A COMPUTERIZED INTERPRETATION MODIFICATION PROGRAM AND ITS EFFECT ON SOCIAL ANXIETY

by

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(Under the Direction of Nader Amir)

ABSTRACT

Social Phobia is a common and debilitating disorder that often goes untreated. The current study translated empirical findings from information processing research to develop a procedure to decrease social anxiety symptoms. Specifically, I evaluated a computerized interpretation modification program that was designed to change biased interpretation and decrease anxiety symptoms in socially anxious individuals. Twenty-three socially anxious individuals were randomly assigned to the interpretation modification program or a placebo condition. The program successfully changed biased interpretation and social anxiety symptoms compared to the placebo condition. This type of procedure has implications for new treatments and understanding mechanisms of change in social anxiety.

INDEX WORDS: Social Anxiety, Interpretation, Information Processing

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B. S., University of Georgia, 2003

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2005

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DEDICATION

I would like to dedicate this thesis to my parents, Robert and Kathleen Beard. You both have provided such incredible support and love throughout my entire academic career. I can never thank you enough.

ACKNOWLEDGEMENTS

I would like to thank my committee, Steven Beach and Karen Calhoun, for their time and helpful comments throughout this process. I would especially like to thank my major professor, Nader Amir, for encouraging me to conduct such an ambitious project, helping me at every stage, and for always being much more than an advisor. I would also like to thank Natalie Stinson and Jackie Simonis for their valuable help in collecting data for the project.

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Introduction

What is Social Phobia and Why is it Important?

The Diagnostic and Statistical Manual (DSM-IV) defines Social Phobia (SP) as a "marked and persistent fear of one or more social or performance situations in which embarrassment may occur" (DSM-IV-TR APA, 1994, p.450). When encountering social situations, individuals with SP experience physiological symptoms such as blushing, sweating, and increased heart rate. Negative cognitions often accompany these symptoms such as "Everyone thinks I'm stupid," or "They are all laughing at me." People encounter social interactions every day; therefore, individuals with SP experience distress and interference due to their anxiety symptoms almost daily.

Social Phobia ranks third in prevalence among all psychiatric disorders (lifetime prevalence 13.3%, Kessler et al., 1994). It typically begins in childhood or early adolescence and has a chronic course (e.g., see Rapee, 1995, chap. 3 for a summary). Moreover, this condition causes significant interference with an individual's functioning in work, family, and social domains. For example, individuals with SP report that their social anxiety prevents them from getting a job or promotion (Stein, Torgrud, & Walker, 2000). Social anxiety tends to go untreated for a number of reasons including financial restraints and concern about other's opinions about utilizing mental health services (Olfson, et al., 2000). Therefore, examining the mechanisms underlying SP, as well as developing effective treatments for it is clearly warranted.

Models of Social Phobia

Researchers have proposed several models to explain SP. However, I will focus on cognitive-behavioral models because they are most relevant to the proposed hypotheses. I will also provide a brief description of the biological models of SP.

Functional brain activation and neurochemical research have informed biological models of SP. Specifically, researchers have implicated the role of the brain's fear network in SP (e.g., Stein, Goldin, Sareen, Zorilla, & Brown, 2002). This research suggests that individuals with SP show enhanced amygdala activation in response to danger signals (e.g., angry faces, Stein et al., 2002). However, enhanced amygdala activation may be a hallmark of all anxiety disorders. For example, models of panic disorder have also implicated an abnormally sensitive fear network, specifically the amygdala (e.g., Gorman, Kent, & Sullivan, 2000).

Neurochemical models of SP have implicated the role of various neurotransmitters based on treatment response to various pharmacological agents including monoamine oxidase inhibitors (MAOIs; e.g., phenelzine: Gelernter et al., 1991), selective serotonin reuptake inhibitors (SSRIs; e.g., paroxetine: Stein et al., 1998), and serotonin-norepinephrine reuptake inhibitors (SNRIs; e.g., venlafaxine: Liebowitz, Gelernberg, & Munjack, 2005). Thus, because individuals with social anxiety respond favorably to MAOIs, SSRIs, and SNRIs, deficient dopaminergic and serotonergic systems have been postulated in the etiology of SP (Stein, 1998). However, these systems have been implicated in other forms of psychopathology (e.g., serotonin in depression; Malison et al., 1998). Thus, although these two lines of

research are informative about the role of fear and neurotransmitters in anxiety disorders, they lack specificity regarding SP.

Researchers have also proposed cognitive-behavioral models of SP suggesting several cognitive processes that maintain this disorder. For example, Clark and Wells (1995) suggested that individuals with SP focus their attention internally during a social situation. This internal focus of attention may take the form of a mental image of the self from an observer's perspective. This self-focus increases their attention to various physiological symptoms (e.g. shaking hands, sweating) and prevents them from receiving positive feedback from other people. Second, individuals with SP engage in safety behaviors (e.g., avoiding eye contact) that are intended to reduce anxiety by preventing negative evaluation. However, these behaviors maintain social anxiety by preventing these individuals from receiving disconfirming evidence about their negative beliefs, interfering with their social performance, and causing their feared consequence of negative evaluation to actually occur. Third, individuals with SP may experience anxiety-induced performance deficits. For example, SPs may respond to people in an abrupt manner because of their anxiety and consequently appear unfriendly. Fourth, SPs engage in anticipatory and post-event processing of social situations, leading them to expect the worst of future social interactions and ruminate over negative aspects of past social interactions. Finally, Clark and Wells (1995) proposed that SPs hold unreasonable assumptions about the standards for social performance and the negative consequences of failed social performances.

Rapee and Heimberg (1997) proposed a similar cognitive model of SP that includes many of the processes outlined by Clark and Wells (1995). This model also

proposes that self-focused attention, safety behaviors, and unreasonable assumptions about performance standards maintain SP. Moreover, Rapee and Heimberg propose that anxiety develops when SPs find a discrepancy between their view of themselves and their perceived expectations of other people. As this discrepancy increases, so does their anxiety. This model differs from Clark and Wells because it suggests that SPs monitor external indicators of negative evaluation (e.g., someone frowning) in addition to internal cues (e.g., racing heartbeat) during a social interaction. Additionally, this model proposes that SPs form their mental image from an observer's perspective using input from long-term memory (e.g., past failed social experiences), internal cues (e.g., racing heartbeat), and external cues (e.g., someone frowning).

Empirical investigations have provided support for both the Clark and Wells (1995) and Rapee and Heimberg (1997) models of SP. Specifically, self-focused attention and taking the observer perspective increases anxiety (e.g., see Spurr & Stopa, 2002 for a review), reducing safety behaviors augments the benefits of exposure therapy (Wells et al., 1995), and post-event processing maintains social anxiety (e.g., Rachman, Gruter-Andrew, & Shafran, 2000). Finally, studies have demonstrated a relationship between social anxiety and the biased processing of negative external cues (e.g. Mogg, Philippot, & Bradley, 2004).

These cognitive models make specific predictions about events that occur during a social interaction. However, most of the empirical investigations of these theories have relied on self-report data. As MacLeod (1993) has argued, the validity of self-report data may be limited because people may not be cognizant of and/or accurately report their cognitive processes. For example, when testing the hypothesis that SPs

form a mental image using input from long-term memory, internal cues, and external cues, SPs may be able to describe their mental image. However, it is unlikely that they can accurately report how they form the image. Thus, MacLeod (1993) suggested that researchers use more direct methods of measuring cognitive mechanisms in addition to self-report methods.

Information Processing Approaches

A more direct approach to understanding cognitive mechanisms in SP relies on the methods of information processing literature. This approach examines the various cognitive factors that may lead to the maintenance of SP using paradigms that do not exclusively rely on self-report data. Information processing approaches suggest that biased attention, interpretation, and memory may play a role in the maintenance and/or etiology of anxiety (Williams, Watts, MacLeod & Mathews, 1997). Most relevant to this proposal, research suggests that individuals with pathological anxiety may interpret ambiguous information negatively. For example, when Butler & Mathews (1983) presented their participants with an ambiguous scenario (e.g., “You hear a loud noise in the night.”), anxious participants tended to choose a negative interpretation (e.g., “Someone is breaking into the house.”) rather than a neutral interpretation (e.g., “The thunder is loud.”) of the scenario. These results suggest that when given a number of options, generally anxious individuals choose the negative explanation of an ambiguous event. Researchers have also used this methodology to examine interpretation bias in other anxiety disorders. Using disorder specific scenarios (e.g., Panic Disorder: You suddenly feel your heart racing), these studies suggest that interpretation bias may play a role in panic disorder (e.g., Clark et al., 1997), obsessive-compulsive disorder (e.g.,

Salkovskis et al., 2000), and social anxiety (e.g., Amir, Foa, & Coles, 1998; Stopa & Clark, 2000). Interpretation of ambiguous information in a threatening manner may be especially relevant to individuals with SP because social cues are often ambiguous and easily distorted (Rapee & Heimberg, 1997). Thus, a negative interpretation style specific to social situations may be particularly debilitating. Consequently, researchers have examined the role of interpretation bias in SP.

Interpretation in Social Phobia

As previously stated, several studies have suggested that individuals with SP interpret ambiguous, social stimuli differently than non-anxious individuals. Consistent with previous studies of interpretation, researchers have developed interpretation questionnaires similar to that used by Butler and Mathews (1983) to examine interpretation bias in SP (e.g., Amir, Foa, & Coles, 1998; Constans, Penn, Ihen, & Hope, 1999; Roth, Antony, & Swinson, 2001; Stopa & Clark, 2000). These questionnaires comprise ambiguous scenarios (e.g., "You see a group of friends having lunch, they stop talking when you approach") and three interpretations of the scenario (i.e., positive: “They are about to ask you to join,” negative: “They were saying negative things about you,” and neutral: “They just ended their conversation”). Participants rank order the interpretations according to how likely they would be to come to mind if they were in a similar situation. The above studies vary in materials used and participant characteristics, but they all concluded that SPs interpret ambiguous information more negatively than non-anxious controls. Moreover, this bias seems to be specific to socially relevant information. However, they all rely on self-report with its inherent limitations. For example, it is not clear whether SP participants simply tend to choose

negative interpretations when faced with a forced-choice decision or if they would rate all interpretation types as equally likely to come to mind if given the opportunity. Given the limitations of self-report data, other researchers have used more direct measures of interpretation by employing tasks that do not explicitly ask individuals about their interpretation.

For example, Hirsch and Mathews (1997) found evidence for an interpretation bias in individuals high in interview anxiety using a series of tasks that measure interpretation using reaction time. They presented individuals high and low in interview anxiety ambiguous descriptions of interviews (e.g., The interviewer asks you to elucidate on your point and you think this means they are….). In the first experiment, participants then read probe words that either confirmed a threatening interpretation (e.g., disagreeing) or a non-threatening interpretation (e.g. listening) of the ambiguous description. Participants made decisions regarding the grammatical correctness of the probe word in the sentence, and their response time was recorded. Interpretation bias is revealed when participants respond more quickly to the threatening words than to the non-threatening words. The second experiment used a similar procedure except that participants made lexical decisions regarding the probe words. Lexical decision tasks require participants to decide if a string of letters is a word (e.g., stupid) or non-word (e.g., sdtuip). In these two experiments, groups did not differ in their response latency to threatening probes. However, individuals high in interview anxiety were slower than individuals low in interview anxiety to respond to non-threatening probes. The authors concluded that individuals high in interview anxiety may lack a positive interpretive bias characteristic of non-anxious individuals. In a follow-up study, Hirsch and Mathews

(2000) used a similar lexical decision task and found that SPs lack a positive bias compared to non-anxious controls. Specifically, SPs failed to demonstrate any bias (i.e., had similar reaction times for threat and non-threat probes), whereas NACs showed a positive interpretation bias (i.e., had faster response latencies to non-threat probes than threat probes).

In summary, researchers have demonstrated an interpretation bias in SP using multiple paradigms. Some studies suggest that individuals with SP display a negative interpretation bias for ambiguous stimuli (Amir, Foa, & Coles, 1998; Stopa & Clark, 2000), while others suggest that SPs are better characterized by a lack of a positive interpretation bias for ambiguous stimuli (Constans, Penn, Ihen, & Hope, 1999; Hirsch & Mathews, 1997, 2000). This discrepancy could result from the use of different paradigms and populations. For example, some studies used participants high in interview anxiety (e.g., Hirsch & Mathews, 1997), while others used individuals with SP (e.g., Amir, Foa, & Coles, 1998). Regardless of the specific direction of the bias, interpretation bias appears to play a role in the etiology and/or the maintenance of SP.

However, the above studies are correlational in nature. This limits the conclusions that can be drawn from the findings because (a) SP could cause individuals to develop an interpretation bias for threat, (b) having an interpretation bias for threat could lead to the development of SP, or (c) a third construct could lead to the development of both SP and interpretation bias for threat. To examine the hypothesis that an interpretation bias causes SP, researchers must randomly assign participants to conditions and then attempt to manipulate their interpretation. If interpretation bias plays a causal role in SP, its manipulation should affect social anxiety symptoms. Although to

date researchers have not manipulated interpretation bias in anxious participants, researchers have recently examined the possibility of manipulating interpretation in non-anxious individuals.

Manipulation of Interpretation

Recent studies suggest that interpretation is malleable and more importantly, that its manipulation can lead to changes in mood. For example, Mathews and Macintosh (2000) presented non-anxious, community volunteers with social scenarios consisting of three sentences (e.g., Your partner asks you to go to an anniversary dinner that their company is holding. You have not met any of their work colleagues before. Getting ready to go, you think that the new people you will meet will find you boring/friendly). These scenarios remained ambiguous except for the final word that was presented as a word fragment implying either the threat (e.g., bo_i_g) or non-threat (e.g., fr_e_dly) interpretation of the scenario. Participants were asked to complete the word fragment as quickly as possible and then answer a comprehension question that reinforced the manipulated interpretation (e.g., Will you be liked by your new acquaintances?). Finally, participants received feedback about the accuracy of their response to the comprehension question. Participants were randomly assigned to a negative condition (i.e., the fragment predominantly resolved the ambiguity in a negative direction) or a positive condition (i.e., the fragment predominantly resolved the ambiguity in a positive direction). After the interpretation induction, participants rated positive and negative interpretations of novel ambiguous scenarios on their similarity to the meaning of the novel ambiguous scenarios. Results revealed that the interpretation induction was effective in changing participants' interpretation. That is, participants in the negative

training were more likely to rate negative interpretations as similar in meaning to the novel ambiguous scenarios after the interpretation induction, while participants in the positive training were more likely to rate the positive interpretations as similar in meaning to the novel ambiguous scenarios. Moreover, this change in interpretation influenced their state anxiety, demonstrating that the negative induction training increased state anxiety and the positive induction training decreased state anxiety.

In the second experiment, Mathews and Macintosh (2000) used the same procedure with the following exception: participants were not required to generate the resolution of the ambiguous scenario. Instead, they read the scenario followed by the completed target word. They then completed a word fragment corresponding to an emotionally neutral word and answered a comprehension question. In this study, the induction was again effective in changing interpretation, but it did not produce a change in anxiety. Taken together these findings suggest that a change in affect may require the active generation (i.e., completing a word fragment) of interpretation.

Researchers have also used homographs (i.e., words with multiple meanings, 'mean' can imply 'average' or 'nasty'), to change interpretation. These studies found similar results suggesting that interpretation is malleable. For example, Grey and Mathews (2000) induced an interpretation bias for ambiguous homographs in non-anxious volunteers in three experiments. Participants were randomly assigned to either a threat or non-threat training condition in each experiment. In the first experiment, participants saw a homograph (e.g., mean) followed by a word fragment (e.g., n_ s_y). Participants indicated as quickly as possible when they knew how to complete the fragment. Depending on the condition, the word fragment either implied a threat (e.g.,

nasty) or a non-threat (e.g., average) meaning of the homograph (e.g., mean). Participants completing the threat training condition responded faster to novel threat word fragments than to novel non-threat word fragments, indicating an interpretation bias for novel, threat-related homographs. The non-threat training, however did not generalize to new homographs. The authors conducted a second study to replicate and extend these findings. Additionally, the test phase in the second study consisted of a lexical decision task, rather than the homograph task used in the training phase. Threat training was effective in changing interpretation for novel stimuli. That is, participants in the threat condition responded faster to novel threat words than novel non-threat words. However, non-threat training failed to generalize to novel stimuli. Thus, Experiment 2 replicated the findings of Experiment 1 and demonstrated that these effects are not limited to a particular task. Finally, these authors conducted a third experiment to examine whether active generation (i.e., completing a word fragment) is necessary for training interpretation. In Experiment 3, participants saw a homograph followed by the completed target word. Participants decided whether or not the two words were related. Although participants were not required to actively generate an interpretation, the training effect generalized to novel homographs for both the threat and non-threat training conditions. This series of experiments suggests that interpretation can be manipulated and that the active generation of interpretation is not required to change interpretation. However, other experiments (i.e., Mathews & Macintosh, 2000) suggest that active generation of interpretation may be necessary to alter mood.

Extension of Previous Studies

To date, no studies have attempted to manipulate interpretation in anxious individuals. Moreover, studies have not examined the effect of manipulating interpretation on symptoms of anxiety. The present study evaluated a computerized interpretation modification program designed to change the way socially anxious individuals interpret ambiguous social information. The study examined the effect of the interpretation change on symptoms of social anxiety. The procedure was based on the studies reviewed above and integrated features that have been implicated in the successful manipulation of interpretation. Specifically, a task similar to the current procedure has been effective in inducing a non-threat interpretation bias in non-anxious individuals (Grey & Mathews, 2000). As reviewed above Grey and Mathews (2000) induced an interpretation bias for ambiguous homographs by presenting a homograph followed by a target word matching the threat or the non-threat meaning of the homographs and asking their participants to decide whether or not the two words were related. Although participants were not required to actively generate an interpretation, the training effect generalized to novel homographs for both the threat and non-threat training conditions. Therefore, judging the relationship between an ambiguous stimulus (e.g., homograph) and a word seems to be an effective way of changing interpretations. However, homographs are inherently limited in the amount of information they can convey as well as being limited in the types of social interaction they can represent.

To address this limitation, I devised a similar paradigm where the ambiguity is conveyed in a sentence, instead of a homograph. Moreover, by presenting both non-threat (e.g., ”funny”) and threat (e.g., “embarrassing”) targets for a particular sentence (e.g.,

"People laugh after something you said"), it was possible to guide participants' interpretation away from threat and toward nonthreat. Specifically, the current paradigm guided participants toward making non-threatening interpretations and rejecting threat interpretations by manipulating the feedback they received (e.g., positive feedback when participants endorsed non-threatening interpretations and negative feedback when participants endorsed threatening interpretations). Although participants did not actively generate interpretations in the procedure, they actively made decisions regarding the interpretations.

I administered the Interpretation Modification Program (IMP) to seven non-anxious individuals in a small pilot study. These participants completed a baseline interpretation assessment, one training session, and a post-assessment of their interpretation. Participants showed a 21% decrease in the percentage of threat interpretations endorsed. However, they did not show an increase in the percentage of non-threat interpretations endorsed. These preliminary results were encouraging, so I continued with the current study in which I added a Placebo Condition (PC) and increased the number of training sessions from one to eight.

Hypotheses:

The current study tested four hypotheses: (a) Participants in the IMP will endorse more nonthreat interpretations at post, controlling for their pre scores, than the PC. (b) Participants in the IMP will endorse fewer threat interpretations at post, controlling for their pre scores, than the PC. (c) This change in interpretation will generalize to the IQ (Amir et al., 1998), an independent measure of interpretation. Specifically, participants in the IMP will rank negative interpretations of the IQ as less likely to come to mind at

post, controlling for their pre scores, than the PC. (d) Participants in the IMP will report fewer social anxiety symptoms at post, controlling for their pre scores, than the PC.

Thus, I examined the above hypotheses by analyzing participants' post scores, controlling for their pre scores, in a double-blind, randomized, placebo-controlled study.

Methods

Participants

Participants were selected from the undergraduate research pool. Individuals scoring above 19 on the Social Phobia Inventory (SPIN; Connor, Davison, Churchill, Sherwood, Foa, & Weisler, 2000) were selected for further assessment. These individuals then completed the Social Phobia and Anxiety Inventory-Social Phobia Subscale (SPAI-SP; Turner, Beidel, Dancu, & Stanley, 1989). Participants scoring above 80 on the SPAI-SP were then invited to participate in the study. I used two screening measures at two time points to maximize my accuracy in identifying participants who had significant social anxiety concerns. Using these criteria, I screened 647 individuals. Thirty-six individuals met the SPIN criteria and completed the SPAI-SP. Twenty-five individuals also met the SPAI-SP criteria and were invited to participate in the study. Two individuals declined to participate: one due to time constraints and one because he or she was uncomfortable with his or her data being saved. I destroyed this individual's data as requested. Thus, 23 individuals were randomly assigned to one of the two experimental conditions (see Figure 1).

Measures

Participants completed self-report measures of anxiety, depression, and interpretation at pre and post-assessments. Self-report measures included the following:

The *Social Phobia Inventory* (SPIN; Conner, Davison, Churchill, Sherwood, Foa, & Weisler, 2000) consists of 17 items that assess fear, avoidance, and physiological

symptoms associated with social situations. The SPIN demonstrated good test-retest reliability (r = 0.89), internal consistency (α ranges from 0.87 to 0.94), and sensitivity to treatment effects (Conner et al., 2000). I used the SPIN as a brief screening tool to select socially anxious participants. Participants did not complete the SPIN again after the original screening.

The *Social Phobia and Anxiety Inventory* (SPAI; Turner, Beidel, Dancu, & Stanley, 1989) consists of 45 items that assess an individual's level of anxiety (i.e., Social Phobia subscale) and avoidance (i.e., Agoraphobia subscale) of various social situations. However, I used only the Social Phobia subscale to assess social anxiety because the agoraphobia subscale has been found to be unrelated to other measures of social anxiety (Herbert, Bellack, & Hope, 1991). The SPAI Social Phobia subscale has good test-retest reliability (r = .86) and internal consistency (α = .96); (Turner, Stanley, Beidel, & Bond, 1989).

The *State Trait Anxiety Inventory* (STAI; Spielberger et al., 1970) consists of 40 items assessing state and trait symptoms of general anxiety. The STAI has adequate psychometric properties such as internal consistency (α = .83 to .92) and test-retest reliability (r ranges from .73 to.86) (Spielberger et al., 1970).

The *Beck Depression Inventory, 2nd ed* (BDI-II; Beck, Steer, & Brown, 1996) consists of 21 items that assess various symptoms of depression (e.g., sleep, anhedonia, suicidal ideation). The BDI-II has high internal consistency (α = .90) in an undergraduate sample (Storch, Roberti, & Roth, 2004).

The *Interpretation Questionnaire* (IQ; Amir, Foa, & Coles, 1998) was developed to assess individuals' interpretation of ambiguous social scenarios. This questionnaire

comprises 22 ambiguous scenarios (e.g., "You see a group of friends having lunch, they stop talking when you approach") and three interpretations of each scenario (i.e., positive: “They are about to ask you to join,” negative: “They were saying negative things about you,” and neutral: “They just ended their conversation”). Participants rank ordered the interpretations according to how likely they would be to come to mind if they were in a similar situation. This questionnaire demonstrated good internal consistency ($\alpha = 0.85$) (Amir et al., 1998). To conserve time, I administered a short version of the IQ comprising 10 items. As would be expected, the short version demonstrated lower internal consistency than the original version ($\alpha = 0.70$).

Materials

I developed the ambiguous sentences and corresponding words used in the computer program (see Appendix for examples). The content of the sentences related to social situations and safety behaviors (e.g., “People laugh after something you said.”). The materials also included some sentences related to general anxiety because most individuals with SP have general worries in addition to social concerns (e.g., 23.8% of SP patients also met criteria for Generalized Anxiety Disorder); (Mennin, Heimberg, & Jack, 2000). Finally, two words were selected that corresponded with each interpretation of each ambiguous sentence, one implying the threat interpretation (e.g., “embarrassing”) and one implying the non-threat interpretation (e.g., “funny”).

I informally examined the materials to ensure that both words were related to their corresponding ambiguous sentence. Volunteers rated each sentence and corresponding words on their relatedness using a scale of 1 (e.g., not at all related) to

10 (e.g., extremely related). Using this data, I omitted any word and sentence pair that received a score of less than 5.0.

Procedure

Participants were assessed and administered the computer program individually. During the pre-assessment, participants read and signed a consent form, provided basic demographic information, completed the self-report measures (i.e., SPAI-SP, STAI, BDI-II, and IQ), and completed the interpretation assessment (described below). After completing the pre assessment, participants were randomly assigned to one of two conditions: Interpretation Modification Program (IMP; $n = 11$) or Placebo Condition (PC; $n = 12$). The participants and the experimenters were blind to the condition. I gave participants an envelope with a number enclosed at the beginning of each session, and participants clicked on the corresponding number to begin the appropriate program (IMP or PC).

Interpretation Modification Program (IMP)

Participants saw the following brief rationale before the first session:

> The purpose of the study is to examine the efficacy of an experimental computerized treatment for social anxiety. You recently participated in a large group testing. We selected you to participate in this study because it seems like you experience some anxiety in social situations. This program is designed to change some of the automatic processes that maintain some people's anxiety. You may receive a treatment or a placebo condition. We will provide you with more details of our hypotheses and your condition after you complete the program.

Participants completed eight sessions (biweekly for four weeks) described below. The duration of each session varied across participants but generally took 10 minutes. The sessions were administered using a computer program that presented words and

sentences to participants and recorded their responses. The computer presented participants with the following instructions at the beginning of each session:

> In this study, you will see a word appear on the screen. The word will then disappear, and a sentence will appear. When you have finished reading the sentence, press the space bar. When the space bar is pressed the computer will ask you to decide whether or not the word and the sentence are related. Press 1 on the number pad to say 'yes, they are related' and press 3 on the number pad to say 'no, they are not related.'

The experimenter read along with the participants and answered any questions they had regarding the procedure. When participants indicated that the instructions were clear, they clicked on their number and began the computer trials.

Trials.

A trial began with a fixation cross appearing on the computer screen for 500 ms. The fixation cross directed the participants' attention toward the middle of the screen and alerted them that a trial was beginning. Second, a threat word (e.g., dumb) or a non-threat word (e.g., smart) appeared in the center of the computer screen for 500 ms. Third, an ambiguous sentence (e.g., You receive an unexpected grade on a test) appeared. The sentence remained on the screen until participants pressed the space bar indicating that they were finished reading. Fourth, the computer prompted participants to press '#1' on the number pad if the word and sentence were related or to press '#3' on the number pad if the word and sentence were not related. Finally, the computer provided participants with feedback about their performance (see Figure 2). Participants completed 110 trials in each session. They completed eight training sessions over four weeks. Thus, participants completed a total of 880 training trials.

Feedback.

Participants received positive feedback (i.e., "You are correct!") when they

responded to non-threat word trials by pressing #1 ('related') and to threat word trials by pressing #3 ('not related'). Thus, participants received positive feedback when they confirmed the non-threat interpretation or rejected the threat interpretation of the ambiguous sentence. Participants received negative feedback (i.e., "You are incorrect.") when they responded to threat word trials by pressing #1 ('related') and to non-threat word trials by pressing #3 ('not related'). Thus, they received negative feedback when they confirmed the threat interpretation or rejected the non-threat interpretation. This feedback contingency was intended to lead participants to interpret ambiguous information in a non-threatening manner.

Assessment.

Participants completed a measure of interpretation using a procedure similar to that described above in their pre and post assessments. The computerized interpretation assessment trials included novel words and sentences. Assessment trials were identical to training trials except that feedback was withheld. Participants completed 110 assessment trials at pre and post. Additionally, participants completed 10 practice trials during the pre-assessment. These practice trials included words and sentences that were unrelated to social anxiety (e.g., "freezing," "The cookies are hot.")

I assessed participants' interpretation bias by calculating the percentage of threat and non-threat trials they endorsed (i.e., the percentage of threat and non-threat words that they confirmed were related to the sentence). Specifically, I compared the percentage of threat interpretations participants endorsed and the percentage of non-threat interpretations participants endorsed.

Placebo Condition (PC)

The PC procedure was identical to the IMP procedure except that feedback about participants' performance was not contingent on the threat relevance of the words presented. Specifically, participants received positive feedback when they endorsed threat interpretations on half of the threat trials and negative feedback when they endorsed threat interpretations for the remaining half of threat trials. This contingency was the same for nonthreat trials. Thus, the placebo group's interpretation should not have changed in any direction.

Results

One participant in the PC began group therapy for social anxiety during the study and was dropped from the analyses. Thus, all analyses are based on 11 individuals in the IMP group and 11 in the PC group. Groups did not differ on any demographic variables or any self-report measures at pre (*ps* > .31; see Tables 1 and 2). Recent studies (e.g., Gueorguieva & Krystal, 2004) examining statistical analyses for repeated measures (pre-post test) designs have suggested that researchers employ mixed effect models because their assumptions allow for assessments to be made at different time points across participants and for missing data, which are common in treatment outcome studies (e.g., Nich & Carroll, 2002). However, I did not encounter either problem in this study. Therefore, I used analysis of covariance (ANCOVA) comparing groups at post controlling for pre scores to test each hypothesis (e.g.,Keppel & Zedeck, 1989; Heimberg et al., 1998).

To examine change in nonthreat interpretations, I submitted participants' post percent endorsement of nonthreat trials to an ANCOVA, controlling for pre scores. This analysis revealed that participants in the IMP endorsed significantly more nonthreat interpretations than the PC at post with pre scores partialled out, $F(1, 19) = 23.39$, $p < .001$, (See Figure 3). To examine change in threat interpretations, I submitted participants' post percent endorsement of threat trials to an ANCOVA, controlling for pre scores. This analysis revealed that participants in the IMP endorsed significantly fewer nonthreat interpretations than the PC at post with pre scores partialled out, $F(1, 19) =$

24.33, $p < .001$, (See Figure 4). To examine change in ranking of negative interpretations on IQ, I submitted participants' post IQ responses to an ANCOVA, controlling for pre scores. This analysis revealed that participants in the IMP did not differ from the PC in their ranking of negative interpretations on the IQ, $F(1, 19) = .57$, $p = .46$. To examine change in social anxiety symptoms, I submitted participants' post SPAI-SP scores to an ANCOVA, controlling for pre scores. This analysis revealed that participants in the IMP scored marginally significantly lower than the PC at post on the SPAI-SP with pre scores partialled out, $F(1, 19) = 2.86$, $p = .11$.

Magnitude of effect

I used the t-value for the group effect reported from the analysis of covariance to calculate effect sizes as reported by Rosenthal & Rosnow (1991, p. 308); ($d = 2t / \sqrt{df}$). I then calculated a confidence interval for d using the formula provided by Hedges and Olkin (1985, p 86). I characterized the effect sizes according to Cohen's (1988) suggestions. Thus, the between group effect size for nonthreat interpretations was large, d = 2.22, (CI, 1.16-3.28). The between group effect size for threat interpretations was also large, d = 2.26, (CI, 1.19-3.33). The between group effect size for the IQ was medium, and as expected the confidence interval included zero, d = 0.35, (CI, -0.49-1.19). Finally, the between group effect size for the SPAI-SP was large, but also included zero, d = 0.78, (CI, -0.09-1.65).

Discussion

Summary of Results

Results suggest that the IMP is effective in changing interpretation. As expected, the IMP group endorsed more nonthreat interpretations and fewer threat interpretations at post than the PC. Thus, both indices of interpretation bias showed the expected change as a result of training, and these changes in interpretation were evident using a novel set of stimuli. Moreover, change in social anxiety symptoms was significantly correlated with change in nonthreat interpretation (r = .58, p = .005). However, change in social anxiety was not significantly correlated with change in threat interpretation (r = .24, p = .28). These findings suggest that interpretation bias maintains social anxiety. Because only change in non-threat interpretation was associated with change in social anxiety symptoms, these findings converge with previous studies claiming that a lack of a positive bias is crucial in social anxiety (e.g., Hirsch & Mathews, 1997, 2000).

Contrary to my hypothesis, groups did not differ on their rankings of negative interpretations on the IQ. The IMP group did rank negative interpretations as less likely to come to mind than the PC group at post, but this effect was not significant. This result is unexpected considering that interpretation change did generalize to novel stimuli within the training paradigm and influenced anxiety symptoms. Participants' rankings of negative interpretations in the current study were similar to those reported in the Amir et al. (1998) study involving individuals with SP. However, this measure's sensitivity to change has not been evaluated. Thus, it is possible that this measure is limited in its

sensitivity to change in interpretation. If this were the case, the short version may be especially limited due to it only having five items related to social situations. Future studies should evaluate the original version's sensitivity to interpretation change before using it as an outcome measure.

Self-report measures of social anxiety corroborated the findings from the computerized assessment of interpretation. Results suggest that interpretation modification decreases symptoms of social anxiety. However, group differences were only marginally significant. Thus, these results should be replicated.

Comparison to Treatment Outcome Studies

Participants in the IMP moved into the normal range on the SPAI-SP (post M = 89.8, nonclinical sample M = 83, Osman, Barrios, Aukes, & Osman, 1995), suggesting that changes in anxiety were clinically significant. Moreover, the reduction in the IMP group's SPAI-SP score (32.36 points) was almost twice as large as the reduction reported in a recent treatment outcome study of Group Cognitive-Behavioral Therapy (G-CBT, 18.5 points; Cox, Ross, Swinson, & Direnfeld, 1998). This comparison is particularly impressive considering the IMP consisted of eight sessions over four weeks with no therapist contact, compared to G-CBT's 12 to 14 sessions with two therapists. Finally, the between group effect size for difference in social anxiety at post, controlling for differences at pre, was large (d = 0.78). Based on this effect size, the addition of eleven participants would provide adequate power to detect significant group differences in social anxiety.

This effect size is comparable to reported between group effect sizes in treatment outcome studies of social anxiety. For example, a review (Gould,

Buckminster, Pollack, Otto, & Yap, 1997) of cognitive behavioral therapies and pharmacological treatments for SP reported effect sizes of 0.49-0.74 based on a measure of social anxiety when compared to a control group using the following formula: d = (Mean at post (Control)– Mean at post (Treatment)) / pooled standard deviation (Cohen, 1988). Using this formula, the effect size for change in social anxiety in the current study remains comparable to other studies (d = 0.43). However, it is difficult to directly compare effect sizes across studies because they used different outcome measures. Additionally, studies employing a strong placebo condition, such as the current study, will have weaker effect sizes compared to studies using wait-list controls (Gould & Johnson, 2001, p. 385).

These results are promising, but did the IMP produce lasting effects? To date, I have followed up with three participants assigned to the IMP condition three months following their post assessment. Participants' mean SPAI-SP score at post did not differ three months after the study. Thus, preliminary evidence suggests that the decrease in social anxiety may last at least three months after completing the program. This maintenance of gains occurred in the absence of booster sessions or further contact. I plan to collect follow-up data for all participants assigned to the IMP condition.

Support for and Extension of Previous Studies

These results support and extend previous studies in which interpretation was experimentally manipulated. Specifically, this study suggests that procedures that are effective in manipulating interpretation in non-anxious individuals (e.g. Grey & Mathews, 2000) may be applicable to anxious populations. More importantly, these results suggest that such procedures may also have an effect on anxiety symptoms in an

anxious population, as has been demonstrated in non-anxious individuals (Mathews & Macintosh, 2000). Future studies should continue to modify information processing paradigms in an effort to manipulate cognitive biases and decrease symptoms in clinical populations.

Advantages of Interpretation Modification Program

In sum, these results suggest that this type of procedure may be an effective method to reduce social anxiety. Moreover, the current study suggests that interpretation modification may have several advantages over traditional interventions because of (a) lower attrition rate (0% drop out after randomization), (b) treatment gains in the absence of therapist contact, (c) treatment gains that require little effort or motivation from clients, (d) no reported adverse side effects, and (e) potential to reach clients that do not have access to CBT or medication. However, this type of intervention also has disadvantages: (a) reliance on technology that may not be available to all participants, and (b) limited opportunity to establish rapport with a therapist.

Limitations

This study had several limitations. First, the sample size was small. Increasing the sample size would increase the power to detect significant group differences in social anxiety at post, providing more confidence in the generalizability of these results. Second, I did not include interview measures, assessment of significant others, or a behavioral assessment (e.g., speech challenge). Including these additional types of assessment would also increase the generalizability of these results and provide more information about clinically meaningful change. Third, this study utilized an analogue sample. It is possible that similar results would not be obtained in a clinical sample.

However, participants' SPAI-SP scores were comparable to those reported in other treatment outcome studies for SP (Cox et al., 1998), suggesting that these participants may be at least as severe as SP patients. Finally, 86% of the sample was female, which further limits the generalizability of these findings to the general population of SP (3:2 female-to-male ratio, Kessler et al., 1994). I intend to recruit more male participants to address this limitation in an extension of this study.

Future Research

In summary, these results suggest that the translation of basic psychopathology research to address a clinical condition may prove useful in developing new treatment. Moreover, these procedures may help identify the mechanisms that may be involved in the pathogenesis of psychiatric conditions. Future studies should examine the IMP in a clinical population, as well as the additive effects or interactive effects of interpretation modification and traditional interventions (i.e., medication and CBT) and other types of information processing training (e.g., attention; Amir, Beard, Klumpp, & Elias, submitted for publication).

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Table 1

Demographic information

Variable	IMP	PC
Age	19	20
Education (years)	13	14
Sex (% female)	91%	82%
Ethnicity		
(% Caucasian)	73%	73%
(% African Am)	9%	9%
(% other)	18%	18%

Table 2

Self-report measures

	M (*SD*)			
	IMP		PC	
	Pre	Post	Pre	Post
SPAI-SP	122.18 (27.59)	89.82 (30.59)	122.91 (27.37)	104.18 (36.79)
BDI-II	18.27 (11.31)	11.91 (11.05)	19.09 (13.79)	12.91 (12.72)
STAI-S	44.55 (8.43)	41.36 (11.52)	43.73 (9.45)	39.45 (12.52)
STAI-T	52.00 (11.25)	42.64 (14.09)	56.27 (10.10)	48.09 (11.48)
IQ	1.47 (0.47)	2.05 (0.61)	1.44 (0.47)	1.89 (0.52)

Note. SPAI-SP = Social Phobia and Anxiety Inventory-Social Phobia Subscale, BDI-II = Beck Depression Inventory, STAI-S = Spielberger State-Trait Anxiety Inventory-State Form, STAI-T = Spielberger State-Trait Anxiety Inventory-Trait Form, IQ = Interpretation Questionnaire- ranking of negative interpretations.

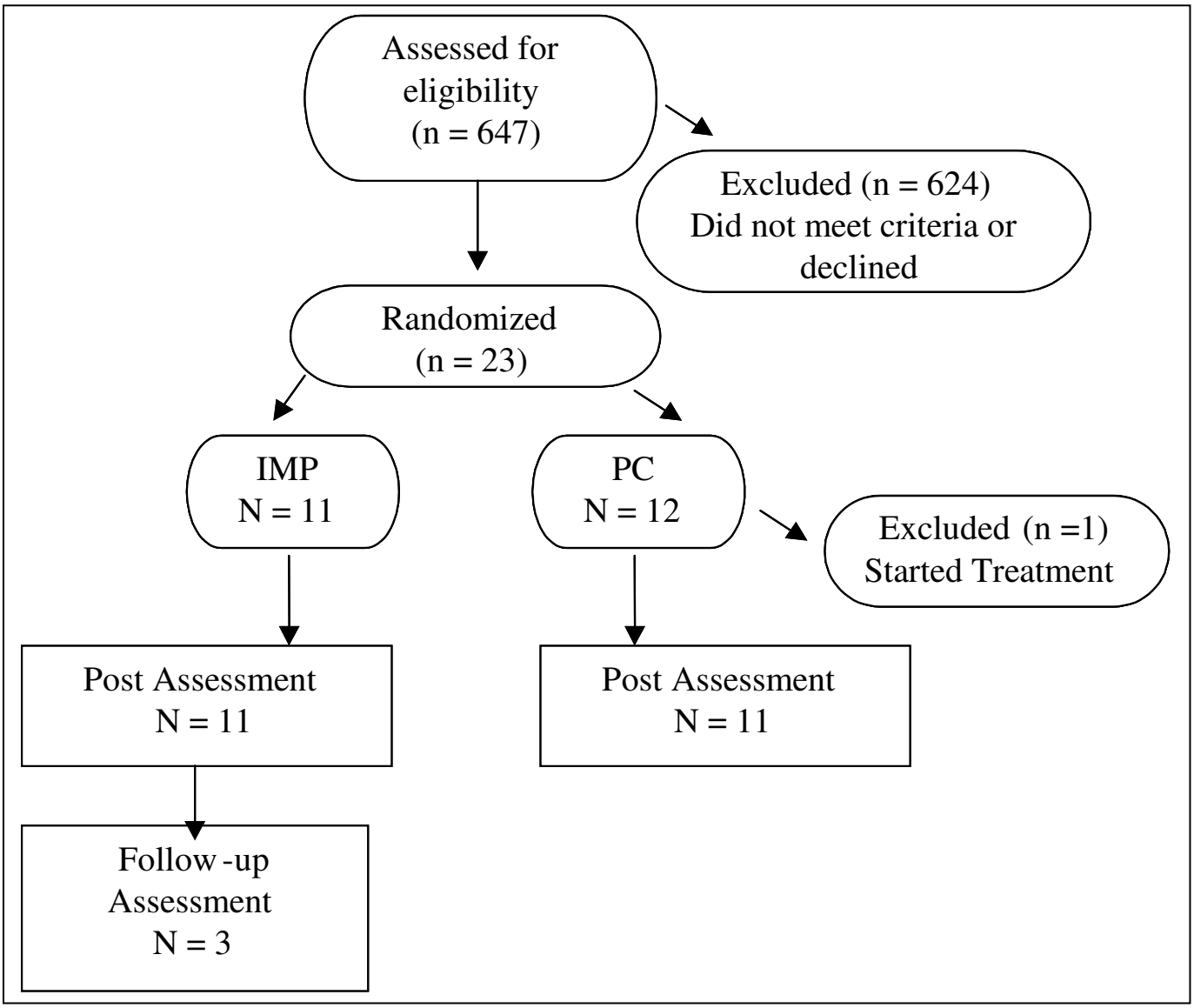

Figure 1. Participant Flowchart

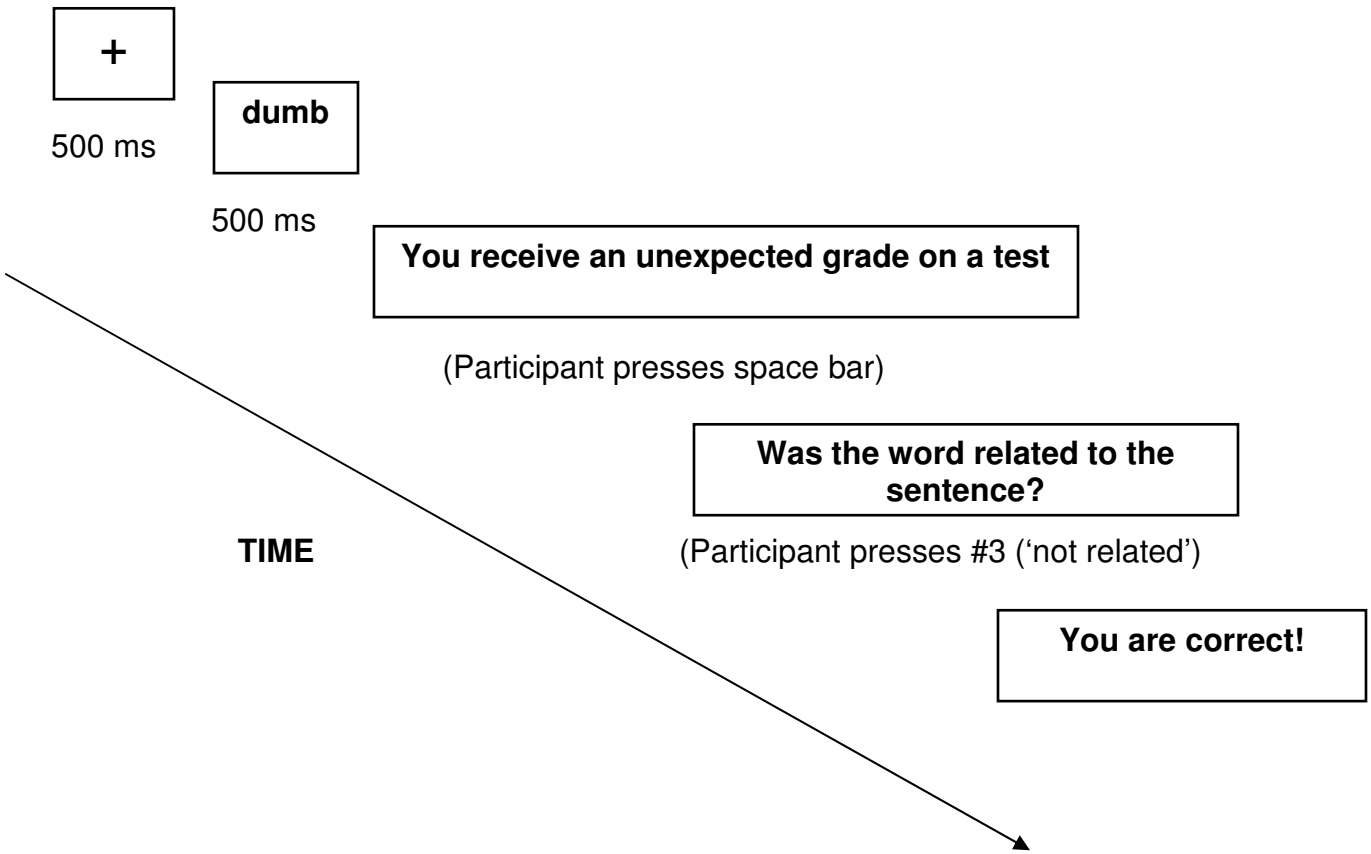

Figure 2. Example Trial.

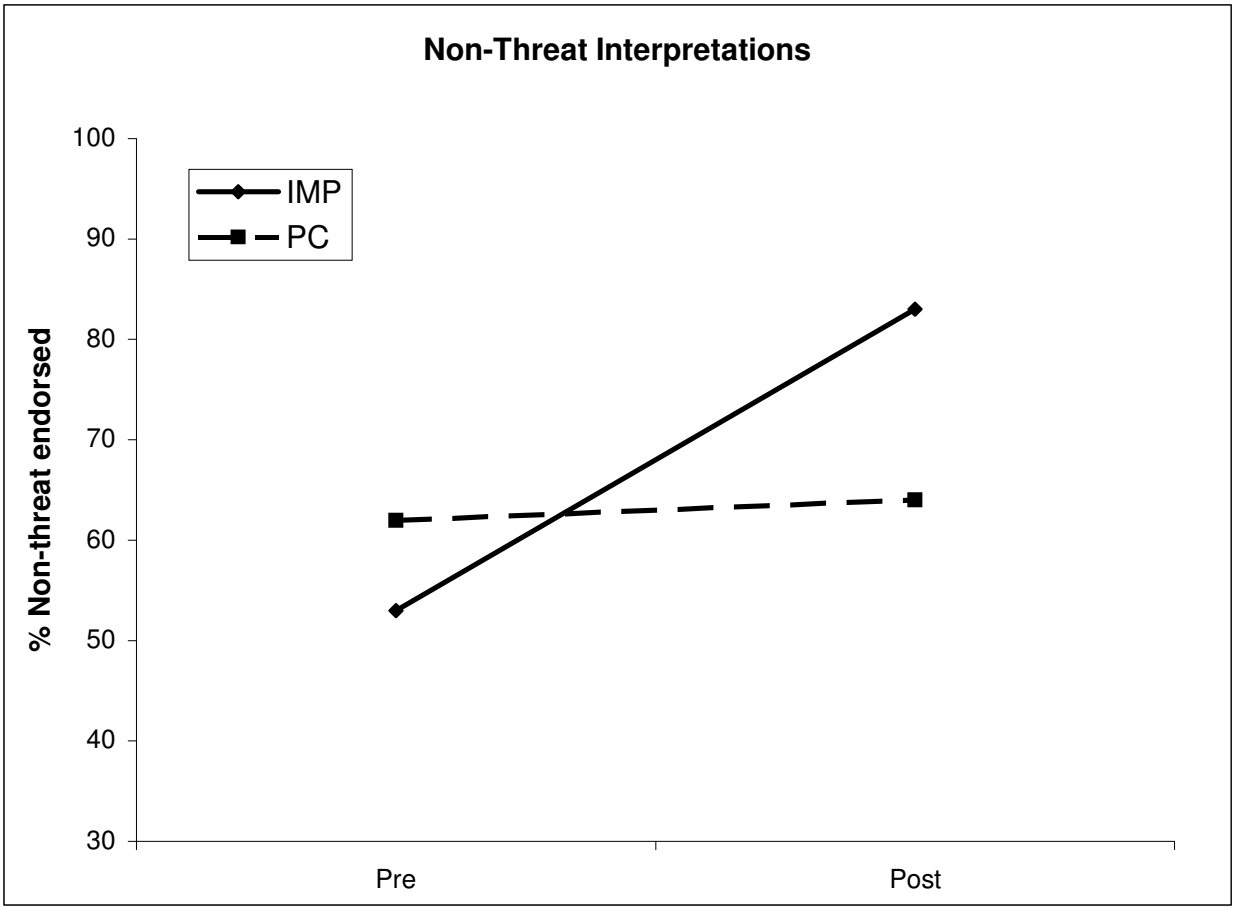

Figure 3. Change in Nonthreat Interpretation.

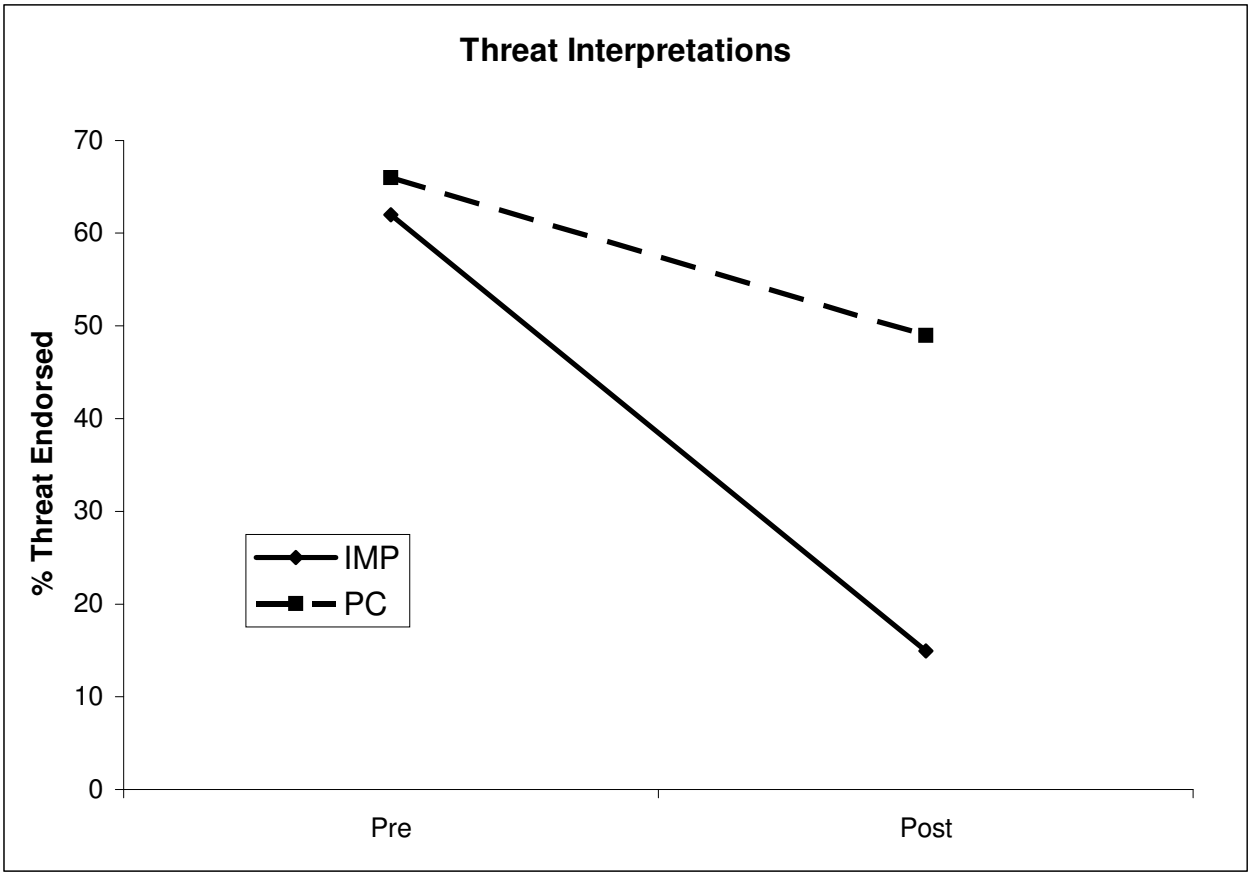

Figure 4. Change in Threat Interpretation.

Appendix.

Example Materials.

	Threat word	Non-threat word	Ambiguous Sentence
Social			
	Criticize	Praise	You boss wants to meet with you.
	Dumb	Smart	You received an unexpected grade on a test.
	Embarrassing	Funny	People laugh after something you said.
Safety Behaviors			
	Avoid	Fun	You are invited to a party.
	Cancel	Excited	You feel jittery before going on a trip.
	Walk away	Approach	You see a group of people approaching you.
General Anxiety			
	Owe	Refund	You receive a letter from the IRS.
	Robber	Thunder	You hear a loud noise in the night.
	Warning	Clock	The alarm goes off.