MANIPULATION OF POSITIVE PERCEPTION OF OTHERS
THROUGH COGNITIVE BIAS MODIFICATION

BY

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ABSTRACT

The present study is designed to assess the effect of Cognitive Bias Modification of Interpretation (CBM-I) on positive perception of others (PPO). Past research has shown that there are consistent individual differences in interpersonal perception that are associated with important life outcomes including aggression and personality disorders (Wood, Harms, & Vazire, 2010). Because CBM-I is designed to modify social interpretation, it is a likely strategy through which interpersonal perception could be manipulated. By measuring PPO before and after CBM-I training, the present study was able to assess the effect of CBM-I on interpersonal perception. Positive CBM-I training was expected to increase the positivity of interpersonal perceptions. The present study also collected data on important outcome variables associated with PPO and interpretation biases with the intention of identifying the unique effects of CBM-I and PPO. Results suggest that relative to a control condition, positive CBM-I training had no effect on the positivity of interpersonal perceptions or any of the outcome variables. PPO was also found to have no effects on any of the outcome variables. Potential causes of the null effect, limitations, and suggestions for future research are discussed.
INTRODUCTION

While it is generally accepted that social context plays an important role in impression formation, research on interpersonal perception has suggested that there are also stable individual differences in the way one person perceives another (Fiske, Cuddy, & Glick, 2007; Kenny, 1994; Wood, Harms, et al., 2010). Kenny (1994) termed these stable individual differences in perception “perceiver effects,” and characterized them as the tendency of an individual to perceive many different targets in roughly the same way. Other related constructs include: working models of attachment (Collins & Read, 1994), social schemas, and “prejudiced personality” (Roets & Van Hiel, 2011). Each of these theories expresses a common theme: individuals have a tendency to perceive others consistently, regardless of social context.

Consistency in social perception has also been identified in clinical literature where it has been shown that perceiver effects play a critical role in the development and maintenance of psychological well-being. Beck et al. (2004) point out that the majority of personality disorders can be associated with the individual’s tendency to perceive others in a particular way. For example, narcissistic personality disorder is associated with the perception that others are inferior and uninteresting, while paranoid personality disorder is linked to the perception that others are devious and manipulative (Beck et al. 2004). Similarly, behavioral problems such as aggression are thought to result in part from the tendency to perceive the actions of others in a negative way (Dodge & Crick, 1990). On the opposite end of the spectrum, there are likely benefits that result from positive interpersonal perception. Past research has suggested that perceiving others positively increases the likelihood of being perceived positively by others you have just
met (Crowe, Wood, & Waugh 2012). Furthermore, it has been shown that a perception of social connectedness, induced through loving kindness meditation with others results in increases in overall well-being (Kok & Fredrickson, 2010).

It stands to reason that we have much to gain by being able to manipulate these stable individual differences in interpersonal perception. The ability to manipulate positive interpersonal perception would be particularly beneficial as such a manipulation has the potential to not only decrease the negative symptoms in clinical populations, but also improve the subjective well-being in healthy populations. However, the prospect of a manipulation of this sort has not been properly explored. The present study will suggest that Cognitive Bias Modification of Interpretation (CBM-I) is uniquely suited for the manipulation of positive perception of others.

**Process of Perception**

Before understanding a possible mechanism through which perception might be manipulated, it is important to first understand the process of interpersonal perception. According to Funder’s (1995) Realistic Accuracy Model, attaining accuracy in interpersonal perception is dependent on four sequential steps:

![Figure 1](image)

**Figure 1**
Depiction of Funder’s Realistic Accuracy Model

First, it is understood that traits are not directly observable. The information that a perceiver receives about a target is in the form of behaviors rather than traits (Srull & Wyer, 1980). Therefore, to be accurately perceived, a trait must first produce a trait-
relevant behavior (Funder, 1995). Second, if a trait does produce a relevant behavior, that behavior must then be made available to the perceiver (Funder, 1995). If the target does not display the trait-relevant behavior, the perceiver does not have the opportunity to judge the target based on that behavior. The third step in the process is detection. If a trait-relevant behavior is displayed, the perceiver must then detect that behavior in order to make a trait assessment based on it (Funder, 1995). The final step in the process is utilization (Funder, 1995), or what we will refer to here as interpretation. This step refers to the fact that even after a trait-relevant behavior is made available and detected, that perceiver must then utilize or interpret that behavior in the correct way. This interpretation process can be problematic because any individual behavior can be interpreted in a number of ways. For example, imagine a student observes an individual giving an answer to someone else during an exam, that student could interpret such a behavior as dishonest, kind, and/or helpful (Srull & Wyer, 1980). Which of these traits is ultimately assigned to the target is going to depend in part on the perceiver (Srull & Wyer, 1980). Once all four steps of this interpersonal perception process are complete, the perceiver behaves in accordance with their ultimate trait perceptions of the target. If those perceptions are positive, you would expect the perceiver’s behavior to reflect the belief that others are good and trustworthy, but if they are often negative, the result can be aggressive or avoidant personality patterns (Beck et al., 2004; Dodge & Crick, 1990).

The Realistic Accuracy Model is useful because it allows us to more specifically identify the interpersonal perception processes through which manipulation of perceiver effects might be possible. The detection and interpretation processes are both dependent on the perceiver rather than the target (Funder, 1995). As such, manipulating either one
would cause an effect on perception that would carry-over from one target to another, a necessary component of perceiver effects. The present study will focus on manipulation of interpretation as a means of manipulating positive interpersonal perception.

**Importance of Interpretation in Social Information Processing**

The information one receives about another is not in the form of clear-cut traits, but rather in the behaviors they exhibit. In many cases, these behaviors can be interpreted in several different ways. Research suggests that this interpretation process will affect several levels of social information processing: the initial impression formation, the encoding of personality impressions, and the recall of those impressions (Mohr & Kenny, 2006; Salemink, Hertel, & Mackintosh, 2010; Srull & Wyer, 1980; Tran, Hertel, & Joormann, 2011). As a result, the perceiver’s immediate and future affective evaluation of the target (i.e., how much the target is “liked”) should be dependent, in part, on the way the target’s behavior is interpreted. If this interpretation process can be manipulated in a positive way, a positive change in the interpersonal perception of all targets could therefore be expected.

**Interpretation and liking in impression formation.** Interpretation of behavior is an important component in the impression formation process, particularly with regards to liking (Mohr & Kenny, 2006). *Person models*, as defined by Mohr and Kenny (2006), are cognitive models perceivers form about what other people are like. Perceptions of liking are important facets of these person models, and it is suggested that interpretation of behavior plays an active role in their development (Mohr & Kenny, 2006; Park, DeKay, & Kraus, 1994). Specifically, Mohr and Kenny (2006) argue that there is an active interplay between positive perception and interpretation. Liking guides the
interpretation of behavior by motivating active evaluation of the target, and interpretation guides liking as the affective evaluation of the target is going to be dependent on how the target’s behavior is interpreted. This suggests that if interpretation can be effectively manipulated in a positive manner, then future affective evaluations of targets will be skewed in a positive way. Importantly, even a relatively small increase in the positivity of social impressions can have a far reaching effect on subsequent interactions by not only eliciting target behavior that is consistent with current perceptions, but also by affecting the frequency of future interactions (Denrell, 2005; Smith & Collins, 2009). Therefore, an induced tendency to interpret ambiguous behavior in a positive way has the potential to positively affect initial impression formation, as well as subsequent perceiver-target interactions.

Social interpretation and encoding. Along with affecting the impression formation process, a bias in social interpretation can affect how the traits of others are encoded into memory (Srull & Wyer, 1980). According to Srull and Wyer (1980), the encoding of person perception can be thought of as a categorization process. When an individual interprets the behavior of a target and forms a trait impression, that information gets encoded into a trait category based on the interpretation of the behavior (Srull & Wyer, 1980). This process of encoding associates the target individual with the interpreted trait as well as other traits that fall within that particular trait category (Srull & Wyer, 1980). The final impression of the target that is stored into memory is a result of this trait categorization process. This model of encoding impressions into memory is congruent with Mohr and Kenny’s (2006) person models and has important implications with regard to the effects of social interpretation, for it is these impressions that are later
recalled to make trait assessments and predict future behavior of the target (Srull & Wyer, 1980).

**Social interpretation and recall.** Interpretation has also been shown to work directly on the memory recall process. For example, during recall of an event, individuals prone towards negative social interpretations are more likely to introduce errors that are congruent with their interpretation bias (Hertel, Brozovich, Joormann, & Gotlib, 2008). In other words, individuals with a negative interpretation bias are not only more likely to interpret ambiguous events in a negative manner, but also more likely to make those events more negative (or less ambiguous) upon later recall. This finding is supported by research on constructive memory, which shows that the way we interpret an event affects the way that event is later recalled (Henriksson, Elwin, & Juslin, 2010; Tran, Hertel, et al., 2011). Importantly, this same process also suggests that a positive bias in interpretation would induce positive errors in memory, and indeed, such an effect has been shown (Salemink et al., 2010; Tran, Hertel, et al., 2011). Taken together, these findings suggest that by manipulating interpretation it is possible to have a retroactive effect on interpersonal perception. Therefore, not only does the induction of a positive interpretation bias have the potential to increase positive perception of others by affecting recall of future social interactions, but it could also function by affecting the interpretation of events that occurred before the bias was induced.

**Interpretation Biases in Clinical Populations**

Considering the above-mentioned effects on memory and impression formation it is not surprising to know that social-cognitive biases in interpretation are thought to play a critical role in the perpetuation of psychopathology. Anxious and depressed individuals
are more prone to interpret ambiguous social situations in a negative way (Hertel et al., 2008; Holmes, Lang, & Shah, 2009; Mathews & Mackintosh, 2000). These clinical populations provide strong evidence for the real-world effects that biases in interpretation can have in social situations. For anxious and depressed individuals the often ambiguous social world can appear threatening or rejecting where it is benign to healthy populations (Beard, 2011). Fortunately, a manipulation has been designed to modify interpretation biases in a positive way. This cognitive bias modification paradigm is therefore a likely strategy through which perceiver effects may be manipulated.

**Interpretation Modification as Interpersonal Perception Manipulation**

Cognitive Bias Modification of Interpretation (CBM-I) was designed to directly modify cognitive biases of interpretation through basic learning processes. Individual tendencies to interpret behavioral information in a positive or negative way can be thought of as well-learned perceptual tendencies (Beard, 2011). Cognitive bias modification is designed to alter current tendencies of interpretation by making the participant repeatedly activate positive social-cognitive schemas. This repeated activation ultimately makes positive interpretations more accessible and thus more likely to occur in the future (Beard, 2011; Srull & Wyer, 1980). Given enough training sessions, positive interpretation becomes the prepotent response to ambiguous social stimuli.

**Cognitive bias modification of interpretation.** CBM-I is designed to modify bias in social interpretation. The most commonly used CBM-I training task, and the task chosen for the present study, is the scenario task developed by Mathews and Mackintosh (2000). In this CBM-I task, a series of short vignettes are presented. The vignettes are
received one at a time, and their emotional valence remains ambiguous until the final word, which is presented as a word fragment. One example of a possible vignette taken from Mathews and Makintosh (2000) is as follows:

“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…

(bo---g/fri----y)”

As mentioned, the vignette remains ambiguous until the final word. Depending on valence of the manipulation, positive or negative, the participant would receive one of the two possible word fragments, “bo---g” or “fri----y.” Each of these words resolves the ambiguity in either a positive or negative way. The participant is instructed to solve the word fragment as quickly as possible by typing the first missing letter of the word. Obviously, “boring” is negatively valenced and “friendly” is positively valenced. Lastly, a question is presented to the participant that is intended to reinforce the valence of the word fragment. The manipulation occurs through the consistent presentation of similarly valenced word fragments (i.e., almost always positive or negative).

The Mathews and Mackintosh (2000) method of inducing a positive interpretation bias through vignettes is ideal for the purposes of the present study as it specifically targets social interpretations and expectations. Other methods of cognitive bias modification of interpretation do exist. One task, for example, uses homographs with threatening and non-threatening meanings (i.e., ruin – ancient ruin vs. bankrupt) to train a bias of interpretation (Beard, 2011; Wilson, MacLeod, Mathews, & Rutherford, 2006).
However, interpretation manipulations such as these are not directly interpersonal in nature. With the scenario task the manipulation itself is designed to address the negative social interpretations that would likely be associated with low levels of positive interpersonal perception making it the most appropriate option for our purposes.

Persistence of positive CBM-I manipulation. Importantly, any changes in social perception that are induced by an interpretation manipulation are likely to persist over time. It has been shown that the interpretation bias induced by CBM-I persists for at least 24 hours after only a single 100-item, one hour training session (Yiend, Mackintosh, & Mathews, 2005). This is important as it suggests the potential for compounding effects of multiple training sessions. Further evidence for the persistence of a positive manipulation of social perception can be found in the broaden-and-build theory (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). A critical component of this line of research is the existence of an “upward spiral” of positivity such that an increase in social connectedness or social resources can increase positivity which then further increases social connectedness (Fredrickson et al., 2008; Kok & Fredrickson, 2010). This suggests that if CBM-I does induce a positive change in social perception, this change could potentially induce a self-perpetuating increase in social connectedness and well-being.

Purpose of the Present Research

Research has shown that perceiver effects are stable individual differences that have been associated with important life outcomes. Interpersonal aggression, personality disorders, and prejudice have all been associated with the tendency to generally perceive others negatively (Beck, Freeman, & Davis, 2004; Dodge & Crick, 1990; Roets & Van Hiel, 2011), while an increase in social connectedness has been associated with an
increased sense of purpose, more social support, and an overall increase in well-being (Kok & Fredrickson, 2010). As such, there are many who could benefit from an increase in the positivity of their interpersonal perceptions. However, the possibility of manipulating generalized interpersonal perception has not been effectively explored. In the current study, the possibility of using cognitive bias modification of interpretation as a manipulation of interpersonal perception was assessed. The CBM-I paradigm developed by Mathews and Mackintosh (2000) was used to manipulate interpretation of ambiguous social stimuli. The effect of cognitive bias modification of interpretation on the positivity of interpersonal perception was assessed by measuring positive perception of others (PPO) across several different social domains before and after modification occurred.

It was hypothesized that those who underwent the positive CBM-I induction would show an increase in the positivity of their interpersonal perceptions. Such an effect, would suggest that the positive effects associated with CBM-I (i.e., decreases in social anxiety and depression) may be mediated by increases in positive interpersonal perception. This possibility has not currently been addressed as no previous research has paired an overt measure of perceiver effects with a cognitive bias modification task. Based on the previous research mentioned above, the CBM-I manipulation was expected to have a positive effect on several other outcome variables including: social connectedness, positive and negative affect, self-esteem, and life-satisfaction. By collecting these outcome variables, the present study is able to expand on the current literature by assessing both the effect of CBM-I on the positivity of interpersonal
perceptions, and the role positive interpersonal perceptions have on the positive outcomes associated with positive CBM-I training.
METHOD

Participants

In total, 42 participants completed all four sessions of this study. Session 1 (the pretest, see Figure 2) was completed by 262 participants, as part of a more general mass-testing session. A total of 79 participants participated in Sessions 2 and 3 (i.e., the first and second CBM-I manipulations; see Figure 2). Of these 79 participants, a total of 23 participants were excluded for various reasons. Eleven participants were dropped because they did not complete the PPO and outcome variable questionnaires during Session 3 (see Figure 2). Three were dropped because they completed the outcome variable questionnaires before completing the second session of CBM-I training (Session 3 in Figure 2). Five more were dropped either because pretest (Session 1 in Figure 2) data was not submitted (N = 3) or it was only half-complete (N = 2). One participant was dropped because Inquisit CBM-I training data was not submitted and a final three were dropped because analysis of their IIDL responses proved their data to be unreliable. More specifically, participant IIDL responses from Session 3 were correlated with their own responses to the same items in Session 4 in an attempt to identify any participants that were simply responding randomly. Participants with a profile correlation of $r < .2$ across sessions, and participants with zero variability in their responses (i.e. all responses were the same value for all questions) were dropped from the analysis as this provided very strong evidence that they responded carelessly.

With these 23 exclusions, the Session 3 data set consisted of 56 participants. Twenty-seven of these participants were assigned to the neutral training condition while 29 were assigned to the positive training condition. Of the 56 participants that completed
Session 3, 41 completed the posttest (Session 4 in Figure 2), 23 were in positive training condition, and 18 were in neutral training condition.

Procedure

The present study had a pretest-manipulation-posttest design that included a total of four data collection sessions, as shown in Figure 2 below:

Figure 2
Organization of Study Sessions

Session 1: Pretest of PPO and outcome variables
Session 2: CBM-I (2 Days)
Session 3: CBM-I and Outcomes (2-5 Days)
Session 4: Posttest of PPO and outcome variables

Pretest (Session 1). During the pretest participants were asked to give the names of several different targets (see Positive Perception of Others section). They then used the PPO scale (described below) to rate each of the targets of perception. A series of outcome measures (described below) were also assessed during the pretest.

CBM-I training (Sessions 2 and 3). Participants were assigned to positive and negative training conditions upon signing-up for Session 2, the difference between these conditions is described below. CBM-I training took place over the course of two separate sessions separated by a 48 hour time period. At the beginning of each training session instructions were shown and 3 practice trials were given. During each session, participants went through 8 blocks of 13 scenarios resulting in the completion of 104 scenarios each training session. For each scenario, participants were instructed to imagine themselves as the central character. In each block, the 13 scenarios consisted of eight training scenarios, three filler scenarios, and two probe scenarios. The presentation
of each block was consistent across participants, but the order of the items within each block was randomized. Immediately following the second CBM-I training session (Session 3 in Figure 2), participants completed an interpretation evaluation (described below), as well as a series of questionnaires in which a second set of PPO ratings and outcome variables were collected.

**Posttest (Session 4).** The posttest took place two to five days after the second training session. The posttest included a second interpretation evaluation assessment and a third and final collection of PPO ratings and outcome variables.

**Cognitive Bias Modification of Interpretation (CBM-I)**

The CBM-I training procedure consisted of 208 scenarios presented over the course of two training sessions. These scenarios can be divided into training scenarios, probe scenarios, and filler scenarios. Roughly half of the scenarios used were adaptations of those developed by Mathews and Mackintosh (2000). The rest of the scenarios were adaptations of those developed by Salemink, van den Hout, and Kindt (2009). The scenarios developed by Salemink et al. (2009) had to be translated from Dutch before adaptations could be made.

**Training scenarios.** A total of 128 training scenarios were presented over the course of the two training sessions (eight in each of the 16 blocks). Many of these scenarios were adapted from those used in Mathews and Mackintosh (2000). Participants were instructed to imagine themselves as the central character in each scenario and press the space bar when they had completed reading the scenario. After pressing the space bar they were immediately presented with the appropriate word fragment. Participants were instructed to solve the fragment by pressing the first missing letter of the word. Once this
...was done, the word fragment was automatically completed and a comprehension question was asked to reinforce the emotional valence of the scenario. Correct and incorrect answers to these comprehension questions were reinforced or punished by positive and negative feedback (i.e., “That is Correct!” or “That is incorrect.”). The scenarios were therefore presented as shown in Figure 3.

**Figure 3**
Presentation of CBM-I Scenarios

![Diagram showing the presentation of CBM-I Scenarios]

*Note: Above is an example of how an individual training scenario would progress*
Probe scenarios. Probe scenarios function as a manipulation check. A total of 32 probe scenarios were presented over the course of the two training sessions (two in each of the 16 blocks). Probe scenarios were structured in the same way as training scenarios but during these scenarios the time between fragment presentation and the correct response was recorded. There was one positively valenced probe and one negatively valenced probe in each training block. Importantly, both the positive training and control conditions received the same probes. If the training was effective, we would expect to see the participants in the positive training condition to respond faster to positive probes and slower to negative probes as the training progresses. Participants in the neutral training condition should show no change in their response times to the probes.

Filler scenarios. A total of 48 filler scenarios were presented over the course of the two training sessions (three in each of the 16 blocks) in order to decrease the transparency of the manipulation. Filler scenarios were structured in the same way as the training scenarios but they were emotionally neutral. An example of a filler scenario is as follows:

You arrange to meet a friend at a local restaurant one evening.

As you arrive, you can’t help but notice that the front of the restaurant has been…

pa-n--d (painted)

Has the restaurant’s appearance changed?

Positive training condition. For those participants in the positive CBM-I training condition, all eight of the training scenarios in each block were positively
valenced. This positive CBM-I training took place over the course of two separate training sessions separated by a 48 hour time period (as shown in Figure 2).

**Control condition.** The control condition was shown the same number of scenarios as the positive training condition, but in each block, four of their training scenarios were positively valenced, and four of their training scenarios were negatively valenced. The control condition’s probe and filler scenarios were the same as those presented to the positive training condition. This form of control has been successfully used in previous research (Salemink et al., 2009).

**Interpretation evaluation.** As a manipulation check, two separate interpretation evaluations were conducted. The first was given immediately following the CBM-I training during Session 3, and the second was given at the beginning of Session 4 (see Figure 2). The interpretation evaluation presents 10 scenarios that are structured in the same way as the training scenarios. However, each of these scenarios is titled and remains ambiguous even following the final word fragment. An example would be as follows (taken from Salemink et al., 2009):

The Job Interview

“You see a job advertised that you’d really like.

You apply and are invited to an interview, where you answer the questions as well as you can.

Reflecting later, you think that the quality of your answers decided the…”

“ou--om--“ (answer: outcome)

“Did you think about your answers later?” <Yes / No>
After 10 of these ambiguous scenarios were presented, participants were shown the titles of the scenarios one at a time along with four versions of the final sentence. These sentences were intended to represent a possible positive interpretation (positive target), a possible negative interpretation (negative target), a positive foil (one with positive valence unrelated to the ambiguity of the sentence), and a negative foil (neutral valence unrelated to the ambiguity of the sentence). Participants were required to rate each sentence on a 4-point scale for its similarity in meaning to the final sentence of the original story. Examples appropriate for the above situation are as follows:

a) You think it must have been your clear answers that got you the job (positive)

b) Reflecting later, you realize that your poor answers lost you the job (negative)

c) Reflecting later, you think it was a good thing you did not take the job (positive foil)

d) You think that your appearance must have made a bad impression (negative foil)

The expectation was that individuals who received an induced positive interpretation would be more likely to rate the positive target as more similar to the original version and more likely to rate the negative target as less similar to the original version.

**Outcome Variables**

Unless otherwise noted, for each of the following scales participants were instructed to rate how much they agreed or disagreed with each statement using a five point Likert scale ranging from strongly disagree to strongly agree. See Results section for scale means and reliabilities.
Positive perceptions of others (PPO). The positive perception of others (PPO) scale (Wood, Harms, et al., 2010) was given as part of Sessions 1, 3, and 4 (see Figure 2). The scale is intended to measure how generally positive the participant perceives a target. The scale instructs participants to describe the target’s personality as accurately as possible using the following 6 items: unfriendly, cold (negatively scored); intelligent, smart; truthful, honest; tense, anxious (negatively scored); competent, capable; careless, irresponsible (negatively scored). Due to time limitations, these six items were selected from the 10 items used in previous studies. All six of these items loaded very highly onto the single PPO factor previously assessed (Crowe et al., 2012). All items were scored using a scroll bar participants could drag to anywhere from zero to 100 with zero being very uncharacteristic, 50 being neither characteristic nor uncharacteristic, and 100 being very characteristic. See Appendix A for an example screenshot of how these items were presented.

The PPO scale was used to rate 12 targets of perception during each session that outcome variables were collected (Sessions 1, 3, and 4, as shown in Figure 2). The targets of perception were as follows: current or most recent roommate, mother, father, two friends at Wake Forest University, two friends from high school, current or most recent significant other, and two professors from the current semester. During the pretest, participants provided the names or initials of four friends at Wake Forest (friends 1 and four were used), four friends from high school (friends 1 and 4 were used) and two professors so that those particular targets could be referred to directly each time perception data was collected. All participants rated each of these 10 targets each time PPO was measured. Participants also rated two strangers based on their picture each time
PPO was collected resulting in 12 total targets of perception each time a PPO measure was collected (see Appendix B for stranger’s pictures). Stranger’s pictures changed each time so that each participant rated a total of six strangers.

**Anxiety.** Anxiety was measured using an IPIP six-item Anxiety scale (Goldberg et al., 2006). The scale’s six items were as follows: “I worry about things”; “I fear for the worst”; “I am relaxed most of the time” (negatively scored); “I get stressed out easily”; “I am not easily bothered by things” (negatively scored); “I don’t worry about things that have already happened” (negatively scored).

**Social discomfort.** Social discomfort was measured using a six-item social discomfort scale (Goldberg et al., 2006). Positively scored items were: “I often feel uncomfortable around others”; “I find it difficult to approach others”; “I only feel comfortable with friends.” Negatively scored items were: “I feel comfortable around people”; “I talk to a lot of different people at parties”; “I am not bothered by difficult social situations.”

**Sociability.** Sociability was measured using a six-item sociability scale (Goldberg et al., 2006). Positively scored items were: “I usually like to spend my free time with people;” “I love to chat;” “I make friends easily.” Negatively scored items were: “I seem to derive less enjoyment from interacting with people than others do;” “I rarely enjoy being with people;” “I would not enjoy a job that involves a lot of social interaction.”

**Social connectedness.** Social connectedness was measured with a two-item scale adapted from one used previously by Kok and Fredrickson (2010): “During my social
interactions over the past week, I felt ‘in tune’ with the people around me” and “During my social interactions over the past week, I felt close to the people around me.”

**Self-Esteem.** Self-esteem was measured using the single item “I have high self-esteem” (Robins, Hendin, & Trzesniewski, 2001).

**Life satisfaction.** Life satisfaction was measured using the five item Satisfaction with Life Scale (Pavot & Diener, 1993): “In most ways my life is close to my ideal”; “The conditions of my life are excellent”; “I am satisfied with my life”; “So far I have gotten the important things I want in life”; “If I could live my life over, I would change almost nothing.”

**Social interaction quality.** A single item was used to measure the participant’s subjective satisfaction with their recent social interactions: “Over the past 24 hours, how pleasant have you found your interactions with others be to be?” Responses to this item were provided on a five-point scale ranging from extremely unpleasant to extremely pleasant.

**Personality inventory.** Fifty-one items from the IIDL personality inventory were included to assess participants’ personality characteristics (Wood, Nye, & Saucier, 2010). Due to length constraints, this was only included in Sessions 3 and 4. Participants were instructed to rate the extent to which each of the 51 characteristics describes how they see themselves using a five point scale ranging from very uncharacteristic to very characteristic. The 51 items were all two-word personality items such as: dependable, reliable; unfriendly, cold; intelligent, smart; truthful, honest; tense, anxious; competent, capable; kind-hearted, caring; careless, irresponsible; stable, well-adjusted; exciting, fascinating.
RESULTS

This section will begin with basic descriptive results and relationships between key variables. The effectiveness of the CBM-I manipulation will then be described followed by the effects of the manipulation on PPO and outcome variables. This section will conclude with unplanned supplementary analyses. Unless otherwise noted, all analyses on Session 1 (pretest data) include only the 56 participants that submitted usable data sets in Sessions 2 and 3.

Descriptive Results

Outcome variables. See Table I for basic descriptive results of all outcome variables. As can be seen in Table I, participants described themselves as neither high nor low in anxiety, and generally sociable with high interaction quality. On average they also claimed to have high self-esteem and be generally satisfied with their lives. It is also important to note that the correlations across sessions indicate most ratings are highly consistent across sessions.

PPO scale analysis. In order to assess which of the six items in the PPO scale were most representative of the scale as a whole, a scale reliability analysis was run for each of the six items across sessions. The corrected item-total correlations of each item were as follows: careless, irresponsible $r = .69$; intelligent, smart $r = .68$; competent, capable $r = .64$; unfriendly, cold $r = .59$; truthful, honest $r = .54$; tense, anxious $r = .30$. These results suggest that tendencies to see others as careless/irresponsible versus intelligent/smart and competent/capable were the most representative of the PPO scale’s meaning, whereas tendencies to see others as “tense, anxious” were not a strong
component of the total scale meaning, and could likely be dropped if this scale were to be used in the future.

**PPO outcomes.** Participants reported having generally positive perceptions of all targets at the pretest, a pattern that persisted throughout all assessments of PPO. Interestingly, professors were perceived most positively across sessions, after professors, parents were viewed most positively. Among all targets of perception, strangers and participants’ roommates were viewed the least positively. These results may reflect the fact that careless and intelligent were the most representative items in the scale.

**PPO and Outcome Variable Correlations**

It was hypothesized that increasing participants’ PPO would cause a positive change in each of the various outcome measures assessed. Before testing this effect
directly, PPO was correlated with each of the outcome measures to confirm a relationship between the variables. As expected, at the time of the pretest, PPO did have a significant positive relationship with self-esteem ($r = .28$, $p = .04$) and interaction quality ($r = .38$, $p = .004$). However, these correlations were not consistent across sessions. When PPO and outcome variables were averaged across sessions no significant relationships were found at the $p < .05$ level. See Table II below for correlation coefficients. As shown though, PPO’s relationship with social interaction quality did approach statistical significance.

To further investigate the expected relationship between PPO and outcome variables, average PPO scores were broken into six items (unfriendly, intelligent, etc.) representing the average of each item across sessions and targets. These six items were correlated with each outcome variable and only one significant relationship was found. The perception that others were unfriendly was negatively associated with life satisfaction ($r = -.28$, $p = .042$).

The fact that across sessions no significant relationships with PPO were found is highly surprising as past research has already established relationships between PPO and trait anxiety as measured by the STAI ($r = .45$, $p < .01$, $n = 75$; Crowe et al., 2012), life satisfaction ($r = .32$, $p < .01$, $n = 75$; Crowe et al., 2012; $r = .21$, $p < .05$, $n = 302$; Wood, Harms, et al., 2010), and reported “general fit with peers” ($r = .22$, $p < .05$, $n = 302$; Wood, Harms, et al., 2010). This suggests that for this sample ($n = 56$), the relationships between PPO and the outcome variables at the pretest are more modest than what has been found in past research.
Table II
Correlations of Outcome Variables with Generalized PPO

<table>
<thead>
<tr>
<th></th>
<th>$r_p$</th>
<th>$r_{MT}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 56</td>
<td>n = 262</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-.12</td>
<td>-.20***</td>
</tr>
<tr>
<td>Social Discomfort</td>
<td>-.10</td>
<td>-.18**</td>
</tr>
<tr>
<td>Sociability</td>
<td>.13</td>
<td>.22***</td>
</tr>
<tr>
<td>Social Connectedness</td>
<td>.13</td>
<td>.20***</td>
</tr>
<tr>
<td>Life Satisfaction</td>
<td>.16</td>
<td>.14*</td>
</tr>
<tr>
<td>Self-Esteem</td>
<td>.15</td>
<td>.19**</td>
</tr>
<tr>
<td>Interaction Quality</td>
<td>.25 ($p = .059$)</td>
<td>.30***</td>
</tr>
</tbody>
</table>

Note. $r_p$ represents correlations of average general PPO across conditions with outcome variables averaged across conditions. $r_{MT}$ represents correlations of general PPO with outcome variables using the entire mass testing sample.

* $p < .05$  ** $p < .01$  *** $p < .001$

To assess the relationship between PPO and the outcome variables of this study more fully, general PPO scores were calculated for the entire mass testing sample (N = 262) and correlated with each of the outcome variables. In this sample, a significant relationship was found between PPO and all six of the outcome variables. See Table II for correlation coefficients. These findings suggest that there is a significant relationship between PPO and the outcome variables assessed with a fairly consistent effect size around $r = .20$, which is smaller than expected, but comparable to what has been found in previous research (Wood, Harms et al., 2010).

**Manipulation Check**

**Probe latency.** In order to assess the effectiveness of our positive CBM-I manipulation, the probe latencies of the experimental and control groups were compared.
A 2x2x2x2 Mixed Model ANOVA was run with condition (experimental vs. control) as the between subjects factor, and probe valence (positive vs. negative), time (first vs. second half of session), and training session (first vs. second) as the within subjects factors. Given the large number of possible interaction terms in this model, the model was limited to assess all main effects, all two-way interactions with condition, the three-way condition x valence x time interaction, and the four-way condition x valence x time x session interaction. We expected individuals in the positive CBM-I training condition to respond slower to negatively valenced probes (relative to control) and faster to positively valenced probes (relative to control). That is, we expected a two-way Condition x Valence interaction. Such results would suggest an effective manipulation. The mean response times by condition are presented in Table III below.

<table>
<thead>
<tr>
<th></th>
<th>Session 2</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Control</td>
</tr>
<tr>
<td>M (SD)</td>
<td>2.86(1.74)</td>
<td>2.78(0.98)</td>
</tr>
<tr>
<td>n = 29</td>
<td>n = 27</td>
<td>n = 29</td>
</tr>
<tr>
<td>Positive probe</td>
<td>2.86(1.74)</td>
<td>2.78(0.98)</td>
</tr>
<tr>
<td>Negative Probe</td>
<td>4.80(2.59)</td>
<td>4.20(2.04)</td>
</tr>
</tbody>
</table>

*Note: Sessions 2 and 3 refer to the first and second CBM-I training sessions (See Figure 2).*

Before running this analysis, a log transformation was applied to the response times to correct for a positive skew. Next, a procedure developed by Tran et al. (2011) was used to identify and remove outliers. Specifically, outliers were identified as response times that exceeded the quartiles by more than three times the interquartile
range. Twenty-three outliers (1.24% of responses) were identified and removed using this process.

As expected, the results revealed a significant probe valence x condition interaction, $F(1, 54) = 13.22, p = .001$. In order to assess if this interaction supported the effectiveness of the CBM-I manipulation, the response times to positive and negative probes were directly compared across conditions. While there was no difference in reaction time to positive probes across conditions, $t(54) = 0.85, p = .399$, there was a significant difference in reaction time to negative probes, $t(54) = -2.08, p = .043$, such that individuals in the positive CBM-I training condition were significantly slower in their responses to negative probes. While there was no difference in response times to positive probes, these results do provide support for the effectiveness of the manipulation. There was also a main effect of session, $(F(1, 54) = 204.65, p < .001)$, such that participants were significantly faster to respond during the second CBM-I training session. There was a main effect of valence, $(F(1, 54) = 132.87, p < .001)$, such that participants were faster to respond to positive probes. There was also a main effect of time, $(F(1, 54) = 40.60, p < .001)$, which unexpectedly indicated that participants were faster to respond to probes during the first half of the CBM-I training sessions.

**Interpretation bias.** As a second manipulation check, the interpretation biases of experimental and control conditions were compared. This was done using the results of the interpretation evaluation scenarios. See Table IV below for mean interpretations of each group.
Table IV
Mean Similarity Ratings by Condition

<table>
<thead>
<tr>
<th></th>
<th>Session 3</th>
<th></th>
<th>Session 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Control</td>
<td>Positive</td>
<td>Control</td>
</tr>
<tr>
<td>M (SD)</td>
<td>n = 29</td>
<td>n = 27</td>
<td>M (SD)</td>
<td>n = 23</td>
</tr>
<tr>
<td>Positive Target</td>
<td>3.09 (.43)</td>
<td>3.02 (.39)</td>
<td>3.05 (.38)</td>
<td>2.82 (.48)</td>
</tr>
<tr>
<td>Negative Target</td>
<td>2.69 (.50)</td>
<td>2.78 (.31)</td>
<td>2.88 (.45)</td>
<td>2.64 (.42)</td>
</tr>
<tr>
<td>Positive Foil</td>
<td>1.90 (.56)</td>
<td>1.74 (.45)</td>
<td>2.16 (.52)</td>
<td>1.68 (.34)</td>
</tr>
<tr>
<td>Negative Foil</td>
<td>1.50 (.52)</td>
<td>1.51 (.45)</td>
<td>1.73 (.55)</td>
<td>1.46 (.35)</td>
</tr>
</tbody>
</table>

*Note: Each of the sentences was rated on a scale of 1-4 ranging from “very different in meaning” to “very similar in meaning.”*

In order to assess the effect of condition on interpretation bias, a 2x2x2x2 Mixed Model ANOVA was run with condition as our between subjects factor, and statement valence (positive vs. negative), statement type (target vs. foil), and session (session 3 vs. posttest) as the within subjects factors. Again, due to the large number of possible iterations, the model used was limited to assess all main effects, all two-way interactions with condition, the three-way condition x valence x type interaction, and the four-way condition x valence x type x session interaction. If the manipulation was successful, we would expect no differences between conditions for the similarity ratings of foil statements as these should universally be seen as dissimilar to the original ending of the interpretation evaluation scenarios. We would, however, expect participants in the experimental group to rate positive target statements as more similar to the original scenario and negative target statements as less similar to the original scenario relative to control participants. Such results would yield a three-way condition x valence x type interaction.
Analysis did not reveal the condition x valence x type interaction, $F(1, 39) = 1.10$, $p = .302$. The results also did not reveal a four-way condition x valence x type x session interaction $F(1, 39) = 0.87$, $p = .357$ which would be expected if the manipulation caused participants in the CBM-I condition to rate target sentences differently, but the effect disappeared by the time of the posttest. However, the sample size of the study was also small, which limits the ability to find higher-level interactions (Chin, Marcolin, & Newsted, 2003). There was a main effect of valence, ($F(1, 39) = 45.09, p < .001$), such that positively valenced items were rated as more similar to the original than negatively valenced items, and a main effect of type, ($F(1, 39) = 242.91, p < .001$), such that target sentences were rated as more similar to the originals than the foil sentences. Lastly, there was a main effect of condition such that participants in the positive training condition rated endings as more similar to originals than participants in the control condition, $F(1, 39) = 9.55, p = .004$.

**Effect of CBM-I on PPO**

In order to assess the effect of CBM-I on generalized positive perception of others, two regressions were run. First, $\text{PPO}_{T3}$ (average PPO after their second training session) was regressed on condition and $\text{PPO}_{T1}$ (average PPO at pretest). This provided the independent effect of experimental condition on $\text{PPO}_{T3}$ controlling for $\text{PPO}_{T1}$. We expected the positive CBM-I manipulation to result in an increase in generalized PPO. Contrary to this hypothesis, however, no significant effect was found $\beta = -.105, t(53) = -1.15, p = .256$. See Table V below for mean PPO scores by condition.

For the second regression $\text{PPO}_{T4}$ (average PPO at posttest) was regressed on condition and $\text{PPO}_{T1}$. This provided the effect of experimental condition on $\text{PPO}_{T4}$
controlling for \( PPO_T1 \). Once again, the expectation was that positive CBM-I would increase the positivity of their interpersonal perceptions, but once again, no significant effect was found \( \beta = -.044, t(38) = -.42, p = .675 \). These results suggest that the CBM-I manipulation had no effect on generalized PPO.

**Effect of CBM-I and PPO on Outcome Variables**

In order to assess the independent effects of CBM-I and PPO on the outcome variables, several multiple step regressions were run. First, a two-step regression was run. In the first step, \( OV_{T3} \) (outcome variable after the second training session) was regressed on experimental condition and \( OV_{T1} \) (outcome variable at pretest). This provided the effect of experimental condition on \( OV_{T3} \) controlling for \( OV_{T1} \). In the second step of the regression, \( PPOT_{T3} \) was added. This allowed us to assess the independent effects of experimental condition and PPO on the outcome variable during Session 3. A second two-step regression was necessary to assess the effects of CBM-I and PPO on the outcome variables as measured during the posttest (\( OV_{T4} \)). As before, the first step regressed \( OV_{T4} \) on experimental condition and \( OV_{T1} \), providing the effect of experimental condition on \( OV_{T4} \) controlling for \( OV_{T1} \). In the second step, \( PPOT_{T4} \) was added to assess the independent effects of condition and PPO on the outcome variable at the time of the posttest. These regressions were run for each of the outcome variables that were assessed (Anxiety, Self-esteem, Sociability, etc.).

Our analysis suggests that experimental condition had a significant effect on two outcome variables, anxiety and sociability. However, both of these outcomes were affected in an unexpected way (see Table VI for mean values by condition).
Table V
PPO Means and Effect Sizes by Condition

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M_1$  $M_3$  $M_4$</td>
<td>$M_1$  $M_3$  $M_4$</td>
</tr>
<tr>
<td></td>
<td>$n=25$ $n=25$ $n=16$</td>
<td>$n=28$ $n=29$ $n=21$</td>
</tr>
<tr>
<td>General PPO</td>
<td>72.50  77.21  75.77</td>
<td>72.55  75.60  75.61</td>
</tr>
<tr>
<td>Tendencies to see specific others positively</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rom. Partner</td>
<td>74.67  74.94  74.13</td>
<td>72.16  74.68  71.49</td>
</tr>
<tr>
<td>Roommate</td>
<td>67.68  70.66  66.76</td>
<td>67.24  65.07  68.88</td>
</tr>
<tr>
<td>Mother</td>
<td>77.50  81.55  78.68</td>
<td>80.69  77.82  75.60</td>
</tr>
<tr>
<td>Father</td>
<td>76.36  77.63  73.73</td>
<td>78.96  79.05  78.77</td>
</tr>
<tr>
<td>WFU Friend 1</td>
<td>66.75  78.70  78.41</td>
<td>65.56  77.08  78.11</td>
</tr>
<tr>
<td>WFU Friend 4</td>
<td>64.48  77.40  79.13</td>
<td>64.55  80.13  79.16</td>
</tr>
<tr>
<td>HS Friend 1</td>
<td>76.04  76.46  75.84</td>
<td>75.54  73.38  74.13</td>
</tr>
<tr>
<td>HS Friend 4</td>
<td>72.92  76.46  72.99</td>
<td>76.46  74.84  75.07</td>
</tr>
<tr>
<td>Professor 1</td>
<td>83.04  83.24  80.01</td>
<td>87.10  82.81  83.97</td>
</tr>
<tr>
<td>Professor 2</td>
<td>83.95  82.82  80.91</td>
<td>83.31  82.94  77.19</td>
</tr>
<tr>
<td>Stranger</td>
<td>63.42  73.59  74.29</td>
<td>59.28  69.67  72.17</td>
</tr>
<tr>
<td>General perceptions of others, separated by item</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfriendly/Cold</td>
<td>21.55  15.15  18.82</td>
<td>22.31  19.35  19.84</td>
</tr>
<tr>
<td>Intelligent/Smart</td>
<td>80.41  80.62  80.09</td>
<td>80.02  78.14  79.10</td>
</tr>
<tr>
<td>Truthful/Honest</td>
<td>76.06  78.91  76.83</td>
<td>76.78  76.90  75.94</td>
</tr>
<tr>
<td>Tense/Anxious</td>
<td>42.71  34.90  37.41</td>
<td>43.56  36.14  35.93</td>
</tr>
<tr>
<td>Competent/Capable</td>
<td>78.52  79.67  78.51</td>
<td>81.26  80.58  78.43</td>
</tr>
<tr>
<td>Careless/Irrespon.</td>
<td>26.81  23.98  26.46</td>
<td>26.45  27.96  26.35</td>
</tr>
</tbody>
</table>

Note: $n$ values of each column represent listwise $n$. $\beta_3$ and $\beta_4$ represent the standardized effect of positive training at Sessions 3 and 4 respectively while controlling for Session 1. Underlined values indicate values that differ significantly across conditions. Scale item values (unfriendly, intelligent etc.) represent averages across all 12 targets rated.
<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Control</th>
<th>Positive</th>
<th>Positive</th>
<th>Control</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M₁</td>
<td>M₃</td>
<td>M₄</td>
<td>M₁</td>
<td>M₃</td>
</tr>
<tr>
<td>Anxiety</td>
<td>2.80</td>
<td>2.77</td>
<td>3.03</td>
<td>2.98</td>
<td>3.26</td>
</tr>
<tr>
<td>Social Discomfort</td>
<td>2.52</td>
<td>2.51</td>
<td>2.40</td>
<td>2.55</td>
<td>2.76</td>
</tr>
<tr>
<td>Sociability</td>
<td>3.73</td>
<td>3.84</td>
<td>3.86</td>
<td>3.89</td>
<td>3.77</td>
</tr>
<tr>
<td>Social Connectedness</td>
<td>4.06</td>
<td>4.02</td>
<td>4.00</td>
<td>3.98</td>
<td>4.07</td>
</tr>
<tr>
<td>Life Satisfaction</td>
<td>3.74</td>
<td>3.87</td>
<td>3.88</td>
<td>3.57</td>
<td>3.74</td>
</tr>
<tr>
<td>Self-Esteem</td>
<td>3.56</td>
<td>3.59</td>
<td>3.72</td>
<td>3.55</td>
<td>3.59</td>
</tr>
<tr>
<td>Interaction Quality</td>
<td>4.33</td>
<td>4.33</td>
<td>4.11</td>
<td>4.24</td>
<td>4.21</td>
</tr>
</tbody>
</table>

Note: β₃ and β₄ represent the standardized effect of positive training at Sessions 3 and 4 respectively while controlling for Session 1. Underlined values represent those that are significantly different across conditions. Each column’s n value represents the listwise n.

Following the second CBM-I training session (Session 3), participants in the positive CBM-I training condition reported being more anxious than those in the neutral CBM-I condition, β = .203, t(53) = 3.24, p = .002. This effect did not persist until the posttest, although it did approach statistical significance, β = .127, t(38), p = .112. The manipulation’s apparent effect on sociability was similarly negative. Results suggest that the positive CBM-I training condition actually decreased scores on the IPIP Sociability scale, β = -.155, t(52) = -2.34, p = .023, and once again, this effect neared statistical significance at the time of the posttest, β = -.141, t(37) = -1.80, p = .079. PPO was not found to have any significant unique effects on any of the outcome variables.
In summary, these results suggest that there was no difference in general PPO across conditions, but participants who received positive CBM-I training did view themselves to be more anxious and less sociable. More generally, the vast majority of CBM-I’s effects on PPO and outcome variables were not statistically significant.

**Supplementary Analysis**

In order to further investigate the effects of the CBM-I manipulation several post-hoc analyses were run.

**CBM-I and the IIDL personality inventory.** In order to assess if the CBM-I manipulation had any effects on participants’ personality characteristics, CBM-I condition was correlated with IIDL items collected during Sessions 3 and 4 (see Figure 2). It should be noted that for this analysis participants in the positive CBM-I condition were coded as one and participants in the neutral training condition were coded as zero. Several significant correlations were found as a result of this analysis. Participant condition was found to have significant relationship with reported anxiety during Session 3 \( (r = .28, p = .036) \). This suggests that during Session 3 those in the positive training condition reported being more tense/anxious than those in the control condition. This effect was not found in the correlations with Session 4 IIDL responses. However, Session 4 IIDL responses did show that participants in the positive training condition reported being more touchy/temperamental \( (r = .35, p = .027) \), and less thankful/grateful \( (r = -.31, p = .045) \). Again, in both sessions though, nearly all of the correlations between condition and the 51 IIDL items did not reach statistical significance.

**Effect of CBM-I on individual PPO domains.** The same methodology used to assess the effects of CBM-I on generalized PPO can also be used to assess the effect of
CBM-I on perception of individual targets (i.e., parents, friends, professors, etc.). See Table V for these mean PPO scores across individual targets. This is potentially important as it is possible that the effects of CBM-I on PPO were particularly pronounced within the domains of targets that participants frequently interacted with. In order to assess that possibility, regressions were run on PPO of each target from Sessions 3 and 4, controlling for Session 1. Because participants only rated each of the strangers’ pictures one time, average perception of strangers from each session were used for that particular regression. In all of these regressions, a significant effect of experimental condition on positive perception was found only once. A significant effect was found suggesting a negative effect of positive CBM-I on participants’ positive perceptions of their mothers following their second CBM-I training session, $\beta = -.234$, $t(52) = -2.07$, $p = .044$. That is, participants viewed their mothers less positively as a result of the positive CBM-I training. By the time of the posttest at Session 4 this effect was no longer significant, $\beta = -.182$, $t(38) = -1.24$, $p = .223$. Once again, it should be noted that the vast majority of these analyses yielded no significant effect.

Effect of CBM-I on individual PPO scale items. Last of all, PPO scores can be separated by item just as they can be separated by target. This analysis is potentially important for, as mentioned, the scale items with the strongest loadings were “careless, irresponsible” and “intelligent, smart.” In this sense, the PPO scale used can best be described as a perception of conscientiousness/intelligence scale, when it is possible that perception of warmth (the unfriendly, cold item) was more strongly affected by the manipulation. Therefore these same regressions were once again run using each
individual item averaged across targets from each session. The means across conditions are reported in Table V. No significant effects were found across conditions.
DISCUSSION

As shown in Figure 1, a major source of a tendency to see others positively – and then its downstream effects on behavior – should be the extent to which a person interprets ambiguous social stimuli positively. For this experiment, it was thus hypothesized that by increasing the positivity of social interpretations, it would be possible to improve interpersonal perceptions, and ultimately have a positive impact on interpersonal functioning and life satisfaction. The results of this experiment, however, show no support for this hypothesis.

Null Effects of CBM-I

For this study, it was hypothesized that positive cognitive bias modification would have two direct effects, one on the positivity of interpersonal perceptions, the second on the emotional and interpersonal outcome variables assessed.

Regarding the expectation that a positive interpretation bias modification would increase the positivity with which participants viewed others, no significant effect was found. Further analyses which separated PPO by targets and scale items suggested the social interpretation manipulation to cause only one effect on PPO. Participants in the control condition temporarily viewed their mothers more positively relative to the positive training condition. Given the number of regressions run however, it seems likely this effect occurred by chance.

Regarding the effect of positive interpretation bias modification on the outcome variables assessed, two effects were found. Positive CBM-I was shown to increase anxiety and decrease sociability. These findings are particularly strange, as positive CBM-I has been shown to decrease anxiety on several different occasions (Amir &
Taylor, 2012; Bowler et al., 2012; Hallion & Ruscio, 2011; Salemink et al., 2009). However, with the findings of previous research in mind and the large number of analyses taken into account, it is once again reasonable to suggest that these are likely chance results.

Supplemental analyses correlated CBM-I training condition with personality variables to assess the extent to which a positive interpretation manipulation affected self-reported personality characteristics. Individuals that received positive CBM-I training reported being more anxious, more temperamental, and less thankful than those who didn’t receive training, but once again, these effects seem negligible as they occurred at no more frequency than would be expected by chance.

With the above results in mind, it seems clear that relative to the control, positive CBM-I training had no real effects to speak of. The most obvious cause of this failure to even replicate past research is in the apparent failure to successfully create a significant difference in interpretation biases across conditions. While the fact that individuals in the positive training condition were slower to respond to negatively valenced probes does support the effectiveness of the manipulation, it seems clear the CBM-I procedure was not as effective as expected. The expected change in probe reaction times alone is not enough to confirm a change in interpretation bias for probe responses do not represent a direct measure of interpretation bias. It is conceivable that positive responses to probe scenarios were primed without effecting interpretation in a generalized way. For this reason, probe response time assessments must be supplemented by the interpretation evaluation, which functions as a more direct measure of interpretation tendencies.
The interpretation evaluation was expected to show a three-way interaction between training condition, valence, and type. Participants in the positive training condition were expected rate the positive target sentences as more similar to the original than the control condition. Unfortunately, no such interaction was found suggesting the desired group difference in interpretation bias was not established. This null effect of the manipulation is quite unexpected given the success with which similar procedures have been used to manipulate interpretation bias. A major question of this discussion therefore becomes: Why didn’t the manipulation work?

**Variations from past procedures.** The CBM-I procedure used in this study was designed to mirror as closely as possible much of the previous research that has successfully manipulated interpretation. Other methodologies have been used to manipulate interpretation biases. Some research has used homographs rather than full vignettes, some have used auditory stimuli rather than visual (Holmes et al., 2009; Murphy, Hirsh, Mathews, Smith, & Clark, 2007), but this variability in method only speaks towards the robustness of the effect. With that being said some minor alternations to previous procedures were necessary for this study.

The most significant change from previous research using this manipulation lies in the scenarios themselves. There were 128 training scenarios and 32 probe scenarios used in this study, roughly half of which were developed by Mathews and Mackintosh (2000). The vocabulary used in many of Mathews and Mackintosh’s original scenarios had to be modified for the present generation and culture. The vast majority of these modifications were extremely minor changes (i.e., “rotation” rather than “rota” or “email” rather than “letter”) intended to make the scenarios more germane to the present
participants. Importantly, whenever a change was made, great care was taken to ensure that the overall structure of the scenario (emotional ambiguity until the end) remained the same.

Due to the number of scenarios required to fill two CBM-I training sessions, the scenarios developed by Mathews and Mackintosh were supplemented by scenarios developed by Salemink et al. (2009). Unfortunately, these scenarios were originally developed in Dutch, so they had to be adapted from translations, which may have resulted in a relatively greater change, but again, with each scenario the overall structure remained the same.

It seems unlikely that the adapted scenarios are responsible for the unexpected results of the present study due to the cognitive nature of the manipulation. If the positive interpretation modification functions through the overtraining of positive interpretive associations, as is suggested by previous literature (Beard, 2011), the specific item should, in theory, make little difference as long as the overall structure of the training process remains the same.

**Processing of each scenario.** Another potential cause of the failed manipulation could lie in the way in which each scenario was processed. Previous research has identified the importance of using active imagery in CBM-I training (Holmes et al., 2009). It is for this reason that previous research using this CBM-I paradigm has stressed to the participants the importance of imagining themselves as the central character in each scenario (Tran, Hertel, et al., 2011). Indeed, the importance of this process was stressed to participants in this study as they were instructed to do so both before beginning their session and between each block. It is possible however that the
participants did not adhere to these instructions to actively imagine themselves in these scenarios. To that end it seems telling that the average participant took 22 minutes to complete a single session of CBM-I training while previous research, which presented the same number of scenarios, has reported the average amount of time to complete a single session to be between 45 and 60 minutes (Salemink et al., 2009; Tran, Hertel, et al., 2011). It cannot be said with certainty, but such a difference in time does suggest that the participants of the present study may not have been devoting much effort to this process. If this was the case, and participants were simply passively working through the scenarios without actively processing them or their valence, it seems likely that the strength of the manipulation could be adversely affected (Holmes et al., 2009; Holmes, Mathews, Dalgleish, & Mackintosh, 2006). Participants’ failure to use imagery in the processing of the scenarios may also help to explain the surprising directionality of some of the results, for one previous study has associated purely verbal processing of positive CBM-I training with a decrease in positive affect and increase in state anxiety (Holmes et al., 2006).

In a more general sense, it is also worth pointing out that roughly a third of the participants of this study had to be excluded due to failure to follow directions or poor data quality suggesting that they may not have been taking the process very seriously.

Possible null effect on healthy populations. The fact that a healthy population of students was used is another important factor for the present findings. As noted above, much of the previous research using a CBM-I procedure has been done on clinical populations, or populations selected for high levels of depression or anxiety (Amir & Taylor, 2012; Mathews, Ridgeway, Cook, & Yiend, 2007; Salemink et al., 2009; Salemink & van den Hout, 2010). The present study is by no means the only case in
which a healthy student population was used (Salemink et al., 2010; Tran, Hertel, et al., 2011; Tran, Siemer, & Joormann, 2011), but the present study is unique among them in its control condition.

Almost all of the previous research using healthy un-selected populations has done so with the intention of comparing the effects of positive interpretation training to the effects of negative interpretation training. While this is understandable considering the CBM-I training procedure was originally developed with clinical populations in mind, this is, in my mind, a major flaw in the literature. Without having research that directly compares the effects of positive and negative CBM-I training to a control condition with interpretation bias assessments before and after training occurs, it is very difficult to know the effects of positive and negative CBM-I training. See Figure 4 below.

**Figure 4**
Possible Effects of CBM-I Training Conditions on Healthy Population

![Possible Effects of CBM-I Training Conditions on Healthy Population](image)

All three of the effects represented in Figure 4 would yield a significant effect across positive and negative training conditions, and as far as I can tell, there has been no study designed to assess the differential effects of these three conditions. The hypotheses
of this study were based on the assumption that the differences across positive and negative CBM-I training conditions were continuous (Possibility 1 in Figure 4), but it is entirely possible that the effects found by previous research on healthy unselected populations were primarily driven by the negative CBM-I training condition rather than an increase in positivity due to positive CBM-I training (Possibility 2 in Figure 4). If in healthy populations positive CBM-I training suffers from a ceiling effect in that it is not powerful enough to make an already positive interpretation bias more positive, a null effect would be expected.

Indeed, this ceiling effect possibility seems to be supported by the results of this study. As shown in Table I, at the Session 1 pretest participants reported being generally satisfied with their lives, and socially connected to others with high social interaction quality. They also reported having generally positive interpersonal perceptions of others. Because no pretest assessment of interpretation bias was collected, it cannot be said where the participant baseline interpretation level of this study’s sample was. However, based on the reaction times of the control group, it seems likely that as a whole the baseline interpretation tendency was already positively biased rather than perfectly neutral. Further support for this ceiling effect is found in the failure of the present study to find a difference in response time to positive probes as well as the main effect of valence in the interpretation assessment.

**PPO and Outcome Variables**

The other major hypothesis of this study was that PPO would have a measurable unique effect on the outcome variables assessed. Before directly testing this hypothesis by regressing PPO on the outcome variables, basic correlations were run to confirm a
relationship between PPO and the outcome variables (Table II). Many of these relationships were expected to replicate past research for PPO has already been associated with life satisfaction, anxiety, antisocial behavior, and “fitting-in” with peers (Wood, Harms, et al., 2010; Crowe et al., 2012). As expected, pretest levels of PPO were shown to correlate with self-esteem and social interaction quality, but not with the remaining variables, and these relationships were not consistent across subsequent sessions. However, running the same correlations with a larger sample revealed the expected relationships did exist, albeit with a smaller magnitude than expected.

**PPO assessment.** Before discussing the observed relationship between PPO and the outcome variables, it is first necessary to point out unique components of the way PPO was assessed in this study. Previous research on PPO as a construct has identified positive interpersonal perceptions to have a consistent single-factor structure. Originally, this single factor was identified using a 57-item assessment (Wood, Harms, et al., 2010), but more recently it was effectively assessed using a 10-item measure (Crowe et al., 2012). For this study however, the scale was further shortened to six items, and it is possible that by reducing the scale to six items from 10, some important information was lost.

Previous research on social cognition has suggested that interpersonal perceptions are best organized into facets of warmth and competence (Fiske et al., 2007). As mentioned previously, the reliability analysis of the six-item PPO scale revealed competence and intelligence as the scale’s most representative items. In this sense, the PPO assessment used was more a perception of competence scale than it was a perception of warmth scale. Because PPO as a construct is intended to assess the positivity of
perceptions as a whole, it is important that both facets are represented. Unfortunately, in this case only one of the six items (unfriendly/cold) is likely to fall squarely into the warmth facet. This could potentially explain the surprising pattern of results found in Table I. Across conditions, the two most positively perceived targets are current professors while current friends at Wake Forest, current roommate, and current or most recent romantic partner all fall into the bottom half of targets in terms of the positivity with which they were perceived. Such results seem unlikely to occur if the PPO scale was truly assessing the overall or general positivity of participants’ perceptions.

Therefore, for the purposes of this discussion, unfriendly/cold scores were calculated for each target by averaging across conditions and the results, from least unfriendly target to most, were as follows: Mother (9.48), Professor 1 (11.90), Wake Forest Friend 1 (16.19), Wake Forest Friend 4 (16.41), Professor 2 (17.50), High School Friend 1 (17.88), Romantic Partner (18.44), High School Friend 4 (19.70), Father (23.96), Strangers (26.12), Roommate (27.51).

The first thing to notice in these ratings is that as expected, Wake Forest friends were rated less unfriendly than most. Interestingly enough, however, for this item too current Wake Forest Professors fell in the top half of the targets in terms of the positivity with which they were perceived. This suggests that the observed positivity ratings are not entirely driven by the competence items. Nevertheless, this divergence from previous assessments of PPO is important to keep in mind as the question of effect size is discussed.

**PPO effect sizes.** The initial failure to replicate correlations previously found between PPO and outcome variables such as anxiety and life satisfaction was quite
surprising. However, additional analyses using the entire mass testing sample revealed that it was primarily a sample size issue as increasing the $N$ to 262 resulted in all of the correlations reaching significance, many at the level of $p < .001$. The effect sizes of these mass testing correlations in Table II are particularly important to note, for while meaningful, they are likely too small to result in measurable unique effects on the outcome variables, given the sample size of this study. Therein lays the probable reason for why no effects of PPO on the outcome variables were found, not because no effect exists, but because the effect is relatively small.

The expectation that PPO could be identified as a partial mediator of the positive effects associated with positive CBM-I was dependent on a larger association between PPO and the outcome variables. This expectation was not entirely unfounded. Indeed, recent findings have suggested PPOs correlations with anxiety and life satisfaction to be $r = .45$ and $r = .32$ respectively, and it was not unreasonable to assume that the associations with overtly social items such as social discomfort and sociability could be even higher. Unfortunately, this was not the case. Instead, it seems that PPO is only a minor vector of change in the outcome variables assessed, and is therefore clearly not the primary mechanism through which CBM-I has its positive effects. With that being said, it does seem reasonable to characterize PPO as a potential risk/resiliency factor for social and emotional well-being, but such a conclusion could not be made on the results of this study alone.

**Potential Procedural Improvements**

Given the various problems that have been mentioned thus far, it is possible that a few variations in the methodology would have made the study more effective. To begin,
the manipulation would likely have been more effective if participants were in some way encouraged to more actively engage in the imagery process. For example, Holmes et al. (2009) required their participants to not only answer a comprehension question following each of the scenarios, but also rate the vividness of their imagery. This simple addition would likely go a long way to strengthen the manipulation by stimulating the use of imagery while processing the scenario and its valence. The result hopefully being a stronger activation of positive social-cognitive associative networks for those in the positive CBM-I condition.

The manipulation could also be improved if procedural changes were made to increase the motivation of the participants. The probe reaction time analysis revealed a main effect of time such that participants were faster to respond to probes during the first half of the training session than the second. This is extremely surprising when you consider the nature of cognitive training. As participants grow accustomed to the CBM-I procedure, they would be expected to increase the speed of their responses rather than decrease, particularly those in the positive training condition. This was, however, not the case. Participants were slower to respond to probes in the latter half of the session, almost suggesting a depletion or exhaustion effect. While it cannot be said with certainty, this effect, in combination with the fact that participants progressed through the sessions so much faster than what has been reported by previous studies, may suggest particularly low motivation levels among participants in this sample.

If this study were tried again, it could also benefit from increasing the number of items in the PPO Scale. As a construct, PPO is characterized by two critical components: it is generalizable across targets of perception, and it is reflective of an individual’s
tendency to view targets in a generally positive sense. By reducing the items in the PPO scale to six, it is possible that this second component is no longer being fulfilled. The six items used to assess PPO primarily assessed perceptions of competence while perceptions of warmth were largely ignored. Previous research does suggest that the six-item assessment of PPO should still be largely representative of the construct (Crowe et al., 2012; Wood, Harms, et al., 2010), but it is possible that important variability was lost (Fiske et al., 2007). Increasing the number of items in the PPO scale would result in a more reliable estimate of the general positivity of participants’ perceptions and thus provide a more theoretically valid assessment of PPO.

More generally, increasing the number of participants in future PPO research will also be important. While it does seem clear that PPO is associated with many important outcomes, the proportion of variance accounted for by those associations is relatively small ($r^2 \approx .04$). Therefore, if future research continues to investigate the effects of positive interpersonal perception, large sample sizes will be a necessity.

Lastly, for future research using the CBM-I paradigm on healthy populations, it will be quite important to include negative, positive, and control conditions. As the literature stands, it is impossible say what the real effects of these conditions are. It is clear that when comparing the results of positive CBM-I training to negative, there is a difference in interpretation bias. However, it can’t be said the extent to which that difference is due to the negative interpretation training. That is, we currently don’t know how effective positive CBM-I training is at increasing the positivity of interpretation tendencies in healthy populations. This is an important gap in the literature that must be filled.
Manipulation of Positive Interpersonal Perceptions

Given the null effect of the present study, there is still a question of whether or not CBM-I can be considered a viable method through which the positivity of interpersonal perceptions can be changed. Given the slight methodological changes suggested above, I do believe that CBM-I should still be considered as a potential strategy through which this manipulation could occur. As pointed out in Figure 1, cognitive bias modification of interpretation is, from a theoretical standpoint, particularly suited for the task of manipulating perceiver effects as it is capable of affecting a major component of the interpersonal perception process. Because this study did not effectively manipulate social interpretation bias, this theoretical argument has still yet to be effectively tested. However, if research does ultimately show a successful manipulation of social interpretation bias, without accompanying changes in the positivity of interpersonal perceptions, a revision of the present theory may be necessary.

Fortunately, there are other possible means through which the interpersonal perception process could be affected. Funder’s (1995) Realistic Accuracy Model is once again helpful for this discussion for any process that can systematically affect any of the stages depicted in Figure 1 has potential as a manipulation of interpersonal perception.

Cognitive Bias Modification of Attention for example is another common bias modification procedure that has been applied to clinical populations. Like CBM-I, this process fits nicely into Funder’s (1995) RAM. It directly targets the detection component, so like CBM-I it has the potential to affect the positivity of interpersonal perception. However, unlike CBM-I, CBM-A has not been shown to effect mood or
memory of past events, which would presumably decrease its effectiveness, relative to CBM-I.

Top-down approaches could also be considered as possible manipulation strategies. Self-monitoring techniques, for example, could likely be effective. Cognitive-behavioral research has shown that self-monitoring of anxiety cues can be effective within the treatment of generalized anxiety disorder (Borkovec & Ruscio, 2001). It therefore seems logical that if an individual could learn to become more cognizant of when they were making a negative interpersonal assessment, and correct for it through a reappraisal process of some sort, it is likely that overtime the general positivity of automatic interpersonal assessments would improve. Loving-kindness meditation (LKM) practices are another similar approach which could be interesting to explore, for rather than trying to alter any component of Funder’s RAM (i.e., detection or interpretation), LKM attempts to change the perceiver’s impression directly. The top-down nature of these approaches would likely require more time to develop as automatic responses. However, I would suggest that because they directly target the perceiver’s conscious perception (perceiver’s impression in Figure 1), they are likely to be particularly powerful manipulation strategies.

Conclusion

The present study suggested that positive interpretation training would lead to an increase in the positivity of social perceptions and social functioning. The results of this study did not support our hypotheses. However, data analysis did suggest a failed manipulation meaning the hypotheses have not been entirely disproven. Despite the null effects, the results of this study raise important questions for future research. The fact
that no difference was found in interpretation tendencies across positive and neutral
CBM-I training conditions highlights the importance of including positive, negative, and
control conditions in future research. Furthermore, with regard to PPO, this study
replicates previous research in finding positive interpersonal perception’s association
with outcome variables to be relatively small. Therefore, while I am still optimistic of
the possibility that PPO can be manipulated, this study does raise questions regarding the
value of such a manipulation. Given the effect sizes found, it is possible that PPO is too
small of a factor for a manipulation of PPO to result in a meaningful behavioral change.
With this in mind, future research on PPO may be better off trying to assess the potential
role of PPO as a resiliency factor for positive social and emotional development.
REFERENCES


Appendix A
Screenshot of PPO Target Ratings

The use of sliders in personality ratings is relatively uncommon, with that in mind this screenshot has been included to clarify the way in which individual targets were rated on the six PPO items.
Appendix B
Pictures for Stranger Target Ratings

Pretest Strangers

Stranger 1

Stranger 2

Session 3 Strangers

Stranger 3

Stranger 4

Session 4 Strangers

Stranger 5

Stranger 6
Curriculum Vitae

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Education

Graduate: Wake Forest University
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Undergraduate: Hampden-Sydney College
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Research

Wood Lab – Winston-Salem, NC
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Graduate Student (2011-2013)

Character Project – Winston-Salem, NC
Wake Forest University
Research Assistant (2012)

Volunteer

Piedmont Geriatric Hospital – Burkeville, VA
Research Assistant (2009)

Wake Forest Baptist Medical Center – Winston-Salem, NC
Cancer Patient Support Program (2012)

Honors

University of Georgia
Excellence in Graduate Recruitment Scholarship (2013-2014)

Hampden-Sydney College
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Publications and Presentations

