Gender and Attention in Depression: Examining the Role of Modified Attention in Shifting Mood and Cognitions

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Abstract

The modified selective attention hypothesis proposes that individuals showing signs of depression will fail to disengage from negative stimuli in the environment. Some research suggests that depressive symptoms decrease once this bias is "corrected". Thus, attention may play a causal and/or sustaining role in depression. The present study examined whether a) attention can be modified in a student sample to induce a negative attentional bias; and b) this trained attentional bias will be associated with negative shifts in mood and cognitions. A sample of undergraduates (*N* = 112) were recruited and asked to complete questionnaires designed to measure depressive symptoms, mood, and negative thoughts toward the self. Participants were then randomly assigned to either an attend-negative (*n* = 60) or a no-training control condition (*n* = 52), and asked to complete a computer task. In the attend-negative condition, the computer task (dot probe) was designed to elicit a transient attentional bias toward negative stimuli. After the completion of this task, participants completed the questionnaires a second time. Participants in the experimental condition evidenced higher negative attentional bias scores in comparison to control participants. Further, females demonstrated more negative attention at the end of the training relative to males. Repeated measures ANOVAs further found that following the completion of the computer task, both groups evidenced a negative shift in mood. These results must be interpreted with caution given that baseline attentional biases were not measured in this study. Replication and extension of the findings of this study is necessary.

Keywords: Attention modification; depression; gender; cognitive bias.

Gender and Attention in Depression: Examining the Role of Modified Attention in Shifting Mood and Cognitions

The cognitive theory of depression postulates that individuals possess cognitive entities, or schemas, that are responsible for the organization and distillation of incoming information (Beck, 1967; Beck, Rush, Shaw, & Emory, 1979). Indeed, the *Selective Attention* hypothesis of the cognitive model of depression postulates that in the bouts of depression, individuals will attend to and/or fail to disengage from negative stimuli in comparison to other stimuli in the environment (Clark, Beck, & Alford, 1999). Early research of this hypothesis failed to find differences between depressed individuals and non-depressed controls in their orientation toward negative material (Mogg, Bradley, & Williams, 1995). In a refinement of the selective attention hypothesis, Williams, Watts, MacLeod, and Mathews (1997) proposed that individuals are not characterized by biases in the orientation of attention, but that they exhibit the biases in post-attentional elaboration, or disengagement from emotional stimuli. A number of studies have examined this reformulated hypothesis in depressed patients and results from such studies have generally been supportive (Gotlib, Krasnoperova, Yue, & Joormann, 2004; Joormann, Talbot, & Gotlib, 2007). Most of such studies employ an attentional allocation/spatial cuing or dot-probe paradigms (MacLeod, Mathews, & Tata, 1986), in studying attention biases (see Fan, McCandliss, Sommer, Raz, & Posner, 2002, for an overview of the literature). In the dot-probe task, individuals are required to identify the location of a target (usually a dot) that replaces either a neutral or emotional stimuli. For instance, two words or faces are presented simultaneously. One of such words or faces is neutral while the other is sad. Participants are asked to identify the location of the dot that replaces one of the words or faces. Response latencies to the probe are taken to indicate the allocation of attention to the spatial position of the stimuli. Generally, the “selected” (i.e., the one attended to) cue, which is presented prior to the probe, is facilitative (i.e., enhances detection time) if it is in the same location as the probe, and it is impeding (i.e., decreases detection time) if it is shown in the opposite location of the probe.

Researchers have proposed that direct manipulation of attentional bias in psychopathology would lead to a diminution of symptoms. To date, most of such attention modification studies have been conducted for anxiety and substance abuse disorders. In substance abuse research, specifically alcohol, results of such attention retraining trials have been mostly unsupportive (e.g., Field & Eastwood, 2005; Schoenmakers, Wiers, Jones, Bruce, & Jansen, 2007). Results have generally been more supportive of attention retraining in the realm of anxiety (Amir, Beard, Burns, & Bomyea, 2009; Amir, Weber, Beard, Bomyea, & Taylor, 2008; Hazen, Vasey, & Schmidt, 2009; Heeren, Reese, McNally, & Philippot, 2012). An early study by MacLeod, Rutherford, Campbell, Ebsworthy and Holker (2002) employed a non-clinically anxious student sample and found that while a trained attentional bias toward neutral stimuli was induced, the trained attentional bias did not result in a diminution of anxiety symptoms. It may be that the study’s null finding is partially accounted for by a sampling artifact. MacLeod and colleagues employed a student sample that scored in the middle third of the State-Trait Anxiety Inventory rather than a clinically anxious sample that would likely have evidenced an existing attentional bias toward negative or threatening stimuli (cf., Clark et al., 1999).

An oft forgotten piece of the MacLeod et al. (2002) study is that these researchers also manipulated participants’ attention toward negative stimuli (i.e., attend negative group) by creating a strong contingency between the probe and negative, anxiety-provoking stimuli (i.e., the probe in this condition replaced the negative stimuli more often than the neutral stimuli).

These researchers found that, even when this manipulation was successful, the attentional retraining had no effect on mood. However, following the attention-retraining task, participants completed an anagram stress task where both the neutral and negative attention-retraining groups exhibited an increase in negative mood. To induce greater stress, participants were further informed that an introductory university class would watch the videos of individuals who performed either particularly skillfully or poorly (see Mogg, Matthews, Bird, & Macgregor-Morris, 1990). Of importance, the negative attention-retraining group evidenced a greater increase in negative mood relative to the neutral attention-retraining group. This pattern of results suggests that the attention retraining procedure was successful and that attention may play a causal role in eliciting negative mood when faced with a stressful life event. Indeed, Gotlib and Joormann (2010) have suggested that attention plays a causal and/or sustaining role in depression.

Attention Modification in Depression

An emerging body of evidence suggests that attentional retraining can reduce depressive symptoms in both student (Haeffel, Rozek, Hames, & Technow, 2011), and clinical samples (Browning, Holmes, Charles, Cowen, & Harmer, 2012). For example, Wells & Beevers (2010) attempted to examine the effects of attention modification among individuals showing signs of depression. Similar to findings obtained by MacLeod and colleagues (2002), dysphoric individuals assigned to the attention training condition, whereby their attention was “corrected” toward neutral material, exhibited a significantly greater decrease in depressive symptoms from baseline to follow-up. Despite the encouraging results reported by Wells and Beevers (2010), the study suffered from a number of limitations, which include but are not limited to small sample size (N = 34), and unorthodoxly high stimuli presentation times (3000-4000 msec). In addition, Baert, De Raedt, Schacht, and Koster (2010) found that attentional training was successful in reducing depressive symptoms for mildly dysphoric students. When individuals exhibited moderate to severe depression, the attentional retraining actually increased the severity of their depressive symptoms. These findings suggest that the severity of depression at baseline likely moderated the relationship between trained adaptive attentional biases and the amelioration of depressive symptoms.

A more recent study (Kruijt, Putman, & van der Does, 2013), examined the effects of attentional retraining in a sample of 30 dysphoric students. The study included six versions of attentional retraining that varied on training direction (i.e., neutral towards positive stimuli or sad towards neutral stimuli) and stimulus duration (e.g., 500 ms, 3000 ms, etc.). The authors found that trained attentional biases were rarely achieved and when they were, the bias did not generalize to stimuli external to the training environment. The authors concluded that none of the tested attentional retraining paradigms were likely to reduce symptoms of depression. Kruijt and colleagues' study was limited by a small sample size (*N* = 30) and the absence of a control group, which may partially account for the discrepancy between their findings and those of Baert and colleagues (2010).

Further, the above summarized trials varied widely in their methodology. For instance, some have used only one session in the retraining of attentional bias (e.g., Amir et al, 2008; Dandeneau, Baldwin, Baccus, Sakellaropoulo, & Pruessner, 2007), while others used four (Wells & Beevers, 2010; Kruijt et al., 2013), eight (Amir et al., 2009) and yet others used 28 sessions (Browning et al., 2012). Stimulus duration was further variable across the studies [e.g., 3000-4000 msec (Wells & Beevers, 2010); 500 ms to 3000 ms (Kruijt et al., 2013), and 500/1000 ms (Browning et al., 2012)]. In addition, and as stated above, although the majority of research on attention modification to date has employed a dot-probe computerized task, some researchers have used different techniques for attention modification. Thus, replication and identification of mechanisms of action in this line of research remains difficult.

Gender Differences in Attention

Despite a vast body of literature suggesting systematic differences between men and women in the prevalence of and correlates of depression, gender differences have not been consistently examined in the attention literature. There is evidence to suggest that the extent to which individuals are susceptible to attentional modification varies between genders. More specifically, it is likely that women have a more trainable attentional bias toward negative stimuli relative to men. This assertion is grounded in three bodies of literature: studies of the epidemiology of depression, response styles theory, and information processing studies. First, the preponderance of depression in women is a widely cited and robust finding in the depression literature (Kessing, Andersen, & Mortensen, 1998; Kessler, Berglund, Demler, Jin, Koretz, Merikangas…, 2003). Lifetime prevalence rates range from 10 to 25% for women and from 5 to 12% for men (American Psychiatric Association, 2000). As such, women are approximately three times more likely to develop depression relative to men (American Psychiatric Association, 2013). Second, Nolen-Hoeksema's (1991; Butler & Nolen-Hoeksema, 1994; Nolen-Hoeksema & Larson, 1998; Nolen-Hoeksema, Morrow & Fredrickson, 1993; Nolen-Hoeksema, Parker & Larson, 1994) response styles theory was developed to elucidate the relationship between gender and depression. The model posits that women are more likely to engage in ruminative responses, which serve to prolong and intensify depressed mood, whereas men are more likely to engage in distraction thereby decreasing the length and severity of a depressive episode (Bagby, Rector, Bacchiochi, & McBride, 2004; Hankin & Abramson, 2001; Just & Alloy, 1997; Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Research has thus demonstrated that rumination is a cognitive vulnerability factor for depression and women's primary response to depressed mood.

In addition, a number of authors have suggested that biased attentional processing towards negative information is more prevalent in individuals who have a tendency to engage in rumination (Davis & Nolen-Hoeksema, 2000; Gotlib & Joormann, 2010; Whitmer & Gotlib, 2013). It has further been posited that difficulties disengaging attention from negative material may play a fundamental role in the tendency to engage in rumination (Donaldson, Lam, & Mathews, 2007; Siegle, Steinhauer, & Thase, 2004). Rochat, Billieux, and van der Linden's (2011) findings revealed that deficits in source switching, the ability to direct one's attention from self-referential cognitions to information in one's environment, mediates the relationship between dysphoria and rumination. The authors postulate that the inability to successfully disengage attention from negative information likely activates negative self-schemas that serve to perpetuate dysphoric states. Given women's tendency to engage in rumination, it is also likely then that they will evidence distinct and greater attentional biases for negative information relative to their male counterparts. Thus, women are likely more vulnerable to attentional training paradigms that direct attention toward negative, depressive material.

Finally, a growing literature has begun to delineate gender differences in information processing. For example, Sänger Schneider, Beste, and Wascher (2012) findings revealed that women exert stronger consolidation of information compared to men. Moreover, Sass, Heller, Stewart, Silton, Edgar, Fisher, and Miller (2010) found gender specific differences in the processing of emotional material. Specifically, anxious females showed greater processing of emotional stimuli at the task's inception relative to their male counterparts, who evidenced a processing bias towards the end of the task. In contrast, female controls evidenced a preferential processing bias for stimuli presented near the conclusion of the task while their male counterparts showed greater processing at the task's onset. Thus, gender evidently moderates the type of processing bias exhibited by both anxious individuals and healthy controls. Gender differences in attentional processes are also present in individuals with high trait anxiety (Tan, Ma, Gao, Wu, & Fang, 2011). Tan and colleagues (2011) found that women evidenced difficulty directing their attention away from threat-related stimuli, while their male counterparts exhibited a bias towards avoiding the stimuli. Together these studies suggest that gender significantly influences the presence and type of attentional processing biases.

Attention Manipulation towards Negative Stimuli in Healthy Populations

Unfortunately, only one study to date, has manipulated the attention of normal, non-dysphoric individuals toward negative, depressive material (Fox, Zougkou, Ridgewell, & Garner, 2011). The authors found that changes in attentional bias, that is either towards positive or depressive stimuli, was moderated by the serotonin transporter gene whereby participants with lower expressions of the gene demonstrated stronger attentional biases, independent of the training direction, relative to participants evidencing higher expressions. Moreover, a study by Sjöberg, Nilsson, Nordquist, Öhrvik, Leppert,Lindström…et al. (2006) found that depressive symptoms only developed in women exhibiting polymorphism in the serotonin transporter gene, whereas men carrying the same polymorphism were protected from developing depression.

While the authors of the above mentioned studies interpreted their findings within a biomedical framework, the present study is situated in the literature on attention and cognitive biases from a cognitive behavioral viewpoint. As mentioned, only one study to date modified the attention of an unselected student sample toward negative, depressive material. Thus, the present procedure can contribute significantly to the depression literature. More specifically, since depression is believed to exist on a continuum (Clark et al., 1999; Flett, Vredenberg, & Krames, 1997; Klein, 2008), understanding the reaction of healthy individuals to manipulations of attention has the potential to inform theories and therapies of this pernicious disorder. Further, and in light of the dimensional nature of depression, evidence for the causal/maintaining role of attention can be gathered if depressive correlates (e.g., mood and cognitions) are found to increase simultaneously with the experimental manipulation of attention.

As to extend earlier research, this study recruited university students and employed the dot-probe paradigm whereby a strong contingency is created between a probe and negative stimuli (attend-negative condition). The control group underwent a similar procedure, the probe in the control condition, however, had an equal chance of replacing neutral/nondysphoric and negative stimuli (no-training control condition). The present study then examined changes in mood and cognitions in response to such attentional manipulation. As expected from research on depression, response styles theory, and information processing biases (see Clark et al., 1999; Ingram, Miranda, & Segal, 1998, for review), we hypothesized that, after the experimental manipulation, individuals in the experimental condition would exhibit a negative attentional bias (i.e., on average, they will notice the dot faster if it replaced a sad face/word, and slower if it replaced the neutral/nondysphoric face/word) than individuals in the control condition. Further, we hypothesized that the effects of the attentional manipulation would be moderated by gender, such that, in comparison to males, females in the experimental condition would demonstrate a greater trained attentional bias for negative information. Of importance, this hypothesis was not generated a priori, and is therefore exploratory in nature. Finally, we hypothesized that individuals in the experimental condition will exhibit a significant reduction in mood and increase in negative cognitions about self.

Method

Participants

Undergraduate students completing courses in psychology were recruited for the purposes of this research. The participants were recruited through the University of Calgary, Department of Psychology's Research Participant System, and thus were offered partial course credit for their participation. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study. This study was approved by the University of Calgary's Conjoint Faculties Research Ethics Board.

Power Analysis

As mentioned above, this is the second investigation to date to attempt the modification of attention in an unselected sample to induce a dysphoria/depressive-like bias. As such, it is difficult to estimate the optimal sample size, given the paucity of studies in this area of research. Given the centrality of attention bias research in depression to the current investigation, we chose to calculate sample size for this study based on the effects found between dysphoric/depressed individuals and healthy controls on measures of attention bias in dot probe paradigms. Taking this literature into consideration (Peckham, McHugh, & Otto, 2010), the effect size upon which the current power analysis is calculated is $d = 0.52$, or medium effect. According to Cohen (1992), with a medium effect size and an alpha level of .05, a two-group analysis requires 64 participants for a power of .80. As such, it is estimated that 60-65 participants per group, or a total N of 120-130, is the optimal sample size to detect the hypothesized effects.

Measures

The Center for Epidemiologic Studies Depression Scale – The Center for Epidemiologic Studies Depression scale (CES-D; Radloff, 1977) is a measure that was designed to assess current levels of depression in the general population. This 20-item instrument uses a “0” to “3” Likert-type scale, by which participants indicate how much they endorsed statements such as “I felt everything I did was an effort” and “I felt depressed” during the past week. Scores on the CES-D range from 0 to 60, and higher scores indicate greater distress. A number of studies have demonstrated the psychometric soundness of this instrument among university populations. For example, Devins, Orme, Costello, Binik, Frizzell and Stam (1988) found that when the instrument was administered to a sample of undergraduate students, it achieved a Cronbach’s Alpha and test-retest reliabilities (.85 and .32-.67, respectively) close to those originally derived by Radloff (1977).

The Visual Analogue Mood Scale – The Visual Analogue Mood Scale (VAMS; Luria, 1975) provides a measure of individuals’ mood states. It consists of a horizontal line where the ends represent extremes of a particular mood: the leftmost end is marked “0” or – “Very Sad” while the right extreme is labelled “100” or – “Very Happy.” Respondents draw a dash on the line at the place that they believe represents their current mood state. Ratings are obtained by measuring the distance between the respondent’s dash and the extremes of the line. The VAMS has been shown to have good test-retest reliability (ranging from $r = .59$ to $r = .80$) in a clinical sample (Luria, 1975).

The Cognitive Triad Inventory – The Cognitive Triad Inventory (CTI; Beckham, Leber, Watkins, Boyer, & Cook, 1986) is a self-report instrument designed to assess the frequency and intensity of negative thoughts toward self, world and future. The measure consists of 36 items (6 of which are filler, non-scored items) and, given its threefold aim of assessment, three subscales each assessing one aspect of Beck’s (1967; Beck et al., 1979) cognitive triad. For the purposes of this investigation, only the self subscale of the CTI (CTI-S) will be used. The CTI-S is comprised of 10 items which are scored on a 7 point Likert scale ("1" or "Totally disagree" to "7" or "Totally agree"), and thus scores may vary from 10-100. With the reversals of positively worded items, higher scores are indicative of a higher frequency of negative thoughts toward the self. The CTI-S has demonstrated good internal consistency ($\alpha = .91$) when used with a sample of depressed individuals (Beckham et al., 1986). Furthermore, Beckham et al. (1986) found that the CTI-S demonstrated adequate construct validity, as it was found to positively correlate with measures of similar constructs. Recently, the scale has shown good reliability and validity when used with an undergraduate sample (Beshai, Dobson, & Adel, 2012).

Attention Training Materials

A set of 80 picture stimuli consisting of 40 sad and 40 neutral faces were chosen from the MacArthur Network Face Stimuli Set (http://www.macbrain.org/ faces/index.htm), developed by The Research Network on Early Experience and Brain Development. This network consists of 646 colored and validated photographs of different facial expressions. The 40 picture pairs were of 40 actors (19 female and 21 male) of varying ethnic origins, with each actor depicting a sad and neutral face. Each presented pair of pictures was matched according to actor and the selected pictures were the closed-mouthed versions of both the sad and neutral expressions.

Secondly, a set of 40 word pairs (N = 80 words) was selected from the Myers word list (Myers, 1980; see Appendix A). The Myers word list is a large database comprised of 400 words that were normed along a number of dimensions (e.g., pleasure, depression, mania, emotionality, frequency, etc.). This list has been used in other published works (for example, see Dobson & Shaw, 1987). The chosen list of words consisted of 40 sad and 40 nondysphoric words which were matched for frequency and emotionality. Further, the word categories did not differ in mean letter length (See Table 1 for a summary of means and standard deviations of depression, pleasure, frequency, length and emotionality, and t-test statistics examining differences between the word categories on these dimensions).

Attention Training Task

All participants in the study partook in a computerized attention-training or no-training control task. For these tasks, participants were seated 60 centimeters from a 21-inch computer monitor. After participants were introduced to the task and given verbal instructions, they were left alone in the room to complete the procedures. In addition to the verbal instructions, both procedures (attention-training and control) begun with detailed on-screen instructions followed by 8 non-scored, practice trials. All trials commenced with the presentation of a fixation cross for 1000 msec that signaled the imminence of the picture or word pairs. The stimulus pair was shown for 1000 msec and was displayed against a black background on the left and right sides of the computer screen. The stimulus pair then disappeared and a dot, replacing one of the pictures or words presented earlier, appeared on either side of the screen.

The scored task commenced after the practice trials. The scored task consisted of a total of 640 trials divided into eight 80-trial blocks (40 word pairs and 40 picture pairs). The first seven blocks (560 trials) consisted of the “training” or “control” trials, while the final 80 trials consisted of the measurement/ attentional bias detection block. Each of the 80-trial blocks consisted of 5, 16-trial sub-blocks. Such sub-segments were organized so that both picture types (sad and neutral) and both word types (sad and nondysphoric) were equally shown on the left and right sides of the screen.

Depending on the condition, the probe in the first seven blocks (560 trials) was made to replace the sad stimuli 75 percent of the time (attention-negative condition) or 50 percent of the time (no-training control condition). The final block of 80 trials had no contingency (i.e., the probe equally replaced sad and neutral/nondysphoric stimuli) for both conditions, and was designed to measure modified or unmodified attentional bias.

Procedure

After offering their consent, all participants were given the pre-attention training package, consisting of a demographic information form, CES-D, VAMS, and CTI-S. A random number generator was used to allocate participants to the experimental or control conditions. Specifically, 50 integers were randomly selected from “1” to “100”, and these 50 numbers were assigned to participants in the control condition. Participants were then numbered sequentially based upon when they signed up for the study (e.g., participant in time slot 1 was numbered “01”, participant in time slot 2 was numbered “02”, etc.).

Based on this allocation procedure, participants were either assigned to the experimental or control conditions. Those in the experimental condition were given the attend-negative attention task, while those in the control condition were given the no-training control task. After the completion of the task, all participants were asked to complete the post-attention training package, which consisted of the VAMS and CTI-S. After this, all participants were thoroughly debriefed and thanked for their participation. Additionally, participants in the experimental condition were offered the opportunity to complete an attend-positive attentional correction task at the end of the study, in which the probe replaced a positive/happy stimulus 75 percent of the time.

Data Analysis Plan

After data cleaning, all the dependent variables were evaluated for normality graphically and by examining skewness and kurtosis. With the exception of scores on time 1 of the CTI, histograms and Normal Q-Q plots generated for the dependent variables did not appear to significantly deviate from what is expected of a normal distribution. Skewness ranged from -.95

(VAMS at time 1) to .48 (DAS) all within the suggested range of +/- 1 for normal distributions (Tabachnick & Fidell, 2007). With the exception of scores on the CTI at time 1 (3.11), all kurtosis statistics for the dependent measures were within the range expected of a normal distribution.

After obtaining descriptive statistics for demographic variables, we tested the effectiveness of the random assignment procedure. As such, a 2 (Condition) by 2 (Gender) ANOVA was conducted in order to examine systematic differences between participants in both conditions after assignment. To examine the first hypothesis regarding condition and gender differences on modified attention scores, we subjected this variable to a 2 (Condition) by 2 (Gender) ANOVA. Attention bias scores were calculated using the procedure outlined in Mogg et al. (1995) using the formula, ½ [(RpLe – RpRe) + (LpRe - LpLe)].

To examine the second hypothesis concerned with changes in mood and negative self-referent thoughts, we subjected the scores to a 2 (Condition) by 2 (Gender) by 2 (Time) repeated measures ANOVA. Also to test this hypothesis, correlational analyses were conducted in order to obtain coefficients for the association of modified attention bias and CTI and VAMS in time 2.

Results

Demographic Information and Data Cleaning

A total of 126 participants partook in the study. Participants who failed to complete at least 90% of the data points, their responses deviated considerably from other participants, and/or made errors on 10% or more of the data were discarded from further analyses. For example, an error on the dot probe attention training task was defined as either misidentification of the location of the dot and/or having a reaction time of less than 100 msec or more than 1000 msec on each of the trials. With the above criteria, a total of 14 (11.1%) participants were excluded from further analyses.

The remaining sample of 112 participants was comprised of 60 (53.6%) males and 52 (46.4%) females. The mean age of the total sample was 22.15 (*SD* = 5.82). Table 2 summarizes pertinent demographic information stratified by condition.

Random Group Assignment

After randomization, the groups did not differ significantly on any of the demographic variables (see Table 3 for a summary of means and standard deviations). A two-way (Gender X Condition) analysis of variance (ANOVA) was conducted to detect statistical differences between males and females in the experimental and control conditions on the employed primary measures. There were no significant main effects for condition, $F(1, 108) = 1.65$, $p > .05$, or gender, $F(1, 108) = .01$, $p > .05$, and no interaction effect, $F(1, 108) = .50$, $p > 05$, for scores on the CES-D. Further, there were no significant main effects for condition, $F(1, 108) = .13$, $p > .05$, and gender, $F(1, 108) = .19$, $p > .05$, and no interaction effect, $F(1, 108) = .58$, $p > .05$, for scores on CTI-S in time 1. Finally, there were no significant main effects for condition, $F(1, 108) = .03$, $p >.05.$, or gender, $F(1, 108) = .72$, $p > .05$, or a significant interaction, $F(1, 108) = .93$, $p > .05$, for scores on the VAMS in time 1.

Post-Training of Attention

A two-way ANOVA was conducted to test the first two main hypotheses of the current study. Specifically a 2 (Gender: Male, Female) by 2 (Condition: Experimental, Control) ANOVA was carried out to examine gender differences between the experimental and control conditions' post-training of attention. Levene's test for the heterogeneity of variance was not significant, $p > .05$. This analysis revealed a significant interaction, as female participants in the experimental condition (*M* = 222.22; SD = 378.70) demonstrated higher trained negative attentional bias scores than male participants in this condition (*M* = -9.64; SD = 423.59), $F(1, 108) = 4.48$, $p < .05$ (partial $\eta^2 = .04$). In terms of main effects, the ANOVA revealed a significant main effect of condition, wherein the experimental group demonstrated a greater attentional bias towards negative information than the control group, $F(1, 108) = 6.45$, $p = .01$ (partial $\eta^2 = .06$). The main effect of gender was not significant, $F(1, 108) = .45$, $p > .05$.

Mood and Cognitive Changes

Table 2 summarizes the means and standard deviations of the main outcome measures, stratified by gender, condition and time. A repeated measures three-way (Time x Condition x Gender) ANOVA was conducted to test the condition and gender differences on mood and cognitions (VAMS and CTI-S, respectively) before and after the experimental manipulation. This analysis revealed a main effect for time on the VAMS, $F(1, 108) = 6.73$, $p = .012$ (partial $\eta^2 = .06$), wherein both groups reported a lower (i.e., sadder) mood in the second administration of the instrument. There were no significant main effects of gender or condition, and no significant interaction effects, $p > .05$. Further, the analyses revealed no significant main effects for time, condition, or gender, and no interaction effects for scores on the CTI-S, $p > .05$.

A correlational analysis was conducted in order to examine the relationship between modified attention bias scores and VAMS and CTI scores in time 2. This analysis revealed a significant and positive relationship between trained attention bias and VAMS scores in time 2, $r = .23$, $p < .05$. There was no significant relationship between modified attention and CTI scores in time 2, $r = -.069$, $p > .05$.

Discussion

The current study is the second to date to induce a dysphoria-like trained attentional bias among a group of unselected participants and examine the effects of this induction on self-referent cognitions and transient mood. One of the primary results of this study, and in line with the first hypothesis, was that the experimental group evidenced a greater bias in their trained attention toward negative material. The trained attentional bias cannot be explained by demographic or symptom differences between the groups, given that no such differences were found between the groups as a result of the random assignment procedure. Second, and in line with predictions, which were not generated a priori, gender moderated the effects of attentional manipulation; females exhibited a significantly greater attentional bias score at the end of the training relative to males. Last, analyses revealed that a negative shift in mood (as measured by the VAMS) was observed for both groups across time. This was corroborated by the correlational analysis that revealed a significant relationship between modified attention and VAMS scores in time 2. It is difficult to interpret whether this represents a shift or bolstering of the association between these constructs post-training of attention, given that baseline attention was not measured. It is possible that the presentation of negative words and faces during the training/control phase of the study functioned as a negative prime for both groups, which may explain this shift in mood (Segal & Ingram, 1994; Gotlib & Joormann, 2010). Further, in the debriefing stage, a number of participants indicated that they found the study to be long, which may have played a role in the mood shift observed across conditions. Previous research (e.g., Malkovsky, Merrifield, Goldberg, & Danckert, 2012) has found links between boredom and mood, and as such, the drop in mood may be accounted for by participants' experience of boredom.

The presence of a trained attentional bias in the experimental condition is a noteworthy finding. An even more novel finding was that the trained attention of females in the experimental condition was associated with a greater negative bias relative to their male counterparts. Previous researchers (e.g., MacLeod et al., 2002; Wadlinger & Isaacowitz, 2008) have demonstrated that trained attentional biases can be induced in clinical populations. Unfortunately, there is a dearth of literature that investigates gender differences in attentional biases in either healthy or clinical populations. Even when studies investigated the effect of gender on biased attention, the authors often used gender as a covariate or as part of a secondary analysis. Results from these studies have also been mixed. For example, researchers have found no evidence for an effect of gender on biased attention in a depressed sample (Peckman et al., 2010), or in an attentional bias modification study on generalized social phobia (Amir, Taylor, & Donahue, 2011). In contrast, Clasen, Wells, Ellis, and Beevers (2013) found evidence for a significant effect of gender on biased attention for fear and sad stimuli, but not happy stimuli in a sample of depressed and non-depressed individuals. Whereby men evidenced a greater bias for fear and sad stimuli relative to women. The present study's findings suggest that women may be particularly sensitive to efforts aimed at modifying attention. While the present study's findings appear to conflict with Peckman and colleagues' (2010) and Clasen et al.'s (2013) results, it is important to note that Peckman's study employed a depressed sample, and Clasen's analysis of gender did not examine between-group differences (i.e., depressed vs. healthy controls). As such, it may be that men evidencing a greater attentional bias were also from the depressed group. Moreover, Clasen's study did not attempt to induce a trained attentional bias. Therefore, findings from their study may support the present study's finding that women evidence a greater response to attentional manipulation, given that men may exhibit a higher baseline attentional bias. Of importance, Clasen and colleagues did not discuss the implications of the significant effect of gender on attentional bias in their paper.

One possible explanation for this gender difference is that women may have a trait tendency to engage in a ruminative response style, which is characterized by a repetitive pattern of self-referent cognitions, whereas men tend to employ a distractive or avoidant response (Nolen-Hoeksema, 1994). Thus, this trait ruminative response style may mediate the gender differences in post-training attention found in this study. Researchers (e.g., Davis & Nolen-Hoeksema, 2000) have further posited that there is an association between rumination, cognitive inflexibility and attentional biases. In their review of the extant literature, Whitmer and Gotlib (2013) contend that individuals who primarily respond to a negative mood by ruminating showed difficulty disengaging from negative material even after controlling for depression severity. A negative attentional bias may be further augmented by ruminators' greater cognitive inflexibility relative to their non-ruminating counterparts (Davis & Nolen-Hoeksema, 2000). Cognitive inflexibility, which in the present study can be conceptualized as difficulties inhibiting the processing of negative information, may contribute to a cognitive vulnerability to attentional manipulations. Therefore, females' tendency to habitually ruminate in response to a negative mood suggests that their gender will evidence greater attentional biases for negative information, because they will exhibit difficulties inhibiting negative stimuli. This reasoning helps elucidate the finding that females may be more vulnerable to attentional manipulations for negative stimuli than males.

The current study had several notable strengths. First, and as mentioned above, this is the second study to date to attempt the training of the attention of an unselected sample into a dysphoria-like bias. Secondly, the study utilized the most valid and reliable materials in the manipulation and examination of attention. Third, the study was theoretically sound, and thus had the potential to answer a number of questions regarding the cognitive theory of depression. In specific, the study had the potential to identify the causal role of attention in the influence of concomitant constructs of depression (e.g., thoughts, attitude and negative mood).

Nonetheless, the study suffered from a number of limitations worth noting. Although there are a number of theoretical links between depression concomitants such as thoughts, mood, attitudes, and attention, depression is a multifaceted and multidetermined disorder (Clark et al. 1999; Dobson & Dozois, 2010). As such, to suggest that a negative shift in attention will be sufficient to cause negative shifts in thoughts and mood is most likely an oversimplification. It is likely that the permanence of this attentional bias, coupled with a number of other cognitive vulnerabilities typical of depression, is the necessary ingredient for the condition (Gotlib & Joormann, 2010). Further, although the design of the current investigation was internally valid, a number of methodological issues plagued the study. For instance, the training procedure was conducted over only a single session, and this was not consistent with some of the previous attention retraining studies (e.g., Amir et al., 2009; Hazen et al., 2009; Schmidt, Richey, Buckner, & Timpano, 2009; Wells & Beevers, 2010). Previous studies (e.g., Amir et al., 2009; Wells & Beevers, 2010) have also used a diverse range of procedures to manipulate attention. At this point, and given the scarcity of these trials, it is difficult to draw conclusions about the optimal methodology to retrain or measure attention. Finally, untrained, baseline attention was never measured; therefore, it was not possible to control for baseline participant biases. As such, it was difficult to interpret the findings as a true shift in attentional bias as a result of the manipulation or whether females had a significantly higher attentional bias at baseline relative to their male counterparts. With this said, however, there was evidence to suggest that the randomization process worked as intended, and therefore, there is no reason to believe that there were systematic differences between groups in their attentional biases at baseline.

Many questions related to attention modification procedures and their relationship to depression still remain to be answered by future research. For instance, Browning, Holmes, and Harmer (2010) have proposed different mechanisms by which attention modification works to alleviate affective disorders. For instance, these researchers postulated that pharmacotherapy alters attention early in the amygdala-based appraisal system, whereas psychological interventions (e.g., dot probe procedures) operate by altering operations later in the prefrontal cortex. These models have yet to be tested in the extant literature. Furthermore, although the majority of behavioral research in this area has utilized the visual dot probe or equivalent paradigms, emergent evidence is suggesting that such paradigms are not psychometrically sound (Epp, Dobson, Dozois, & Frewen, 2012; Schmukle, 2005). As such, new, non-invasive, and practical paradigms to measure and modify attention are of order.

Furthermore, the causal mechanisms of certain cognitive features in depression still remain elusive (Ingram, Atchley, & Segal, 2011). As such, it is difficult to delineate the role of attention; to date, it is unclear whether biased attention is responsible for the etiology or maintenance of depression, or whether it is simply a correlate. Moreover, attention is not a unitary construct. As suggested by Hasher and Zacks (1988), there are likely two mechanisms involved in selective attention: Activation of and orientation toward relevant information, and disengagement from and suppression of irrelevant stimuli. Some evidence is suggesting that depression is more likely related to the latter attention deficit, as opposed to the former (Eizenman et al., 2003). Given the dramatic evidence emerging in support of attention modification procedures in the amelioration of dysphoria, more research is needed in order to understand the mechanisms by which such procedures are capable of achieving the above named findings.

The success of attentional bias modification in remediating depression symptoms has wide implications on the treatment and prevention of depression. For instance, if attention modification is found to be effective in future research, depression prevention efforts may benefit from adopting such attention retraining procedures in their protocols, especially for women. In addition, findings from the current study revealed that gender moderated attentional responses post-training. This result is significant and has important implications for the treatment of depression. For instance, it is incumbent upon researchers to assess gender differences when investigating the therapeutic value of attentional training for the treatment of depression. Hypothetically, and extrapolating from the results of the present study, women may have a more trainable attentional bias relative to men. As such, and if this hypothesis is supported in future studies, attention modification interventions may be more efficacious for females. Thus, researchers must consider the benefits of positive attentional processing training in depressed women and men independently. Future research should also develop and test attentional training paradigms capable of facilitating positive attentional biases that ameliorate depression. Further, and given that most of the attention modification procedures are computerized, such efforts may be disseminated in the form of self-administered or self-help treatment packages.

Cognitive features, such as attention, are optimally conceptualized as existing on a continuum of functioning. On one end of this hypothetical continuum is health and function; while on the other extreme end of this continuum is pathology and dysfunction. This investigation attempted to momentarily disrupt what is otherwise healthy and functional attention and then examine whether other cognitive features (mood and thoughts) would shift simultaneously in the same direction along the continuum of functioning. Noteworthy, the current study also examined gender differences in attentional bias modification. Future research that replicates the current study's significant gender effect is needed. Specifically, future research should examine gender differences in attentional biases based on hypotheses generated a priori. To our knowledge, this is one of the first studies to experimentally induce negative shifts in attention in conjecture with other cognitive features. Since depression is now widely believed to be dimensional in nature, research that examines and briefly manipulates healthy reactions and functioning is of great importance in the understanding and amelioration of this pernicious disorder.

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Table 1.

Means and Standard Deviations of Depression, Pleasure, Frequency, Length, and Emotionality/Arousal Scores of the Selected Attention Training Words, Stratified by Word Category, and Statistical Significance Between Categories on these Dimensions.

	Sad words (*N* = 40)	Nondysphoric words (*N* = 40)	Statistical Significance	
Dimension	*M* (*SD*)	*M* (*SD*)	t-statistic	Sig (*p*)
Depression	8.45 (.16)	4.2 (.50)	54.95*	< .001
Pleasure	2.05 (.58)	5.11 (2.29)	-8.16*	< .001
Frequency	.26 (.46)	.22 (.35)	.49	= .62
Letter Length	7.65 (2.21)	8.10 (2.28)	-.99	= .32
Emotionality/Arousal	5.63 (1.17)	5.50 (1.51)	.58	= .56

Note. * Significant at the .01 level

Table 2.

Summary of Participant Demographics, Stratified by Condition.

Demographic Variable	**Control (*n* = 52)**	**Experimental (*n* = 60)**
Age	*M* = 21.33 (*SD* = 5.07)	*M* = 22.98 (*SD* = 6.57)
Gender		
Male	29 (55.77%)	31 (51.67%)
Female	23 (44.23%)	29 (48.33%)
Marital Status		
Single	50 (96.15%)	58 (96.67%)
Religion		
Christianity	17 (32.70%)	30 (50.0%)
Atheism/Agnosticism	19 (36.54%)	16 (26.67%)
Other	16 (30.77%)	14 (23.33%)
Year of Study		
Juniors, Sophomores (Year 1, 2, & 3)	35 (67.31%)	38 (63.33%)
Seniors (Year 4 and 5+)	17 (32.70%)	22 (36.67%)

Note. *N* = 112. No significant differences on any of the demographic variables were found between individuals of the control and experimental conditions.

Table 3.

Means and Standard Deviations for Outcome Measures Pre and Post-Attention Training,

Stratified by Condition, Gender and Time.

	Experimental (*n* = 60)				**Control (*n* = 52)**			
	Time 1 *M* (*SD*)		**Time 2 *M* (SD)**		**Time 1 *M* (SD)**		**Time 2 *M* (*SD*)**	
Measure	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
CES-D[a]	17.00 (1.88)	18.48 (1.94)	-		15.86 (1.94)	14.52 (2.18)	-	
VAMS[b]	65.23 (3.58)	64.79 (3.70)	61.84 (3.42)	62.03 (3.53)	62.28 (3.70)	69.13 (4.15)	59.53 (3.53)	62.91 (3.97)
CTI-S[c]	40.32 (5.95)	39.68 (8.44)	40.10 (5.15)	41.97 (5.10)	39.76 (6.89)	41.43 (8.36)	40.69 (5.50)	42.83 (5.55)
Post Training Attention*	-		-9.65 (423.59)	222.22 (378.70)	-		-45.09 (439.77)	-166.87 (523.77)

Note. a = Centre for Epidemiologic Studies Depression Scale; b = Visual Analogue Mood Scale; c = Cognitive Triad Inventory – Self Subscale.

*Positive post training attention bias values indicate attention toward the negative stimuli, where negative values indicate attention away from the negative stimuli.

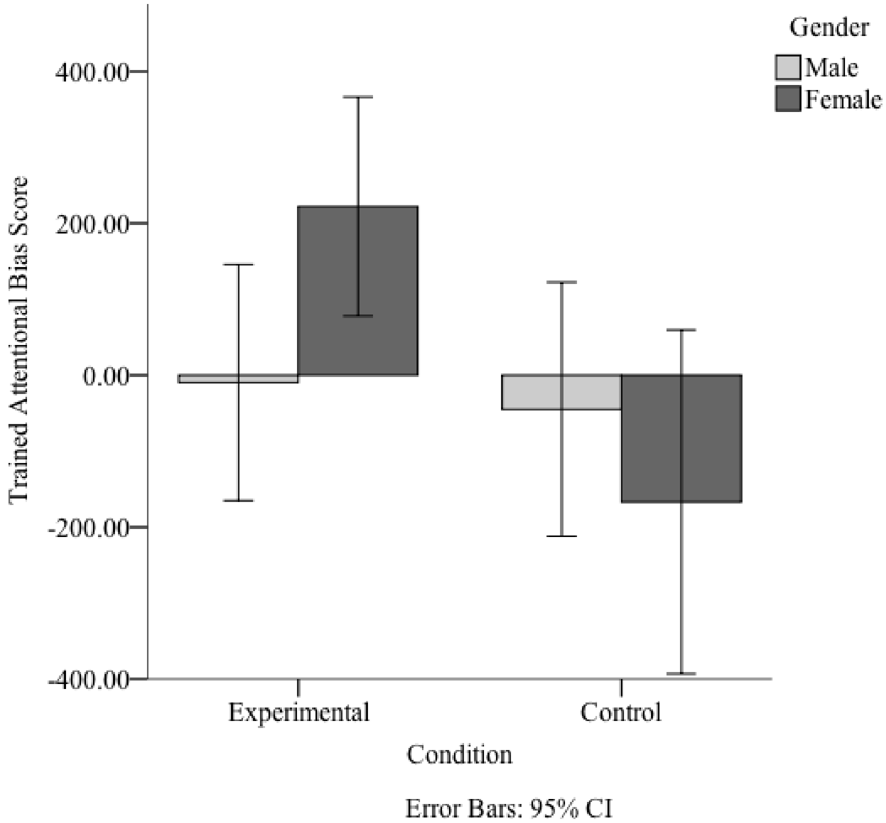

Figure 1. *Mean ratings of trained attentional bias by gender and condition.*

Appendix A

Nondysphoric Words	Sad Words
Rational	Outcast
Hostile	Forlorn
Impatient	Worthless
Sarcastic	Depressed
Orderly	Useless
Logical	Tearful
Cooperative	Discouraged
Systematic	Fatigued
Cruel	Tired
Attentive	Rejected
Harsh	Empty
Devoted	Failure
Materialistic	Insignificant
Persistent	Despairing
Driven	Dull
Mean	Blue
Tolerant	Unwanted
Restless	Forsaken
Neat	Low
Calm	Sad
Mellow	Glum
Vengeful	Burdened
Generous	Listless
Greedy	Alone
Foolhardy	Hopeless
Understanding	Incompetent
Trusting	Lifeless
Belligerent	Inadequate
Sadistic	Unloved
Demanding	Anguished
Prejudiced	Desolate
Sharing	Lonesome
Protective	Sorrowful
Furious	Doomed
Gracious	Helpless
Maternal	Apathetic
Threatening	Miserable
Pretentious	Exhausted
Loving	Troubled
Neighborly	Downhearted