^2 = .40$. Within groups post hoc analyses showed that fear significantly increased between post-treatment and FU1 as a function of time alone for all groups, all ts > 2.65, ps < .012, ds > 0.71. Between groups post hoc analyses revealed that both the BBB and BCDEF groups reported significantly lower fear than the BEF group at FU1 ts > 3.70, ps < .012, ds > 0.99. No significant difference was found between the BBB and BCDEF groups $t(28) = 0.86$, $p = .85$, $d = 0.11$.

Post-treatment to FU2 analyses (see Figure 1) showed a significant main effect of Time, $F(1, 43) = 62{,}00$, $p < .001$, $\eta_p^2 = .60$, a significant main effect of Group $F(1, 43) = 9.78$, $p < .001$, $\eta_p^2 = .30$, and a significant Group × Time interaction, $F(2, 43) = 9{,}63$, $p < .001$, $\eta_p^2 = .31$. Within groups post hoc analyses revealed significant increases in SUDS ratings from post-treatment to FU2 for all groups ts > 2.43, ps < .012, ds > 1.59. Between groups post hoc analyses revealed that the BEF group reported significantly higher SUDS ratings than the

BBB and BCDEF groups, *t*s > 3.38, *p*s < .012, *d*s > 1.28 at FU2. There was no significant difference between the BBB and BCDEF groups at FU2 $t(28) = 0.91$, $p = .36$, $d = 0.38$.

HR Post-Treatment to FU1 and FU2. Post-treatment to FU1 results (see Figure 2) revealed a main effect of Time, $F(1, 43) = 14.06$, $p = .001$, $\eta_p^2 = .25$ and a significant Group × Time interaction, $F(2, 43) = 4.52$, $p = .0.17$, $\eta_p^2 = .17$. Within groups post hoc analyses revealed that there was a significant increase in HR for the BEF group from post-treatment to FU1, $t(15) = 3.9$, $p = .001$, $d = 1.20$. However, no significant increases in HR was observed for the BBB or BCDEF groups from post-treatment to FU1, *t*s < 1.37, *p*s > .19, *d*s < 0.35. Between groups post hoc comparisons at FU1 showed significantly lower HR for the BBB group than the BEF group, $t(29) = 4.20$, $p < .001$, $d = 1.12$. No further group differences were found, *t*s < 2.00, *p*s > .05, *d*s < 0.35.

Post-treatment to FU2 analyses (see Figure 2) revealed a main effect of Time, $F(1, 43) = 22.75$, $p < .001$, $\eta_p^2 = .35$, a main effect of Group, $F(1, 43) = 19.30$, $p = .009$, $\eta_p^2 = .20$, and a significant Group × Time interaction, $F(2, 43) = 8.63$, $p = .001$, $\eta_p^2 = .29$. Within groups post hoc analyses confirmed a significant increase in HR from post-treatment to FU2 for the BEF and BCDEF groups, *t*s > 2.88, *p*s < .012, *d*s > 0.66, but not the BBB group, $t(14) = .38$ $p = .47$, $d = 0.01$. The analyses showed significantly lower HR in the BBB group than the BEF group at FU2, $t(29) = 3.55$, $p = .001$, $d = 1.31$. With no other group differences reaching significance when corrected for Type I error, *t*s > 1.9, *p*s > .013, *d*s > 0.60.

Avoidance Post-treatment to FU1 and FU2. Post-treatment to FU1 (see Figure 3) analyses only a main effect of Time, $F(1, 43) = 19.51$, $p < .001$, $\eta_p^2 = .31$. Figure 3 shows that all groups significantly increased in avoidance from post-treatment to FU1. Post-treatment to FU2 analyses revealed a significant main effect of Time, $F(1, 43) = 28.34$, $p < .001$, $\eta_p^2 = .40$, a main effect of Group, $F(1, 43) = 3.40$, $p = .04$, $\eta_p^2 = .14$, and a Group × Time interaction

$F(2, 43) = 3.70$, $p = .033$, $\eta_p^2 = .15$. Within groups post hoc analyses confirmed a significant increase in avoidance for all groups from post-treatment to FU2, ts > 2.6, ps < .013, ds > 0.93. Between groups analyses revealed significantly larger avoidance ratings in the BEF group than the BBB and BCDEF groups, ts > 3.97, ps < .013, ds > 0.74. No difference was found between the BBB and BCDEF groups at FU2, $t(29) = 0.15$, $p = .88$, $d = 0.11$.

Discussion

The current study demonstrated successful treatment of moderate to high spider fear using one session exposure treatment (Öst, 1989). Subsequently, results demonstrated that renewal of fear occurred when exposure treatment was conducted in one context when subsequent fear tests were conducted in novel contexts, confirming the first hypothesis. These results support laboratory studies (e.g., Bandarian-Balooch et al., 2012b; Effting & Kindt, 2007, Milad et al., 2005; Neumann & Longbottom, 2008) and clinical-analogue studies (e.g., Dibbets et al., 2013; Mineka et al., 1999),where a contextual mismatch between treatment and post-treatment phases resulted in renewal of fear.

A strength of the current study is that, similar to a small number of previous clinical-analogue studies (Culver et al., 2011; Dibbets et al., 2013; Rodriguez et al., 1999; Shiban et al., 2013), renewal was found with a triad of measures including verbal (SUDS), physiological (HR), and behavioural (avoidance) measures. Previous research has suggested that ceiling and floor effects may be responsible for difficulties to detect renewal of fear with non-verbal measures of fear (Mineka et al., 1999; Mystkowski et al., 2006). To increase the likelihood of observing renewal with HR and avoidance measures, (for a discussion see, Bandarian-Balooch et al., 2013) the current study increased the hiatus between treatment and final follow up testing. Larger effect sizes were observed for the differences between FU1 and FU2 in the Group × Time interactions for the HR ($\eta_p^2 = .17$ vs. $\eta_p^2 = 29$,) and avoidance

measures (η_p^2 = 12 vs. η_p^2 = .15) but not the SUDS ratings (η_p^2 = .40, vs. η_p^2 = .31). Thus, some important group differences only became apparent at FU2. These results supported previous recommendations that increasing the hiatus between treatment and follow up testing can increase the likelihood of observing renewal with a triad of measures.

More importantly, the results of the current study provide strong evidence that renewal of fear can be attenuated by conducting exposure treatment in multiple real-life contexts, confirming the second hypothesis. These results are consistent with investigations of the effects of multiple extinction contexts on renewal in the animal literature (e.g., Chelonis et al., 1999; Thomas et al., 2009),human conditioning literature (e.g., Bandarian-Balooch & Neumann, 2011; Bandarian-Balooch et al., 2012b), and clinical-analogue research using video technology (Vansteenwegen et al., 2007) or virtual reality technology (Shiban et al., 2013) . The current study adds to previous literature by confirming that exposure treatment of fear of spiders in multiple real-life contexts can attenuate renewal of fear.

Interestingly, the HR data, which is arguably more objective than SUDS ratings, only supported partial attenuation of renewal. Thus, it is possible that the use of multiple extinction contexts alone is not enough to fully attenuate renewal. Numerous other methods of attenuating renewal have been identified (for a review see Bandarian-Balooch, Neumann, & Boschen, 2012a; Bandarian-Balooch et al., 2013; Boschen, Neumann, & Waters, 2009), which may be effectively combined with exposure in multiple contexts to attenuate renewal. For instance, previous laboratory studies completely attenuated renewal by combining multiple extinction contexts with extended exposure (Thomas et al., 2009) and context similarity (Bandarian-Balooch & Neumann, 2011). Future research could combine extended exposure or context similarity with exposure in multiple contexts using clinical samples to

examine whether this maximizes treatment benefits and reduces the likelihood of renewal of fear occurring.

The effects of extinction treatment in multiple contexts on renewal of fear can be explained using Bouton's (e.g., 1994) memory model of learning. According to this model, during fear acquisition learning CS-US associations (e.g., spider-pain associations) are learnt and stored in memory. During extinction treatment, CS-noUS associations (e.g., spider-no pain associations) are learnt and stored in memory alongside CS-US associations and this makes the relationship between the CS and US inherently ambiguous. When the feared object (CS) is encountered following treatment, the ambiguity between the CS and US is resolved by the memory retrieval cues available in the environment. If the cues present in the follow up context overlap more with the treatment context than the acquisition context, the CS-noUS association will be retrieved and a renewal of fear will be attenuated. If not, then the CS-US association will be retrieved and a renewal of fear will occur.

Thus, the more cues present from the exposure treatment context at follow up, the more likely that the CS-noUS association will be retrieved and renewal will be attenuated. Results consistent with this explanation have been found in human laboratory based conditioning research with ABA renewal designs (Bandarian-Balooch & Neumann, 2011). In the present experiment, contexts were manipulated by changing factors such as location, spider boxes and their contents, and exposure tools. Some of the cues present in these environments (e.g., colour, shape, and size of walls, floors, and materials used) were similar. For the BCDEF group conducting exposure treatment in multiple contexts theoretically created more overlapping cues between the exposure treatment and novel follow up contexts when compared to the initial fear acquisition context and novel follow up contexts. Therefore, the CS-noUS association was retrieved for this group during follow up testing and renewal of

fear was attenuated. Conversely, for the single exposure context group (BEF) it appears that the overlap in contextual cues between the treatment context and follow-up context were not sufficient to avoid the retrieval of the CS-US association resulting in a renewal of fear.

Further explaining the current results is the evidence that increased experience, defined as learning with diverse examples, settings, and stimuli (for review see Stokes & Baer, 1977) reduces the context specificity of non-fear related learning (e.g., problem solving skills). Attention theories, which are built as extensions of the memory model of retrieval (for a review, see Rosas, Callejas-Aguilera, Ramos-Álvarez, & Abad, 2006), suggest that increased experience enhances the predictability of the stimuli and reduces attention to the context (Myers & Gluck, 1994). In turn, this reduces the context specificity of learning. This notion is important because it suggests that diversifying experience during exposure treatment increases the generalisability of extinction learning and reduces attention to contextual cues.

In the current study, the use of multiple real-life contexts provided participants in the BCDEF group with more diverse exposure treatment experience than the BEF group. The spider cage contents were different in each context and the spider would position itself differently in each cage. Thus, each cage required a unique method of picking up the spider. For instance, in the patio context the spider frequently sat on a branch, which participants used to lift the spider from the cage. On the other hand, the contents of the computer lab cage (computer mouse, coffee cup, small diary) were slippery and could not easily be used to lift the spider. Instead, participants frequently allowed the spider to climb onto their sleeves when removing it from the cage. Consequently, the BCDEF group learnt to handle the spider using different techniques. The diverse set of skills learnt by those in the BCDEF group potentially increased their perception of predictability of the spider and reduced their attention to the treatment context. The reduced attention to contextual cues potentially enhanced the

generalisability of exposure learning to novel contexts, which attenuated renewal of fear. Future research could test this notion further by systematically controlling for the diversity of experience with handling a spider and testing for differential recall of contextual stimuli.

The current experiment had some limitations. Firstly, similar to previous research (e.g., Culver et al., 2011; Rodriguez et al., 1999) it used moderate to high spider fearful participants rather than clients with spider phobia. This limitation can be overcome by using clinically phobic participants similar to (Shiban et al., 2013). Secondly, unlike previous studies (e.g., Mineka et al., 1999; Mystkowski et al., 2006), the current study used the same therapist throughout the experiment and the groups were not blind to the therapist. This potentially resulted in experimenter and participant allegiance effects, which may have affected the results. For instance, the discrepancy between SUDS ratings and HR data at follow up may reflect participant attempts to please the experimenter by reporting lower fear than actually experienced. To control for potential allegiance effects, treatment was standardized and the experimenter was absent during post-treatment and follow up BATs. However, future research can further these attempts by also conducting BATs with researchers who are unaware of group allocation.

In conclusion, the current study observed verbal, physiological, and behavioural evidence that renewal can be attenuated by conducting exposure treatment in multiple contexts, supporting previous studies in rats (e.g., Chelonis et al. 1999) and humans (e.g., Bandarian-Balooch & Neumann, 2011; Bandarian-Balooch et al., 2012; Shiban et al., 2013; Vansteenwegen et al., 2007). These findings provide clinicians with a greater understanding of the role of the context in relapse and how the likelihood of relapse can be reduced by making small but important adjustments to already empirically validated behavioural treatment protocols.

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Declaration of Interest

The authors have no conflicts of interest to declare.

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Table 1

The 16 Step Exposure Hierarchy and Associated BAT Score.

BAT Step	BAT Score	Action Required at Each Step
1.	16	Stand 3 metres away from the spider in a closed cage.
2	15	Stand 2 metres away from the spider in a closed cage and look the spider.
3	14	Stand 1 meter away from the spider in a closed cage and look at the spider.
4	13	Place your hand on the closed spider cage.
5	12	Place both your hands on the spider cage and your face within 0.5 metres of it.
6	11	Stand at an arm's length to the open spider cage and concentrate on the spider.
7	10	Using a 20cm long stick, gently direct the movement of the spider.
8	9	Touch the spider with boxing gloves.
9	8	Allow the spider to be placed and walk on your boxing-gloved hand.
10	7	Touch the spiders with latex gloves.
11	6	Allow for the spider to be placed and walk on your latex-gloved hand.
12	5	Touch the spider with bared index finger.
13	4	Allow for the spider be placed and walk on your bared hand.
14	3	Allow for the spider to be placed and walk on your covered arm.
15	2	Lift the spider from the cage and place it on your naked lower arm.
16	1	Lift the spider from the cage and place it on your naked shoulder.

Note. BAT = Behavioural Approach Task, higher scores indicate higher avoidance of the spider. Each step was performed in the presence and absence of the therapist (therapist was out of sight). For the multiple extinction context group (BCDEF) the exposure treatment was momentarily stopped and the participant guided to the next exposure treatment context either at a 30 minute interval or at steps 7 and 12. For the participants in the single extinction context groups (BBB and BEF) the exposure treatment was momentarily stopped and the spider carried out of the room along with its cage at a 30 minute interval or steps 7 and 12.

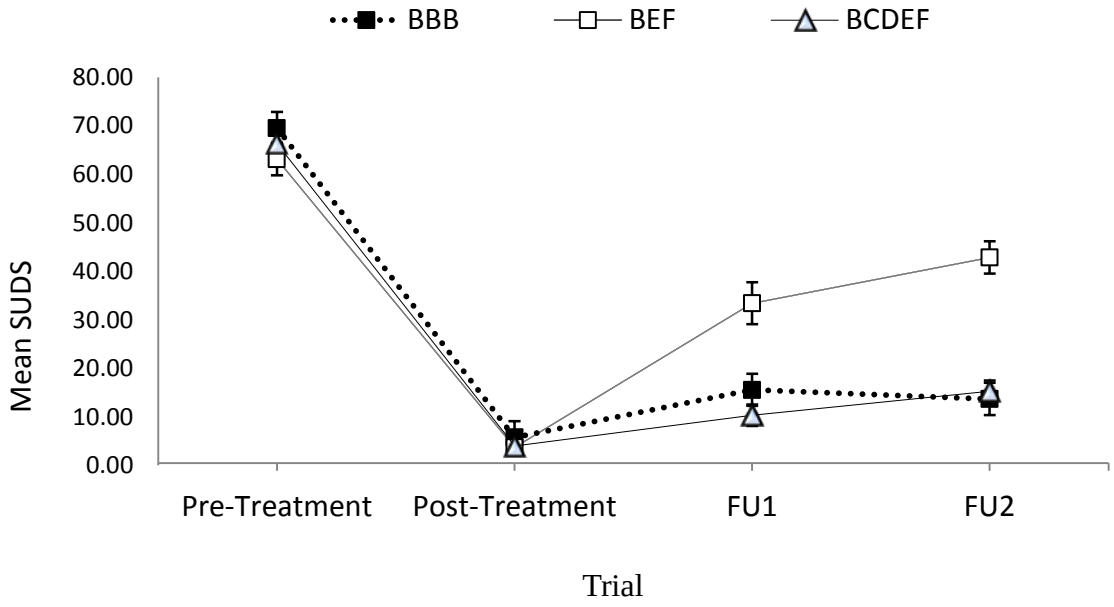

Figure 1. Mean SUDS ratings for BBB, BEF, and BCDEF groups separately from Pre-Treatment, to Post-Treatment, to FU1 and FU2. Error bars reflect the standard error of the mean.

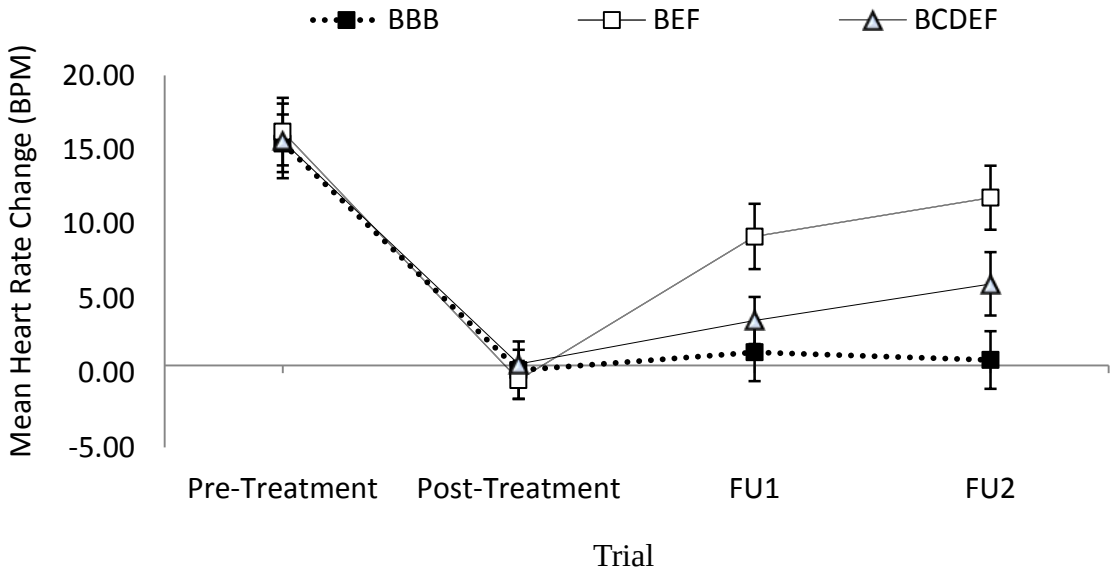

Figure 2. Mean heart rate change scores (BPM = beats per minute) for the BBB, BEF, and BCDEF groups separately from Pre-Treatment, to Post-Treatment, to FU1 and FU2. Error bars reflect the standard error of the mean.

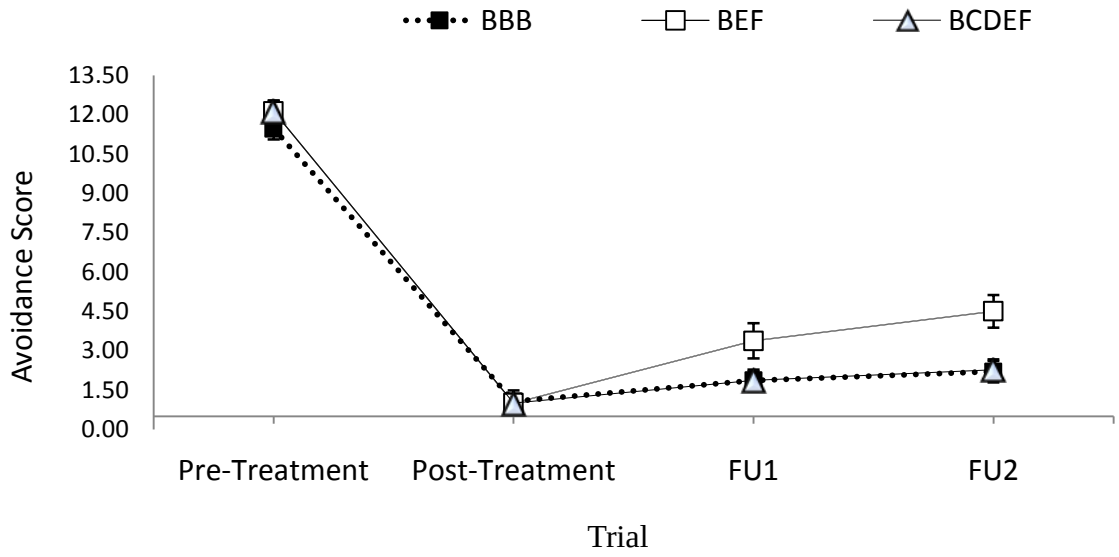

Figure 3. Mean avoidance scores for the BBB, BEF, and BCDEF groups separately from Pre-treatment to Post-treatment, to FU1 and FU2. Error bars reflect the standard error of the mean.