Reaching new heights: Comparing interpretation bias modification to exposure therapy for extreme height fear

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Abstract

Cognitive models of anxiety posit that biases in interpretation maintain, and potentially cause, anxiety disorders. This study tested whether it is possible to decrease height fear symptoms through cognitive bias modification for interpretations (CBM-I). Additionally, the clinical utility of CBM-I was tested by comparing it to an already established treatment: exposure therapy. Extremely height fearful (*N*=110) individuals participated in the study. Acrophobic symptoms were measured before and after two sessions of CBM-I, and compared to the standard treatment for acrophobia (exposure therapy), a combination of CBM-I and exposure therapy, and a Control condition. As a secondary goal, the current study examined the attenuation of perceptual bias following height fear reduction.

In line with hypotheses, participants in all three active conditions (but not the Control condition) experienced a decrease in height-relevant interpretation bias, symptoms, and behavioral avoidance. Of note, symptom change was mediated by change in interpretation bias. Additionally, as expected, changes in outcome measures tended to correlate with each other. Further, symptom reduction for all active conditions was maintained or further reduced at one-month follow-up. Surprisingly, results only provided very minimal evidence for the attenuation of perceptual bias following fear reduction. Overall, findings suggest that different pathways of fear reduction (exposure vs. shifting interpretations) can lead to similar reductions in height fear. This study provides the first evidence that directly shifting cognitive processing, even with no

therapist involvement, can reduce symptoms as effectively as the gold standard, therapist-directed exposure therapy.

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Introduction

Exposure therapy, in which people confront their feared stimuli and try to remain in the situation until their fear declines, is currently the gold standard for phobia treatment. Meta-analyses and literature reviews have shown that the beneficial effects of exposure are robust and gains are maintained or improved over time (e.g., Choy, Fyer, & Lipsitz, 2007; Wolitzky-Taylor, Horowitz, Powers, & Telch, 2008). Despite the well-documented success of exposure therapy, many phobic individuals do not improve, or find confronting their feared stimuli aversive, and consequently drop out of or avoid treatment (e.g., Choy et al.). In fact, data from the Epidemiologic Catchment Area study showed that approximately 70% of people with diagnosable phobias had not sought treatment, and of those who had, less than 50% sought services specific to psychological health (see Wolitzky-Taylor et al. for review). Given these limitations, there is a clear need to explore alternate approaches to phobia treatment.

The current study evaluates a new approach to the treatment of phobias: cognitive bias modification for interpretations (CBM-I) for individuals with extreme height fear. To examine the utility of modifying interpretation biases, height fear and related symptoms were measured before and after two sessions of CBM-I, and compared to an Exposure Only condition, a combination of CBM-I and exposure therapy (labeled CBM-I+Exposure), and a Control condition.

Acrophobia and interpretation bias

Acrophobic individuals have biases in their judgments and interpretations such that they tend to overestimate danger and doubt their ability to cope in height-relevant

situations. For example, they report higher estimates of the likelihood of falling from heights and higher estimates of the probability of injury resulting from heights compared to non-phobic control participants (Menzies & Clark, 1995; Williams & Watson, 1985). Of note, biased height-relevant interpretations have been shown to predict fear and avoidance on actual heights (Steinman & Teachman, 2011). Additionally, acrophobic individuals are prone to interpret ambiguous bodily sensations as threatening compared to non-fearful individuals (Davey, Menzies, & Gallardo, 1997). The current study expands on this correlational research by attempting to directly modify height fear-relevant threat interpretations and examining the effects on subsequent height fear. Specifically, the experimental intervention in this study attempts to modify interpretations about whether or not heights are dangerous, and whether or not individuals can cope with their anxiety while on heights. Modifying interpretations is expected to be an effective tool for reducing height fear given the centrality of biased interpretations in cognitive models of anxiety (e.g., Beck & Clark, 1997; Beck, Emery, & Greenberg, 1985; Williams, Watts, MacLeod, & Mathews, 1997). As Beck and Clark state, "It is the propensity of this information processing apparatus to inappropriately generate threat meaning assignments to innocuous stimuli that is the main problem that must be rectified in the treatment of anxiety disorders" (p. 51).

A growing number of studies have shown that it is possible to directly manipulate interpretive biases using brief computerized paradigms in which participants read and imagine themselves in a string of emotionally ambiguous scenarios that are resolved in a non-threatening way (a paradigm referred to in the current study as Scenario Training).

For instance, researchers have used modifications of Scenario Training to induce healthier interpretations in participants with high levels of social anxiety (Murphy, Hirsch, Mathews, Smith, & Clark, 2007), trait anxiety (Mathews, Ridgeway, Cook, & Yiend, 2007), spider fear (Teachman & Addison, 2008), anxiety sensitivity (Steinman & Teachman, 2010), obsessive compulsive symptoms (Clerkin & Teachman, 2011), and worry (Hirsch, Hayes, & Mathews, 2009). Moreover, there is mounting evidence that Scenario Training can reduce subsequent reports of anxiety symptoms on questionnaires (e.g., among individuals with high levels of worry: Hirsch et al.; trait anxiety: Mathews et al.; anxiety sensitivity: Steinman & Teachman).

Complementing the effects of Scenario Training, Beard and Amir (2008) created an additional paradigm (Interpretation Modification Paradigm, or IMP) to train participants high in social anxiety symptoms to make benign interpretations and reject threatening interpretations. In IMP, participants saw a word representing either a benign interpretation or a threat interpretation, followed by an ambiguous sentence. In the Positive training condition, participants were told they were correct if they responded that the ambiguous sentence and the benign interpretation word were related or that the ambiguous sentence and the negative interpretation word were not related. Otherwise, they were told they were incorrect. Compared to a Control condition, Positive training resulted in fewer threat interpretations and more benign interpretations of subsequent ambiguous sentences, and lowered social anxiety symptoms as measured by a questionnaire. Because using multiple CBM-I approaches may strengthen effects by

targeting multiple facets of interpretation bias (see Hirsch et al., 2009), a combination of Scenario Training and IMP was used in the current study.

A recent meta-analysis evaluating CBM for anxiety and depression found that CBM-I significantly decreased interpretation bias, anxiety, and emotional vulnerability when presented with a stressor (Hallion & Ruscio, 2011). However, effects for reduction of anxiety were small, especially for single-session interventions. Thus, in addition to combining CBM-I paradigms, the current study also used multiple sessions of CBM-I to strengthen effects. Additionally, participants repeated the CBM-I paradigms within each training session with slight variations (e.g., read silently, read aloud) to both enhance learning and to maintain participants' engagement. Further, time between CBM-I sessions and testing outcomes was incorporated so that individuals had the opportunity to practice using their new, healthier interpretations in real-life situations. Thus far, to our knowledge, CBM-I has only been compared to Neutral or No Training conditions, and other computerized treatments (e.g., Bowler et al., 2012). In order to determine the clinical utility of CBM-I, a logical next step is to compare CBM-I to an already established, gold standard treatment.

Mechanisms of change

The cognitive mediation hypothesis of cognitive models of anxiety theorizes that changes in cognition lead to changes in anxiety (e.g., Beck et al., 1985). In fact, Hollon, Stewart, and Strunk (2006) stated, "Change in what people believe and the way they process information is the primary mechanism of change" in cognitive therapy (p. 293). Surprisingly, relatively few studies have examined whether cognition is a mediator of

cognitive-behavioral treatment effects (see Teachman, Beadel, & Steinman, in press). A small, but growing number of studies provide support for the cognitive mediation hypothesis, such that they have found evidence of change in cognition (e.g., interpretation bias, judgment bias) both preceding, and partially or fully mediating, changes in anxiety (e.g., Smits, Rosenfield, McDonald, & Telch, 2006; Teachman, Marker, & Clerkin, 2010). Further, as expected, a growing number of studies have found that change in interpretation bias mediates training effects for CBM-I (e.g., Beard & Amir, 2008). The current study extends this line of research by evaluating whether change in cognition (i.e., height-relevant interpretation bias) is a mechanism of change in height fear for the active treatment conditions (Exposure Only, CBM-I Only, and Exposure+CBM). Given that CBM-I is designed to modify interpretation bias, and the growing evidence that cognitive-behavioral treatments reduce fear through change in cognition, it is hypothesized that change in interpretation bias will mediate intervention effects on height fear for all three active conditions.

Attenuation of perceptual bias

Recently, a small but accumulating number of studies has shown that people with height fear actually see heights differently from non-fearful individuals (e.g.,Teachman, Stefanucci, Clerkin, Cody, & Proffitt, 2008), especially if they are reminded about the potential costs of being in a high environment (e.g., falling; Clerkin, Cody, Steffanucci, Proffitt, & Teachman, 2009). An important next step in this line of research is to examine the malleability of perceptual biases following fear reduction. This will help determine if change in fear is causally linked to biased perception.

A potential explanation for biases in perception stems from theories of embodied cognition, which suggest that visual perception "promotes survival by making us aware of both the opportunities and costs associated with action" (Proffitt, 2006, p. 11). Given that height fear is related to increased estimates of the probability of danger and injury when confronted with a height (Menzies & Clark, 1995), the costs associated with acting in height-relevant locations are likely to be perceived as much higher for height-fearful relative to non-fearful individuals. Consequently, visual perception of heights may also differ based on fear level. Teachman et al. found that compared to non-fearful individuals, people high in height fear overestimate heights (when viewed from above). Moreover, it has been shown that people overestimate heights more after they imagine themselves falling, particularly if they are high in acrophobia symptoms (Clerkin et al.). This suggests that acrophobic individuals may be especially vulnerable to perceptual biases when triggered by a stressor (e.g., imagery of falling off a balcony). To increase the likelihood of seeing biased perception in the current study, perception measurements were preceded by guided imagery exercises in which participants imagined themselves falling.

The malleability of perceptual biases was examined by comparing the expected overestimation of heights before and after height fear reduction procedures. It was hypothesized that the three active conditions would reduce the perceived costs of acting in height environments, and consequently would reduce perceptual bias. Additionally, it was expected that the Control condition would not affect perception of heights. Finally, it was hypothesized that changes in perceptual bias would correlate with changes in other

height fear measures. Theoretically, this would provide support for models of embodied perception and would be consistent with the idea that height fear is causally related to perception.

Overview and hypotheses

Individuals with extreme height fear were assigned to two sessions of CBM-I Only, Exposure Only, CBM-I+Exposure, or a Control condition. In the CBM-I+Exposure condition, participants completed each individual intervention for half as much time as participants in either of the stand-alone intervention conditions. Thus, we are not able to fully separate the effects of combining the interventions from that of time spent in each intervention. This design choice was made because of the importance of keeping total treatment time equivalent across conditions, which we felt was ultimately more important than keeping each intervention dose equivalent.

It was expected that following treatment, participants in the three active treatment conditions (but not the Control condition) would show significant reduction in interpretation biases, height fear, and related symptoms. Additionally, it was hypothesized that the CBM-I+Exposure condition would show the greatest reduction. MacLeod, Koster, and Fox (2009) predict that using cognitive bias modification, such as CBM-I, with traditional treatments will result in "therapeutic synergies" in which conventional therapy approaches and bias modification positively impact each other. Given that threat meaning assignment is thought to play a central role in anxiety disorders (e.g., Beck & Clark, 1997), and given the wide support for exposure procedures in the treatment of anxiety (e.g., Wolitzky-Taylor et al., 2008), a treatment that both targets the

ascription of threat meanings (through CBM-I) and includes exposures may outperform a treatment with only one of these two components. Additionally, it was expected that changes in outcome variables would correlate with each other, and that change in interpretation bias would mediate change in height fear. Finally, this study examined the malleability of perceptual biases to explore if fear reduction attenuates the anticipated overestimation of heights.

Overall, the current study provides a first look at how interpretation bias modification compares to and may complement exposure procedures, the current gold standard for phobia treatment.

Methods

Participants and recruitment

Extremely height fearful students and community members were recruited through the university's psychology department participant pool, flyers, and newspaper advertisements. Individuals were offered course credit or $50 compensation for participation. Potential participants completed the Acrophobia Questionnaire-Anxiety subscale (AQ-Anxiety; Cohen, 1977). Individuals had to score at least a 45.45 on the AQ-Anxiety (i.e., within one standard deviation below the mean in a previous acrophobic sample; Cohen, 1972) to be considered for study inclusion[1]. Individuals who met criteria were screened over the phone using the Specific Phobia section of the Structured Clinical

[1] To reduce the number of participants who were screened over the phone and unlikely to meet inclusion criteria, potential participants completed three modified questions from the SCID at the same time that they completed the AQ-Anxiety, asking individuals to rate whether: 1) they are more afraid of heights than they should be or than makes sense, 2) they go out of their way to avoid heights, and 3) their feelings towards heights distress them or get in the way of things they want to do. The items used a 0 (*not at all*) to 6 (*extremely*) scale, and participants had to endorse at least a "2" on one or more of the three questions to be phone screened.

Interview for the Diagnostic and Statistical Manual of Mental Disorders (4th ed., SCID; First, Spitzer, Gibbon, & Williams, 1994). Participants included in the study scored in the subthreshold or threshold range for all criteria on the SCID during the phone screen. However, ten individuals participated in the study despite not endorsing one criterion, so to be conservative, we describe our sample as "extremely height fearful" rather than "subthreshold to threshold acrophobic," despite our sample being similar to a diagnosed sample. In fact, our sample's mean on the AQ-Anxiety at baseline (M = 62.30; SD = 12.73) was slightly above that of a previous, diagnosed acrophobic sample (M = 61.30; SD = 15.85; Cohen, 1972).

See Figure 1 for a Consolidated Standards of Reporting Trials (CONSORT) diagram that details exclusion and attrition during recruitment. The final sample included 110 participants (75.5% female). Eighty participants were recruited through the psychology department participant pool, and 30 were recruited through flyers or newspaper advertisements. The mean age of the sample was 23.63 years (SD = 11.38, range = 18 - 67). The reported race of the participants was White (68.2%), Asian (18.2%), Black/African American (7.3%), multiple ethnicities (4.5%) and other (1.8%). Note that one participant (in the Exposure Only condition) dropped out of the study following the baseline assessment, due to scheduling issues. No other participants dropped out after beginning the study. This study received approval from, and complies with, the university's Institutional Review Board (IRB).

Materials [2]

[2] Not all measures included in the study are reported here. In particular, Size Estimation, a second visual matching task that was completed on the balcony is not reported here. Due to experimenter error, the data

Unless otherwise noted, all measures listed below were administered during a baseline assessment, and again at a post-intervention assessment, to evaluate effects of the interventions on height fear.

Height fear measures

The Acrophobia Questionnaire (AQ; Cohen, 1977) is a 40-item Likert-type questionnaire that asks participants to rate their anxiety (AQ-Anxiety) and avoidance (AQ-Avoidance) associated with 20 height-relevant situations (e.g., "riding a Ferris wheel"). The full AQ has good psychometric properties and is widely used (Baker, Cohen, & Saunders, 1973; Bourque & Ladouceur, 1980). Across the preselection, baseline, post-intervention, and follow-up assessments, Cronbach's alpha for the AQ-Anxiety and AQ-Avoidance subscales ranged from .72-.92 (average = .81).

The Attitudes Towards Heights Questionnaire (ATHQ; Abelson & Curtis, 1989) is a 6-item measure in which individuals read pairs of dichotomous adjectives describing ways people may feel about heights (e.g., "Good/Bad," "Safe/Dangerous"), and rate how they feel about elevated places on a scale of 0 (which corresponds with the first adjective) to 10 (which corresponds with the second adjective). The ATHQ has been used in several height fear treatment studies and is sensitive to treatment effects (Coehlo, Santos, Silvério, & Silva, 2006; Emmelkamp, Bruynzeel, Drost, & van der Mast, 2001). In the

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from this task were not analyzable. Additionally, we originally planned to measure intervention effects on heart rate. However, due to malfunctioning heart rate monitors, this measure was cut partway through data collection. Additionally, while not described in this paper, the phobia section of the SCID was completed a second time, in person. Other excluded measures included the Heights Visited Questionnaire (developed by the author), measurements of eye height, ratings of vividness following the Imagery Exercise, and additional administrations of the PANAS.

current study, Cronbach's alpha for the ATHQ was .86 at the baseline assessment, and .91 at the post-intervention assessment.

General mood and affect measures

The Depression Scale of the Depression Anxiety Stress Scales short form (DASS21-DS; Lovibond & Lovibond, 1995) is a 7-item measure with adequate psychometric properties (Antony, Bieling, Cox, Enns, & Swinson, 1998; Clara, Cox, Enns, 2001) in which participants rate the degree to which statements tied to depressive symptoms (e.g., "I felt down-hearted and blue") applied to them over the past week. Cronbach's alpha for the DASS21-DS was .85. Note that the DASS21-DS was only administered at preselection.

The Fear Subscale of the Positive and Negative Affect Schedule-Expanded Form (PANAS-FS; Watson & Clark, 1994) is a 6-item self-report measure of state fear based on adjective ratings. The PANAS has good reliability and validity (Waston & Clark). In the current study, the PANAS-FS was used to examine change in affect following the stair-climbing and the balcony tasks. Across administrations in the baseline and post-intervention assessments, Cronbach's alpha ranged from .60-.93 (average = .82).

The Treatment History Questionnaire for Heights Fear (designed by the author) is a 4-item measure that asks participants to list if they have ever received treatment for their fear of heights. Specifically, the questionnaire asks if participants have ever taken medications for their height fear, are currently being treated by anyone for their height fear, have seen someone in the past for their height fear, or ever received cognitive behavioral therapy or exposure fear reduction procedures for their height fear. Of note, in

the current sample, all participants reported that they had not had any current or past treatment for their heights fear (although two participants reported other past anxiety treatment [self-reported diagnoses: PTSD and "situational anxiety"], and one participant reported seeing a therapist for depression).

Interpretation bias measures

The Heights Interpretation Questionnaire (HIQ; Steinman & Teachman, 2011) is a measure of height-relevant interpretation bias. Participants are asked to read and imagine themselves in two height-relevant scenarios (e.g., climbing a ladder) and then rate the likelihood of eight interpretations related to each scenario (e.g., "You will fall"). Cronbach's alpha for the HIQ was .89 at the baseline assessment, and .93 at the post-intervention assessment.

The Recognition Rating Task (modified from Mathews & Mackintosh, 2000) was used to evaluate whether the interventions influence subsequent novel interpretations. During the post-intervention assessment (but not during the baseline assessment), participants were asked to read and imagine themselves in 10 height-relevant scenarios that were ambiguous with regard to whether the participant's anxiety is manageable or the height is dangerous. Each of the scenarios included a title, and ended with a word fragment to be completed by the participant that was followed by a comprehension question to ensure participants read the scenario. Neither the word fragments nor the comprehension questions resolved the ambiguity of the scenario.

Five minutes after reading the scenarios and completing a distractor task (working on a jigsaw puzzle), participants were shown the title of each scenario, followed by four

disambiguated interpretations of each scenario. One interpretation was negative and height-relevant and one was positive and height-relevant. The other two were a negative and a positive interpretation that were unrelated to heights or fear. Participants were asked to rate how similar each of the four interpretations was to their recollection of the meaning of the original scenario on a scale of 1 (*very different in meaning*) to 4 (*very similar in meaning*). See Appendix for examples of recognition scenarios.

The disambiguated interpretation options were previously validated by an independent sample of 15 participants. Participants were asked to rate each interpretation option on a scale of -5 (the interpretation resolves the ambiguity in a very negative way) to +5 (the interpretation resolves the ambiguity in a very positive way). Results suggested that interpretation options were valid, such that positive rating options were rated as positive (greater than zero) and negative rating options were rated as negative (below zero). Moreover, one-sample *t*-tests demonstrated that interpretation options significantly differed from zero in the expected directions (e.g., the average of positive height and the average of positive foil options were significantly greater than zero, and the average of negative height and the average of negative foil options were significantly less than zero; all $p < .001$).

Height Approach Task

The Height Approach Task (HAT) measures fear and approach behavior while the participant climbs a 5-story staircase. Stair-climbing is a typical anxiety provocation in height fear research and has demonstrated treatment sensitivity (e.g., Emmelkamp, Krijn, Hulsbosch, de Vries, Shuemie, & van der Mast, 2002; Wolitzky & Telch, 2009).

Participants were asked to climb as high on a staircase as they were willing. On each landing, they were asked to complete four tasks: 1) stand near the railing, 2) look at a target placed on the ground below, 3) stand on a short stool (12.25 x 10 x 7.12), and 4) look at the target on the ground below while standing on the stool. As done in Steinman and Teachman (2011), approach was measured by adding the number of stories a participant climbed and the percentage of tasks the participant completed on that landing (e.g., a participant who climbed to the third landing and stood near the railing, but refused to look at the target below would score a 3.25). Immediately following the HAT, participants were asked to report their peak fear using the PANAS-FS.

Balcony tasks

To examine perception of heights, participants completed a visual matching task, called Distance Estimation, on a 2-story, 26 feet high balcony. This task has been used in past studies examining perceptual bias related to heights (e.g., Clerkin et al., 2009; Teachman et al., 2008), and is designed to minimize the influence of explicit cognitive processes when estimating heights. To increase the sensation of interacting with the environment, prior to the estimation tasks, participants completed a guided imagery exercise in which they imagined themselves falling off the balcony (modified from Clerkin et al., 2009; see Appendix).

To reduce potential practice effects, participants stood on opposite ends of the balcony during the baseline and post-intervention sessions, so they would not be able to match to the same markers on the balcony or ground across measurement occasions (the locations were counterbalanced). The Distance Estimation task asked participants to look

over the balcony ledge at a circular disc on the ground below the balcony. They were told to position the experimenter to be as far away from them horizontally along the balcony as the participant is from the circular disc on the ground below the balcony (i.e., vertically). Participants were encouraged to look back at the disc on the ground frequently while positioning the experimenter. If participants did not look down at the target at least twice, the experimenter prompted them to look down at the target again and check that the distance was correct. A ratio was computed comparing the estimation of distance with the actual distance. For example, if a participant estimated the distance to the disc to be 32 feet, the overestimation ratio would be 1.23 (i.e., 32/26).

The Agoraphobic Cognitions Questionnaire (ACQ; Chambless, Caputo, Bright, & Gallagher, 1984) measures thoughts related to losing control (e.g., "going crazy") and physical concerns (e.g., "throwing up") while on a height. In this study, we used a modified version of the ACQ, which included additional items specifically related to being on a balcony. Participants were asked to rate how strongly 17 thoughts occurred to them while on the balcony on a scale of 0 (not at all) to 4 (extremely). Its companion measure, the Body Sensations Questionnaire (BSQ; Chambless et al.), measures anxiety-related bodily sensations (e.g., "heart palpitations"). Participants completed a modified version of the BSQ, in which they were asked to rate how much they experienced 17 sensations while on the balcony on a scale from 0 (none) to 4 (very severe). The modified ACQ and BSQ were completed on the balcony during the baseline and post-intervention assessments. At the baseline assessment, Cronbach's alpha was .90 for the ACQ and .91

for the BSQ. At the post-intervention assessment, Cronbach's alpha was .92 for both the ACQ and the BSQ.

At the end of the balcony task, subjective fear was measured by asking participants to report on their peak fear during the task using the PANAS-FS.

Height fear reduction interventions

In a past exposure-based acrophobia treatment study that allowed for unlimited exposure time, the range of treatment time was 35 to 360 minutes, with a mean of 115 minutes (Bourque & Ladouceur, 1980). In the current study, participants in all conditions completed a total of 180 minutes of intervention or control tasks (slightly above the midpoint of the above range), divided between two intervention sessions.

CBM-I. Participants in the CBM-I Only and the CBM-I+Exposure conditions completed modifications of two CBM-I paradigms: Interpretation Modification Program (IMP) and Scenario Training (see Appendix for examples).

Following Beard and Amir's (2008) IMP paradigm, participants completed 76 trials in which they were trained to associate positive words with ambiguous, height-relevant sentences. Each height-relevant sentence was written to be emotionally ambiguous with regard to one or more of the following: if the reader will be able to handle his/her anxiety, if the reader will be able to accomplish tasks while on a height (e.g., screwing in a light bulb while on a ladder), if the reader finds heights to be dangerous, and if the reader finds heights to be scary. In each trial, a fixation cross was displayed for 500 ms in the center of the computer screen. Next, either a positive or negative word appeared in the center of the computer screen for 500 ms, followed by an

ambiguous, height-relevant sentence, which remained on the screen until the participant finished reading the sentence and pressed the space bar. For example, following the fixation cross, participants saw either "risky" or "stable." After 500 ms, the word was replaced by "As you stand on a stepladder, you feel it rock slightly beneath you." Next, participants were asked to press "1" if they felt the word and the sentence were related, or to press "3" if they felt the word and the sentence were not related. Participants received positive feedback ("You are correct!") if they responded that positive words were related to the sentences or that negative words were not related to the sentences. Otherwise, they received negative feedback ("You are incorrect."). This contingency was expected to reinforce positive height-relevant interpretations and extinguish negative height-relevant interpretations.

Scenario Training was modeled off of the paradigm developed by Mathews and Mackintosh (2000) but used height-relevant scenarios. In line with prior research (e.g., Steinman & Teachman, 2010; Teachman & Addison, 2008), Scenario Training included 64 scenarios that participants were asked to read and imagine themselves in. Each scenario was three sentences long and written to be emotionally ambiguous with regard to the same domains as the IMP sentences. At the end of each scenario, participants were asked to complete a word fragment (which had only one solution) that resolved the ambiguity of the preceding scenario in a positive direction. An example of a scenario was, "You are on the roof of a five story apartment building. Grasping the railing, you realize you have never been this high up before. Getting off the roof when you need to will be e_sy." Participants typed the letter "a" to complete the word "easy," ascribing a

positive, or non-threatening, interpretation to the preceding text. Following each word fragment, participants answered a comprehension question that reinforced the positive interpretation of the scenario. For the above scenario, the corresponding comprehension question was, "Will it be difficult to safely get off the roof?" Participants typed the letter "n" to indicate "no." Participants were not able to proceed to the next scenario until they correctly completed both the word fragment and the comprehension question. To be sure participants understood the instructions, participants completed five practice scenarios and comprehension questions that were unrelated to heights or fear at the start of each round of Scenario Training.

To ensure that the scenarios in Scenario Training and the sentences in IMP accurately reflected concerns related to height phobia, approximately 85% of the Scenario Training scenarios and IMP sentences were based off of height situations mentioned in the AQ. For example, a scenario about driving over the Golden Gate Bridge was based on the AQ item "Driving over a large bridge (Golden Gate, George Washington)." The remainder of the sentences and scenarios incorporated other height-relevant situations, such as standing on bleachers in a sport stadium. Given that individuals with acrophobia are prone to interpret bodily sensations as threatening (Davey et al., 1997), approximately 25% of the materials referred to ambiguous bodily sensations (e.g., heart racing, sweating) while in a height situation. (Note that some of these materials overlap with the 85% that correspond with the AQ items; thus, the sum of percentages exceeds 100.)

To ensure that total intervention time was comparable across conditions, the IMP and Scenario Training were repeated during each session. To maintain participants' interest and to enhance learning, subtle variations were made to IMP and Scenario Training at each repetition (note that these variations were not yet in place for the first eight participants). Specifically, participants could go through the following sequence, depending on how many times they repeated the CBM intervention materials: 1) Complete IMP silently, 2) Complete Scenario Training silently, 3) Complete IMP aloud, 4) Complete Scenario Training aloud, 5) Complete an alternate version of IMP silently, in which word and sentence pairs differed slightly (same words and sentences, but paired together differently), 6) Complete an alternate version of Scenario Training silently, in which participants were asked an additional comprehension question (unrelated to heights or anxiety) following the original comprehension question, 7) Complete alternate IMP aloud, and 8) Complete alternate Scenario Training aloud. Participants in the CBM-I Only condition completed approximately six versions of IMP and Scenario Training, and participants in the CBM-I+Exposure condition completed approximately four versions of IMP and Scenario Training during each intervention session (based on experimenters' estimate; this was not recorded systematically).

Control versions of Scenario Training and IMP. Participants in the Control condition completed a sham variation of Scenario Training and IMP (see Appendix for examples). In this variation, none of the trials were related to height fear. The Control tasks were designed to match the Scenario Training and IMP paradigms for task demands, such as attention, time, format, and other nonspecific factors. To control for

effects related to reading about heights and make this condition more credible, approximately 25% of the trials included height content. However, the height content did not involve fear or emotional ambiguity (in Scenario Training) and was not related to whether the word and sentence were related (in IMP). In past CBM-I studies (e.g., Murphy et al., 2007; Teachman & Addison, 2008), the Control condition (termed "Neutral training") was composed of the same ambiguous scenarios as the Positive training condition, except half of the scenarios ended negatively. This methodology was not selected in the current study because it is currently unclear whether the combination of half positive and half negative scenarios is interpreted in a completely neutral way by anxious populations (see Clerkin & Teachman, 2010). Additionally, because exposure therapy already has a large empirical support base, the Control condition in the current study was predominantly designed to control for the effects of CBM-I, rather than for exposures.

Similar to the conditions involving CBM-I, the sham versions of the IMP and Scenario Training were repeated multiple times during each session, and were modified slightly at each repetition (followed the same sequence as conditions involving CBM-I).

Validation of CBM-I and Control stimuli. All training materials were validated by an independent sample of 14 participants. Participants were asked to rate each scenario in Scenario Training, and each sentence and word pair in IMP, on a scale of -5 (the fragment or word resolves the ambiguity in a very negative way) to +5 (the fragment or word resolves the ambiguity in a very positive way). We included stimuli if positive stimuli were rated as 0 or above, and Control stimuli fell in the -3 to +3 range. Any

materials' ratings that did not match their expected valence were edited, and re-rated by the independent sample. Following revisions, results suggested that all positive scenarios for Scenario Training, and positive words paired with sentences in IMP were rated as 0 or above, and all Control trials fell in the -3 to +3 range. Additionally, one-sample *t*-tests indicated that the average of all positive training materials was rated as significantly different from zero ($p < .001$ for both Scenario Training and IMP materials), while the average of Control training materials was rated as not significantly different from zero ($p > .05$ for both Scenario Training and IMP materials).

Exposure therapy. Participants in the Exposure Only and the CBM-I+Exposure conditions completed an exposure therapy treatment protocol modified from Antony, Craske, and Barlow's (2006) widely used fears and phobia treatment manual. Exposure therapy was comprised of two highly structured sessions, which included: 1) brief psychoeducation about the prevalence, development, and persistence of fears, 2) socialization to treatment, which involved an explanation of habituation and the goals of exposure exercises, and 3) exposure exercises. The exposure exercises took place on various heights throughout the university's campus, such as a balcony, bridge, staircase, and bleachers of a stadium. The exposures were individualized, so that participants visited the locations that they were most afraid of based on their personal fear hierarchy, and exposures were modified as necessary to incorporate participants' particular height fears (e.g., by inducing bodily sensations or imagining falling). Of note, exposure hierarchies were completed in a graded manner, such that participants were asked to try visiting heights that they found less scary at first, and then to work their way up to

heights that they found the most fear-inducing. See Appendix for a worksheet used by participants and therapists to aid in designing each participant's fear hierarchy.

Exposure therapy sessions were led by graduate students who had completed at least one year of intervention coursework, had one year of prior therapy experience, and had previously worked with anxious clients. Additionally, all therapists completed extensive training led by the author (an advanced graduate student) and her research advisor (a licensed clinical psychologist), which involved biblio-training, role-playing, watching a tape of acrophobia exposure therapy done by the author, and evaluation of the therapists' taped, pilot exposure session. The therapists attended a weekly supervision session with the author and her research advisor to review challenges in delivering the intervention.

The Credibility Scale (modified from Borkovec & Nau, 1972) is a 3-item measure in which participants' rate the credibility of a treatment. Specifically, participants rated how logical the treatment seemed, their confidence that the treatment would eliminate their height fear, and their confidence in recommending the treatment to a height fearful friend. Participants in all conditions completed the Credibility Scale after receiving psychoeducation about the rationale for treatment. Participants in the CBM-I+Exposure condition completed the Credibility Scale twice: once after the psychoeducation for interpretation training, and once after the psychoeducation for exposure. The average of these two scores was used for this condition. Cronbach's alpha for the 3 items was .77 among participants receiving the Control and Interpretation psychoeducation, and .82 among participants receiving the Exposure psychoeducation.

Procedure

Prior to study enrollment, all participants completed the AQ-Anxiety and modified SCID questions (either through the psychology department participant pool, or through an online questionnaire). Participants who scored above the established cutoff on the AQ-Anxiety and endorsed the modified SCID questions (see footnote 1) were contacted by email to schedule a phone screen. Interested participants were administered the Specific Phobia section of the SCID over the phone by the author or a trained research assistant. Participants who met SCID inclusion criteria were told that the purpose of the study was to investigate a new, experimental height fear reduction technique, and to compare this new technique to a more traditional fear reduction approach. Participants were sequentially assigned to the CBM-I Only, Exposure Only, CBM-I+Exposure, or the Control condition (except in occasional cases when a scheduling difficulty necessitated assignment to a given condition based on availability of a therapist or research assistant). Groups were balanced for gender. Participants were informed that if they were assigned to a Control condition or the new, experimental condition, they would be given the opportunity to complete the traditional fear reduction approach following conclusion of the study. They were not told which conditions reflected the new versus traditional fear reduction approaches.

Baseline assessment. Following informed consent, participants filled out a brief demographic questionnaire and the PANAS-FS to provide a baseline measure of state fear. Next, participants completed the AQ-Avoidance, ATHQ, DASS21-DS, and HIQ as baseline measures of height avoidance, attitudes toward heights, depression symptoms,

and height-relevant interpretation bias, respectively. Next, participants completed the balcony height exposure task. Participants underwent the guided falling imagery exercise, and then completed the visual matching task (Distance Estimation). Participants then completed the ACQ, followed by the BSQ, to measure anxious cognitions and bodily sensations experienced while on the balcony. Next, participants rated their peak fear during the balcony task using the PANAS-FS. The stair-climbing HAT was then administered, and included completion of the PANAS-FS based on participants' peak fear while doing the HAT. Participants then returned to the original study room to complete the PANAS-FS again to ensure that they were not experiencing any residual fear before leaving the study.

Height fear reduction/Control intervention sessions. For all participants, the first intervention session took place approximately 24 hours after the baseline assessment. The second intervention session took place approximately 1 week after the first intervention session. Each intervention session was 90 minutes long.

In the first intervention session, participants in the CBM-I Only condition were given psychoeducation about the importance of interpretations in the development and maintenance of anxiety (followed by the Credibility Scale). Next, they completed repetitions of IMP and Scenario Training. The second intervention session repeated the training sequence.

For participants in the Exposure Only condition, the first intervention session included psychoeducation, socialization to treatment, (followed by the Credibility Scale)

and exposure exercises. The second intervention session consisted of more exposure exercises.

For participants in the CBM-I+Exposure condition, the first intervention session included 45 minutes of repetitions of CBM-I (preceded by psychoeducation about the importance of interpretations in anxiety and the Credibility Scale). Next, participants completed 45 minutes of exposure therapy (which began with psychoeducation and socialization to treatment and the Credibility Scale). CBM-I was offered before exposure therapy because it was expected that participants would practice using the more benign interpretations during the exposure exercises. Moreover, it was predicted that CBM-I would make exposure therapy more palatable. The second intervention session repeated the CBM-I then exposure sequence.

For participants in the Control condition, the first intervention session consisted of psychoeducation about the importance of interpretations in the maintenance and development of anxiety followed by the Credibility Scale (note that this was the same psychoeducation provided to participants in the CBM-I conditions). Next, they completed repetitions of the Control versions of IMP and Scenario Training to match the training sequence for the CBM-I Only condition. The second intervention session repeated the sham training sequence.

Post-Intervention assessment session. The post-intervention assessment occurred approximately 24 hours after the second intervention session. It was identical to the baseline assessment, with a few exceptions: the DASS21-DS was not administered, and participants completed the AQ-Anxiety and the Recognition Rating Task. (The

Recognition Rating Task was not administered at baseline to reduce participants' measurement burden, given the HIQ was already included as a baseline measure of interpretation bias.)

Follow-up. To evaluate durability of the intervention effects, one month after the post-intervention assessment, participants received an email asking them to complete an online version of the AQ-Anxiety. After completing the AQ-Anxiety (or approximately two weeks after they were asked to complete the AQ-Anxiety if they did not respond to the email), participants were debriefed over the phone. Given that Exposure fear reduction procedures are the current gold standard for phobia treatment, following debriefing, an optional 1.5-3 hours of Exposure therapy was offered to all participants not in the Exposure Only condition.

Results

Data reduction

All measures were scored following scoring procedures described in the original publications or manuals. Plots of data and descriptive analyses were conducted to reveal any potential problems with the data. To increase normality, data from the ACQ and BSQ were log transformed. Additionally, one extreme outlier was removed from the baseline state fear variable (as measured by the PANAS-FS).

Descriptive statistics

A series of Chi-square tests (for categorical variables) and Analyses of Variance (ANOVAs; for continuous measures) demonstrated that conditions did not differ at the $p = .05$ level for demographic characteristics (gender, race, age) or pre-intervention

symptom and affect measures (DASS21-DS, AQ-Anxiety, AQ-Avoidance, HIQ, ATHQ, peak PANAS-FS on HAT), or any of the measures completed during the Balcony Task, (peak PANAS-FS, ACQ, BSQ, and Distance Estimate). However, intervention conditions did significantly differ on pre-intervention level of approach during the HAT ($F(3,104) = 3.04$, $p = .033$, $\eta_p^2 = .08$). Specifically, follow-up tests indicated that the CBM-I+Exposure condition showed less approach than the Control condition and the CBM-I Only conditions, and the Exposure condition showed less approach than the CBM-I Only condition. There were no other significant differences between conditions. Additionally, baseline state fear (as measured by the PANAS-FS) differed between conditions ($F(3,105) = 3.66$, $p = .015$, $\eta_p^2 = .095$), such that the CBM-I Only condition had lower baseline state fear, relative to the CBM-I+Exposure and Control conditions (there were no other significant condition differences). See Table 1.

Given the group differences in baseline HAT approach and PANAS-FS , we re-ran the primary analyses with baseline approach as a covariate, and then with baseline fear as a covariate. The general pattern of results remained unchanged when these covariates were included (e.g., the significant Time by Condition interactions outlined below remained significant). Consequently, these covariates are not included in the following analyses.

Effects of intervention condition

Primary outcome measures included height fear symptoms and attitudes, interpretation bias, and response to the stair-climbing HAT. Secondary outcome measures included tasks completed on the balcony, including anxious cognitions, body sensations,

subjective fear, and distance estimates. For each outcome measure (except where noted below), a repeated measures ANOVA with one within-subjects factor (Time: Pre-intervention, Post-intervention) and one between-subjects factor (Condition: CBM-I Only, Exposure Only, CBM-I+Exposure, Control) was conducted. Of note, there was a significant main effect of Time in all analyses, indicating less height fear pathology post-intervention, relative to pre-intervention (all $p < .01$, unless noted below). For all analyses, Time by Condition interactions were expected, such that the three active conditions would show greater improvement on all outcome measures, compared to the Control condition. Note that there are uneven *N*s across analyses due to some missing data (due to computer problems or experimenter error).

Effects of intervention condition on interpretation bias: Was cognitive bias modification successful?

To evaluate effects on interpretation bias, participants completed the HIQ pre- and post-intervention, and Recognition Ratings post-intervention. Results from the repeated measures ANOVA with the HIQ revealed the expected Time by Condition interaction ($F(3,102) = 4.78$, $p = .004$, $\eta_p^2 = .12$; see Figure 2). Follow-up LSD analyses showed that post-intervention, all three active conditions had lower HIQ scores than the Control condition ($p < .01$), as expected, and the three active conditions did not significantly differ from one another ($p > .05$).

Recognition Ratings (which were only completed post-intervention) were analyzed using a repeated measures ANOVA with two within-subjects factors (Topic of disambiguated interpretation: Height-relevant, Non-height-relevant; and Valence of

disambiguated interpretation: Positive, Negative), and the between-subjects Condition factor. We discuss only those effects relevant to Condition, as this was the primary research question. There was a main effect for Condition ($F(3,105) = 2.85$, $p = .041$, $\eta_p^2 = .08$) and a significant Valence by Condition interaction ($F(3,105) = 35.77$, $p < .001$, $\eta_p^2 = .51$), which was qualified by the expected three-way Topic by Valence by Condition interaction ($F(3,105) = 38.64$, $p < .001$, $\eta_p^2 = .53$; see Figure 3). Follow up ANOVAs indicated significant Condition effects for the two height-relevant interpretations (Negative height-relevant: $F(3,105) = 16.47$, $p < .001$, $\eta_p^2 = .32$; Positive height-relevant: $F(3,105) = 32.89$, $p < .001$, $\eta_p^2 = .48$), but not the Non-height-relevant positive and negative interpretations (both $p > .05$), pointing to the content specificity of the training effects. Subsequent LSD analyses revealed that both conditions that included CBM (CBM-I Only and CBM-I+Exposure) reported significantly higher endorsements of Positive height-relevant interpretations and lower endorsements of Negative height-relevant interpretations, relative to the two non-CBM conditions (Exposure Only and Control; all $p < .01$), suggesting CBM-I altered scenario interpretations as expected. Note that the Exposure Only and Control conditions did not differ from each other, and the CBM-I Only and CBM-I+Exposure conditions did not differ from each other (all $p > .05$).

Effects of intervention condition on height fear symptoms and attitudes

Results from the repeated measures ANOVA with height fear as the dependent variable (measured by the AQ-Anxiety) revealed the expected significant Time by

Condition interaction ($F(3,102) = 6.70$, $p < .001$, $\eta_p^2 = .17$; see Figure 4). As anticipated, follow-up paired sample *t*-tests revealed that AQ-Anxiety scores for the three active conditions significantly decreased over time (all $p < .001$), while the Control condition did not change over time ($p > .05$). Additionally, as expected, follow-up LSD analyses indicated that all three active conditions had lower AQ-Anxiety scores than the Control condition ($p < .001$, except that the difference between Exposure and Control did not reach significance; $p = .061$). Again, the three active conditions did not significantly differ from one another post-intervention (all $p > .05$).

When evaluating the effects of intervention condition on height avoidance (measured by the AQ-Avoidance), there was a main effect of Condition ($F(3,101) = 3.75$, $p = .013$, $\eta_p^2 = .10$), such that the Control condition reported more avoidance than the three active conditions (all $p < .05$), which did not differ from one another (all $p > .05$). However, the expected Time by Condition interaction did not reach significance ($F(3,101) = 1.91$, $p = .132$, $\eta_p^2 = .05$). To be consistent in our analytic approach, and because the interaction effect size was in the medium range, we conducted the follow-up univariate analysis. Follow-up LSD analyses showed that all three active conditions had lower AQ-Avoidance scores than the Control condition post-intervention (all $p < .01$), and the three active conditions did not significantly differ on the AQ-Avoidance post-intervention (all $p > .05$).

The repeated measures ANOVA with attitudes toward heights as the dependent variable (measured by the ATHQ) showed the expected Time by Condition interaction

($F(3,101) = 3.13$, $p = .029$, $\eta_p^2 = .09$). Follow-up paired sample *t*-tests demonstrated that ATHQ scores for the three active conditions significantly decreased over time ($p < .01$), while the Control condition did not change over time ($p > .05$), again as expected.

Effects of intervention condition on response to the Height Approach Task

To determine the effects of intervention condition on responses to a height stressor, participants completed the HAT in the baseline and post-intervention assessments. Results from the repeated measures ANOVA with HAT approach as the dependent variable revealed the expected, significant Time by Condition interaction ($F(3,103) = 4.36$, $p = .006$, $\eta_p^2 = .11$). As anticipated, follow-up paired sample *t*-tests revealed that participants in the three active conditions showed significantly more approach over time ($p < .01$), while the Control condition did not change ($p > .05$).

To evaluate intervention effects on fear in response to the stair-climbing HAT, standardized residuals were created so that peak fear during the HAT could be calculated while accounting for baseline fear. Specifically, for both baseline and post-intervention assessments, PANAS-FS scores from the beginning of the assessment session were regressed on the PANAS-FS during the HAT scores (see recommendations for examining change in Hummel-Rossi & Weinberg, 1975). The repeated measures ANOVA with peak fear during the HAT as the dependent variable also showed the expected Time by Condition interaction ($F(3,104) = 3.17$, $p = .027$, $\eta_p^2 = .08$). Note that this analysis did not show a main effect of time ($F(1,104) = .004$, $p = .953$, $\eta_p^2 < .001$). Follow-up LSD analyses suggested that only the Exposure Only condition significantly differed from all

other conditions at the post-intervention assessment (all $p < .05$), while the three other conditions did not differ from one another (all $p > .05$). Further, paired sample *t*-tests revealed that participants in the Exposure Only condition reported significantly less peak fear from baseline to post-intervention ($p < .05$), while the other three conditions did not change (all $p > .05$).

However, recall that baseline HAT approach and baseline fear differed across conditions. Specifically, during the baseline HAT, the CBM-I+Exposure condition showed less approach than the Control condition and the CBM-I Only conditions, and the Exposure condition showed less approach than the CBM-I Only condition. Additionally, recall that the CBM-I Only condition had lower baseline state fear on the PANAS-FS, relative to the CBM-I+Exposure and Control conditions. Thus, these analyses should be interpreted with some caution.

Effects of intervention condition on balcony tasks

To evaluate condition effects on tasks completed on the balcony, a series of four repeated measure ANOVAs were conducted (i.e., one ANOVA for each balcony task). Of note, the expected Time by Condition interaction did not reach significance for any of the balcony tasks (change in perception, cognitions, body sensations, and peak fear, all $p > .05$). However, to be consistent in our analytic approach, we conducted follow-up analyses for all balcony tasks.

When examining intervention effects on perception of heights, paired sample *t*-tests showed that participants in the Exposure Only condition saw heights as significantly

smaller over time ($p < .01$), while the other three conditions did not change ($p > .05$).[3] Of note, participants in all conditions overestimated the size of heights, both at baseline and the post-intervention assessment (i.e., overestimation ratios significantly greater than one, all $p < .01$).

When examining intervention effects on anxious cognitions experienced on the balcony (as measured by the ACQ), a significant main effect of condition emerged ($F(3,105) = 4.45$, $p = .006$), such that the Control condition reported more anxious cognitions than the three active conditions (all $p < .05$), which did not differ from one another (all $p > .05$). Additionally, the follow-up univariate ANOVA demonstrated condition differences post-intervention. Specifically, follow-up LSD analyses showed that all three active conditions had less anxious cognitions on the balcony than the Control condition post-intervention (all $p < .01$), and the three active conditions did not significantly differ on anxious cognitions on the balcony post-intervention (all $p > .05$).

When examining intervention effects on body sensations experienced on the balcony (as measured by the BSQ), the follow-up univariate ANOVA and LSD analyses suggested post-intervention condition differences. Specifically, while the three active conditions did not differ in body sensations experienced post-intervention (all $p > .05$), the Control condition experienced more body sensations compared to the Exposure Only and CBM-I Only conditions post-intervention (all $p < .05$). Surprisingly, the Control and

[3] While most experimenters rounded distance estimates to the nearest inch, one experimenter rounded estimates to the nearest half-foot. When excluding participants run by this experimenter, the general pattern of distance estimate results remained the same, except participants in both the Exposure Only and the CBM-I Only conditions saw heights as significantly smaller over time ($p < .05$).

CBM-I+Exposure conditions did not differ in body sensations experienced post-intervention (p = .101).

To test the effects of interventions on peak fear during the balcony tasks, standardized residuals were created (as done for peak fear during the HAT), such that for both assessment sessions, PANAS-FS scores from the beginning of the assessment were regressed on the PANAS-FS scores on the balcony. Of note, this analysis did not show a main effect of time ($F(1,104) = .012$, $p = .914$, $\eta_p^2 < .001$). Follow-up paired sample t-tests also suggested that conditions' peak fear during the balcony tasks did not change over time, and there were no condition differences at post-intervention (all $p > .05$). Again, recall that baseline fear differed across conditions, so these analyses should be interpreted with some caution.

Correction for multiple tests. Given we conducted follow-up analyses following five null omnibus tests (four balcony tasks and AQ-Avoidance), to be conservative, we re-ran these follow-up analyses using Bonferroni's correction (corrected alpha = .01). All patterns of results remained the same, except the follow-up univariate ANOVA for body sensations experienced on a balcony no longer suggested condition differences.

Effects of intervention condition at a one-month follow-up

Ninety-eight[4] participants completed the AQ-Anxiety over the Internet approximately one month after the post-intervention assessment. Note that there were no significant differences in either baseline or post-intervention AQ-Anxiety scores between participants who completed the AQ-Anxiety at follow-up, and those who did not (all $p \geq$

[4] Of note, the AQ-Anxiety data at Session 4 for three of these participants was lost, due to computer problems.

.05). Results of a repeated measures ANOVA with Post-Treatment and Follow-up as the two time points revealed a significant Time by Condition interaction ($F(3,91) = 3.89$, $p = .011$, $\eta_p^2 = .11$). Follow-up paired sample *t*-tests revealed that there was no difference between the post-intervention assessment and follow-up for the two conditions including CBM (CBM-I Only and CBM-I+Exposure), suggesting that participants in these conditions maintained their gains ($p > .05$). Results for the other two conditions (Exposure and Control) showed a significant decrease in AQ-Anxiety scores between the post-intervention assessment and follow-up ($p < .01$), suggesting further gains for the Exposure group following treatment, and an unexpected, delayed reduction in symptoms for the Control condition.

Reliable Change

A reliable change criterion of 18.60 on the AQ was calculated (following Jacobson & Truax, 1991, and Evans, 1998, using Cronbach's alpha of .72 and standard deviation of 12.73 for the AQ-Anxiety at preselection). Percentages of individuals displaying reliable change on the AQ from preselection to the post-intervention assessment for each condition are as follows: 25.93% for Control, 46.15% for Exposure, 69.23% CBM-I Only, and 66.67% for CBM-I+Exposure. Percentages of individuals displaying reliable change on the AQ from preselection to follow-up for each condition are as follows: 37.50% for Control, 70.83% for Exposure, 60.00% CBM-I Only, and 60.00% for CBM-I+Exposure. Significantly fewer participants in the Control condition experienced reliable change on the AQ compared to participants in the three active

conditions (grouped together in this analysis), at both the post-intervention assessment (χ^2(df = 1)= 9.78, p = .002) and at follow-up (χ^2(df = 1)= 5.01, p = .025).

Mediation

To determine whether change in interpretation bias mediated the relationship between condition and change in height fear, we used PROCESS, a plug-in for SPSS developed by Preacher and Hayes (2008). Through bootstrapping (1,000 samples), this plug-in determines 95% confidence intervals for the indirect effect of condition on change in height fear via change in interpretation bias. The mediation effect is determined to be significant (p < .05) if the confidence intervals of the indirect effect do not include zero.

To examine mediation separately for all three active conditions relative to the Control condition, three mediation models were computed. In each model, Condition was the independent variable (CBM-I Only vs. Control, Exposure Only vs. Control, and CBM-I+Exposure vs. Control), change in AQ-Anxiety was the dependent variable, and change in HIQ was the proposed mediator. All three models were statistically significant (p < .01). Additionally, for all three models, the indirect effect of Condition on change in AQ-Anxiety via change in HIQ was significant (i.e., bootstrapping confidence intervals did not include zero, p < .05). Overall, mediation results suggest that change in interpretation bias was a mediator for each condition's effect on height fear.

Credibility of interventions

A univariate ANOVA indicated condition differences on the Credibility Scale (F(3,100) = 5.93, p = .001, η_p^2 = .15), such that participants in the Exposure condition

provided significantly higher credibility ratings compared to the other three conditions ($p < .05$). Surprisingly, participants in the Control condition provided higher credibility ratings relative to the CBM-I Only condition ($p = .026$), despite being provided identical explanations for the interventions. There were no other significant differences in credibility between conditions.

Relationships between Changes in Outcome Variables

Finally, we examined relationships between changes in the various height fear variables. Change variables for all measures administered both at baseline and post-intervention were computed (scores at post-intervention were subtracted from scores at baseline), and Pearson correlations between all variables were computed (see Table 2). As expected, in general, change in height fear variables tended to correlate with change in other height fear variables, suggesting the outcome measures changed in comparable ways. Of note, change in the distance estimates completed while on the balcony did not correlate with change in any of the other outcome measures (all $r \leq .13$, all $p > .05$), suggesting that change in perception was not related to change in height fear. Interestingly, change on the HIQ was the only outcome measure to significantly relate to change on all other measures (except the distance estimate; all $r \geq .24$. all $p < .05$), highlighting the centrality of interpretation bias to changes in height fear.

Post hoc tests: Moderators of intervention effects and influence of credibility

Following the planned analyses, additional *post hoc* tests were conducted to evaluate possible moderators of the intervention effects. Specifically, we evaluated whether baseline level of interpretation bias (as measured by the HIQ), baseline level of

height fear (as measured by the AQ-Anxiety), credibility of the intervention (as measured by the Credibility Scale), and several demographic factors (gender, race, and whether the participant was recruited through the university's participant pool or the community) were significant moderators. For each potential moderator, a series of repeated measure ANOVAs was conducted with four different primary outcomes, including height fear (measured by the AQ-Anxiety), attitudes toward heights (measured by the ATHQ), interpretation bias (measured by the HIQ), and approach on heights (measured by approach during the stair-climbing HAT). Note that univariate ANOVAs were conducted when the dependent variable being assessed was also a moderator (e.g., when the potential moderator was baseline AQ-Anxiety score, and the dependent variable was post-intervention AQ-Anxiety score). Despite the large number of tests conducted, none of the variables tested were moderators (in fact, with one exception[5], there were no significant Time by Condition by Potential Moderator three-way interactions for repeated measure ANOVAs, and no significant Condition by Potential Moderator two-way interactions for univariate ANOVAs).

Next, given the condition differences in credibility, *post hoc* regressions were conducted to explore if credibility of the interventions predicted height fear (as measured by the AQ-Anxiety) post-intervention and at follow-up. Results suggest that credibility was a significant predictor of height fear at follow-up ($\beta = -.32$, $p = .002$), but not at post-intervention ($\beta = -.16$, $p = .104$). When data were split by Condition, credibility significantly predicted height fear post-intervention and at follow-up for the CBM-

[5] There was a significant three-way interaction for Time by Condition by Credibility of intervention for approach on the HAT ($F(3,94) = 4.21$, $p = .008$, $\eta_p^2 = .12$. However, Credibility was not a moderator for the other three dependent variables tested.

I+Exposure condition (β = -.49, p = .009 at post-intervention, and β = -.49, p = .012 at follow-up), but not for the other three conditions (all $p > .10$). Taken together, this pattern of results suggests that credibility was not a consistent predictor of height fear following the interventions, but may be of particular importance when CBM and exposure therapy are combined.

Discussion

The current study evaluated the efficacy of reducing acrophobia symptoms through directly shifting interpretation biases with computerized CBM-I, and tested the clinical utility of CBM-I by comparing and combining it with exposure therapy, the gold standard treatment for specific phobia. All three active conditions (CBM-I Only, Exposure, and CBM-I+Exposure) had similar results. Specifically, all three conditions showed similar reductions in negative interpretation bias as measured by the HIQ, similar reductions in acrophobia symptoms as measured by the AQ, and similar increases in approach as measured by the HAT, and the three active conditions routinely showed greater symptom reduction than the Control condition. Notwithstanding, a few differences between the active conditions occurred, and null findings occurred for the time by condition interactions for all balcony tasks (change in perception, cognitions, body sensations, and peak fear). Of note, changes in outcome measures tended to correlate with each other, suggesting that outcome measures tended to change at comparable rates. In this discussion, we review implications of results that were similar across conditions, and then discuss results that diverged from the typical pattern.

As expected, all three active conditions significantly reduced negative interpretation bias as measured by the HIQ. This is in line with past CBM-I studies (see meta-analysis by Hallion & Ruscio, 2011) and past research demonstrating that cognitive-behavioral treatments lead to change in interpretations (e.g., Teachman et al., 2010). Of note, this is the first study to provide evidence that it is possible to shift interpretation bias in a height-fearful sample, and highlights the malleability of interpretations. This suggests that the CBM-I paradigms used in this study were effective at manipulating interpretive bias. Finally, changes in interpretation bias (on the HIQ) correlated with changes in all other outcome measures (except for distance perception), highlighting the importance of change in height-relevant interpretation bias in change in height fear.

In line with hypotheses, all three active conditions resulted in reductions in both self-reported height fear symptoms (as measured by the AQ), and attitudes (as measured by the ATHQ), as well as behavioral approach, as measured by the Heights Approach Task (HAT). Importantly, change in height fear symptoms (as measured by the AQ-Anxiety) was reliable, based on the evidence of reliable change (RCI) and maintenance of gains at follow-up. The fact that the CBM-I conditions led to changes in height fear provides support for the causal claim in cognitive models of anxiety (e.g., Beck et al., 1985) that decreasing cognitive bias reduces anxiety. Further, the CBM-I findings suggest that it is possible to reduce fear without activation of negative affect or verbal mediation, two processes previously theorized to be necessary for fear reduction (e.g., Beck & Clark, 1997; Foa & Kozak, 1986). Of note, even though participants in the three

active conditions experienced a significant decrease in AQ-Anxiety scores (based on both ANOVA and RCI tests), mean AQ-Anxiety scores for each condition at the post-intervention assessment were still higher than scores from a previous student sample (*M* = 27.10, *SD* = 17.32: Cohen, 1977). This suggests that participants still have room to improve, and may have benefited from additional intervention sessions.

Additionally, as hypothesized, all three active conditions displayed an increase in behavioral approach post-treatment, as measured by the HAT. This provides evidence that both exposure therapy and shifting interpretations can lead to a change in actual behavior, and not just on questionnaire measures of anxiety. These results provide further support for cognitive models of anxiety, by demonstrating that shifts in behavioral approach occur alongside shifts in interpretive bias.

Despite time by condition interactions not reaching significance for outcomes on the balcony task, follow-up tests for the measures of anxious cognitions and body sensations showed a similar pattern, such that the three active conditions improved, while the control condition did not. This suggests that both shifting interpretations and exposure therapy can lead to changes in thoughts and physiological sensations reported while on a height. Future research should test whether these interventions actually change thoughts and body sensations experienced, or if they change participants' *post hoc* reports of thoughts and body sensations. Perhaps participants still experience the same reactions (e.g., thoughts about losing control, rapid heart beat), but due to their lowered level of height fear post-intervention, are less likely to interpret these reactions as meaningful,

and as a result, less likely to report them. Nonetheless, we caution against the over interpretation of these results, given that the omnibus tests were not significant.

Importantly, although all three active conditions showed similar results on most outcome measures, a few differences between conditions occurred. First, while all three active conditions showed a similar pattern of change in interpretation bias as measured by the HIQ, a different pattern of results occurred for the Recognition Ratings. Only the conditions including CBM-I (and not the Exposure Only or Control conditions) led to significantly more positive and less negative interpretations of novel ambiguous scenarios. A number of differences between the HIQ and the Recognition Ratings may account for the mixed findings. First, there is overlap in the format of the CBM-I Scenario Training and the Recognition Ratings, which may have contributed to the condition differences. Second, the Recognition Ratings measure both positively and negatively valenced biases, while the HIQ measures only negatively valenced bias. It is possible that CBM-I leads to an increase in positive interpretations, while exposure only leads to a decrease in negative interpretations. However, this seems unlikely, given that the Exposure Only condition did not affect negative interpretations assessed on the Recognition Ratings. Third, the Recognition Ratings focus on interpretations occurring in the present and future, while the HIQ assesses interpretations related only to the likelihood of future events. It may be that both CBM-I and Exposure are able to modify interpretations about future events, but only CBM-I is able to manipulate interpretations of current events. Finally, it is possible that the Recognition Ratings measures memory bias, rather than interpretation bias, given the delay between reading scenarios and

making ratings (see Hertel & Mathews, 2012). This would suggest that while both interventions successfully manipulate interpretation bias, only CBM-I paradigms also affect memory bias. Additionally, change in HIQ and change in Recognition Ratings differentially correlated with change in other outcome measures, further suggesting that two measures tap into different facets of interpretation bias. Of note, in the current study, it is difficult to tease apart whether interventions changed participants' actual interpretation biases, or if interventions merely changed how participants responded to questionnaires and tasks related to interpretations. To address this issue, future studies should consider developing and using a more uncontrollable or indirect measure of interpretation bias.

In line with predictions, at the one-month follow-up, both the CBM-I and CBM-I+Exposure conditions maintained their treatment gains (as measured by the AQ-Anxiety). However, the Exposure Only condition experienced further treatment gains between the post-intervention assessment and follow-up. The reason for the discrepant further gains is unclear: it could be that the groups differed in the extent of further practice of their new skills (i.e., the Exposure Only group continued tolerating anxiety in height situations, whereas the CBM-I and CBM-I+Exposure conditions got relatively less practice making non-threatening interpretations once the computerized training programs were no longer available). We cannot address this possibility directly with these data, though our findings raise interesting questions about whether further CBM-I gains could be promoted by more directly advocating ongoing practice of healthy interpretations in new situations after the initial intervention has ended, or by offering booster sessions with

the computerized training programs. It is important to note that, despite the condition difference, the CBM-I conditions did not show decline in treatment gains over time, in line with other findings of durable gains following CBM (e.g., Schmidt, Richey, Buckner, & Timpano, 2009). An alternate explanation is that CBM-I mitigates the effects of exposure therapy over time, given that the Exposure Only group continued to improve, while the CBM-I+Exposure condition only remained stable, although this seems unlikely given it is difficult to determine how making more benign interpretations could make exposure therapy less effective (unless it meant anxiety was not effectively activated during exposures, but there was no reason to suspect that occurred based on a review of cases). On the contrary, it may be that a longer dose of exposure therapy (90 minutes per session in the Exposure Only condition vs. 45 minutes per session in the CBM-I+Exposure condition) may be necessary to result in ongoing improvement at follow-up.

Of note, these follow-up results should be interpreted with considerable caution, given the smaller sample size, the fact that only one measure of height fear was tested at follow-up, and because the Control condition also experienced gains following the post-intervention assessment. While this could partially reflect some regression to the mean, it is hard to explain why this would occur only at the follow-up and not immediately following treatment. Perhaps a more plausible explanation is that the Control condition involved completion of multiple height exposures as part of the baseline and post-intervention assessments, which may have led to some habituation and fear reduction. Nevertheless, why Exposure led to further gains, while CBM-I led to maintenance of gains deserves further study.

Finally, while all three active conditions showed increased approach behavior during the HAT at the post-intervention assessment, only the Exposure Only condition differed significantly from the Control condition in level of peak fear during the HAT at the post-intervention assessment, as measured by the PANAS-FS. This may be because the HAT was very similar to what was done during the exposure intervention (e.g., many participants visited a similar staircase during exposures, and many participants practiced standing on stools during exposures). The condition differences in baseline fear may also have played a role (though this variable was accounted for in the peak fear analyses). Surprisingly, there were no effects of intervention condition (or effects of Time) on peak fear experienced during the balcony tasks, suggesting that none of the interventions led to a change in fear on the balcony post-intervention. This may be due to the balcony task not eliciting very high levels of fear (*post hoc* analyses suggest that peak fear on the balcony was lower than peak fear during stair-climbing HAT at the baseline assessment). Notably, given that all active conditions changed their approach behavior on the stair-climbing task, but not their peak fear on the balcony or the stair-climbing HAT, these results suggest that a decrease in state fear is not necessary for simultaneous increases in approach behavior to occur. This is in line with past research demonstrating uncoupling across multiple systems through which fear can be expressed (Lang, 1978; Lang, Cuthbert, & Bradley, 1998), and highlights the need to use multiple outcome measures that tap into various fear systems. An alternate interpretation of the HAT results is that extended experience on heights (e.g., 90 minute sessions as opposed to 45 minute sessions) is necessary to reduce subjective fear experienced on heights, but we caution

against over-interpretation of a single outcome measure, given that the general pattern of results suggests that the three active conditions had equivalent effects on height fear.

Surprisingly, we did not see the expected synergistic interaction between CBM-I and exposure therapy in the CBM-I+Exposure condition. Although this is contrary to hypotheses, it is in line with past studies suggesting that combining separate efficacious interventions does not enhance treatment effects (e.g., Foa et al., 2005). A growing number of studies have suggested that change in cognition is an active mechanism of change in exposure (e.g., Foa, Franklin, Perry, & Herbert, 1996; Hofmann, 2004; McManus, Clark, & Hackmann, 2000). Perhaps both exposure and CBM-I affect some of the same mechanisms of fear reduction (i.e., cognitive change); as a result, combining the two interventions is superfluous. This explanation is further supported by our mediation results, which suggest that all three active conditions had an effect on change in height fear via change in interpretation bias. Finally, understanding the lack of synergy between treatments is complicated by the fact that interventions in the combined condition were each half as long as they were in the individual treatments (i.e., 45 minutes of each intervention vs. 90 minutes of each intervention). It is possible that a dose-response relationship exists, such that synergistic effects would only be observed if participants completed longer courses of each intervention.

Results provided only minimal support for hypotheses related to perception. Despite the omnibus test not reaching significance, *t*-tests suggested that perception of heights significantly decreased over time for the Exposure Only condition, but not for any other condition. This suggests practice being on heights may be a necessary component

of changing perception (as opposed to only requiring a decrease in height fear). However, change in perception from baseline assessment to post-intervention trended to decrease over time in the CBM-I+Exposure and CBM-I conditions ($.05 < p <. 10$), but not in the control condition ($p > .10$). Although these changes did not reach significance, they provide hints that effects for all active conditions may have emerged with a larger sample size. Alternatively, effects for all active conditions may be more likely to occur following additional intervention sessions, given that individuals were still experiencing elevated levels of height fear at the post-intervention assessment, on average. Surprisingly, change in perception did not correlate with changes in the other height fear outcome measures, suggesting that change in fear and perception were not directly linked in this study. This is unexpected, because we had hypothesized that change in perception would relate to change in the other height fear measures, given research demonstrating the relationship between perception and height fear (e.g., Clerkin et al., 2009; Teachman et al., 2008). Of note, this is not the first study conducted by our lab group that failed to find a connection between height fear and perception (e.g., Twedt, Steinman, Clerkin, Zadra, Proffitt, & Teachman, 2008), suggesting that this effect may only appear under specific conditions that are not yet fully understood. Taken together, the perception results provide mixed support for theories of embodied cognition. Clearly, a better understanding of when changes in fear affect perception is needed.

Despite the few differences seen across outcomes, the overall pattern of results suggests that CBM-I, alone or in combination with exposure therapy, is effective as a treatment for reducing height fear. This is exciting given the potential ease of

disseminating the intervention widely, due to the relatively low resources required to administer the intervention (e.g., no therapist time is needed) and its likely cost efficiency. Further, the success of the CBM conditions is especially notable given that this intervention was rated as less credible than exposure prior to treatment. This indicates that CBM's effects do not simply rely on explicit beliefs about its promise, and suggest that demand effects are not likely responsible for the observed pattern of results. Of note, we do not advocate for CBM-I to replace exposure therapy. Rather, we view CBM-I as a complementary approach to exposure therapy that someday may either be used as an adjunct treatment or an alternate treatment for individuals who choose not to complete exposure therapy for various reasons (e.g., cost of seeing a therapist, availability of a therapist trained in exposure procedures, low palatability of exposures, etc.).

In the current study, height fear was chosen as an exemplar for anxiety difficulties more broadly; it was selected because of its high prevalence, and because it allowed us to test hypotheses related to perception. It will be important for future research to evaluate the generalizability of these results to other anxious samples, as well as more diverse samples. Additionally, testing how the different interventions affect quality of life and functional impairment is an important next step. Further, it will be helpful for future studies to evaluate how many CBM-I sessions (and of what duration) are necessary to reduce fear. Finally, future studies should evaluate potential moderators of treatment effects, such as practice visiting heights between sessions.

A few caveats should be considered when interpreting these results. First, not all participants in the study had clinical levels of acrophobia. It is possible that results would be different with a diagnosed acrophobic sample; however, this seems unlikely given the strict inclusion criteria applied in the current study. Additionally, as noted, our sample's pre-treatment mean on the AQ-Anxiety was very similar (even a little higher) to that of a previous acrophobic sample, highlighting how similar our sample is to a diagnosed acrophobic sample. Second, baseline differences in approach (as measured by the HAT) and fear (as measured by the PANAS-FS) compromise interpretation of the behavioral approach outcomes. However, recall that when these variables were included as covariates and the primary analyses were rerun, they did not change the general pattern of results. Third, therapists and researchers were not blind to condition when conducting the interventions, so it is possible that allegiance or demand effects may have biased results, pointing to the value of including measures in future research that minimize vulnerability to demand effects (e.g., measures that are indirect or difficult to strategically control). However, given that our research group studies both CBM and exposure therapy, it is unlikely that researchers or therapists would have felt strong levels of allegiance to one intervention over the other. Finally, although our study suggested that CBM-I gains are maintained at one-month follow-up, future studies should evaluate durability of CBM-I findings by using more measures at follow-up (not just a single questionnaire measure of acrophobia symptoms) and including longer follow-up durations. Despite these limitations, the current study provides novel evidence that CBM-I can be an effective

treatment for height fear, and that it has comparable results to exposure therapy, the current gold standard treatment for phobias.

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Table 1. Descriptive Statistics at Baseline.

	Control *M*(*SD*)	**Exposure** *M*(*SD*)	**CBM-I** *M*(*SD*)	**CBM-I+Exposure** *M*(*SD*)
Gender	75% Female	71% Female	78% Female	78% Female
Age	21.96(8.19)	27.54(16.66)	24.56(11.79)	20.37(3.74)
DASS21-DS	8.52(7.63)	6.07(7.43)	5.85(6.37)	6.22(6.31)
AQ-Anxiety	60.52(14.18)	61.36(10.68)	65.23(15.55)	62.20(9.85)
AQ-Avoidance	17.46(5.00)	15.79(4.40)	15.04(4.31)	15.19(5.26)
HIQ	48.71(11.35)	45.97(10.90)	46.04(11.84)	47.81(11.27)
ATHQ	38.96(7.75)	39.82(6.48)	39.59(8.92)	38.46(5.50)
HAT Avoidance*	4.13(1.00)	3.64(1.13)	4.27(.99)	3.52(1.23)
Baseline PANAS-FS*	8.96(2.47)	8.15(1.77)	7.22(1.48)	8.30(1.98)
Peak PANAS-FS on HAT	22.25(4.39)	21.34(5.04)	22.41(6.48)	21.44(5.34)
Balcony Task: PANAS-FS	17.93(5.21)	18.21(6.33)	16.96(5.80)	17.59(5.09)
Balcony Task: ACQ	1.16(.68)	.84(.45)	.82(.58)	.93(.65)
Balcony Task: BSQ	1.30(.62)	1.25(.73)	1.07(.74)	1.18(.67)
Balcony Task: Distance Ratio	1.56(.52)	1.45(.44)	1.39(.32)	1.45(.45)

Note. DASS21-DS = Depression Anxiety Stress Scales short form-Depression Subscale, AQ-Anxiety = Acrophobia Questionnaire-Anxiety Subscale, AQ-Avoidance = Acrophobia Questionnaire-Avoidance Subscale, HIQ = Heights Interpretation Questionnaire, ATHQ = Attitudes Towards Heights Questionnaire, HAT = Height Approach Task, PANAS-FS = Positive and Negative Affect Schedule-Expanded Form-Fear Subscale, ACQ = Agoraphobic Cognitions Questionnaire, BSQ = Body Sensations Questionnaire. * = significant differences between conditions at baseline.

Table 2. Relationships between Changes in Outcome Variables

	Δ AQ-Anxiety	Δ AQ-Avoid	Δ HIQ	Δ ATHQ	Δ HAT-Approach	Δ HAT-Fear	Δ Balc-Distance Estimate	Δ Balc-Fear	Δ Balc-ACQ	Δ Balc-BSQ	Post NH	Post PH
Δ AQ-Anxiety	1	.45*	.40*	.54*	-.19	.19	.01	.12	.25*	.34	-.27*	.39*
Δ AQ-Avoid	-	1	.54*	.49*	-.31*	.28*	.06	.36*	.51*	.49*	-.18	.11
Δ HIQ	-	-	1	.47*	-.39*	.24*	.06	.40*	.64*	.61*	-.45*	.24*
Δ ATHQ	-	-	-	1	-0.10	.25*	.06	.24*	.41*	.45*	-.29*	.31*
Δ HAT-Approach	-	-	-	-	1	-0.15	-.03	-.44*	-.44*	-.44*	.03	.09
Δ HAT-Fear	-	-	-	-	-	1	-.13	.54*	.46*	.38*	-.08	.02
Δ Balc-Distance Estimate	-	-	-	-	-	-	1	-.07	.01	-.03	.13	-.12
Δ Balc-Fear	-	-	-	-	-	-	-	1	.65*	.57*	-.15	-.03
Δ Balc-ACQ	-	-	-	-	-	-	-	-	1	.78*	-.23*	.06
Δ Balc-BSQ	-	-	-	-	-	-	-	-	-	1	-.20*	.04
Post NH	-	-	-	-	-	-	-	-	-	-	1	-.45*
Post PH	-	-	-	-	-	-	-	-	-	-	-	1

Note. AQ-Anxiety = Acrophobia Questionnaire-Anxiety Subscale, AQ-Avoid = Acrophobia Questionnaire-Avoidance Subscale, HIQ = Heights Interpretation Questionnaire, ATHQ = Attitudes Towards Heights Questionnaire, HAT = Height Approach Task, Balc = task was completed on balcony; ACQ = log of Agoraphobic Cognitions Questionnaire, BSQ = log of Body Sensations Questionnaire; NH = Recognition rating for negative height-relevant interpretations; PH = Recognition rating for positive height-relevant interpretations. All data in this table represents correlations between change variables (score at post-intervention subtracted from score at baseline), except for NH and PH, which were only completed at post-intervention. HAT-Fear and Balc-Fear were calculated by subtracting PANAS-FS standardized residual at post-intervention from PANAS-FS standardized residual from baseline, to account for baseline fear.
* = correlation is significant at the $p < .05$ level.

Figure 1. Consolidated Standards of Reporting Trials (CONSORT) diagram.

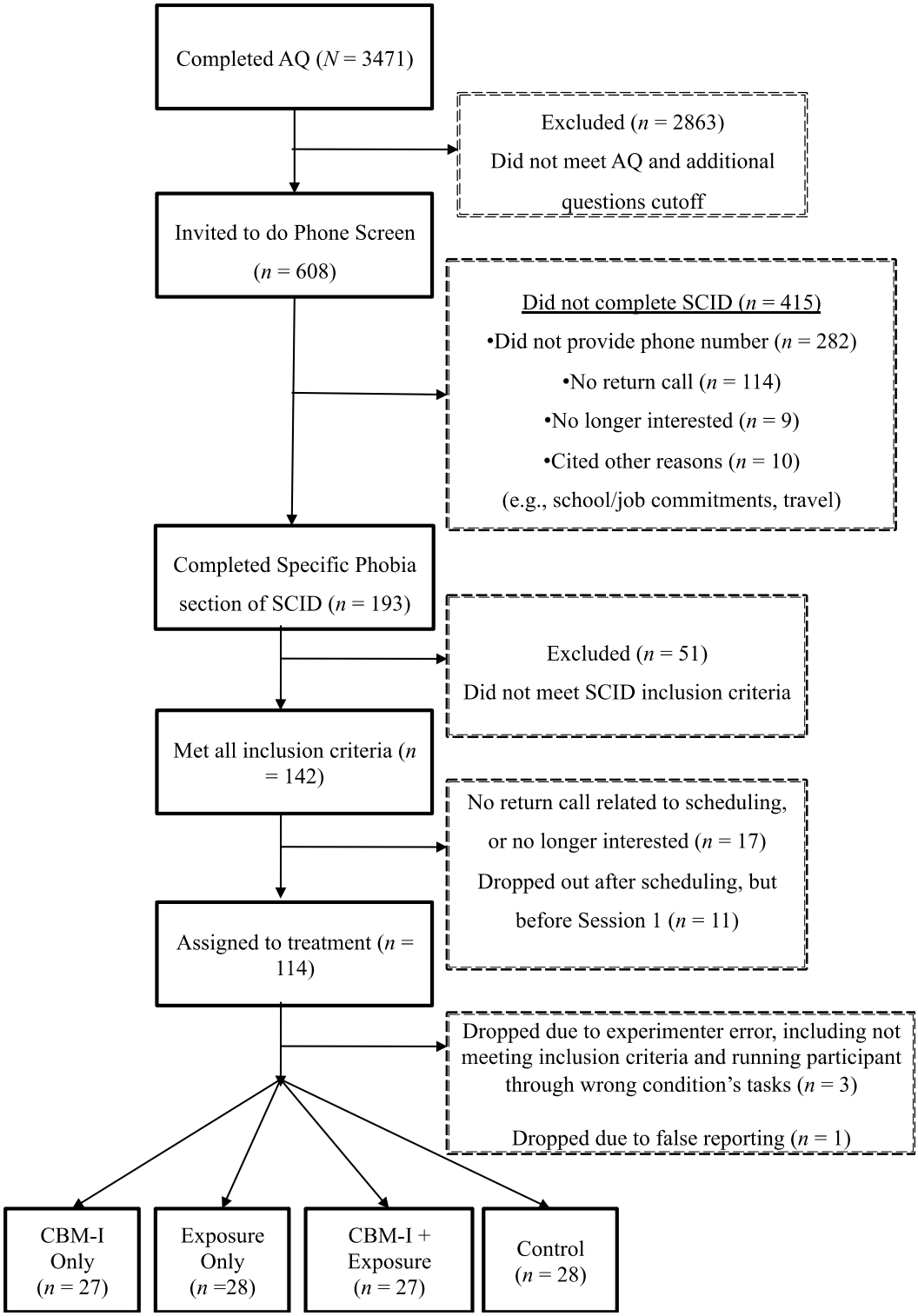


Figure 2. Change in Interpretation Bias

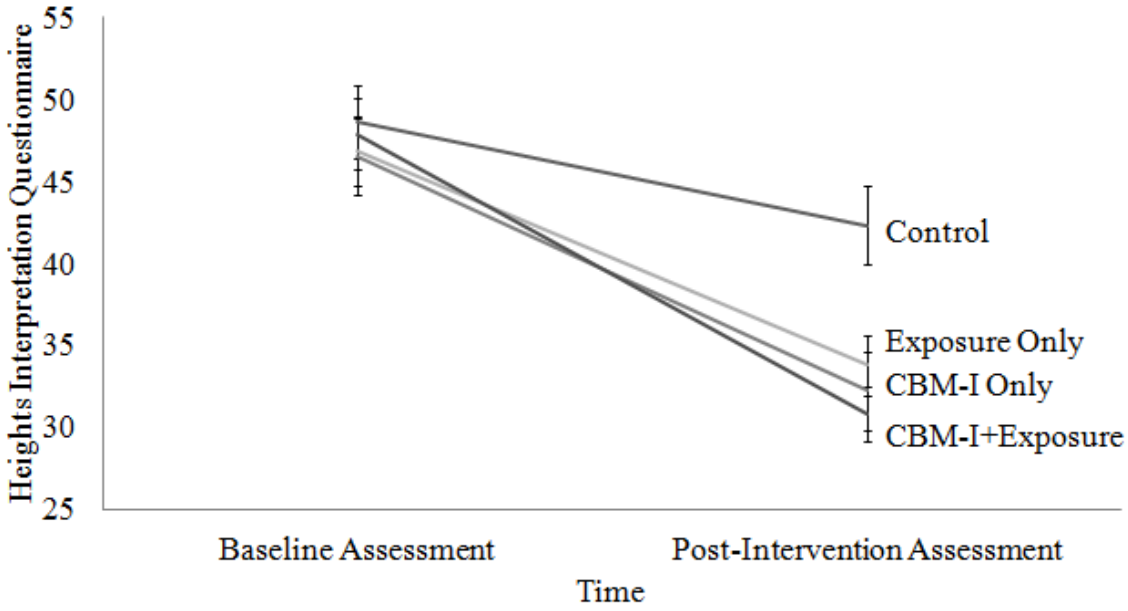


Figure 3. Interpretations of Novel Ambiguous Scenarios

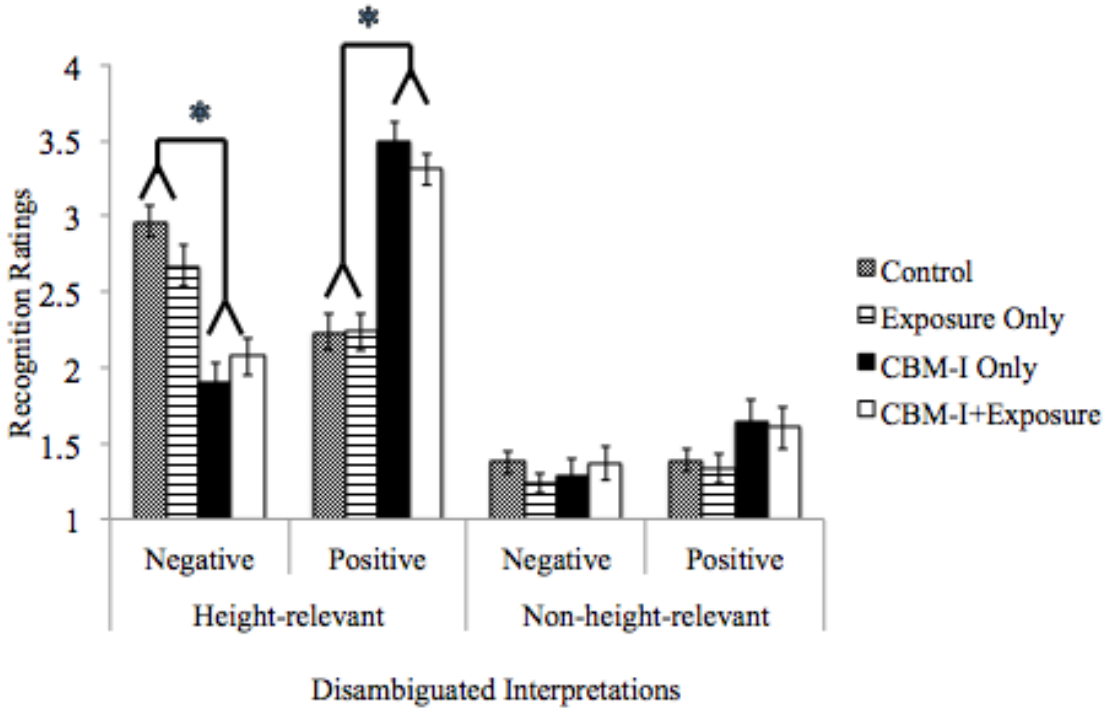
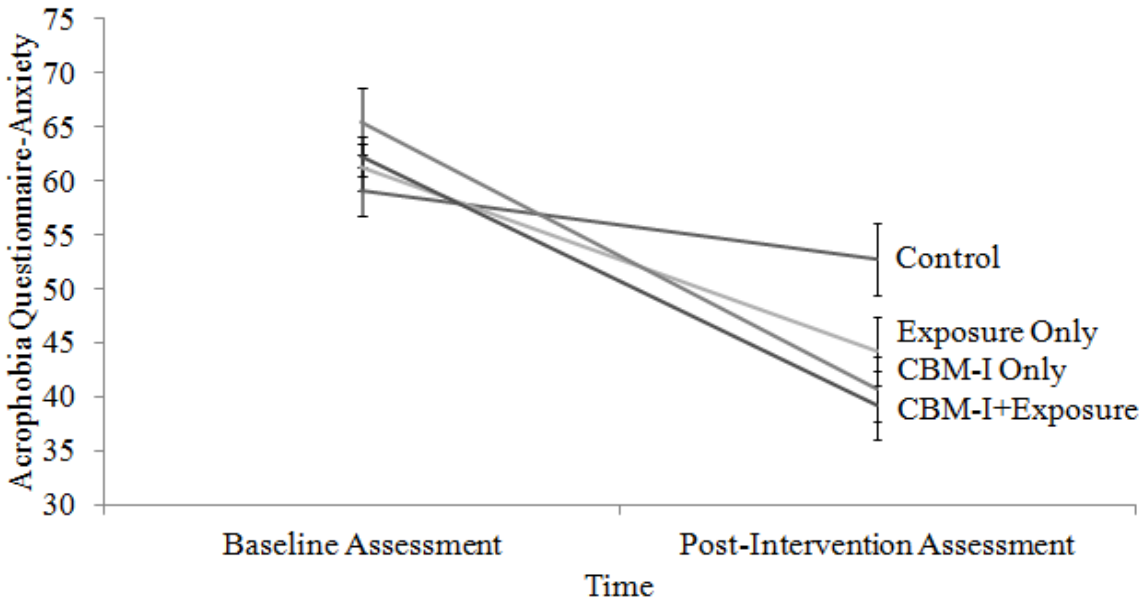


Figure 4. Change in Acrophobia Symptoms



Appendix

Informed Consent Agreement

Please read this consent agreement carefully before you decide to participate in the study.
Purpose of the research study: The purpose of the study is to investigate a new, experimental fear reduction technique for fear of heights, and to compare this new technique to a more traditional approach.

What you will do in the study:

1. Complete a series of computer tasks that require you to evaluate various words and sentences and complete word fragments that are presented in brief stories.

2. Engage in tasks that some people will find anxiety provoking. You may stop the tasks whenever you want—the experiment is designed so that few people will want to complete all of the tasks. You may stop the tasks whenever you want without penalty.

3. Complete various tasks and questionnaires that describe your current mood, fears and your thoughts.

4. Wear a heart rate monitor, which allows for measurement of your heart rate.

5. Make estimates of sizes and distances.

6. You may be presented with traditional and/or experimental fear reduction techniques, such as completing computer tasks or interacting with situations involving heights (e.g., climbing stairs or standing on a balcony). These techniques will be fully explained to you in advance of your participation, and you can choose what you complete. Alternatively, you may be asked to complete control tasks, which are tasks that are similar to experimental fear reduction techniques, but not designed to reduce fear.

7. You may be audio-taped while responding to various questions about your fears.

8. You may be in a "piloting" group, which is designed to help us edit our materials and procedures. If this is the case, you may not be asked to complete the full experiment. Rather, you will be asked to do some of the tasks listed above and we may ask your opinions about some of the procedures. Your experimenter told you if you are in the piloting group when you were handed this form.

Time required: The study will require two 1 hour assessment sessions and two 1.5 hour fear reduction (or control task) sessions, totaling about 5 hours of your time. The study will also include a brief follow-up, done over email, which will take about 5-10 minutes of your time.

Risks: There is no risk of harm to you (other than possible temporary discomfort following exposure to anxiety-provoking materials) as a result of participating in this experiment.

Benefits: There are no direct benefits to you. Depending on your experimental condition, you may complete procedures that we hope to be beneficial to reducing height fear. If you are not in one of the conditions that already has research evidence for reducing height fear, you will be given the option to complete fear reduction procedures which have been shown to help reduce height fear after the study.

Confidentiality: The information that you give in the study will be handled confidentially. The only exceptions to this guideline are if we learn of possible child abuse or danger to self or others. Your information will be assigned a code number. The list connecting your name to this code will be kept in a

locked file. When the study is completed and the data have been analyzed, this list will be destroyed. Your name will not be used in any report.

Voluntary participation: Your participation in the study is completely voluntary.

Right to withdraw from the study: You have the right to withdraw from the study at any time without penalty. You also have the right to have your data destroyed.

How to withdraw from the study: If you want to withdraw from the study, tell the experimenter and quietly leave the room. There is no penalty for withdrawing. If you have been audiotaped, we will immediately erase or destroy the tape. You will still receive full credit or payment for the experiment. If you would like to withdraw after your materials have been submitted, please contact Shari Steinman (sas6sy@virginia.edu). If you withdraw from the study, you will be debriefed and your data will be destroyed.

Payment: You will receive $10 or 1 hour of experimental credit for each hour of participation in the experiment, totaling 5 credits or $50 (or a combination of money and credits, depending on your course credit needs if you are not in the piloting group). As compensation for completing the brief follow-up questionnaires, you will be entered into a raffle to win $50. If you are in the piloting group, you will receive $10 or 1 hour of experimental credit for each hour of participation.

If you have questions about the study, contact: Prof Bethany Teachman, Department of Psychology, 102 Gilmer Hall, rm. 207, University of Virginia, Charlottesville, VA 22903. Telephone: (434) 243-7646. E-mail: bteachman@virginia.edu, or: Shari Steinman, Department of Psychology, 102 Gilmer Hall, room 202, University of Virginia, Charlottesville, VA, 22903 at (434) 243-7646.

If you have questions about your rights in the study, contact: Tonya R. Moon, Ph.D., Chair, Institutional Review Board for the Social and Behavioral Sciences, One Morton Dr Suite 500, University of Virginia, P.O. Box 800392, Charlottesville, VA 22908-0392, Telephone: (434) 924-5999, Email: irbsbshelp@virginia.edu, Website: www.virginia.edu/vprgs/irb

Agreement:
I agree to participate in the research study described above.

Signature: _____ Date: _____
You will receive a copy of this form for your records.

Materials Release Form for future data analysis
Project Title: Heights Fear Reduction

During the experiment, you were audiotaped while responding to various questions about your fears. We would like to ask permission to use your audiotape for future research analyses. For example, in the future, we may want to refer to participants' audiotapes to determine which of our participants have a phobia. If you agree to have your audiotape used in subsequent research, your audiotape may be listened to by a graduate student or the faculty advisor of this study. Your name will not be linked to these materials, as the questionnaire data and audiotape are linked only by your study ID number. All audiotapes will be securely locked in filing cabinets for up to 7 years and then destroyed. If you choose not to give us permission to use your audiotape, there is no penalty. You will still receive full credit or payment for the experiment.

In the future, if you wish to change the status of your audiotape recording, you may contact Shari Steinman (sas6sy@virginia.edu, 434-243-7646).

___ I give permission for my audiotape to be used for future research.

___ I do NOT give permission for my audiotape to be used for future research. Please destroy it once this study is complete.

Signature: _____

Date: _____

You will receive a copy of this form for your records.

Debriefing: Heights Fear Reduction

Thank you for participating in our study! The general purpose of this research is to evaluate an experimental anxiety intervention and to determine whether it enhances traditional fear reduction procedures or potentially could stand on its own as a new treatment for height phobia. The experimental intervention used in the study is based on cognitive models of anxiety, which state that anxious people tend to interpret ambiguous situations as threatening. It has been proposed that this tendency to interpret things in a threatening way plays a role in the onset of, and recovery from, anxiety disorders. The experimental fear reduction procedures in this study are designed to induce a healthier interpretation style among persons with height fear.

You were in 1 of 4 conditions (or a piloting group, to help us revise our materials and procedures): Interpretation Training Only, Exposure Only, Interpretation Training and Exposure, or Control. If you were in the Interpretation Training Only condition, you completed 3 hours of our experimental, computer-based anxiety intervention, which was designed to reduce height fear by training participants to interpret ambiguous scenarios related to heights in a positive way. If you were in the Exposure Only condition, you completed 3 hours of traditional fear reduction procedures, which were designed to reduce height fear by having participants gradually expose themselves to heights to become more comfortable in these situations. If you were in the Interpretation Training and Exposure condition, you completed 1.5 hours of our experimental treatment and 1.5 hours of traditional fear reduction procedures. This condition was designed to examine the effect of combining interpretation training and gradual exposure to heights. If you were in the Control condition, you completed tasks that were similar to the Interpretation Training Only condition, except the tasks were unrelated to heights or fear. This task was designed to be similar to interpretation training, but was not expected to reduce height fear.

A secondary purpose of this research is to investigate the role of fear in perception of heights. Previous studies have demonstrated that a high fear of heights can be related to overestimating heights (i.e., seeing heights as higher than they truly are). This study examines whether fear reduction decreases the overestimation of heights typically seen in people with height fear.

This research study is designed to determine if all the conditions (except the Control condition) will decrease participants' fear, avoidance, interpretation and perceptual biases related to heights. Given that Exposure fear reduction procedures are the gold standard for phobia treatment, we would like to offer an optional 1.5-3 hours of Exposure fear reduction procedures to all participants who were not in the Exposure Only condition. Please tell the experimenter if you are interested.

If you feel especially concerned about your fear or emotional distress, please feel free to phone our lab (434-924-0676) and speak to one of the investigators about options for counseling. Alternatively, you could also phone the UVA Counseling and Psychological Services (434-243-5556) or the Mary D. Ainsworth Psychological Clinic in the psychology department (434- 982-4737).

If you are interested in learning more about modifying interpretation biases, see:

- Beard, C. & Amir, N. (2008). A multi-session interpretation modification program: Changes in interpretation and social anxiety symptoms. *Behaviour Research and Therapy, 46,* 1135-1141.
- Teachman, B. A., & Addison, L. M. (2008). Training non-threatening interpretations in spider fear. *Cognitive Therapy and Research, 32*(3), 448-459.

If you are interested in learning more about perception in individuals with height fears, see:

- Teachman, B. A., Stefanucci, J. K., Clerkin, E. M., Cody, M. W., & Proffitt, D. R. (2008). A new mode of fear expression: Perceptual bias in height fear.

If you are interested in learning more about phobia treatments (including Height Phobia), see:

- Choy, Y., Fyer, A. J., & Lipsitz, J. D. (2007). Treatment of specific phobia in adults. *Clinical Psychology Review, 27,* 266-286.

For a non-academic reference about phobias and phobia treatment (including Height Phobia), see:

- Craske, M., Antony, M., & Barlow, D. (1997). Mastery of your specific phobia: Client workbook. Academic Press.

Once again, thank you for participating in our study. If you have any further questions regarding any aspect of this research, please feel free to contact Prof Bethany Teachman, Department of Psychology, 102 Gilmer Hall, rm. 207 at (434) 924-0676, or Shari Steinman at (434) 243-7646. In addition, if you have any concerns about any aspect of the experiment, you may contact Tonya R. Moon, Ph.D., Chair, Institutional Review Board for the Social and Behavioral Sciences, Suite 500, Morton Bldg., One Morton Dr., University of Virginia, P.O. Box 800392 Charlottesville, VA 22908. Telephone: (434) 924-5999. Email: irbsbshelp@virginia.edu Website: www.virginia.edu/vprgs/irb

AQ-Anxiety (Measure of height fear)

Below we have compiled a list of situations involving height. We are interested to know how anxious (tense, uncomfortable) you would feel in each situation nowadays. Please indicate how you would feel by putting one of the following numbers (0, 1, 2, 3, 4, 5, or 6) in the space beside each item:

0 Not at all anxious; calm and relaxed
1
2 Slightly anxious
3
4 Moderately anxious
5
6 Extremely anxious

_____ 1. Diving off the low board at a swimming pool.

_____ 2. Stepping over rocks crossing a stream.

_____ 3. Looking down a circular stairway from several flights up.

_____ 4. Standing on a ladder leaning against a house, second story.

_____ 5. Sitting in the front of a second balcony of a theater.

_____ 6. Riding a Ferris wheel.

_____ 7. Walking up a steep incline in country hiking.

_____ 8. Airplane trip (to San Francisco).

_____ 9. Standing next to an open window on the third floor.

_____ 10. Walking on a footbridge over a highway.

_____ 11. Driving over a large bridge (Golden Gate, George Washington).

_____ 12. Being away from a window in an office on the 15th floor of a building.

_____ 13. Seeing window washers ten flights up on a scaffold.

_____ 14. Walking over a sidewalk grating.

_____ 15. Standing on the edge of a subway platform.

_____ 16. Climbing up a fire escape to the 3rd floor landing.

_____ 17. On the roof of a ten story apartment building.

_____ 18. Riding an elevator to the 50th floor.

_____ 19. Standing on a chair to get something off a shelf.

_____ 20. Walking up the gangplank of an ocean liner.

AQ-Avoidance (Measure of height avoidance)

Now that you have rated each item according to anxiety, we would like you to rate them as to avoidance. Indicate in the space to the left of the items below how much you would now avoid the situation, if it arose.

0 Would not avoid doing it
1 Would try to avoid doing it
2 Would not do it under any circumstances

_____ 1. Diving off the low board at a swimming pool.

_____ 2. Stepping over rocks crossing a stream.

_____ 3. Looking down a circular stairway from several flights up.

_____ 4. Standing on a ladder learning against a house, second story.

_____ 5. Sitting in the front of a second balcony of a theater.

_____ 6. Riding a Ferris wheel.

_____ 7. Walking up a steep incline in country hiking.

_____ 8. Airplane trip (to San Francisco).

_____ 9. Standing next to an open window on the third floor.

_____ 10. Walking on a footbridge over a highway.

_____ 11. Driving over a large bridge (Golden Gate, George Washington).

_____ 12. Being away from a window in an office on the 15th floor of a building.

_____ 13. Seeing window washers ten flights up on a scaffold.

_____ 14. Walking over a sidewalk grating.

_____ 15. Standing on the edge of a subway platform.

_____ 16. Climbing up a fire escape to the 3rd floor landing.

_____ 17. On the roof of a ten story apartment building.

_____ 18. Riding an elevator to the 50th floor.

_____ 19. Standing on a chair to get something off a shelf.

_____ 20. Walking up the gangplank of an ocean liner.

ATHQ (Measure of attitudes towards heights)

You will read six pairs of dichotomous adjectives, describing the way people might feel regarding heights. Draw a circle around the number that better describes the way you feel in this moment relatively to heights. For example, if you feel good in high places you choose 0 and if you feel bad you choose 10.

When I am in elevated places I feel that the place is:

0 ------- 1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7 ------- 8 ------- 9 ------- 10
Good - Bad

0 ------- 1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7 ------- 8 ------- 9 ------- 10
Awful - Nice

0 ------- 1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7 ------- 8 ------- 9 ------- 10
Pleasant - Unpleasant

0 ------- 1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7 ------- 8 ------- 9 ------- 10
Safe - Dangerous

0 ------- 1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7 ------- 8 ------- 9 ------- 10
Threatening - Unthreatening

0 ------- 1 ------- 2 ------- 3 ------- 4 ------- 5 ------- 6 ------- 7 ------- 8 ------- 9 ------- 10
Harmful - Harmless

DASS21-DS (Measure of depressive symptoms)

Circle how much each statement applied to you over the past week.
0 = "did not apply to me at all" to 3 = "applied to me very much, or most of the time"

I couldn't seem to experience any positive feeling at all.	0	1	2	3
I felt that I had nothing to look forward to.	0	1	2	3
I felt I wasn't worth much as a person.	0	1	2	3
I felt down-hearted and blue	0	1	2	3
I was unable to become enthusiastic about anything.	0	1	2	3
I felt that life was meaningless.	0	1	2	3
I found it difficult to work up the initiative to do things.	0	1	2	3

PANAS-FS (Measure of state fear)

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now. Use the following scale to record your answers:

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

_____afraid	_____shaky	_____nervous
_____jittery	_____scared	_____frightened

HIQ (Measure of heights-relevant interpretation bias)

You will be asked to imagine an event in your head. Think about yourself in the event as much as possible. After you read about the event, some thoughts about the event are listed. It is your job to rate how believable you think each of these thoughts is. Don't rate how believable you think each thought is right now. Instead rate how believable you think each thought would be when you are in the event. Next to each thought, circle the number to show your answer. Remember that it is very important that you try to imagine yourself in the event as much as possible.

Situation #1

Imagine that you are climbing a ladder that is leaning against the side of a two story house. As you move from one rung to the next, you feel the cold metal beneath your hands. You pass a window on the first floor of the house. You continue to climb, feeling the wind on your face. You pass a window on the second floor of the house. You look down and the ground looks very far away.

How likely is it that…

	Not Likely		Somewhat Likely		Very Likely
1. You will hurt yourself.	1	2	3	4	5
2. You will fall.	1	2	3	4	5
3. You will not be able to tolerate your anxiety.	1	2	3	4	5
4. You will panic and lose control.	1	2	3	4	5
5. You are not safe.	1	2	3	4	5
6. You will faint.	1	2	3	4	5
7. You will freeze and not be able to climb back down the ladder.	1	2	3	4	5
8. Being on the ladder is dangerous.	1	2	3	4	5

Situation #2

Imagine that you are on a balcony on the 15th floor of a building. As you hold onto the warm metal railing that comes up to your waist, you feel the heat of the sun on your face. You listen to the sounds of cars and people down below. You look down and the people and cars on the ground seem small and very distant. Even the tree tops down below seem far away.

How likely is it that…

	Not Likely		Somewhat Likely		Very Likely
1. You will hurt yourself.	1	2	3	4	5
2. You will fall.	1	2	3	4	5
3. You will not be able to tolerate your anxiety.	1	2	3	4	5
4. You will panic and lose control.	1	2	3	4	5
5. You are not safe.	1	2	3	4	5
6. You will faint.	1	2	3	4	5
7. You will freeze and not be able to get off the balcony.	1	2	3	4	5
8. Being on the balcony is dangerous.	1	2	3	4	5

ACQ (Measure of thoughts related to losing control and physical concerns while on a height)

Several types of thoughts are described below. Please indicate how strongly each thought occurred to you during your exposure to the high place.

0	1	2	3	4
Not at all	Slightly	Moderately	Definitely	Extremely

1. I am going to throw up.	0	1	2	3	4
2. I am going to pass out.	0	1	2	3	4
3. I will have a heart attack.	0	1	2	3	4
4. I will choke to death.	0	1	2	3	4
5. I am going to act foolish.	0	1	2	3	4
6. I am going blind.	0	1	2	3	4
7. I will not be able to control myself.	0	1	2	3	4
8. I will hurt someone.	0	1	2	3	4
9. I am going to go crazy.	0	1	2	3	4
10. I am going to scream.	0	1	2	3	4
11. I am going to babble or talk funny.	0	1	2	3	4
12. I will be paralyzed by fear.	0	1	2	3	4
13. This ledge is not safe.	0	1	2	3	4
14. I am going to fall.	0	1	2	3	4
15. I am going to jump.	0	1	2	3	4
16. The railing will not protect me.	0	1	2	3	4
17. I am losing my balance.	0	1	2	3	4

BSQ (Measure of bodily sensations experienced while on a height)

Several types of bodily sensations are described below. Please indicate how much you experienced each sensation during the exercise on the following scale:

0 None	1 Mild	2 Moderate	3 Severe	4 Very Severe

1. Heart palpitations	0	1	2	3	4
2. Pressure in chest	0	1	2	3	4
3. Numbness in arms or legs	0	1	2	3	4
4. Tingling in finger tips	0	1	2	3	4
5. Numbness in another part of your body	0	1	2	3	4
6. Feeling short of breath	0	1	2	3	4
7. Dizziness	0	1	2	3	4
8. Blurred or distorted vision	0	1	2	3	4
9. Nausea	0	1	2	3	4
10. Butterflies in stomach	0	1	2	3	4
11. Knot in stomach	0	1	2	3	4
12. Lump in throat	0	1	2	3	4
13. Wobbly or rubber legs	0	1	2	3	4
14. Sweating	0	1	2	3	4
15. Dry throat	0	1	2	3	4
16. Feeling disoriented and confused	0	1	2	3	4
17. Feeling disconnected from your body	0	1	2	3	4

SCID-Phobia Section: Height focused (Diagnostic interview)

"I have a few questions to ask you about your fear of heights."

For all of the following questions, 1 = absent or false 2 = subthreshold 3 = threshold or true

A. Fear is marked, persistent, and excessive.

"Do you have an extreme fear of heights?" ***(Circle Yes / No)***

IF YES, "Tell me about that."

_____
_____
_____
_____

"What are you afraid will happen when you are on a height?"

_____
_____
_____
_____

Rater: Does person have a marked and persistent fear that is excessive or unreasonable, cued by the presence or anticipation of heights?

1 2 3

****

B. Heights result in immediate anxiety.

"Do you almost always feel frightened when confronted with heights?"

_____
_____
_____
_____

Rater: Does exposure to the phobic stimulus almost invariably provoke an immediate anxiety response, which may take the form of a situationally bound panic attack?

1 2 3

****

C. Recognizes fear is excessive/unreasonable.

"Do you think that you were more afraid of heights than you should have been or made sense?"

_____
_____
_____
_____

Rater: Does he/she recognize that the fear is excessive or unreasonable?

1 2 3

****

D. Heights are avoided OR endured with anxiety/distress.

"Do you go out of your way to avoid heights?" ***(Circle Yes / No)***

_____
_____

_____
_____

"Are there things you don't do because of this fear, that you would otherwise do?" ***(Circle Yes / No)***
_____
_____
_____
_____

IF NO, "How hard is it for you to confront heights?"
_____
_____
_____
_____

Rater: Are heights avoided, or else endured with intense anxiety or distress?
1 2 3

****

E. Fear of heights interferes with life or causes marked distress.
"How much does your fear of heights interfere with your life?"
_____
_____
_____
_____

"Is there anything you've avoided because of being afraid of heights?" ***(Circle Yes / No)***
_____
_____
_____
_____

IF FEAR DOES NOT INTERFERE WITH LIFE: "How much does the fact that you were afraid of heights bothered you?"
_____
_____
_____
_____

Rater: Does avoidance, anxious anticipation, or distress related to heights interfere significantly with his/her normal routine, occupational or academic functioning, or social activities or relationships? OR there is marked distress about having the phobia?
1 2 3

****

TREATMENT HISTORY QUESTIONNAIRE FOR HEIGHTS FEAR

1. Are you taking any medications for your heights fear? ***Yes / No (circle one)***

IF YES, list name of medication(s), dose, and duration of time on med below.

Medication: _____
Dose: _____
Duration: _____

Medication: _____
Dose: _____
Duration: _____

Have you been stable on the medication(s) for at least six weeks? ***Yes / No***

2. Are you **currently** seeing anyone, like a medical doctor or a therapist, counselor, or psychologist, for your height fear? ***Yes / No***

IF YES, list any diagnoses given, duration of treatment, and type of treatment below.

Diagnosis: _____
Duration: _____
Treatment: _____

3. Have you seen anyone in the **past** for your height fear, like a medical doctor or a therapist, counselor, or psychologist? ***Yes / No***

IF YES, list any diagnoses given, dates of treatment, and type of treatment below.

Diagnosis: _____
Dates: _____
Treatment: _____

4. Have you received CBT (Cognitive Behavioral Therapy) or Exposure Fear Reduction Procedures for treatment of Heights Phobia?

Yes / No

IF YES, on a scale of 1 (*not helpful at* all) to 7 (*extremely* helpful), to what extent was the treatment helpful?

CS

Please rate each of the following items using the scale below:

1--------2--------3--------4--------5--------6--------7--------8--------9--------10
Not at all Somewhat Extremely

1. How logical does this type of treatment seem to you?

Rating: _____

2. How confident are you that this treatment will be successful in eliminating fear of heights?

Rating: _____

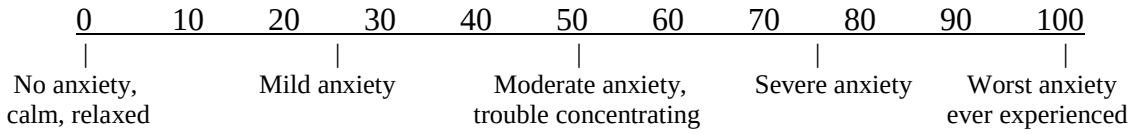
3. How confident would you be in recommending this treatment to a friend who was extremely anxious about being on heights?

Rating: _____

For Exposure Only and CBM-I+Exposure Conditions:
Heights Phobia Treatment: Hierarchy Questionnaire

Please use the following scale to rate how anxious you would feel in each of the following height situations.

Subjective Units of Discomfort Scale (SUDS)



Height Situation	**Anxiety 0-100**
Balcony (overlooking grass, no people)	
Balcony (overlooking people walking)	
Bridge (over traffic)	
Staircase (can look down and see the bottom floor)	
Stadium bleachers	
Stadium stairs	
Video clips of heights	
Standing on a chair or table	
Other:	

Now, please use the SUDS scale to rate how anxious you would feel if you experienced each of the following bodily sensations while on a height.

Sensations while on heights	**Anxiety 0-100**
Slight nausea	
Lightheaded or dizzy	
Heart racing	
Dry throat	
Short of breath	
Tingling	
Sweating	
Other:	

Finally, please use the SUDS scale to rate how anxious you would feel if you did any of the following actions while on a height.

Action	**Anxiety 0-100**
Imagine and/or describe self falling	
Stand on a stool	
Look over ledges or out windows	
Close your eyes	
Not hold onto the railing	
Have people walk behind you	
Hear noises behind you	
Change body position (stand, lean, sit)	
Move around	
Be alone on a height (instead of with therapist)	
Think about past scary experiences with heights	
Other:	

CBM-I Only and CBM-I+Exposure conditions:

Scenario Training Examples

Scenario: You are riding a Ferris wheel at a carnival. When you reach the top, you realize you are so high up that you can no longer see your family down below. This makes you uneasy, but your anxiety can be hand_ed.

Comprehension Question: Are you able to manage your anxiety?

Scenario: You are on a flight to Chicago. Looking out of your window, you begin to feel slightly dizzy from looking at the land so far below. You know that having this sensation is nor_al.

Comprehension Question: Is your dizziness a sign of danger?

CBM-I Only and CBM-I+Exposure conditions:

Interpretation Modification Paradigm (IMP) Examples

Words that may be displayed: Alarming or Normal

Sentence: You feel short of breath as you are climbing up a fire escape to a 4th story landing.

Words that may be displayed: Alright or Threatening

Sentence: As you are cleaning leaves from your gutter, the ladder you are on makes a creaking sound.

Control Condition:

Scenario Training Examples

Non-height-relevant:

Scenario: You go to the grocery store. While you are there, you buy eggs, bread, and juice. You forget to purchase m_lk.

Comprehension Question: Did you remember to buy milk?

Height-relevant:

Scenario: You are on a date. You are eating dinner at a restaurant on a rooftop terrace. You look at your date as the food is served and feel h_ngry

Comprehension Question: Are you eating at a restaurant?

Control Condition:

Interpretation Modification Paradigm (IMP) Examples

Non-height-relevant:

Words that may be displayed: Big or Small

Sentence: You watch a tiny ant crawl across the floor.

Height-relevant:

Words that may be displayed: Cold or Hot

Sentence: While on a balcony, you feel the warm sun on your face.

All Conditions: Recognition Rating Examples

Note that in the study, participants will see the scenarios and comprehension questions five minutes before rating the disambiguated interpretations. Participants do not see any interpretation option labels in the Disambiguated Interpretations sections (e.g., "Positive Heights").

Title: **THE FOOTBRIDGE**

Scenario: You are walking on a footbridge over a highway. The footbridge is long and you must walk over it for many minutes. As you think about how far you are above the highway, you notice that the footbridge has a low railin_.

Comprehension Question: Are you on a footbridge?

Disambiguated Interpretations:

Positive Heights: As you traverse the footbridge, you know you are safe despite the fact that the railings are low.

Negative Heights: As you traverse the footbridge, the low railings make you think that you are unsafe.

Positive Foil: As you traverse the footbridge, you smile as you feel the warm sun on your face.

Negative Foil: As you traverse the footbridge, you step on a piece of gum.

Title: **THE OPEN WINDOW**

Scenario: You were recently offered a promotion at work, which comes with a new office on the 10th floor next to a large window. While visiting the office, your boss asks if you will accept the promotion. As you think about whether or not to accept the promotion, you feel a gust of wind come in from the large open wind_w.

Comprehension Question: Is the new office on the ground floor?

Disambiguated Interpretations:

Positive Heights: As you walk by the open window, you think it will be manageable to have an office so high up.

Negative Heights: As you walk by the open window, you think that you will not be able to manage having an office so high up.

Positive Foil: As you walk by the open window, you are happy because this new job comes with a large salary increase.

Negative Foil: As you walk by the open window, you are upset because you are late for a meeting.

Imagery Script

"Now I'd like you to do an imagery exercise, I want you to imagine this situation not as if you were an actor in a play, but as if you were really there, looking out at it through your own eyes. Please close your eyes and imagine yourself leaning out far over the edge of the balcony."

Make sure participant closes his or her eyes and keeps them closed. Say the following slowly, allowing participant time to form a detailed image.

"Imagine how the balcony wall feels as it presses into your body and think about what you are seeing as you look down at the ground. Now imagine that you've leaned out too far and are losing your balance. Your stomach lurches suddenly as you slip, topple over, and begin to fall toward the ground. Think about where you would be looking and imagine the sights that you see as you fall. Think about what sounds you hear as you rush toward the ground. Think about what you feel on your skin and in your muscles as you fall. Imagine what you would be thinking and how you would be feeling emotionally. Remember how this is similar to other times when you have lost your balance and fallen. Now I want you to hold that image in your mind and replay it over and over."

Have participant focus on image for 30 seconds.

HVQ-B

For the following items, please circle the letter that corresponds to how challenging or anxiety producing this situation has been for you in the past (**before beginning this study**) using the following scale:

	A not at all challenging	B slightly challenging	C moderately challenging	D very challenging
An outdoor balcony	A	B	C	D
An indoor balcony	A	B	C	D
A theater balcony	A	B	C	D
A circular stairway	A	B	C	D
A roof	A	B	C	D
An elevator	A	B	C	D
A ladder	A	B	C	D
A bridge you walked over	A	B	C	D
A bridge you drove over	A	B	C	D
A high amusement park ride	A	B	C	D
An airplane	A	B	C	D
A fire escape	A	B	C	D
A sidewalk grating	A	B	C	D
A cliff or edge while hiking	A	B	C	D
Bleachers (e.g., of a sports stadium)	A	B	C	D
A high diving board	A	B	C	D
A subway (or metro) platform	A	B	C	D
Climbing/walking on rocks	A	B	C	D
Standing on a chair or table	A	B	C	D
Standing on a stepstool	A	B	C	D
Standing near an open window (on the 2nd floor of higher of a building)	A	B	C	D
Looking at pictures of heights	A	B	C	D
Watching videos of heights	A	B	C	D

HVQ-S4&F

For the following items, please circle the letter that corresponds to how many times you visited the locations listed below or did any of the actions listed below **since your second study session** using the following scale (do **NOT** include heights visited during the actual experiment sessions):

	A 0 times	B 1-2 times	C 3-4 times	D 5 or more times
An outdoor balcony	A	B	C	D
An indoor balcony	A	B	C	D
A theater balcony	A	B	C	D
A circular stairway	A	B	C	D
A roof	A	B	C	D
An elevator	A	B	C	D
A ladder	A	B	C	D
A bridge you walked over	A	B	C	D
A bridge you drove over	A	B	C	D
A high amusement park ride	A	B	C	D
An airplane	A	B	C	D
A fire escape	A	B	C	D
A sidewalk grating	A	B	C	D
A cliff or edge while hiking	A	B	C	D
Bleachers (e.g., of a sports stadium)	A	B	C	D
A high diving board	A	B	C	D
A subway (or metro) platform	A	B	C	D
Climbed/walked on rocks	A	B	C	D
Stood on a chair or table	A	B	C	D
Stood on a stepstool	A	B	C	D
Stood near an open window (on the 2nd floor of higher of a building)	A	B	C	D
Looked at pictures of heights	A	B	C	D
Watched videos of heights	A	B	C	D