# The Influence of Social Comparison on Cognitive Bias Modification and Emotional Vulnerability

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**Abstract**

The Cognitive Bias Modification (CBM) paradigm was devised to test predictions that cognitive biases have a causal influence on emotional status. Increasingly, however, researchers are testing the potential clinical applications of CBM. While generally successful in reducing emotional vulnerability in clinical populations, the impact of CBM interventions has been somewhat variable. The aim of the current experiment was to investigate whether social comparison processing might be an important moderator of CBM. Healthy participants were presented with 80 valenced scenarios devised to induce a positive or negative interpretative bias. Critically, participants answered a series of questions designed to establish whether they *assimilated* or *contrasted* themselves with the valenced descriptions. The induction of an interpretation bias that was congruent with the valence of the training scenarios was successful only for participants who tended to assimilate the valenced scenarios, and not for those participants who tended to evaluate themselves against the scenarios. Furthermore, the predicted influence of CBM on emotional outcomes occurred only for those who had an assimilative rather than evaluative orientation towards CBM training material. Of key importance, results indicated that "evaluators" showed increased emotional vulnerability following positive CBM training. This result has both theoretical and clinical implications in suggesting that the success of CBM is dependent upon the way in which participants socially compare themselves to CBM training material.

Key words: cognitive bias modification, social comparison, interpretation bias, emotional vulnerability

# The Influence of Social Comparison on Cognitive Bias Modification and Emotional Vulnerability

Cognitive models of psychopathology predict that information processing biases have a causal influence on affective experience (e.g., Beck & Clark, 1997; Mathews & Mackintosh, 1988; Williams, Watts, Macleod & Mathews, 1988, 1997). Thus, persistent selective *negative* biases in attention, interpretation and memory are thought to induce higher levels of emotional vulnerability. The Cognitive Bias Modification (CBM) paradigm was devised to specifically explore this predicted causal relationship between selective processing biases and emotional vulnerability. The idea is that by inducing either a positive or a negative bias in information processing we can assess the consequent impact on emotional vulnerability. Many CBM studies have supported such models by showing - within a laboratory setting - that inducing a positive or a negative interpretation bias has a congruent influence on mood and emotional vulnerability (Hallion & Ruscio, 2011; Koster, MacLeod & Fox, 2009, Macleod & Mathews, 2012; Mathews & Hertel, 2011, for reviews).

Given that maladaptive processing biases are thought to play a role in the aetiology as well as the maintenance of anxiety and depression disorders, the clinical potential of CBM interventions has not gone unnoticed. On the basis of this scientifically endorsed causal relationship between selective processing and emotional status, CBM is currently being developed as a potential supplement to psychological (Blackwell & Holmes, 2010; Brosan, Hoppitt, Shelfer, Sillence & Mackintosh, 2011) as well as pharmacological (Browning , Grol, Ly, Goodwin, Holmes, & Harmer, 2011) interventions for anxiety and depression. The central idea is that CBM can retrain maladaptive processing biases so that they are normalized with consequent benefits to mental health. To take CBM outside the controlled laboratory setting into a

wider more variable clinical environment, it is important to establish whether the relationship between selective processing and emotional status is as discrete as CBM research has implicitly suggested. This is particularly important since a recent meta-analysis has found that the effect sizes of CBM interventions on both biases, and especially on emotional status, are more modest than was originally thought (Hallion & Ruscio, 2011).

In addition, a handful of CBM studies that attempted to modify biases in the interpretation of ambiguity have reported concurrent mood change and emotional vulnerability findings that run counter to the predictions made by theoretical models (e.g., Williams et al., 1988, 1997). Thus, exposure to positively valenced social training scenarios can result in a decrease in positive mood state during CBM training (e.g., Holmes, Coughtrey, & Connor, 2008; Holmes, Mathews, Dalgleish, & Mackintosh, 2006) and a decrease in emotional resilience after a stress task (e.g., Holmes, Lang, & Shah, 2009; Standage, Ashwin & Fox, 2009). These results highlight a need to investigate potential contraindications to CBM interventions prior to clinical application and developments outside of a laboratory setting.

A possible explanation for such anomalous CBM findings comes from the social comparison literature. Social comparison research shows that we automatically make other-self comparisons that can be either assimilative (the comparison standard is absorbed into the self-concept) or contrasting (the comparison standard is used as a reference point to evaluate oneself against) (Markman & McMullen, 2003). Many factors are thought to influence which form of social comparison is adopted. Similarity/dissimilarity is one such influential factor and has been reported to engender a respective assimilative or evaluative orientation. To illustrate, Mussweiler (2001) primed first year undergraduate participants to look for similarities or

dissimilarities between themselves and a description of a target person (a second year student who had adjusted well to University life). The similarity - primed group reported adjusting well to their own new University environment whereas the dissimilarity group reported difficulties in adjustment. Such empirical findings support a theory within the social comparison literature (Selective Accessibility Model, Mussweiler, 2001) that perceived similarity between the self and the comparison standard provokes assimilation of and identification with the characteristics of the standard, whereas perceived dissimilarity triggers an evaluative perspective between the self and the standard whereby difference and contrast are emphasized. For a review of social comparison research see Suls and Wheeler (2007).

The very nature of CBM interpretation training forces participants to process exceptionally positive or negative social interpretations set by another individual that likely differ from their own natural thinking. This is particularly the case when positive interpretation training is presented to people with depression. The contrast from their normal processing style is likely to be salient and to elicit strong social comparison processes. Based on predictions from the Selective Accessibility Model a perceived dissimilarity between pre-written social scenarios and the participants' own social experiences are perfect conditions to elicit an automatic social comparison with contrast effects (Mussweiler, 2001). This is exactly the case in scenario-based CBM studies that attempt to modify biases in the interpretation of ambiguity. For example with healthy samples negative CBM training is likely to elicit a downward contrast (''my social life is more successful than the situations described in these scenarios'') thus bolstering one's subjective wellbeing. However, with positive CBM training the contrast will be upward resulting in a decrease in one's subjective wellbeing and possibly engendering an increase in post-CBM negative mood and emotional

vulnerability. Thus, it is possible that CBM interpretation training might inadvertently induce social comparison processes that may explain some of the anomalous results in previous research.

In addition to situational factors, there are individual differences with regard to social comparison orientation (Gibbons & Bunnk, 1999) with personality traits such as neuroticism being positively associated with a tendency to evaluate the self against a comparison standard. For example, Van der Zee, Bunnk and Sanderman, (1998) presented recently diagnosed breast cancer patients with upward or downward comparison information about a woman who had been treated for breast cancer. Women scoring high on neuroticism demonstrated affective contrast with the upward comparison yet identification with the downward comparison relative to those low in neuroticism. Van der Zee et al. (1998) demonstrated that emotionally vulnerable people tend to adopt a comparison orientation that decreases rather than increases positive affect (i.e., assimilation of negative outcomes and contrast with positive outcomes). It is therefore possible that positive CBM training, which is likely to be of most use in clinical settings, might have an adverse effect on the very target population that it is designed to support. Therefore, the aim of the present study was to establish whether contrast effects operate within a typical CBM interpretation training intervention.

The experiment employed a well-established scenario-based CBM interpretation training procedure. Participants were presented with positively and negatively valenced training scenarios and modification of interpretation style was indexed by assessing participants' responses to new ambiguous scenarios (see Mathews & Mackintosh, 2000; Standage et al., 2009). Furthermore we assessed the influence that CBM has on emotional vulnerability (mood change as a function of

being exposed to a stressful situation). Emotional vulnerability was elicited by requesting participants to present a speech into a camera. In order to assess whether social comparison processing was occurring during CBM manipulations and creating a secondary influence, participants were asked a series of questions concerning how they compared themselves to the valenced training scenarios. These questions were designed to provide an index of 1) whether social comparison processing was present and 2) if present, whether social comparison processing influenced interpretation bias modification and emotional vulnerability.

Based on a considerable body of previous CBM research (Hallion & Ruscio, 2011; Koster et al., 2009; Mathews & Hertel, 2011), it is expected that a CBM interpretation training intervention will a) successfully induce an interpretation bias congruent with the valence of the training, and b) have a congruent influence on emotional vulnerability. Based on models of social comparison processing (e.g., Mussweiler, 2001) we predict that the impact of CBM interpretation training will differ for those who have an assimilative rather than evaluative orientation. Specifically, participants who tend to evaluate themselves against the training scenarios are expected to demonstrate a valenced interpretative bias and emotional vulnerability effect counter to classic CBM prediction, whereas those who tend to assimilate the scenarios are expected to show effects congruent with the direction (positive or negative) of CBM training.

## Method

### Participants

One hundred and fifty two participants were recruited through advertising within the University of Essex. There was a gender distribution of 110 females and 42 males. The age range was 18–64 years with a mean of 24.99 years. All participants

had normal or corrected-to-normal vision and hearing and no history of psychiatric illness.

**Apparatus**

The stimuli were presented to participants via booklets. A Sony Handicam DTR-TRV 900 E PAL was used for the ostensible purpose of recording speeches to be given by participants.

**Materials**

The CBM stimuli were based on those devised by Mathews and Mackintosh (2000), with some modifications. After publication of the 2000 paper, Mathews and Mackintosh refined their pool of CBM training scenarios by excluding the least effective scenarios and replacing them with new and improved scenarios. The present study used the updated pool of scenarios from Mathews and Mackintosh.

**Training Items.** A training scenario consisted of 3 lines of text presented as one unified paragraph. The social descriptions were identical for both the positive and negative training conditions, except for the final word, which defined the valence of what was a previously emotionally ambiguous scenario. An example of a training item 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* ***friendly/boring****''*

A comprehension question followed the training scenario and required a yes/no answer. For example, the comprehension question below corresponds to the scenario quoted above.

*''Will you be liked by your new acquaintances?''* ***Yes/No***

There were 2 practice training items and 80 training trials. The order of presentation

of the trials was the same for all participants.

**Test Items and Recognition Sentences.** The test items consisted of a title followed by three lines of text with the final word preserving the ambiguity of the scenario. The comprehension questions that accompanied each test scenario were also neutrally toned. An example of a test scenario with its accompanying comprehension question is as follows:

***''The Wedding Reception''***

*''Your friend asks you to give a speech at her wedding reception*

*You prepare some remarks and when the time comes, get to your feet.*

*As you speak, you notice some people in the audience start to laugh''*

*''Did you stand up to speak?'' Yes/No*

There were 2 recognition sentences pertaining to each test scenario, one positively valenced and one negatively valenced. Examples of the recognition sentences corresponding to the ''Wedding Reception'' test scenario are given below:

***"The Wedding Reception"***

*"As you speak, people in the audience laugh appreciatively."*

*"As you speak, people in the audience find your efforts laughable."*

For the response to the sentence recognition task, all participants were presented with four choices labeled as: ''very different'', ''fairly different'', ''fairly similar'' and ''very similar'' which represented a 4-point scale ranging from 1 to 4 respectively. Participants used these four choice labels to compare the recognition sentences with the test items. There were 10 ambiguous test scenarios and therefore 20 recognition sentences in total. The order of presentation of the test scenarios and the recognition sentences was the same for all participants.

**Comparison Style Items.** Six questions were devised to measure whether

participants assimilated the scenarios as part of their self-concept, or regarded the scenarios as a separate entity from which to form a self-evaluation. Participants responded to the questions by marking a 15cm horizontal line consisting of a 30-point scale with "1" representing "Not at all" and "30" representing "Completely." Two examples of comparison style items are as follows:

*Whilst reading the descriptions, to what extent did you feel the scenarios fitted with your idea of your social self?*

*Not at all* *Completely*
*1----------30*

*Whilst reading the descriptions, to what extent did you contrast the scenarios with your social self?*

*Not at all* *Completely*
*1----------30*

**Valenced Contrast Items.** On the assumption that participants will use the scenarios as a reference point from which to draw a personal contrast, a further four questions were devised to index the valenced direction of the contrast (i.e., assessment of upward and downward comparison). As with the comparison style items, participants responded to the questions by marking a 15 cm horizontal line consisting of a 30-point scale with "1" representing "Not at all" and 30 representing "Completely." Two examples of valenced contrast items are as follows:

*"Whilst reading the descriptions, to what extent did you compare yourself to the scenarios in a self-devaluing way?"*

*Not at all* *Completely*
*1----------30*

*"Whilst reading the descriptions, to what extent did you compare yourself to the scenarios in a self-enhancing way?"*

*Not at all* *Completely*
*1----------30*

**Visual Analogue Mood Scales.** To monitor pre- and post-CBM mood and assess emotional vulnerability two visual analogue mood scales (VAMS) were presented at various points throughout the experiment to participants. As with MacLeod, Rutherford, Campbell, Ebsworthy & Holker (2002) each scale consisted of a 15 cm horizontal line with a 30-point scale. The terminal labels on one scale were relaxed and anxious and this was referred to as the anxiety scale. The terminal labels of the other scale were happy and depressed and this scale was referred to as the depression scale. Higher scores indicated a higher negative mood state.

**Procedure**

All participants were tested individually and recorded their responses at a self-paced rate directly into the booklet. Participants first recorded their pre-CBM anxiety and depression using the two VAMS. Next participants were presented with two practice training items. A single instruction given was as follows: "Please read the following short descriptions of social scenarios. Try to imagine yourself as actually being in the social situation. Please answer the comprehension question at the end of each scenario." Having read the scenario, participants completed the associated comprehension question by circling a "YES" or "NO" answer. Following the two practice training items, participants went on to complete 80 negative or positive training items depending upon group allocation. After this interpretation training, participants completed a post-training VAMS measure of depression and anxiety and then responded to the comparison style and valenced contrast items. Next interpretative bias was assessed by means of 10 ambiguous test items with the same procedure as the training items. After the test items, participants' were instructed to complete the 20 recognition sentences by indicating on a four-point scale how similar

in meaning each sentence was to its corresponding test scenario. The final stage of the experiment concerned the elicitation of emotional vulnerability. Participants were informed of a requirement to give a 4-minute speech into a camera (**"**How socially successful you consider yourself to be, giving examples from your recent past to support your claims") whilst the experimenter simultaneously set up a video camera in the room. Participants were reminded that they could leave the experiment at any time. They were told that they would be given 90 seconds to prepare the speech, but prior to preparing their speech they should record their levels of depression and anxiety using the VAMS. This final mood measurement provided under stress served as an index of emotional vulnerability. On completion of the third VAMS, participants were informed that the speech requirement was a ruse. Participants were fully debriefed.

## Results

### Data Treatment

**Similarity Ratings.** Ratings of how similar the positive and negative recognition sentences were to the test scenarios served as the dependent measure for interpretation bias induction. Similarity ratings for the negative recognition sentences were subtracted from the similarity ratings for the positive recognition sentences to give a composite measure of interpretation bias with positive values indicating a positive bias, and negative values representing a negative bias and zero denoting neutrality.

**Comparison Style Ratings.** Items one, three and five measured the extent to which participants assimilated the training scenarios with higher ratings representing greater assimilation. Ratings for items two, four and six indexed the extent to which participants contrasted themselves to the training scenarios with higher ratings

denoting an increased tendency for evaluation and conversely a lower tendency for assimilation. Items two, four and six were reverse coded. All six items were assessed for internal consistency and exceeded the .70 criterion (Cronbach's Alpha = .76). The ratings for the six items were averaged to make a single composite measure of comparison style with higher ratings representing an assimilation orientation and lower ratings representing a tendency to evaluate oneself against the scenarios.

**Valenced Contrast Ratings.** Items one and four measured the extent in which participants reported making downward ("I'm better") comparisons with the scenarios. Ratings for items two and three indexed the extent to which participants made upward ("I'm worse") comparisons and were reverse coded. All four items were assessed for internal consistency and exceeded the .70 convention (Cronbach's Alpha = .86). The ratings for the four items were averaged to make a single composite dependent measure of valenced contrast with a higher rating representing a more positive contrast against the training scenarios.

**Preliminary Analyses**

Data was screened for multivariate outliers using Mahalanobis distances. These highlighted four outliers that were subsequently found not to represent extreme outliers for any singular variable but to have relatively high scores across a number of variables. These cases were not therefore excluded from the analysis but in order to ensure that findings were not vulnerable to these outliers all moderation effects were examined with and without these cases. No changes in the direction or significance of effects were found and therefore the results of analyses with all cases included are reported. Participants were randomly allocated to either a positive or negative CBM training group with the constraint of two equal sized groups. The two CBM groups did not differ on age, pre-CBM depression, pre-CBM anxiety (*t's* < 1) or gender ($\chi 2$

< 1). Means, standard deviations, and the correlations between the study variables can be found in Table 1. None of the correlation coefficients between variables exceeded .70, indicating that multicollinearity was not likely to be a problem. Further examination of the collinearity diagnostics associated with regression analyses indicated that all tolerance values were above .20, the value below which multicollinearity may be deemed to be problematic (Cohen, Cohen, & West, 2003; Tabachnick & Fidell, 2001).

Table 1 here

**Main Analyses**

Moderated regression was used to investigate comparison style as a potential moderator of CBM training effects. Regression analyses were conducted in line with the specific procedures recommended by Aiken and West (1991) and predictor variables were standardised prior to analysis. Significant interactions were decomposed using simple slopes analysis (Preacher, Curran, & Bauer, 2006) in order to examine the nature of CBM training effects at specified points along the comparison style ratings scale. This yielded regression coefficients for the effects of CBM training on interpretation bias, valenced contrast, and emotional vulnerability at low comparison style scores (i.e., evaluators) and high comparison style scores (i.e., assimilators). These conditional values of comparison style were specified as 1 SD above and below the comparison style mean.

In order to examine whether CBM training induced an interpretation bias and whether this induced bias differed for those who assimilate or evaluate, a regression was conducted with interpretation bias as the criterion variable. CBM Group (Step 1), comparison style rating (Step 2), and the CBM Group by Comparison Style

interaction term (Step 3) were entered as predictor variables. In the first step CBM Group was a significant predictor ($B$ = -.28, $p$ = .001), with the positive group showing a positive bias following training relative to the negative group who showed a negative bias. The model accounted for 7% of the variance in interpretation bias ($F$(1,150) = 10.82, $p$ = .001). The addition of Comparison Style in the second step resulted in a non-significant change in this variance accounted for ($R^2_{change}$ = .001, $F_{change}$ = .24, $p$ = .628) and Comparison Style was not found to be an independently significant predictor of interpretation bias ($B$ = -.04 $p$ = .628). CBM Group remained the only significant predictor of bias in this step ($B$ = -.29 $p$ = .001, $F$(2,149) = 5.50, $p$ = .005). The variables entered in the third step accounted for 18% of variance in bias induction, $F$(3, 148) = 10.58, $p$ < .001. CBM Group remained a significant independent predictor ($B$ = -.28, $p$ = .001), providing further support for the initial hypothesis that CBM would be successful in inducing an interpretation bias that was congruent with training. Comparison style ratings remained a non-significant independent predictor ($B$ = -.03, $p$ = .758), however, the CBM Group by Comparison Style interaction term was found to be a significant independent predictor and its inclusion in the third step resulted in a significant increase in the variance accounted for ($B$ = -.36, $p$ < .001, $R^2_{change}$ = .11, $F_{change}$ = 19.38, $p$ < .001), indicating that induced interpretation bias differed according to Comparison Style and therefore across assimilators and evaluators.

Simple slopes analysis indicated that the effect of CBM group on interpretation bias was non-significant for evaluators ($B$ = .08 $t$(148) = 0.67, $p$ = .507) and significant and negative for assimilators ($B$ = -.64, $t$(148) = -5.59, $p$ < .001). This indicates that, for assimilators, positive CBM training was associated with positive bias and negative CBM training was associated with negative bias. No significant

relationship was found between training and bias for evaluators at the conditional comparison style score of -1 SD. An interaction plot of these effects can be found in Figure 1. As the simple slope at the conditional value of low comparison style scores/evaluators (i.e., 1 SD below the mean) did not reach significance, the regions of significance associated with the simple slopes were examined. The examination of the regions of significance allows for the identification of the points along the comparison style scale at which significant slopes emerge. Regions of significance indicate that for evaluators, a significant and reversed relationship emerged between CBM training and bias at comparison style scores of 7.83 ($B$ = .32, $t$(148) = 1.98, $p$ =.050). Therefore, for evaluators with comparison style scores below 7.83, positive CBM training was associated with a negative interpretation bias.

Figure 1 here

To further substantiate the claim that valenced contrast effects due to an evaluative perspective are operating within the CBM procedure, a self-report measure of upward and downward comparisons was taken using the four valenced contrast items. If social comparison processes are present, then evaluators should report upwards contrasts with positive scenarios and downward contrasts with negative scenarios. This prediction was investigated via a regression in which valenced contrast was entered as the criterion variable and CBM Group (Step 1), comparison style rating (Step 2), and the CBM Group by Comparison Style interaction term (Step 3) were entered as predictor variables. In the first step, CBM Group was a non-significant predictor ($B$ = -.11, $p$ = .179, $F$(1,150) = 1.82, $p$ = .179). The addition of Comparison Style in the second step also resulted in a non-significant model ($F$(2,149) = 1.57, $p$ = .213). The addition of the CBM Group by Comparison Style interaction term in the third step resulted in a significant model ($F$(3,148) = 25.87, $p$ <

.001) and accounted for 34% of the variance in valenced contrast. CBM Group and Comparison Style remained non-significant predictors ($B$ = .08, $p$ = .161 and $B$ = -.07, $p$ = .324, respectively). The CBM Group by Comparison Style interaction term was found to be a significant independent predictor ($B$ = -.58, $p$ < .001, $R^2_{change}$ = .32, $F_{change}$ = 72.98, $p$ < .001), indicating that valenced contrast differed across assimilators and evaluators in relation to the valence of CBM training.

Simple slopes analyses revealed that the effect of CBM group on valenced contrast was significant and positive for evaluators ($B$ = .68, $t(148)$ = 7.02, $p$ < .001) and significant and negative for assimilators ($B$ = -.49, $t(148)$ = 5.11, $p$ < .001). For evaluators, positive CBM training is associated with upwards contrast and negative CBM training is associated with downwards contrast, whereas the opposite holds for assimilators. An interaction plot of these effects can be found in Figure 2.

Figure 2 here

Separate analyses examining moderation effects with regards to anxiety and depression revealed the same pattern of effects in each case. Anxiety and depression ratings were therefore collapsed into pre- and post-CBM mood ratings (first and second VAMS administrations) and emotional vulnerability (third VAMS administration). It was hypothesised that the effect of CBM on emotional vulnerability, controlling for pre- and post-CBM mood, would differ according to comparison style. This prediction was investigated via a regression in which emotional vulnerability was entered as the criterion variable and CBM Group, pre-CBM mood, and post-CBM mood were entered in Step 1. Comparison style rating was entered as an additional predictor in Step 2 and the CBM Group by Comparison Style interaction term was entered as an additional predictor in Step 3. In the first

step, CBM Group and pre-CBM mood were non-significant predictors ($B$ = .04, $p$ = .575, and $B$ = .04, $p$ = .424, respectively) and post-CBM mood was found to be the only predictor of emotional vulnerability ($B$ = .61, $p$ < .001). This set of variables accounted for 39.7% of the variance in emotional vulnerability ($F(3,148) = 32.48$, $p$ < .001). The addition of Comparison Style in the second step resulted in a non-significant increase in this variance accounted for ($R^2_{change}$ = .01, $F_{change}$ = 1.31, $p$ = .254) and post-CBM mood remained the only significant predictor within the model ($B$ = .64, $p$ < .001, $F(4,147) = 24.74$, $p$ < .001). The addition of the CBM Group by Comparison Style interaction term in the third step resulted in a significant model ($F(5,146) = 22.45$, $p$ < .001) and accounted for 44% of the variance in emotional vulnerability. CBM Group, pre-CBM mood and Comparison Style remained non-significant predictors ($B$ = .02, $p$ = .771, $B$ = .00, $p$ = .976 and $B$ = -.08, $p$ = .220, respectively). Post-CBM mood remained a significant independent predictor ($B$ = .61, $p$ < .001) and the CBM Group by Comparison Style interaction term was also found to be a significant independent predictor ($B$ = .19, $p$ = .004, $R^2_{change}$ = .03, $F_{change}$ = 8.34, $p$ = .004), indicating that emotional vulnerability differed across assimilators and evaluators in relation to the valence of CBM training.

Simple slopes analyses revealed that the effect of CBM group on emotional vulnerability was borderline significant and negative for evaluators ($B$ = -.17, $t(146)$ = 1.85, $p$ = .067) and significant and positive for assimilators ($B$ = .21, $t(146) = 2.30$, $p$ = .023). For evaluators, positive CBM training is associated with increased emotional vulnerability and negative CBM training is associated with decreased emotional vulnerability. In contrast, for assimilators, positive CBM training is associated with decreased emotional vulnerability and negative CBM training is associated with

increased emotional vulnerability. An interaction plot of these effects can be found in Figure 3[1].

Figure 3 here

## Discussion

The results of the current experiment demonstrate the novel finding that a person's comparison style when processing training material moderates the effectiveness of CBM on interpretation bias and emotional vulnerability. As predicted, the effects of CBM training were found to depend upon whether an individual engaged in assimilative or evaluative processing when reading the training scenarios. Specifically, for those who assimilated the scenarios, CBM was successful across both bias induction and emotional vulnerability. For those who evaluated themselves against the scenarios, bias induction was unsuccessful and moreover emotional vulnerability effects were in opposition to conventional CBM predictions.

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[1] A moderated mediation analysis was conducted in order to investigate whether, in addition to the moderation effects investigated within the current paper, the effects of CBM on emotional vulnerability were mediated via interpretation bias. All moderated effects reported within the original moderated regression were still present and significant in this second analysis. However, interpretation bias was not found to serve as a mediator between CBM training and emotional vulnerability as the path between interpretation bias and emotional vulnerability failed to reach significance within the moderated mediation model. Attention to and interpretation of this finding was considered as outside the remit of the current paper. To interested readers, please contact the authors for further information.

This outcome is consistent with models of social comparison whereby perceived similarity or dissimilarity to a standard (e.g., scenarios) triggers an assimilative or evaluative stance enhancing comparability or contrast effects respectively (e.g., Mussweiler, 2001).

For those who assumed an assimilative approach, positive CBM training consistently led to higher levels of positive interpretation and consequent emotional resilience. Similarly, for these assimilators negative CBM training led to lower levels of positive interpretation and subsequent lower emotional resilience. Thus, consistent with cognitive models of psychopathology (e.g., Williams et al., 1988, 1997) these results show cognitive biases to have a causal influence on levels of anxiety and depression. However, our results suggest a possible modification of this theory in that we found these effects only for people who assimilate the training scenarios.

Our findings present a possible contraindication of positive CBM training that needs to be explored further given the unfavourable effects that emerged for individuals who assume an evaluative social processing approach. The moderated regression analysis clearly demonstrated that lower scores on the comparison style scale (evaluation focus) were significantly associated with a paradoxical effect of CBM training. For those who adopted an evaluative orientation, positive CBM training induced lower emotional resilience. That is, for these individuals, the positive CBM training resulted in increased levels of anxiety and depression in the face of stress. Conversely, negative CBM training was associated with a decrease in anxiety and depression vulnerability. With regard to bias induction and evaluative focus, CBM was ineffective. In addition, the region of significance analysis indicated that scores below 7.83 on the comparison style scale (7.77 points below the mean) would render the relationship between CBM training and bias induction as opposing. Thus

our results indicate a potential individual difference in social comparison processing that might have a strong impact on the effectiveness of CBM.

The above finding may go some way towards explaining the previous mixed results of CBM interventions on clinical outcome (Hallion & Ruscio, 2011) and the counter-to-prediction post-CBM mood (Holmes et al., 2006; Holmes et al., 2008) and emotional vulnerability results (Holmes et al., 2009; Standage et al., 2009) that have been reported in previous research. A preponderance of participants with an evaluative orientation in these studies may have produced the discrepant mood and emotional vulnerability effects. Moreover, the type of CBM paradigm may provoke or inhibit latent individual difference evaluative tendencies.

It is clear that most published CBM research finds successful bias modification combined with congruent changes to emotion. For instance, Mackintosh, Mathews, Yiend, Ridgeway and Cook (2006) reported an interpretative bias induction and subsequent emotional vulnerability change in line with CBM valence. Interestingly though, Mackintosh et al. used scenarios relating to physical health rather than social issues. The non-social theme of the scenarios may have failed to evoke social comparison processes. Beard and Amir (2008) induced a positive interpretation bias in high socially anxious participants and reported a consequent decrease in symptoms. However, Beard and Amir used the Word Sentence Association Paradigm (WSAP) rather than a scenario-based method. The participant's task of deciding whether a single valenced word matches a single ambiguous sentence is more detached and less personal than reading/imaging social descriptions with one's self as the central character. Therefore, as with Mackintosh et al. (2006), the alternative interpretative CBM methodology used by Beard and Amir (2008) may have precluded social comparison processes.

The same argument of impersonal training procedures preventing social comparison processes can be applied to successful interpretative CBM using homograph methodology (e.g., Grey & Mathews, 2000; Wilson, MacLeod, Mathews & Rutherford, 2006) as well as successful attentional CBM training using the dot probe methodology (e.g., MacLeod et al., 2002; Hakamata et al., 2010). Both homograph and dot probe methods of bias induction use single words or pictures as stimuli and require responses that are more dispassionate and less personally involving than scenario methodology. Thus there is some suggestion from the collective CBM literature that social comparison processing is only triggered when using the more personally engaging scenario-based CBM procedures. From a social psychological point of view, valenced stimuli such as single words or pictures provide sparse social information and therefore it would be both difficult and futile to use as a point of reference to draw an informative self-focused personal comparison. Lengthier descriptions of another's private and personal thoughts and feelings in response to various social situations, provide a privileged insight and rich resource from which to draw personally meaningful comparisons with the aim of furthering one's understanding of the self in relation to the social world. Thus the implicit motivation to engage in social comparison processing is more likely to be present in scenario-based CBM than in other forms such as the dot probe, WSAP and homograph method.

Nonetheless, there remain a considerable number of social scenario-based CBM studies that have achieved successful interpretation bias induction and emotional change. For example, Mathews, Yiend, Ridgeway & Cook (2007) used four sessions of scenario-based CBM to induce a positive interpretation bias in high trait anxious individuals and reported a subsequent reduction in trait anxiety.

Mathews et al. also noted that for CBM to be effective, the level of positivity of the scenarios needed to be graduated so that the first scenarios presented to participants were not overly extreme and their potency increased slowly as the experiment progressed. This gradual increase in positivity will have softened the stark contrast and dissimilarity between the reference scenario and the self thereby encouraging a CBM compatible assimilative as opposed to evaluative stance. As such, the scenario-based success reported by Mathews et al. is consistent with the underlying presence of social comparison processing within a CBM context.

Other examples of successful scenario-based research come from Hirsch, Mathews and Clark (2007) and Murphy, Hirsch, Mathews, Smith and Clark (2007). These studies used participants with high levels of anxiety. The social comparison literature would predict that individuals scoring high on measures of anxiety are likely to adopt a negative evaluative rather than positive assimilative focus (Gibbons & Bunnk, 1999; Van der Zee, Bunnk & Sanderman, 1998). Our CBM data go some way to supporting this prediction in that participants' mood state when entering the experiment negatively correlated with valenced contrasts made against the scenarios irrespective of CBM group allocation [$r(151) = -.350$, $p = .001$]. In other words, the more depressed and anxious participants were, the less positive the contrasts that were made. Thus the results from Hirsch et al. (2007) and Murphy et al. (2007) are more difficult to reconcile with the current findings and those from the social comparison literature. A possibility is that comparison processing was occurring within the above studies, but the effects were not sufficiently strong to fully undermine the CBM influence.

Consistent with the argument that evaluative processing is an underlying contradictory presence within scenario-based CBM, are experiments that have

exposed sub-clinical or clinical participants to scenario training and not achieved full success. For example, Salemink, van den Hout and Kindt (2009) exposed high trait anxious individuals to multiple sessions of scenario training and achieved mixed results with participants improving on state and trait anxiety, but not on measures of social anxiety and emotional vulnerability. In addition, Blackwell and Holmes (2010) in a single case series presented seven participants diagnosed with major depression with scenario training. Only four of the seven participants reported positive benefits from the training. Of the three participants for whom CBM was ineffective, two reported being unable to use visual imagery when processing the scenarios as instructed. This imagery absence CBM failure is consistent with Holmes et al. (2009) who reported CBM success for participants who used visual imagery rather than verbal analysis to process scenarios. However, past scenario-based CBM success has been achieved without explicit use of imagery processing (e.g., Standage, Ashwin & Fox, 2010). A possibility is that scenario-based procedures that generally constrain participant activity, by for example instructing participants to visually imagine scenarios, complete word fragments or impose a time limit, may reduce the opportunity for evaluative processing. The current experiment's methodology was self-paced with little cognitive load on participants other than to think about being in the social situation described. Thus it may be tightly constrained procedures rather than visual imagery per se that prevents evaluative processing. Blackwell and Holmes stressed the importance of identifying both the effective and failing components if CBM is to be taken from the laboratory to the clinic. The results of the current experiment suggest that evaluative processing is one potentially failing component within scenario-based CBM that may be enhanced or diminished by different

procedural paradigms. Its antagonistic effects can be overlooked if not explicitly tested for and may manifest in only partial CBM success.

A limitation to the current experiment is that the measure of comparison style was devised by the first author and has no proven psychometric properties as a trait measure of individual difference in social comparison processing. Furthermore comparison style was assessed after exposure to training material therefore, a possibility is that, training may have predicted comparison style rather than comparison style predicting response to training. A suggestion for future research is to assess social comparison orientation prospectively using a validated measure to see if individual difference on such a scale moderates the CBM outcome. A further limitation was that the stress task arguably lacked ecological validity and the measurement of emotional vulnerability was purely self-report lacking any behavioural and/or physiological correlates of stress.

Clearly more research is necessary to elucidate the underlying mechanisms operating within CBM paradigms. The current study has provided strong evidence that a form of social comparison processing is evoked within a scenario-based CBM context and influences CBM outcomes, often to the detriment of the more emotionally vulnerable individuals. An argument has been put forward that evaluative processes are restricted to less constrained social scenario-based CBM and not present in homograph, WSAP or Dot Probe methodology. However, further experimental work is needed to test this argument as there have been reported CBM failures using both homograph and dot probe procedures (e.g., Hayes, Hirsch, Krebs & Mathews, 2010 & Carlbring et al., 2012 respectively).

A final point to make is that the contradictory CBM outcomes reported in the current study mirror findings within the emotion regulation literature, for example

paradoxical effects of emotional suppression have been reported (Dalgleish, Hauer, & Kuyken, 2008; Wenzlaff & Wegner, 2000) prompting a clinical movement towards acceptance techniques rather than suppression in dealing with unwanted emotion (e.g., Hayes, Strosahl, & Wilson, 2003; Segal, Williams, & Teasdale, 2001). A goal of CBM research is to modify the manner in which individuals interpret ambiguous information in order to alleviate psychological distress. In this way CBM can be seen as another example of an emotion regulation strategy alongside existing techniques such as suppression, cognitive reappraisal, mindfulness, distraction etc. The emotion regulation literature is complex (Dunn, Billoti, Murphy, & Dalgleish, 2009) and which strategy to advise a patient to adopt within clinical practice depends on numerous factors: the individual psychological characteristics of the patient (Joormann & Gotlib, 2010), the nature of the disorder, the focus of the intended remediation (experiential, behavioural, physiological), the chosen time point within the emotion-generative process to address (Gross & John, 2003) etc. According to Rottenberg and Gross (2007, p325) there is "no one-size-fits-all solution" with different techniques only effective under specific circumstances. As such the mechanisms that contribute to CBM successes and failures, be it social comparison and/or a combination of other moderators, need to be more widely explored in the light of other relevant literatures.

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**References**

Aiken, L. S., & West, S. G. (1991). *Multiple regression:Testing and interpreting interactions*. Thousand Oaks: Sage.

Beard, C., & Amir, N. (2008). A Multisession Interpretation Modification Program:Changes in Interpretation and Social Anxiety Symptoms. . *Behaviour Research and Therapy, 46*, 1135-1141.

Beck, A. T., & Clark, D. A. (1997). An information processing model of anxiety: Automatic and strategic processes. *Behaviour Research and Therapy, 35*, 49-58.

Blackwell, S. E., & A., H. E. (2010). Modifying Interpretation and Imagination in Clinical Depression: A Single Case Series using Cognitive Bias Modification. *Applied Cognitive Psychology, 24*, 338-350.

Brosan, L., Hoppitt, L., Shelfer, L., Sillence, A., & Mackintosh, B. (2011). Cognitive bias modification for attention and interpretation reduces trait and state anxiety in anxious patients referred to an out-patient service: Results from a pilot study. *Journal of Behavior Therapy and Experimental Psychiatry, 42*, 258-264.

Browning, M., Grol, M., Ly, V., Goodwin, G. M., Holmes, E. A., & Harmer, C. (2011). Using an Experimental Medicine Model to Explore Combination Effects of Pharmacological and Cognitive Interventions for Depression and Anxiety. *Neuropsychopharmacology: Official Publication Of The American College Of Neuropsychopharmacology, 36*, 2689-2697.

Carlbring, P., Apelstrand, M., Sehlin, H., Amir, N., Rousseau, A., Hofmann, S. G., & Andersson, G. (2012). Internet-delivered attention bias modification training

in individuals with social anxiety disorder - a double blind randomized controlled trial. *BMC Psychiatry, 12*, 66-66.

Cohen, J., Cohen, P., & West, R. R. (2003). *Applied Multiple Regression/Correlation Analysis for the Behaviour Sciences*. London: Lawrence Erlbaum.

Dalgleish, T., Hauer, B., & Kuyken, W. (2008). The Mental Regulation of Autobiographical Recollection in the Aftermath of Trauma *Current Directions in Psychological Science, 17*, 259-263.

Dunn, B. D., Billoti, D., Murphy, V., & Dalgleish, T. (2009). The Consequences of Effortful Emotion Regulation When Processing Distressing Material: A Comparison of Suppression and Acceptance. *Behaviour Research and Therapy, 47*, 761-773.

Gibbons, F. X., & Bunnk, B. P. (1999). Individual Differences in Social Comparison: Developmentof a Scale of Social Comparison Orientation. *Journal of Personality and Social Psychology, 76*, 129-142.

Grey, S., & Mathews, A. (2000). Effects of training on interpretation of emotional ambiguity. *The Quarterly Journal Experimental Psychology, 53A*, 1143-1162.

Gross, J. J., & John, O. P. (2003). Individual Differences in Two Emotion Regulation Processes: Implications for Affect, Relationships, and Well-Being. *Journal of Personality and Social Psychology, 85*, 348-362.

Hakamata, Y., Lissek, S., Bar-Haim, Y., Britton, J. C., Fox, N. A., Leibenluft, E., . . . Pine, D. S. (2010). Attention Bias Modification Treatment: A Meta-Analysis Toward the Establishment of Novel Treatment for Anxiety. *Biological Psychiatry, 68*, 982-990.

Hallion, L. S., & Ruscio, A. M. (2011). A meta-analysis of the effect of cognitive bias modification on anxiety and depression. *Psychological Bulletin, 137*, 940-958.

Hayes, S., Hirsch, C. R., Krebs, G., & Mathews, A. (2010). The effects of modifying interpretation bias on worry in generalized anxiety disorder. *Behaviour Research and Therapy, 48*, 171-178.

Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (2003). *Acceptance and Commitment Therapy: An Experiential Approach to Behaviour Change*. New York: Guilford Press.

Hirsch, C. R., Mathews, A., & Clark, D. M. (2007). Inducing an interpretation bias changes self-imagery: A preliminary investigation. *Behaviour Research and Therapy, 45*, 2173-2181.

Holmes, E. A., Coughtrey, A. E., & Connor, A. (2008). Looking at or through rose-tinted glasses? Imagery perspective and positive mood. *Emotion, 8*, 875-879.

Holmes, E. A., Lang, T. J., & Shah, D. M. (2009). Developing interpretation bias modification as a 'cognitive vaccine' for depressed mood - Imagining positive events makes you feel better than thinking about them verbally. *Journal of Abnormal Psychology, 118*, 76-88.

Holmes, E. A., Mathews, A., Dalgleish, T., & Mackintosh, B. (2006). Positive Interpretation Training: Effects of Mental Imagery Versus Verbal Training on Positive Mood. *Behavior Therapy, 37*, 237-247.

Joormann, J., & Gotlib, I. H. (2010). Emotion Regulation in Depression: Relation to Cognitive Inhibition. *Cognition and Emotion, 24*, 281-298.

Koster, E. H. W., Fox, E., & MacLeod, C. (2009). Introduction to the special section on cognitive bias modification in emotional disorders. *Journal of Abnormal Psychology, 118*, 1-4.

Mackintosh, B., Mathews, A., Yiend, J., Ridgeway, V., & Cook, E. (2006). Induced Biases in Emotional Interpretation Influence Stress Vulnerability and Endure Despite Changes in Context. *Behaviour Therapy, 37*, 209-222.

MacLeod, C., & Mathews, A. (2012). Cognitive Bias Modification Approaches to Anxiety. *Annual Review of Clinical Psychology, 8*, 189-218.

MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G., & Holker, L. (2002). Selective attention and emotional vulnerability: assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology, 111*, 107-123.

Markman, K. D., & McMullen, M. N. (2003). A reflection and evaluation model of comparative thinking *Personality and Social Psychology Review, 7*, 244-267.

Mathews, A., & Hertel, P. T. (2011). Cognitive Bias Modification:Past Perspectives, Current Findings, and Future Applications. *Perspectives on Psychological Science, 6*, 521-536.

Mathews, A., & Mackintosh, B. (1998). A Cognitive Model of Selective Processing in Anxiety *Cognitive Therapy and Research, 22*, 539-560.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology, 109*, 602-615.

Mathews, A., Ridgeway, V., & Cook, E. (2007). Inducing a benign interpretation bias reduces trait anxiety. . *Journal of Behavior Therapy and Experimental Psychiatry, 38*, 225-236.

Murphy, R., Hirsch, C. R., Mathews, A., Smith, K., & Clark, D. M. (2007). Facilitating a benign interpretation bias in a high socially anxious population. *Behaviour Research and Therapy, 45*, 1517-1529.

Mussweiler, T. (2001). 'Seek and ye shall find': antecedents of assimilation and contrast in social comparison. *European journal of social psychology, 31*, 499-509.

Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interaction effects in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational and Behavioural Statistics, 31*, 437-448.

Rottenberg, J., & Gross, J. J. (2007). Emotion and Emotion Regulation: A Map for Psychotherapy Researchers *Clinical Psychology: Science and Practice, 14*, 323-328.

Salemink, E., van den Hout, M., & Kindt, M. (2009). Effects of positive interpretive bias modification in highly anxious individuals. *Journal of Anxiety Disorders, 23*, 676-683.

Segal, Z. V., Williams, M. G., & Teasdale, J. D. (2001). *Mindfulness- Based Cognitive Therapy for Depression: A New Approach to Preventing Relapse*. New York: Guildford Press.

Standage, H., Ashwin, C., & Fox, E. (2009). Comparing visual and auditory presentation for the modification of interpretation bias. *Journal of Behavior Therapy and Experimental Psychiatry, 40*, 558-570.

Standage, H., Ashwin, C., & Fox, E. (2010). Is manipulation of mood a critical component of cognitive bias modification procedures? *Behaviour Research and Therapy, 48*, 4-10.

Suls, J., & Wheeler, L. (2007). Psychological Magnetism: A Brief History of Assimilation and Contrast in Psychology. In D. A. Stapel & J. Suls (Eds.),

*Assimilation and Contrast in Social Psychology*. East Sussex: Psychology Press.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using Multivariate Statistics*. Boston: Allyn & Bacon.

Van der Zee, K., Bunnk, B. P., & Sanderman, R. (1998). Neurotism and Reactions to Social Comparison Information Among Cancer Patients. *Journal of Personality, 66*, 176--194.

Wenzlaff, R. M., & Wegner, D. M. (2000). Thought suppression. *Annual Review of Psychology, 51*, 59-91.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1988). *Cognitive Psychology and Emotional disorders*. Chichester: Wiley.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1997). *Cognitive psychology and emotional disorders*. Chichester: John Wiley & Sons.

Wilson, E., MacLeod, C., Mathews, A., & Rutherford, E. (2006). The causal role of interpretative bias in anxiety reactivity. *Journal of Abnormal Psychology, 115*, 103-111.

Table 1. Means (standard deviations) and correlations between study variables [a].

| Variables | Mean (SD) | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1. CBM group[b] | - | - | | | | | |
| 2. Comparison Style | 15.60 (4.67) | -.21* | - | | | | |
| 3. Interpretation Bias | 0.30 (1.07) | -.26** | .02 | - | | | |
| 4. Valenced Contrast | 17.22 (6.39) | .11 | -.11 | .42** | - | | |
| 5. Pre-CBM Mood | 9.32 (5.63) | -.03 | .00 | -.23** | -.28** | - | |
| 6. Post-CBM Mood | 10.85 (6.14) | .09 | .21** | -.30** | -.32** | .68** | - |
| 7. Emotional Vulnerability | 16.37 (6.97) | -.02 | -.05 | -.29** | -.37** | .45** | .63** |

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

[a] higher values = more assimilative comparison style, more positive interpretation bias, more positive valenced contrast, and higher negative mood and emotional vulnerability.

[b] CBM training coded 1= positive training, 2= negative training.

Figure 1.

Interaction plot illustrating the effects of CBM training on interpretation bias according to comparison style.

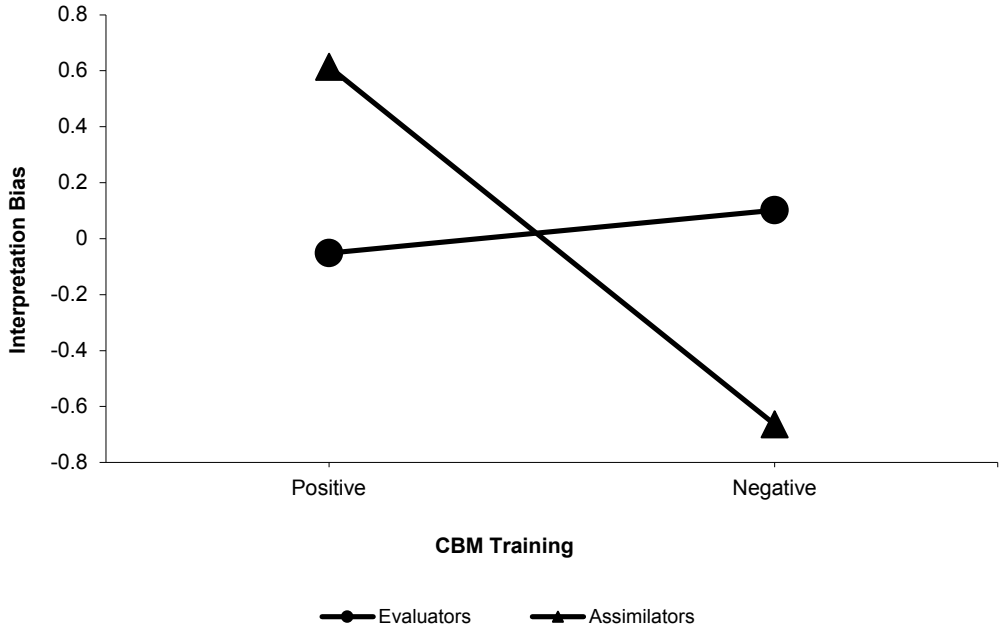

Figure 2.

Interaction plot illustrating the effects of CBM training on valenced contrast according to comparison style

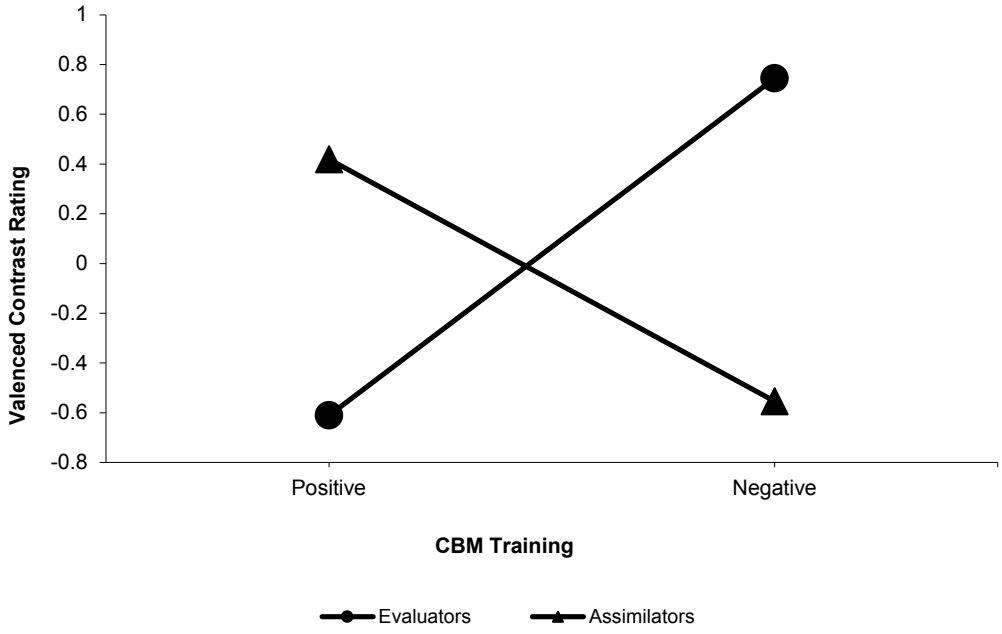

Figure 3. Interaction plot illustrating the effects of CBM training on emotional vulnerability according to comparison style