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The Effects of Interpretation Training on Hostile Attribution Bias and Reactivity to Anger Provocation

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THE EFFECTS OF INTERPRETATION TRAINING ON HOSTILE ATTRIBUTION BIAS AND REACTIVITY TO ANGER PROVOCATION

By

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ABSTRACT

Research suggests that individuals high in trait anger have a cognitive bias for attributing hostile intentions to ambiguous situations. However, no studies have tested whether this interpretation bias can be altered to influence anger reactivity to an interpersonal insult. The current study tested this with a single-session cognitive bias modification program. One hundred thirty-five undergraduate students were randomized to receive positive training, negative training, or a neutral condition. Anger reactivity to insult was then assessed with observational measures, self-report, and blood pressure. Positive training led to increases in positive interpretation bias relative to the negative training group and there was a trend for increase in positive interpretation bias relative to the neutral group. Additionally, negative training led to increases in negative interpretation bias relative to the other two groups. Participants in the positive training condition were rated by observers as less irritated than those in the negative condition and more amused than the other two conditions. During the insult, participants in the positive condition reported less anger than those in the neutral condition. However, reported anger for the negative training condition was not consistently different than the other two groups. Assessments of blood pressure during insult did not demonstrate any meaningful differences between conditions. Though mediation of effects via modification of bias was not demonstrated for the whole sample, amongst the positive training condition, interpretation bias was correlated with self-reported levels of anger and observed irritation, which provides evidence that positive training reduced anger reactivity by its influence on interpretation biases. These findings suggest that positive interpretation training may be a promising treatment option for reducing anger.

INTRODUCTION

There are often cases in which anger is a justified, even healthy, reaction to an event. When individuals are confronted by harm or maltreatment, anger can motivate them to fight or to assert themselves. There are many people throughout history who accomplished great things because of their angry reactions to social injustices (e.g., Dr. Martin Luther King, Jr.). However, when anger becomes a default response, even to benign situations, it can be maladaptive and may lead to a variety of problems. Anger problems impact millions of Americans, and are associated with significant personal distress, health issues, and societal cost. For example, people with high levels of trait anger are more likely to develop heart disease (Williams et al., 2000; Smith, 1992), engage in aggressive behavior (Wilkowski & Robinson, 2008; Tafrate, Kassinove, & Dundin, 2002), abuse alcohol (Deffenbacher, 1993), and experience relationship problems (Baron et al., 2007; Tafrate et al., 2002; Miller, Markides, Chiriboga, & Ray, 1995). Additionally, although there is currently no "anger disorder" in the DSM-IV, anger is a central feature of a number of psychological disorders (i.e., major depressive disorder, posttraumatic stress disorder, bipolar disorder, intermittent explosive disorder, and various personality disorders) (American Psychiatric Association, 2000). Anger related problems are often a primary reason why people seek psychological treatment (Lachmund, DiGiuseppe, & Fuller, 2005).

Cognitive models of anger propose that individuals prone to anger are more likely to interpret ambiguous situations as hostile (see Wilkowski & Robinson, 2008). This tendency, also known as the hostile attribution bias, was first found in aggressive children (Dodge, 1980) and has since been found in adults with high trait anger (Epps & Kendall, 1995; Hazebrook, Howells, & Day, 2001; Bond, Verheyden, Wingrove, & Curran, 2004; Wenzel & Lystad, 2005). In the absence of additional cues, this processing bias leads people to infer hostile intent to the action of others. For example, if a person bumps into them, they attribute it to aggressive motives, which may lead them to experience anger. For individuals who hold this cognitive bias, the world is an anger-provoking place.

Cognitive-behavioral approaches to the treatment of anger target such biases through techniques such as psycho-education and cognitive restructuring (Novaco, 1975; Gorenstein, Tager, Shapiro, Monk, & Sloan, 2007; Beck & Fernandez, 1998). These treatments have generally been adapted from cognitive behavior therapy (CBT) techniques developed for anxiety

and depression. Although these techniques have been effective for anger problems (76% of patients do better than untreated controls), they are not as effective as those for anxiety and depression (DiGuiseppe & Tafrate, 2003). Many patients do not improve, and even those who do tend to not reach normative levels of trait anger following treatment.

A particular challenge in treatment of anger is the low rate of attendance to therapy sessions and failure to complete treatment (Siddle, Jones, & Awenat, 2003; Hird, Williams, & Markham, 1997). Hird et al. (1997) took a survey of mental health clinic patients over a period of 3 years and found that, of 95 people referred to anger treatment, only 18% completed their treatment program. The majority of people treated for anger are perpetrators of domestic abuse, violent and aggressive juveniles, and prison inmates (Beck & Fernandez, 1998). Many of these individuals do not recognize that they have a problem, are forced into treatment, and are unlikely to willingly engage in the process. Additionally, patients tend to be difficult to retain due to the high incidence of anger problems in populations with mental disorders that also have high attrition rates (e.g., post-traumatic stress disorder) (Chemtob, Novaco, Harnada, & Gross, 1997).

When in therapy, angry patients may respond resentfully to the therapist's suggestions that their interpretations are incorrect (Gorenstein et al., 2007) and they may cling to a belief that it is other people who need to change, not them (Siddle, et al., 2003; DiGuiseppe & Tafrate, 2007). Whereas an anxious patient may feel relief to learn that their interpretations of threat are unfounded, an angry patient may feel misunderstood or judged. These factors, as well as the usual limitations of therapy (limited resources, cost of treatment, time commitments, etc.), make anger therapy particularly difficult. Anger treatments that are empirically supported, quick, cost-effective, easy to administer, and perhaps less confrontational could be extremely beneficial. Such treatments could be used to prevent aggressive behavior among individuals high in trait anger or they could even be used as a way to "ease" severely angry patients into therapy by first reducing anger-related symptoms or interpretive biases. Additionally, researchers have recently argued that individual psychotherapy is severely limited as a means of reducing the burden of mental illness (Kazdin & Blase, 2011). They argue for more effective methods of treatment delivery, including self-help interventions, media, and computerized treatments.

Recently, several researchers have focused on developing computerized training programs to alter the cognitive biases that are theorized to cause and maintain depression and anxiety disorders. The first studies of this kind were conducted by Mathews and Mackintosh

(2000). In a series of experiments with non-clinical participants, the researchers were able to affect state anxiety in response to a stressor by experimentally inducing benign or anxious interpretations to ambiguous events. Since then, subsequent studies have used similar methods to reduce social anxiety (Beard and Amir, 2008), symptoms of generalized anxiety disorder (Hayes, Hirsch, Krebs, & Mathews, 2010), anxiety sensitivity (Steinman & Teachman, 2010), trait anxiety (Mathews, Ridgeway, Cook, & Yiend, 2007), and depressive symptoms (Watkins, Baeyens, & Read, 2009; Holmes, Tamara, & Dhruvi, 2009). However, to date, no studies have attempted to use cognitive modification strategies to alter anger-related biases and affect reactivity to anger provocation.

The current study expands the use of cognitive bias modification techniques through targeting hostile attribution biases in a non-clinical sample. The method was adapted from paradigms used by Mathews and Mackintosh (2000), Steinman and Teachman (2010), and Beard and Amir (2008). Mathews and Mackintosh (2000) have found that a single session is adequate to alter interpretation biases either negatively or positively in a non-clinical population. Therefore, a similar single-session design was used for this study. Participants were randomized to one of three conditions: positive interpretation, negative interpretation, or a control condition. In order to ensure that training was successful in altering hostile attribution bias, we assessed interpretation bias before and after training. Following the bias modification training, participants' anger reactivity was assessed through the use of an interpersonal insult (an ambiguous, but potentially anger-producing, situation). Further, because trait anger has been linked to increases in blood pressure following insult (Anderson, Linden, & Haba, 2005), blood pressure was assessed during the insult to determine whether the interpretation modification had an effect on psychophysiological aspects of anger.

It was hypothesized that, following training and relative to other conditions, participants in the negative condition would make more negative and fewer positive interpretations of novel ambiguous scenarios (increased hostile attribution bias) and participants in the positive condition would make more positive and fewer negative interpretations of novel ambiguous scenarios (decreased hostile attribution bias). It was also hypothesized that participants in the negative interpretation condition would report more anger and have higher blood pressure compared to those in the positive interpretation and control conditions following insult. Additionally, it was

predicted that participants in the positive interpretation condition would report less anger and exhibit lower blood pressure than the other conditions following insult.

METHODS

Participants

Participants were recruited from the undergraduate psychology department participant pool at Florida State University and received course credit for taking part in the study. One hundred thirty-five students (71.1% female, mean age= 18.87, SD= 1.30, range= 18-25) participated in the study. The sample consisted of diverse ethnic groups: Caucasian (61.5%), African American (12.6%), Hispanic (17.0%), Asian or Pacific Islander (3.7%), and other (0.7%). Data for 13 participants was not included in analyses because they guessed that the confederate was part of the study. The total sample of 135 does not include these participants.

Materials and Tasks

Screening Measure. In order to maximize the chances of finding an effect with a student sample, we oversampled for individuals high in anger. Students who scored 8 (1 SD above the mean) or greater on the Dimension of Anger Reactions Scale 5 (DAR5; Hawthorne, Mouthaan, Forbes, & Novaco, 2006) in a pre-screening battery of questionnaires were contacted via email and invited to participate. Of the total sample, thirty-eight (28%) participants were recruited in this way. The DAR5 is a 5-item Likert scale inventory that asks participants to rate their tendency to experience anger on a 0 (not at all) to 4 (very much) scale.

Self-report measures. Trait anger was assessed with the Trait Anger Scale (TAS) from the State Trait Anger Expression Inventory (Speilberger, 1988). This is a 10-item Likert scale inventory that asks subjects to indicate how they generally feel on a 1 (almost never) to 4 (almost always) scale.

In order to assess state anger, participants were asked to rate how *angry, bad, irritable, annoyed, agitated, hostile, and frustrated* they felt on a scale of 1(not at all) to 5 (extremely). In order to conceal the hypotheses, ratings of these emotions were dispersed amongst other emotions unrelated to anger (e.g., words related to depression, happiness, or fear.).

Additionally, the Positive and Negative Affect Scale (PANAS) (Watson, & Clark, 1994) was administered pre- and post-insult in order to assess general positive and negative mood. This measure was included to test whether anger levels were being manipulated as opposed to general positive and negative affect.

Interpretation bias assessment. An assessment of interpretation bias was administered both prior to and following the interpretation bias modification task in order to obtain a baseline measurement of hostile attribution bias and to determine if the training was able to effectively alter these biases. The assessment paradigm was adapted from one used by Matthews and Mackintosh (2000) and consisted of 20 situations developed for the purposes of this study (10 before and 10 after the modification task). Each situation had an identifying title and the participants were asked to read the situations, fill in the missing letter of the last word, and answer a comprehension question. For example:

The Supermarket

> You are shopping for groceries at the supermarket. As you walk down the cereal aisle you see a man walking towards you. As you get closer to him, he stops in the middle of the aisle and blocks your w_y [way].
>
> Q: Are you in the cereal aisle? (Yes/No).

After the participants read through each of the 10 scenarios, they completed a five-minute "filler" task (working on a puzzle). After this break they were shown the identifying titles from the scenarios they had read (e.g., "The Supermarket") and four versions of the final sentence. There was a positive interpretation, a negative interpretation, and a negative and positive foil:

1. As you get closer, the man stops for a moment in the aisle. (positive)
2. As you get closer, the man refuses to move for you to pass. (negative)
3. At the grocery store the cereal that you want is on sale. (positive foil)
4. At the grocery store the cereal that you are looking for is sold out. (negative foil)

Participants were asked to rate each sentence on a scale of 1 to 4 for its similarity in meaning to the original sentence. A score of 1 meant very different in meaning, and a score of 4 meant very similar in meaning. Higher ratings for statement 1 indicated less hostile attribution bias, whereas higher ratings for statement 2 indicated stronger hostile attribution bias. Statements 3 and 4 allowed us to specify whether or not participants were more apt to provide negative or positive interpretations in general.

Positive and negative interpretation modification conditions. Sixty-four ambiguous and twenty-four neutral (filler) scenarios were created for the purpose of this task by the author. Scenarios appeared on a computer screen and participants were asked to read them and imagine

themselves in these situations. All scenarios were one sentence long, for example, "You are walking down the hallway and someone bumps into you." Following this sentence, another sentence appeared on the screen to provide a less ambiguous interpretation of the scenario. However, one letter was missing from the key word of this sentence. For the negative interpretation condition the sentence following this scenario read "This person is aggre_sive" and for the positive interpretation condition it read "This person is clu_sy." The participant was required to fill in the missing letter of the word (to form the words "aggressive" or "clumsy") in order to assign the positive or negative interpretation to the situation. Next, this interpretation was reinforced by requiring the participants to correctly answer "yes" or "no" to a comprehension question ("Did this person intend to bump you?") before they proceeded to the next scenario.

The filler scenarios were dispersed amongst these to make the training less obvious and reduce expectancy effects. An example of a filler sentence is, "You are driving in the car listening to the radio," followed by, "You are listening to mu_ic." Once the participant filled in the letter "s" to complete the word "music," a comprehension question, "Are you listening to the news?" was asked.

Control condition. Participants in the control condition responded to 88 of the filler scenarios described above.

Insult. The insult used was modified from Swann and Rentfrow (2001). Participants were all lead to believe that there was another "participant" completing the same experiment in another room. A same-sex confederate was always waiting in the waiting room where the participant was collected to begin the experiment. Both participants were taken to the lab and consent was obtained from both the participant and the confederate. Next, the participant was started on some computerized questionnaires and the confederate was lead to another room to do the same. Following the post-training interpretation assessment, the participants were told that, for convenience, they will be doing the next task with the other "participant." They both were lead to a different room that had been set up with colored pencils, blank pieces of paper, and a blood pressure machine. They were told that for this part of the experiment was to investigate the effects of drawing on mood and blood pressure levels. Baseline blood pressure ratings were obtained from both "participants." Next, participants were told:

> For this part of the experiment, please draw a picture that represents an experience from your past that was particularly meaningful and important to you. Please try to include as much detail as possible. The quality of your drawing is not important, but we do want to see the form and process that you use to express yourself through artwork, so we will videotape you while you draw. Please continue to draw the whole time I am gone, please stay seated, and please don't disturb the other participant. Start drawing now. I will be back in a few minutes to get another blood pressure rating and a quick mood rating from you both half-way through this task.

The experimenter then left the room for 4 ½ minutes, returned to take blood pressure and mood ratings from both individuals, and then left for another 4 ½ minutes. During this 9-minute period, the confederate's role was to subtly aggravate the participant. This interaction was scripted and was done the same way for each participant. The confederate tapped his/her fingers and colored pencils on the table, spun in the chair knocking the desk, threw crumpled papers in to the trash can that "accidentally" hit the participant, made ambiguously hostile remarks (e.g., "Wow, nice drawing! Are you going to hang that on your fridge?"), and received a phone call.

Participants were videotaped during this whole interaction in order to obtain behavioral measures of their reaction to the confederate. Research assistants who were unaware of the participants' experimental condition later watched these videotapes. Each videotape was broken down into three 3-minute sections and each section was rated on the basis or how *irritated*, *angry*, and *amused* the participants appeared on a scale of 1 (*not at all*) to 7 (*extremely*) and how many verbal responses the participants made to the confederate. Two research assistants scored each video in order to establish inter-rater agreement.

Procedure

Participants were told that they were taking part in a study investigating memories and emotions associated with drawing pictures of past experiences. After signing the consent form, they were assigned a participant number. Prior to the start of the study, participant numbers were randomly assigned to one of the three experimental conditions and the computer was programmed to administer the appropriate training for each participant number. In this way, the participant, experimenter, and confederate were each blind to the assigned condition.

Participants began by completing the PANAS, TAS, and state anger measures. The questions from these scales were included amongst other filler questions in order to reduce reactivity to the experimental situation. Next, the pre-training Interpretation Bias Assessment was administered followed by the appropriate Interpretation Bias Modification (positive, negative, or control) condition. Immediately after the completion of the training or control task, the PANAS and state anger measures were re-administered to test if training altered participants' mood. After this, the post-training Interpretation Bias Assessment was administered to examine if biases were altered. Upon the completion of this assessment, the confederate administered the insult. Then, in order to assess mood, state anger measures and the PANAS were administered during and following the insult.

At the end of the study, participants completed a funnel debriefing in which they were asked several questions to determine whether they guessed the hypothesis and to rule out any demand effects. They were asked if they have any comments about the study, if they had any guesses about the hypotheses, and why they thought they were asked to read the scenarios and fill in letters to complete words.

They were then debriefed about the aims of the study and informed that the person with whom they spoke was a confederate and that his or her actions were scripted and did not reflect actual feelings about the participant. Lastly, in order to prevent other potential participants from learning about the aims of the study, they were asked not to discuss the experiment's procedure or goals with others.

RESULTS

Baseline comparisons

Chi-square tests to evaluate equivalence of the three training groups revealed that the training conditions did not differ by gender ($\chi^2 = 2.18$, $p = .34$) or ethnicity ($\chi^2 = 15.18$, $p = .13$). Further, analysis of variance (ANOVA) tests revealed that there were no significant differences between the training conditions in age ($F_{(2,103)} = 1.535$, $p = .22$, $\eta_p^2 = .029$), trait anger ($F_{(2,134)} = 1.103$, $p = .34$, $\eta_p^2 = .016$), or baseline state anger ($F_{(2,132)} = .200$, $p = .82$, $\eta_p^2 = .003$). There were also no significant differences in baseline positive interpretation bias ($F_{(2,132)} = .183$, $p = .83$, $\eta_p^2 = .003$) or negative interpretation bias ($F_{(2,132)} = .384$, $p = .68$, $\eta_p^2 = .006$). See Table 1 for pre- and post-training descriptive statistics separated by training condition.

Evidence of training interpretive bias

To examine the effects of training on interpretive bias, ratings from the Interpretive Bias Assessments were entered into a repeated measures ANOVA with training condition as the between-subjects factor and three within-subject factors: time (pre or post training), valence (positive or negative), and target (possible interpretation or foil). Results indicated a main effect for valence, such that participants gave higher similarity ratings for positive versus negative items ($F_{(1,129)} = 83.273$, $p < .001$, $\eta_p^2 = .392$), and a main effect for target, such that participants gave higher similarity ratings for possible interpretations than for foil sentences ($F_{(1,129)} = 1697.495$, $p < .001$, $\eta_p^2 = .929$). There was also a significant valence by condition interaction ($F_{(2,129)} = 4.388$, $p < .05$, $\eta_p^2 = .064$) and a significant time by valence interaction ($F_{(1,129)} = 4.941$, $p < .05$, $\eta_p^2 = .037$). In terms of three-way interactions, there was a time by valence by condition interaction ($F_{(2,129)} = 6.907$, $p < .001$, $\eta_p^2 = .097$), a significant valence by target by condition interaction ($F_{(2,129)} = 4.271$, $p < .05$, $\eta_p^2 = .062$), and a significant time by valence by target interaction ($F_{(1,129)} = 8.271$, $p < .005$, $\eta_p^2 = .060$). These three-way interactions were subsumed by a significant time by valence by target by condition four-way interaction ($F_{(2,129)} = 7.300$, $p < .001$, $\eta_p^2 = .102$).

The four-way interaction of time by valence by target by condition was decomposed by carrying out separate analyses for targets and foils. Analyses revealed a significant three-way time by valence by condition interaction for possible interpretations ($F_{(2,129)} = 9.320$, $p < .001$,

η_p^2= .126), but not for foils ($F_{(2,129)}$ = 0.702, *ns*, η_p^2= .011). The three-way interaction for possible interpretations was further decomposed by carrying out separate analyses for negative and positive interpretations. Analyses revealed a significant time by condition interaction for the positive interpretations ($F_{(2,129)}$ = 3.149, p <.05, η_p^2= .047) and the negative interpretations ($F_{(2,129)}$ = 6.898, p <.001, η_p^2= .097). Follow-up analyses revealed that positive interpretations increased significantly from pre- to post-training assessments for the positive training group relative to the negative training group ($F_{(1,129)}$ = 5.611, p <.05, η_p^2= .042) and the difference between the positive group and the neutral group approached significance ($F_{(1,129)}$ = 3.617, p <.06, η_p^2= .027). The neutral and negative training groups did not significantly differ ($F_{(1,129)}$ = 0.241, *ns*, η_p^2= .002). Additionally, negative interpretations increased significantly from pre- to post- training assessments for the negative training group relative to the positive training ($F_{(1,129)}$ = 13.267, p <.001, η_p^2= .093) and neutral groups ($F_{(1,129)}$ = 6.146, p <.05, η_p^2= .045), however the neutral and the positive groups were not significantly different ($F_{(1,129)}$ = 1.417, *ns*, η_p^2= .011) (see Figure 1).

Trait anger and gender were entered as possible moderators of the effects of training condition on interpretation bias, however, there were no significant interactions between training condition and trait anger or gender (all p-values >.31).

Accuracy

To examine whether there were differences between conditions in the accuracy of completing the target word and in selecting the correct yes/no answer in response to the comprehension question, an ANOVA was conducted with training condition as the between-subjects factor. There was no significant difference between the groups in terms of accuracy ($F_{(2,134)}$ = 1.971, *ns*, η_p^2= .029).

Impact of training on self-report measures immediately following interpretation training

To examine whether training condition led to differential changes in state mood measures directly, repeated measures ANOVAs were conducted on PANAS and state anger ratings with training condition as a between-subjects factor and time (pre- and post-training) as a within-subjects factor. For state anger, there was no significant main effect of time ($F_{(1,125)}$ = 2.826, *ns*, η_p^2= .022) or interaction between time and condition ($F_{(2,125)}$ = 1.541, *ns*, η_p^2= .024). For general

negative mood, there was a significant main effect of time ($F_{(1,125)} = 17.398$, $p < .001$, $\eta_p^2 = .122$), such that negative mood decreased after training, but there was no interaction between time and condition ($F_{(2,125)} = 0.240$, *ns*, $\eta_p^2 = .004$). For general positive mood, there was a significant main effect of time ($F_{(1,121)} = 48.440$, $p < .001$, $\eta_p^2 = .286$), such that positive mood decreased after training, but there was no interaction between time and condition ($F_{(2,121)} = 3.014$, *ns*, $\eta_p^2 = .047$).

Impact of training on blood pressure measures

To examine whether training altered blood pressure reactivity to the insult ANCOVAs were conducted covarying for baseline measures to increase statistical power (Van Breukelen, 2006). Prior to conducting analyses, the homogeneity of regression assumption was evaluated and met. The data for systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse were examined separately, similar to previous research (Anderson, Linden, & Habra, 2005). When covarying for baseline SBP, there was no effect of condition on SBP either halfway through the insult ($F_{(2,129)} = 0.597$, *ns*, $\eta_p^2 = .009$) or at the end of the insult ($F_{(2,128)} = 0.004$, *ns*, $\eta_p^2 = .000$). When controlling for baseline DBP, there was no effect of condition on DBP either halfway through the insult ($F_{(2,129)} = 0.693$, *ns*, $\eta_p^2 = .011$) or at the end of the insult ($F_{(2,128)} = 1.922$, *ns*, $\eta_p^2 = .029$). When controlling for baseline pulse, there was no effect of condition on pulse halfway through the insult ($F_{(2,129)} = 1.901$, *ns*, $\eta_p^2 = .029$). However, there was a significant effect of condition on pulse at the end of the insult ($F_{(2,128)} = 4.804$, $p < .01$, $\eta_p^2 = .070$). Follow-up analyses found that participants in the neutral group had higher heart rates at the end of the insult as compared to participants in the negative group ($F_{(1,128)} = 6.755$, $p < .01$, $\eta_p^2 = .050$) and the positive group ($F_{(1,128)} = 6.642$, $p < .05$, $\eta_p^2 = .049$). However, the positive and negative groups did not differ significantly ($F_{(1,128)} = 0.018$, *ns*, $\eta_p^2 = .000$). See Table 2 for descriptive statistics during the confederate insult.

Trait anger and gender were entered as possible moderators of the effects of training condition on SBP, DBP, and pulse, however, there were no significant interactions between training condition and trait anger or gender (all *p*-values > .22).

Impact of training on overt behavior of participants during insult

Due to technical difficulties, video recordings were lost for all but 85 participants, resulting in a lower sample size for these analyses (neutral condition: *N*=29; negative training: *N*=29; positive training: *N*=27). Conditions did not differ based on demographics or baseline

measures. See Table 2 for descriptive statistics during the confederate insult. Both research assistants' ratings of how irritated, angry, and amused participants appeared and how many verbal responses were made were significantly correlated (*r*'s= .34- .75, *p*'s<.01- 001). Ratings were averaged across raters. Next, the three 3 minute ratings across the nine minute insult were summed to obtain a total score. Total scores of irritation and anger were significantly correlated with participant self-reported state anger during the confederate interaction (irritation: *r*= .45, *p*<.001, anger: *r*=.36, *p*<.001). Ratings of amusement did not correlate with self-reported state anger (*r*=.02, *ns*) and there was a trend between number of responses made to the confederate and self-reported anger (*r*=.20, *p*=.06).

To examine whether training influenced how the participant responded to the confederate, a series of ANOVAs were conducted comparing ratings of irritation, anger, amusement, and number of responses across conditions. Ratings of irritation were significantly different between the three conditions ($F_{(2,82)} = 3.400$, $p < .05$, $\eta_p^2 = .077$). Specifically, follow-up analyses found that participants in the positive training condition appeared less irritated than those in the negative training condition ($F_{(1,82)} = 6.615$, $p < .05$, $\eta_p^2 = .075$). Significant differences were not found between the positive training and neutral groups ($F_{(1,82)} = 2.890$, *ns,* $\eta_p^2 = .034$) or the negative training and neutral groups ($F_{(1,82)} = 0.788$, *ns*, $\eta_p^2 = .010$). Additionally, ratings of amusement were significantly different between the three conditions ($F_{(2,82)} = 4.536$, $p < .05$, $\eta_p^2 = .100$). Specifically, follow-up analyses found that participants in the positive training condition appeared more amused than those in the negative training condition ($F_{(1,82)} = 8.231$, $p < .01$, $\eta_p^2 = .091$) and those in the neutral group ($F_{(1,82)} = 5.152$, $p < .05$, $\eta_p^2 = .059$). Significant differences were not found between the negative training and neutral groups ($F_{(1,82)} = 0.373$, *ns*, $\eta_p^2 = .005$). Ratings of angry appearance were not significantly different between the groups ($F_{(2,82)} = 1.587$, *ns*, $\eta_p^2 = .037$) and neither were the number of verbal responses made to the confederate ($F_{(2,82)} = 0.480$, *ns*, $\eta_p^2 = .012$).

Trait anger and gender were entered as possible moderators of the effects of training condition on overt behavior during the insult, however, there were no significant interactions between training condition and trait anger or gender (all *p*-values >.10).

Impact of training on state anger measures during and following insult

To examine whether training affected self-reported anger during and following the insult ANCOVAs were conducted covarying for baseline state anger to increase statistical power (Van Breukelen, 2006). Prior to conducting analyses, the homogeneity of regression assumption was evaluated and met. State anger ratings taken halfway through the insult and ratings taken immediately after the insult were examined separately. When controlling for baseline state anger, there was an effect of condition on state anger halfway through the insult ($F_{(2,128)} = 3.475$, $p<.05$, $\eta_p^2 = .051$) but not at the end of the insult ($F_{(2,123)} = 2.050$, *ns*, $\eta_p^2 = .032$). Simple effect tests, Bonferroni adjusted for multiple comparisons, confirmed that participants in the positive condition reported significantly less anger during the insult (covariate adjusted mean: $M_{adj=}$ 8.45; $SE = .62$) than those in the neutral condition (covariate adjusted mean: $M_{adj=}$ 10.67; $SE = .60$). Participants in the negative training group (covariate adjusted mean: $M_{adj=}$ 10.02; $SE = .62$) did not differ significantly from the other groups. See Table 2 for descriptive statistics during the confederate insult.

Trait anger and gender were entered as possible moderators of the effects of training condition on state anger during and following the insult. There were no significant interactions between training condition and gender (all *p*-values >.31). Additionally, there was not a significant interaction between trait anger and condition during the insult ($F_{(2,125)} = 1.904$, *ns*, $\eta_p^2 = .030$), however, there was a significant interaction between trait anger and condition following the insult ($F_{(2,120)} = 5.447$, $p<.01$, $\eta_p^2 = .083$). The interaction between condition and trait anger following the insult was followed up by repeating the ANCOVA at both high and low levels of trait anger (+ or – 1 *SD* from the mean). At high levels of trait anger, there was a main effect of condition ($F_{(2,120)} = 8.300$, $p<.001$, $\eta_p^2 = .122$). Simple effect tests, Bonferroni adjusted for multiple comparisons, confirmed that participants in the neutral condition reported significantly more anger following the insult (covariate adjusted mean: $M_{adj=}$ 16.56; $SE = 1.09$) than those in the negative condition (covariate adjusted mean: $M_{adj=}$ 11.65; $SE = .88$) and the positive condition (covariate adjusted mean: $M_{adj=}$ 11.23; $SE = .98$). There was no effect of condition for low trait anger ($F_{(2,120)} = .540$, *ns*, $\eta_p^2 = .009$). At low trait anger, participants in the neutral condition had a covariate adjusted mean of 8.65 ($SE = .90$), participants in the negative condition had a covariate adjusted mean of 9.85 ($SE = 1.00$), and those in the positive group had a covariate adjusted mean of 8.59 ($SE = .92$). See Figure 2.

Mediation effect

Post-training interpretive bias was not associated with state anger either halfway through the confederate insult or immediately following it. Therefore, changes in interpretation bias did not significantly mediate the effects of training condition on anger reactivity. However, among participants in the positive training condition, but not the negative training or neutral conditions, negative interpretation bias after training was positively correlated with state anger during the insult (r= .35, p<.05) and immediately after the insult (r= .33, p<.05). Additionally, positive interpretation bias was negatively correlated with observer ratings of irritation during the insult (r= -.52, p<.01). Thus, there appears to be a relationship between post-training interpretation bias and anger reactivity among those in the positive training condition.

DISCUSSION

The current study sought to modify hostile attribution bias in a non-clinical population by training participants to complete a series of ambiguous scenarios with positive interpretations (positive training condition), negative interpretations (negative training condition), or neutral interpretations (neutral condition). Interpretation training altered biases in the expected direction. Positive training resulted in increases in positive interpretation bias relative to the negative training group and there was a trend for increase in positive interpretation bias relative to the neutral group. Additionally, negative training resulted in increases in negative interpretation bias relative to the other two groups.

Interpretation training also resulted in different reactions to the confederate insult, both on self-report and observer ratings. Specifically, participants in the positive training condition were rated by observers as appearing less irritated than those in the negative condition and more amused than the other two conditions. During the insult, participants in the positive condition reported less anger than those in the neutral condition. Overall, participants in the positive training group fared the best during and after the confederate insult, indicating that, as hypothesized, training was effective at reducing angry reactions to an ambiguous stressor.

Interestingly, following the insult, participants with high trait anger in the neutral condition reported more anger than those in either of the other two groups. Additionally, the results for the negative training condition were not consistently different than the other two groups. It is possible that having participants complete the negative interpretation training task led them to be more aware of negative interpretation biases and may have led to a less angry response for some individuals. Perhaps some of the negative interpretations were interpreted as exaggerated negative responses and were not subtle enough to impact anger response. Additionally, the fact that post-training interpretive biases were correlated with angry response to insult for the positive training condition but not the negative training condition suggests that the effects of negative training were not as straightforward as that found for positive training.

Assessments of blood pressure during insult did not demonstrate any meaningful differences between the training conditions. Contrary to the hypotheses, participants in the negative condition did not display higher blood pressure levels than the other two groups during the insult. In fact, the only notable finding from the blood pressure ratings was that participants in the neutral condition had higher pulse rates at the end of the insult than those in the other two

groups. Despite previous research demonstrating the relationship between anger and blood pressure (Anderson, Linden, & Habra, 2005), meta-analytic reviews have found this relationship to be inconsistent (see Schum, Jorgensen, Verhaeghen, Sauro, & Thibodeau, 2003). Additionally, in the present study, only one baseline assessment of blood pressure was collected, which may have not been adequate to get an accurate measure of baseline levels to use as a covariate. Participants' initial blood pressure ratings may have been unduly influenced by additional variables, such as reactivity to the experimental situation. It would also have been more informative to continue to measure blood pressure in the minutes following the confederate insult, as there may have been differences in blood pressure recovery amongst the training conditions. Also, it is possible that the effect of training on blood pressure may have not been large enough to detect differences in a nonclinical sample.

Since post-training interpretation bias was not correlated with insult-related anger, we could not demonstrate that changes in interpretation bias mediated the effects of training condition on angry response. However, amongst the positive training condition, interpretation bias was correlated with self-reported levels of anger and observed irritation, which provides evidence that positive training reduced anger reactivity by its influence on interpretation biases. This finding suggests that positive interpretation training may be a promising treatment option for reducing anger.

Very few studies to date have explored the mechanisms of change in anger treatments and this has been a critique of anger research in general (Olatunji & Lohr, 2004). This study is unique as it allowed us to test how modification of hostile attribution bias can influence subsequent anger reactivity, thus confirming that hostile attribution bias is malleable and that reductions of it can lead to less anger reactivity. Essentially, the positive interpretation training program sought to induce more perspective taking in participants. Though individual differences in dispositional perspective taking and anger have been have been associated, little work has been done to enhance perspective taking skills in anger treatments (Mohr, Howells, Gerace, Day, & Wharton, 2007).

There are a number of methodological strengths in the current study. Specifically, we were able to obtain several different measures of anger (self-report, observation, and blood pressure). Additionally, the use of a confederate insult allowed us to examine how interpretation training could influence behavioral and emotional response to an ambiguous stressor. The

sample size allowed for adequate power to detect differences between groups. The use of three distinct conditions is another strength, as we were able to compare the positive training condition to both a neutral/no training condition and a negative training condition.

Although our findings are promising, there are several limitations. As stated earlier, we should have included more blood pressure assessments in the baseline phase so as to obtain a more reliable measure. Additionally, it would have been interesting to continue recording blood pressure levels after the insult to obtain a measure of cardiovascular recovery following the insult. The effects of positive training on positive interpretation bias were not as strong as we would have predicted and did not differ significantly from that of the negative training condition. This may be due to weakness of training effects, which suggests that multi-session studies would do more to alter interpretation biases. However, it is also possible that the interpretation bias assessment used was not sensitive enough to adequately detect the effects of positive interpretation training.

Despite the over sampling of individuals with high levels of trait anger, the use of a largely unselected undergraduate sample is a weakness and makes it difficult to make strong inferences about the potential use of this treatment in a more clinical sample. Additional research is needed to explore the use of this computerized treatment in a treatment-seeking, high trait anger sample. The current study did not include any follow-up assessments to determine the durability of the effects of a single-session of interpretation training on subsequent anger reactivity. Future studies should include more follow-up assessments.

Table 1. Descriptive statistics (means and SDs) for pre- and post-training measures.

	Positive training		Negative training		Neutral condition	
	M	SD	*M*	SD	*M*	SD
Pre-training measures						
Trait anger	18.02	6.2	19.53	6.5	17.76	5.7
State anger	9.84	4.3	10.42	4.6	10.26	4.4
Positive mood	22.67	10.0	23.12	8.8	22.76	7.8
Negative mood	12.70	5.4	13.52	4.5	13.51	5.1
Positive interpretation	3.21	0.4	3.25	0.4	3.21	0.4
Negative interpretation	3.00	0.6	3.09	0.5	3.01	0.6
Positive foil	1.56	0.4	1.58	0.5	1.51	0.4
Negative foil	1.25	0.3	1.34	0.4	1.31	0.3
Post-training measures						
State anger	9.88	3.9	10.84	4.5	12.05	5.9
Positive mood	19.63	9.0	17.90	8.9	18.81	7.9
Negative mood	11.38	3.2	11.95	2.3	12.24	3.5
Positive interpretation	3.41	0.4	3.22	0.5	3.22	0.5
Negative interpretation	2.66	0.8	3.24	0.6	2.82	0.6
Positive foil	1.54	0.5	1.53	0.6	1.46	0.5
Negative foil	1.22	0.2	1.33	0.5	1.28	0.3

Table 2. Descriptive statistics (means and SDs) during the confederate insult.

	Positive training		Negative training		Neutral condition	
	M	SD	*M*	SD	*M*	SD
Blood pressure						
Pre SBP	110.50	14.3	105.13	12.9	109.72	14.0
Pre DBP	70.09	8.5	69.98	8.9	69.83	8.2
Pre pulse	65.02	10.5	64.56	9.1	63.43	10.3
Midway SBP	109.57	13.4	106.20	13.5	109.37	14.5
Midway DBP	72.16	8.9	69.82	8.3	70.98	9.4
Midway pulse	70.16	11.0	70.00	12.2	70.07	14.8
End SBP	112.98	14.2	106.56	12.7	111.04	13.3
End DBP	74.07	8.8	70.87	10.4	71.93	11.6
End pulse	70.79	10.9	70.56	10.2	68.59	14.6
Video ratings						
Irritated	4.35	1.5	5.78	2.5	5.29	2.0
Angry	3.31	0.8	3.86	1.5	3.60	1.0
Amused	6.72	3.2	4.74	2.4	5.16	2.1
Responses	3.46	2.3	2.83	1.7	3.24	3.2
State anger						
During insult	8.35	2.0	9.96	4.5	10.70	5.2
Following insult	9.78	3.5	10.78	4.9	11.93	6.3

NOTE: SBP= systolic blood pressure; DBP= diastolic blood pressure

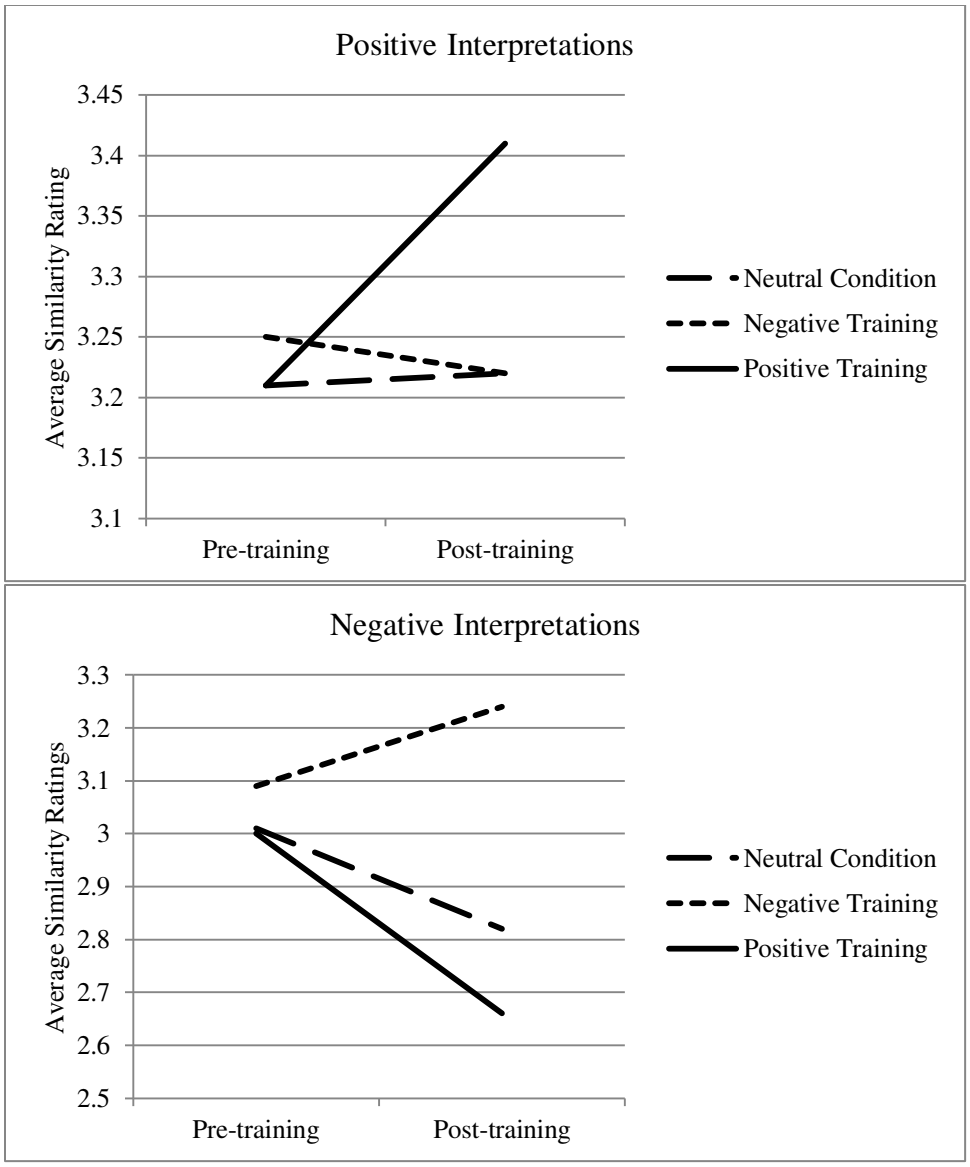

Figure 1. Changes in positive and negative interpretation bias.

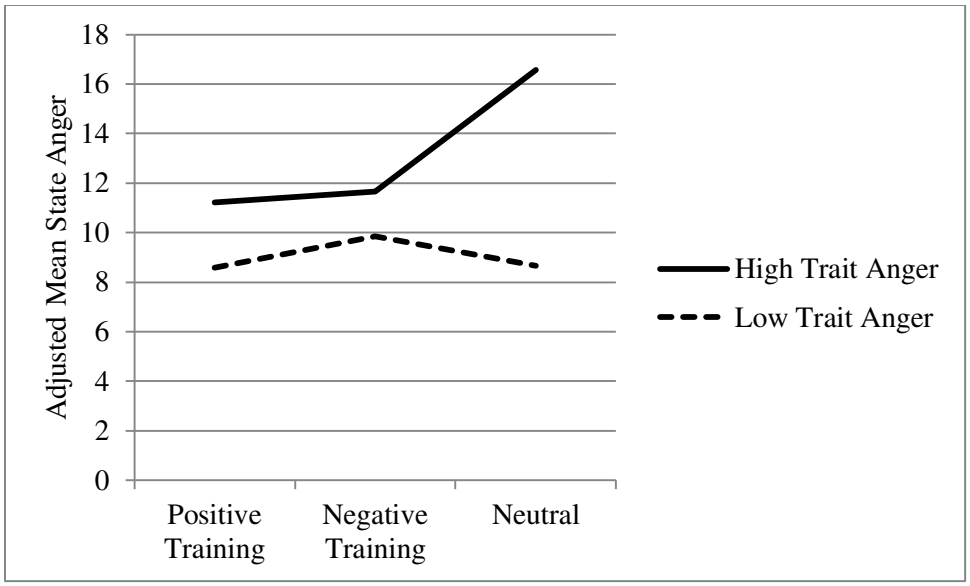

Figure 2. Covariate adjusted mean state anger scores following the confederate insult at high and low levels of trait anger (+ or – 1 *SD* from the mean).

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673, FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 10/7/2011

To: Kirsten Hawkins

Dept.: PSYCHOLOGY DEPARTMENT

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
Interpretation Training on Hostile Attribution Bias

The application that you submitted to this office in regard to the use of human subjects in the research proposal referenced above has been reviewed by the Human Subjects Committee at its meeting on 09/14/2011. Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 9/12/2012 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is FWA00000168/IRB number IRB00000446.

Cc:
HSC No. 2011.6865

APPENDIX B

INFORMED CONSENT

INFORMED CONSENT FORM

DRAWING AND MOOD

I, _____, being 18 years of age or older, freely and voluntarily and without undue inducement or any element of force, fraud, deceit, duress, or other form of constraint or coercion, consent to be a participant in the above named research project, to be conducted at the Florida State University by graduate student Kirsten Hawkins under the supervision of Jesse Cougle, Ph.D., an Assistant Professor of Psychology. Listed below are the procedures to be followed in this research and their purposes, any risks, discomfort, and benefits associated with participation in this study, and the measures which will be taken to ensure confidentiality of the information obtained.

Procedures for the research: I understand that if I participate in the project I will be asked to fill out questionnaires about my mood, behaviors, thoughts, feelings, and personality dispositions. I understand that some of the questions deal with sensitive issues such as whether I have experienced or witnessed traumatic events. If I should reveal that I am a threat either to myself or others, I understand that the experimenter will approach me to ensure my safety and may provide me with referral information. I will also be asked to do some computer tasks and draw some pictures. My blood pressure will be measured and I will be videotaped while I draw these pictures. In total, I will participate in one experimental session. The total time commitment would be approximately two hours. If I participate I will receive two hours of PSY2012 credit for my time.

Potential risks or discomforts: I understand there is minimal risk involved in this study, although some individuals may be uncomfortable describing their thoughts and behaviors. I have the right to refuse or discontinue participation at any time. If I decide to stop participation, I will still be entitled to the two hours of PSY2012 credit for my time.

Potential benefits to you or others: I have not been given any guarantee that I will benefit from my participation in this study. I may derive benefit from the self-assessment as it may increase my awareness of my thoughts, feelings, and behaviors. I will also be provided referrals to appropriate clinical services, if I seek them. I may also develop a better understanding of research methodology and will be providing researchers with valuable insight.

Confidentiality: I understand my participation is totally voluntary and I may stop participation at any time. All my answers to the questions will be kept confidential, and my confidentiality will be protected to the full extent allowed by law. My name will not appear on any of the results and only group findings will be reported. I understand that, because this is a confidential study, the administrator will not be able to link my responses to me and initiate counseling, if needed. I may, however, inquire about referral sources if I wish, and the experimenter will be able to provide me with that information. All data will be destroyed on or before December 31, 2018.

I understand that this consent may be withdrawn at any time without prejudice, penalty or loss of benefits to which I am otherwise entitled. I have been given the right to ask any inquiry concerning the study. Questions, if any, have been answered to my satisfaction. I understand that I may contact Kirsten Hawkins or Jesse Cougle, Florida State University, Department of Psychology, (850) 645-8729 for answers to questions about this research or my rights. Group results will be sent to me upon my request. I understand that if I have any questions about my rights as a participant in this research, or if I feel I have been placed at risk, I can contact the Chair of the Human Subjects Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-8633.

I have read and understand this consent form. By choosing freely and voluntarily to participate in the study as described here I indicate my informed consent:

_____ _____

(Participant Signature) (Date)

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BIOGRAPHICAL SKETCH

Kirsten Hawkins attended McGill University, where she graduated with a Bachelor of Science degree in Psychology in 2004. She is currently a graduate student in the Clinical Psychology doctoral program at Florida State University.

Kirsten's research interests involve the development of novel and effective treatments to target both anger and anxiety disorders as well as exploring the relationship between and common mechanisms underlying anger and anxiety disorders.