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Abstract

Cognitive theories of depression posit that automatically activated cognitive schemas, including negative thoughts about the self and the future, predispose individuals to develop depressive disorders. However, prior research has largely examined these constructs using explicit tests in currently depressed individuals. Using the Implicit Association Test (IAT), the present study examined automatic associations between the self and mood state (“depression IAT”) and between the future and mood state (“hopelessness IAT”) before and after a negative mood induction in 19 remitted depressed individuals and 23 healthy controls. In the depression IAT, remitted depressed participants exhibited an overall lower tendency to associate themselves with happiness relative to the healthy controls before the mood induction. Control, but not remitted depressed, participants' automatic associations between the self and happiness diminished following the mood induction. Contrary to our hypotheses, no significant findings emerged when considering the hopelessness IAT. Consistent with prior studies, no significant correlations emerged between implicit and explicit biases, suggesting that these measures probe different processes. Results extend prior IAT research by documenting the presence of a reduced tendency to associate the self with happiness in a sample at increased risk for depression.

Keywords: Depression; Cognitive Vulnerability; Affect; Implicit Association Test; Dysfunctional Attitudes.

Two prominent theories of major depressive disorder (MDD) highlight cognitive diatheses that may confer increased vulnerability to depression. According to Beck's cognitive theory of depression, the activation of negative schemas about worthlessness, loss, and expected failure in response to a stressor, increases risk for depression (Beck, Rush, Shaw, & Emery, 1979). The hopelessness theory argues that the tendency to make stable, global, and internal attributions about unpleasant events should lead to pessimism about the future, which serves as a diathesis for depression (Abramson, Metalsky, & Alloy, 1989). Importantly, both of these constructs are thought to exist among individuals in a non-depressed mood state, conferring vulnerability to depression when activated by a negative life event.

Although longitudinal studies represent the ideal tests of vulnerabilities, many studies examine populations at high-risk for future depressive episodes, including individuals who have experienced a depressive episode in the past, but are no longer depressed (e.g., remitted depressed (RD); see Scher, Ingram, & Segal, 2005, for a review). Consistent with the activation hypothesis (Teasdale, 1988), these studies indicate that negative cognitive biases emerge when RD individuals are induced into a transient negative mood (Miranda, Persons, & Byers, 1990), suggesting that the negative mood activates state-dependent vulnerabilities. Although this literature is compelling, these studies have generally emphasized explicit measures of negative cognitive styles, via self-report measures of dysfunctional attitudes, cognitive attributions, or effortful recall of valenced information (e.g., Segal, et al., 2006, Watkins, Grimm, Whitney, & Brown, 2005). It is unclear whether these biases operate at an implicit level, guiding automatic reactions to emotional stimuli, as hypothesized by several cognitive theories of depression (Beck et al., 1979; Beevers, 2005). Investigating implicit biases in RD populations is important given recent research suggesting that implicit and explicit measures may assess different components of cognitive processes (Beevers, 2005; Haeffel et al., 2007), and that implicit measures may better predict distress and psychopathology than explicit measures (e.g., Nock & Banaji, 2007).

One approach that shows promise for investigating implicit biases is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). Originally designed to assess implicit prejudicial attitudes, the IAT measures the relative strength of participants' automatic associations between pairs of concepts. Responses to stimuli are hypothesized to be faster when the association between concepts is strong than when this link is weak. The IAT has been used recently to examine automatic implicit attitudes that may confer vulnerability in populations with psychopathology (e.g., Egloff & Schmukle, 2002; Gemar, Segal, Sagrati, & Kennedy, 2001).

Only a small number of studies have used the IAT to assess negative cognitive styles in populations at risk for depression. Two recent reports assessed the degree to which undergraduate students associated words related to the self with pleasant versus unpleasant adjectives (defined as implicit self-esteem). The first indicated that negative implicit biases of self-esteem predicted distress following a laboratory stressor (Haeffel et al., 2007), whereas the second found that low positive implicit self-esteem interacted with recent stressful life events to predict depressive symptoms in undergraduates characterized by increased cognitive vulnerability to depression (Steinberg, Karpinki, & Alloy, 2007). Moreover, relative to healthy controls, RD participants displayed higher levels of positive implicit self-esteem (Franck, De Raedt, & De Houwer, in press; Gemar et al., 2001). In both IAT studies, following a negative mood induction (MI), RD participants exhibited a significantly larger decrease in implicit self-esteem than controls; additionally, RD participants' post-MI implicit bias was equivalent to that of the currently depressed samples (Franck et al., in press; Gemar et al., 2001). Although intriguing, interpretations of these findings were complicated by a lack of differences between RD and control participants' post-MI implicit self-esteem (Franck et al., in press; Gemar et al., 2001). Taken together, these findings suggest that implicit biases may predict affective responses to stressors in the laboratory (Franck et al., in press; Gemar et al., 2001; Haeffel et al., 2007) as well as to self-reported life stressors (Steinberg et al., 2007).

The IATs used in the aforementioned studies assessed implicit self-esteem, yet cognitive theories of depression (Abramson et al., 1989; Beck et al., 1979) suggest that negative cognitive styles about other concepts (e.g., the future) also confer vulnerability to depression. However, few studies have tested for the presence of these other implicit biases, and none have been with RD populations. One unpublished study documented increased implicit hopelessness in a sample of currently depressed individuals (Friedman et al., 2001); a second study noted correlations between increased tendency to associate the self with anxious and worry-related mood states and distress in response to a behavioral task designed to produce anxiety (Egloff & Schmukle, 2002). Therefore the goal of the present study was to extend the existing literature by investigating whether RD participants exhibit automatic tendencies to associate the self as well as the future with an unpleasant mood state before and after a MI. We hypothesized that: (1) RD participants would have smaller positive implicit biases compared to control participants, and that this differentiation would be greatest after the induction of a sad mood; (2) participant groups would show similar change in affect following the MI (Gemar et al., 2001); (3) RD participants, but not healthy controls, would display decreased positive implicit biases and increased dysfunctional attitudes after the MI (Franck et al., in press; Gemar et al., 2001; Segal et al., 1999; 2006); and (4) implicit and explicit measures of depression and hopelessness would not correlate given prior research indicating the independent natures of these measures (e.g., Bosson, Swann, & Pennebaker, 2000; Gemar et al., 2001; Haeffel et al., 2007).

Methods

Participants

Fifty-two participants, ages 18 – 55, were recruited from the greater Boston community. Participants were right-handed, native English speakers, with no self-reported neurological conditions, serious physical illness, or current Axis I diagnoses, as assessed using the Structured Clinical Interview for the DSM-IV, Patient Edition (SCID-I/P; First, Spitzer, Gibbon, & Williams, 1995). Three RD participants had a history of past substance abuse at least a year prior to the study; no participants met criteria for a lifetime history of substance dependence. Control participants had no lifetime history of any Axis I disorder.

Twenty-eight healthy controls met inclusion criteria and participated in the study. Twenty-four participants met criteria for RD, based on the National Institute of Mental Health guidelines (Birmaher, Ryan, & Williamson, 1996). Criteria for RD were assessed by responses to a self-report measure and during the SCID interview and included each of the following: (1) having fewer than 2 symptoms of MDD at a subthreshold level (a 2 on the SCID) in the previous 2 months, neither of which included depressed mood or anhedonia; (2) at least 1 major depressive episode within the last 10 years; and (3) Beck Depression Inventory – II (BDI-II; Beck, Steer, & Ball, 1996) scores less than 14. No RD participant was taking psychotropic medications or herbal extracts (e.g., St. John's Wort), or was receiving psychotherapy at the time of testing. For the RD sample, the mean number of prior MDE and the mean age of MDD onset were 2.94 (range: 1-10) and 20.12 (range: 11-28), respectively.[1]

Four participants (2 RD, 2 controls) were excluded from analyses due to an insufficient number of correct trials on the IAT (Greenwald et al., 1998), three participants (1 RD, 2 controls) were excluded over concerns that they were not following instructions for the MI, two RD participants no longer met inclusion criteria on the day of testing (BDI-II > 14), and one control was excluded due to missing post-MI questionnaires. Data from 42 participants (n = 19 RD, n = 23 controls) were available for the analyses and are presented below.

Measures

Implicit Association Test (IAT). The IAT provides a measure of the strength of association between four categories by pairing two concept categories (e.g., *Me/Not-Me*) with two attribution categories (e.g., *Happy/Sad*; Greenwald et al., 1998). Based on the theory that pairing two similar categories is easier than pairing two dissimilar ones, the IAT effect is calculated by the amount of time that it takes for participants to categorize an exemplar. The longer the response time, the weaker the presumed association is between two categories. Reaction times were computed into a measure of effect size (D values) using the revised scoring algorithm, with larger D values indicating more positive bias (Greenwald, Nosek, & Banaji, 2003). The IAT demonstrates acceptable internal consistency, reliability, and construct validity (Greenwald et al., 1998; Nosek, Greenwald, & Banaji, 2005). Two IATs consisting of seven blocks of trials were used to measure implicit depression and implicit hopelessness. Stimuli for both tasks were taken from similar IATs designed by Friedman and colleagues (2001; see Appendix).

Mood Induction (MI). We implemented a standard MI procedure that has been used successfully with both healthy controls (Clark & Teasdale, 1985) and RD participants (Franck et al., in press; Gemar et al., 2001; Segal et al., 2006). Participants listened to a piece of music (the orchestral introduction to the film *Alexander Nevsky*, entitled "Russia Under the Mongolian Yoke") played at one-quarter speed for eight minutes, while recalling a sad memory.

<u>Explicit Measures and Self-report Assessments of Mood</u>

Visual Analogue Scale (VAS). Participants rated their current mood using two 115-mm horizontal lines with the following bipolar dimensions: "happy/sad" and "relaxed/tense". Prior research has demonstrated that the VAS is an expedient and reliable method of measuring participants' mood state (Little & Crawford, 1973).

Positive and Negative Affect Schedule (PANAS). Participants also completed the state version of the PANAS, which contains two 10-item scales and has high internal consistency and reliability (Watson, Clark, & Tellegen, 1988).

Beck Depression Inventory – II (BDI – II). The revised 21-item version of the BDI was used to assess the severity of participants' depressive symptoms and has acceptable test-retest reliability and high internal consistency (Beck, et al., 1996).

Beck Hopelessness Scale (BHS). The BHS was used as an explicit measure of participants' hopelessness. This 20-item true/false scale has been found to possess acceptable reliability and high levels of construct validity (Beck & Weissman, 1974).

Spielberger's State/Trait Anxiety Inventory (STAI-S/STAI-T). The STAI was used to assess state and trait levels of anxiety, and has shown satisfactory psychometric properties (Spielberger, Gorush, & Luschene, 1970).

Cognitive Styles Questionnaire (CSQ). The CSQ (Alloy et al., 2000) includes ratings for the likelihood and the personal relevance of 24 hypothetical negative and positive events. In the present study, this reliable and valid measure (Alloy et al., 2000) was used to assess participants' cognitive beliefs about the projected impact of these events on their sense of self-worth and on the expected impact of the events in their future.

Dysfunctional Attitudes Scale (DAS). The DAS, form A, was used to provide an explicit measure of maladaptive attitudes, including perfectionistic standards of performance, need for approval, and rigid ideas about the world (Weissman, 1979). The DAS contains 40 items which participants rate from 1 (totally agree) to 7 (totally disagree). Higher scores on the DAS indicate greater levels of dysfunctional attitudes.

Mood and Anxiety Questionnaire (MASQ). The 62-item version of the MASQ, a self-report measure with satisfactory validity and reliability (e.g., Watson et al., 1995), was used to assess anxiety-specific symptoms (Anxious Arousal, AA), depression-specific symptoms (Anhedonic Depression, AD), and general distress (General Distress-Anxious Symptoms, GDA; General Distress-Depressive Symptoms, GDD).

Procedure

All procedures met approval from Harvard University's Institutional Review Board, and participants provided informed written consent after a study description. Participants who qualified for the study were interviewed by trained advanced graduate students in clinical psychology or a licensed, masters-level clinical interviewer, using the SCID. Interviewers received training on SCID administration through graduate coursework under the supervision of a licensed doctoral level clinical faculty member. For the present study, diagnostic reliability was established by randomly selecting 10 audiotaped SCID interviews. The interrater reliability for RD ($\varkappa = 1.00$) and control ($\varkappa$ = 1.00) participants was excellent. Eligible participants were scheduled for the computer session at a separate time and given the CSQ to take home and complete at least 24 hours prior to the experimental session.

During this session, participants completed the pre-MI DAS before receiving instructions for the IAT task and completing one depression IAT and one hopelessness IAT (IAT order was counterbalanced across participants). Next, participants completed the PANAS and VAS, underwent the MI procedure, followed immediately by the completion of the PANAS, VAS, and a second depression IAT and hopelessness IAT in the same order as before. After the post-MI IATs, participants completed the PANAS, VAS, and remaining questionnaires (including a second administration of the DAS). Afterwards, participants viewed a brief amusing film clip to counteract any lingering effects of the MI. Participants were then debriefed and compensated $15/hr for their time. The computer session lasted approximately one hour; total participation in the study lasted three to four hours.

Statistical Analyses

Chi square tests and unpaired *t*-tests were used to examine group differences on demographic data (sex, ethnicity, age, education) and self-report measures (BDI, BHS, CSQ). A MANOVA, with *Group* (Remitted, Control) and MASQ subscore (AA, AD, GDA, GDD) as multiple dependent variables, was performed to test for potential group differences in depressive and anxious symptoms. To test the effects of the MI on self-reported mood, 2 x 3 ANOVAs were performed separately for the VAS and PANAS using *Group* as the between-subjects factor and *Time* (pre-MI, post-MI, and post-IAT) as a repeated measure. An analogous *Group* x *Time* (pre-MI, post-IAT) ANOVA was performed on the DAS score. D values from each IAT were entered into separate 2 x 2 mixed ANOVAs using *Group* and *Time* (pre-MI, post-MI) as factors. The Greenhouse-Geisser correction was utilized when appropriate; significant ANOVA effects were followed up with post-hoc Newman-Keuls tests.

To assess the relation between implicit and explicit measures of negative biases, Pearson's correlations were computed between (1) the changes scores (post-MI – pre-MI) for both the DAS and IAT scores; and (2) baseline CSQ and the IAT changes scores (unlike the DAS, the CSQ was administered only once). Correlational analyses were performed for each group separately. Overall, two-tailed p-values are reported.

Results

Sociodemographic and self-reported mood data

Demographic and self-reported mood data are presented in Table 1. Groups did not differ with respect to sex, ethnicity, age, or education. Groups also did not differ in their MASQ scores, as assessed by multivariate testing using the Hotelling's criterion, $F(4, 37) = 1.45$, $p > 0.23$, partial $\eta^2 = 0.136$). RD participants reported significantly higher scores on the BDI-II, BHS, STAI-S, and STAI-T (all *p*s < 0.04; see Table 1) as well as a trend for higher levels of negative cognitive styles on the CSQ, $t(40) = -1.93$, $p < 0.07$.

Mood Manipulation Check

VAS mood. The MI successfully lowered participants' mood, *Time*, $F(2, 80) = 79.17$, $p < 0.01$, partial $\eta^2 = 0.67$. Post-hoc tests indicated that the lowest levels of happiness occurred after the MI (41.63±19.64), with intermediate levels at the post-IAT assessment (55.85±18.95), and the highest levels of happiness before the MI (70.95±14.48) (post-MI > post-IAT > pre-MI; all *p*s <

0.005). Thus, a significant decrease in happiness was observed immediately after the MI, which persisted until the post-IAT assessment, albeit in a lessened form. There was a nonsignificant trend for RD participants to report overall lower levels of happiness than controls, *Group,* $F(1, 40) = 3.36$, $p < 0.07$; the *Group* x *Time* interaction was not significant, $F(2, 80) = 1.76$, $p > 0.15$.

VAS tension. A significant main effect of *Time,* $F(2, 74) = 8.16$, $p < 0.01$, partial $\eta^2 = 0.18$, emerged due to significantly higher tension at the post-MI (43.27±24.42) compared with the post-IAT (30.08±18.27) and pre-MI (30.50±18.16) assessments (both *p*s < 0.01). No differences emerged between the post-MI and post-IAT assessments ($p > 0.20$). Additionally, RD participants (46.39±3.83) reported significantly overall higher tension scores than controls (31.62±3.37), *Group*, $F(1, 37) = 8.40$, $p < 0.01$, partial $\eta^2 = 0.19$. The *Group* x *Time* interaction was not significant, $F(2, 74) = 1.13$, $p > 0.30$, partial $\eta^2 = 0.03$.

PANAS NA. The only reliable finding was the main effect of *Time,* $F(2, 80) = 14.41$, $p < 0.01$, partial $\eta^2 = 0.26$, due to significantly higher NA scores following the MI (14.52±6.29) as compared with both the pre-MI (10.93±1.35) and post-IAT (11.93±3.57) assessments (both *p*s < 0.005). The main effect of *Group* and the *Group* x *Time* interaction were not significant*,* $F(1, 40) = 3.74$, $p > 0.06$, partial $\eta^2 = 0.09$, and $F(2, 80) = 1.76$, $p > 0.15$, partial $\eta^2 = 0.04$, respectively.

PANAS PA. As above, the main effect of *Time* was significant, $F(2, 80) = 36.85$, $p < 0.01$, partial $\eta^2 = 0.48$, as participants reported lower PA scores at the post-MI (20.07±8.76) compared to both the pre-MI (26.40±8.72) and post-IAT (21.98±9.16) assessments, which in turn differed from each other (all *p*s < 0.02). This effect was qualified by a nearly significant *Time* x *Group* interaction, $F(2, 80) = 2.91$, $p = 0.07$, partial eta$^2 = 0.07$. This trend was followed-up with post-hoc tests; no group differences emerged. The main effect of *Group* was not significant, $F(1, 40) = 1.50$, $p > 0.20$, partial $\eta^2 = 0.04$.

Effects of MI on explicit measures

A main effect of *Time,* $F(1, 40) = 8.34$, $p < 0.01$, partial $\eta^2 = 0.17$, emerged due to significantly higher DAS scores after the MI relative to the pre-MI assessment (Figure 1). The main effect of *Group,* $F(1, 40) = 2.31$, $p > 0.10$, partial $\eta^2 = 0.06$, and the *Group* x *Time* interaction, $F(1, 40) = 0.56$, $p > 0.40$, partial $\eta^2 = 0.01$, were non-significant.

Effects of MI on implicit measures

Depression IAT. Significant main effects of *Time*, $F(1, 40) = 13.40$, $p < 0.01$, partial $\eta^2 = 0.25$ and *Group,* $F(1, 40) = 8.70$, $p < 0.01$, partial $\eta^2 = 0.18$, were qualified by a *Group* x *Time* interaction, $F(1, 40) = 4.08$, $p < 0.05$, partial $\eta^2 = 0.09$. Post-hoc tests clarified that, compared to control participants, RD participants reported lower D scores (indicating lower positive bias) both before ($p < 0.0004$) and after ($p < 0.03$) the MI. Contrary to our hypothesis, control ($p < 0.0001$) but not RD ($p > 0.25$) participants showed a significant reduction in this bias after the MI (Figure 2a).

Although RD participants reported anxiety and depression symptoms below clinical significance (Table 1), BDI, BHS, and STAI scores were significantly higher than those of control participants. Consequently, hierarchical regression analyses were performed to determine if group differences in pre-MI depression IAT scores remained after factoring out the variance accounted for by depression, anxiety, and hopelessness. To this end, BDI, BHS, STAI-S, and STAI-T scores were simultaneously entered in the first step of the model, followed by the variable *Group* (dummy-coded). Self-reported measures did not predict depression IAT scores (all $|\beta s| < 0.18$; all $|ts| < 0.87$, all $ps > 0.35$). Critically, *Group* was a significant predictor of pre-MI depression IAT scores ($\beta = 0.54$; $t = 3.35$, $p < 0.002$), even after accounting for differences in baseline symptoms ($\Delta R^2 = 0.23$, $\Delta F(2, 39) = 11.20$, $p < 0.003$).[2] A second (control) hierarchical regression analysis was performed to account for the increased tension levels reported by RD participants. As above, *Group* remained a significant predictor of pre-MI IAT scores, even after accounting for initial tension levels, $\Delta R^2 = 0.26$, $\Delta F(1, 35) = 12.74$, $p < 0.01$.

Hopelessness IAT. As with the depression IAT, both groups displayed a bias towards associating the future with happiness. Contrary to our hypotheses, the effects of *Time,* $F(1, 40) = 1.16$, $p > 0.20$, partial $\eta^2 = 0.03$, and *Group,* $F(1, 40) = 2.78$, $p > 0.10$, partial $\eta^2 = 0.07$, and the *Group* x *Time* interaction*,* $F(1,40) = 0.03$, $p > 0.80$, partial $\eta^2 = 0.001$, were not significant.

Relationship between implicit and explicit measures

Consistent with prior studies (e.g., Bosson, et al., 2000; Gemar et al., 2001; Haeffel et al., 2007), no significant correlations emerged between implicit and explicit measures for either group (Table 2). However, for both RD and control participants, respectively, the two IATs were positively correlated with each other both before ($r = 0.46$, $p < 0.07$; $r = 0.42$, $p < 0.05$) and after

($r = 0.38$, $p < 0.01$; $r = 0.42$, $p < 0.04$) the MI, indicating that greater tendencies to associate the future with happiness were linked to greater tendencies to associate the self with happiness.

Discussion

To the authors' knowledge, this is the first study to investigate implicit depression and implicit hopelessness concurrently among RD individuals. Results from the current study suggest that RD individuals are characterized by a reduced and state-independent tendency to associate the self with positive mood state words relative to healthy controls. Accordingly, whereas healthy controls experienced a decrease in their tendency to associate the self with happiness after a MI, RD participants' reduced implicit bias was not affected by a worsening of their mood. These effects were not related to current levels of self-reported anxiety, depression, tension, or hopelessness. Contrary to our hypotheses, the RD individuals exhibited an equivalent tendency to associate the future with happiness as control participants; moreover, this bias was unaffected by the MI.

Depression IAT

The reduced tendency to associate the self with happiness among RD participants prior to the MI extends prior research investigating implicit biases in at-risk population, including studies suggesting that low implicit self-esteem in undergraduates predicted increased distress after a laboratory stressor (Haeffel et al., 2007) and higher depression symptoms following life stressors (Steinberg et al., 2007). Further, findings from the present study contrast with prior findings of greater positive implicit self-esteem to controls prior to and equivalent implicit self-esteem following a MI in two RD samples (Franck et al., in press; Gemar et al., 2001). As implicit biases are thought to guide immediate reactions to stressors (Beevers, 2005), and positive self-ideation is posited to serve as a protective factor (Taylor & Armor, 1996), a reduced tendency to view the self as happy or as a worthwhile person may increase the likelihood of developing explicit negative cognitive styles and depressive symptoms following a stressor. More generally, the present findings of reduced positive implicit bias provide important empirical evidence in support of theoretical arguments that have emphasized links between MDD and deficits in an approach-related system promoting positive affect (e.g., Depue & Iacono, 1989; Pizzagalli, Jahn, & O'Shea, 2005; Watson & Clark, 1984).

However, the finding of reduced positive bias in RD participants *prior* to the MI is inconsistent with prior studies. First, although a limited number of IAT studies exist in RD samples, baseline implicit self-esteem bias scores have been found to be more positive than those of healthy controls and decrease following a MI (e.g., Franck et al., in press; Gemar et al., 2001); only one prior study has found differences between individuals at high and low cognitive risk for MDD without an MI (Steinberg et al., 2007). Second, information processing studies have frequently failed to document baseline negative biases among RD samples without the use of a MI or stressor (Miranda et al., 1990). Finally, recent research indicates that self-esteem instability places individuals at risk for depressive episodes (Franck & De Raedt, 2007); as such, significant changes in bias scores following the MI would have been expected in the current RD sample.

One possible explanation for the stability of the RD participants' implicit biases is that implicit tendencies to view the self as being happy are more stable and less affected by transient mood as compared with other self-concepts. Whereas prior studies examined implicit *self-esteem*, a construct consisting of global statements about the self using stimuli such as Valuable/Worthless (e.g., *successful*, *incompetent*; De Raedt et al., 2006) or Positive/Negative (e.g., *trustworthy*, *quarrelsome*; Gemar et al., 2001), the present study assessed the degree to which individuals associated themselves with depressed or positive mood and used the stimulus category Happy/Sad (e.g., *cheerful, gloomy*). While self-esteem is explicitly contained in the negative schemas from Beck's (1979) cognitive theory, associations of mood with the self are linked to negative cognitive schemas as components of an individual's self-concept. Although implicit self-esteem may contain an emotional component related to mood state, implicit depression, as tested in the present study, is solely concerned with mood. Therefore, performance differences in these two implicit tasks may reflect the specificity of our task relative to the broader construct tapped in self-esteem IATs. Given the literature reporting increased implicit self-esteem in RD compared to healthy participants prior to a MI, the current findings warrant further investigation.

Alternatively, given prior research noting that changes in dysfunctional attitudes in response to a MI (Segal et al., 2006) or unstable self-esteem in response to daily stressors (Franck & De Raedt, 2007) predicted increase in depressive symptoms, the relative stability of implicit and explicit measures in the current study may indicate that our RD sample might be less susceptible to relapse. However, if RD participants' reduced tendency toward associating the self with happiness is resistant to negative affective fluctuations, it might be equally unaffected by positive mood states (e.g., joy); such a lack of reactivity may further strengthen associations between the self and sadness. Finally, RD participants' lack of change on the depression IAT may be due to a floor effect. Their diminished positive biases may have been unable to be further reduced by such a brief stressor; in contrast, control participants' higher positive associations may have had more ability to vary in the presence of a brief negative mood. Future studies testing these hypotheses, particularly in a larger sample with a wide range of remission durations, are warranted.

Hopelessness IAT

Contrary to our hypotheses, as well as Abramson and colleague's (1989) hopelessness theory, both participant groups showed an implicit bias toward associating the future with happiness, and RD individuals did not exhibit a greater tendency to view the future as less happy than control participants, even after a MI. The lack of significant findings is surprising, particularly in light of previous research that found biases towards implicit hopelessness in currently depressed individuals (Friedman, et al., 2001), increased levels of explicit hopelessness in healthy controls after a negative MI (Hepburn, Barnhofer, & Williams, 2006), and the overall increased implicit depression in the same population (current study). However, the MI procedure in the present study included an autobiographical component ("think of a sad memory"). Unintentional priming of associations between the past and sadness may have occurred, leading to a decreased ability to detect an implicit hopelessness bias because the IAT scoring paradigm used relies on the juxtaposition of opposing sets of pairings. In addition, because the IAT was designed to assess participants' associations between the future and pleasant or unpleasant mood states, it may have not adequately tapped into the attributions that are hypothesized to play a key role in the hopelessness theory of depression. According to the hopelessness theory, individuals may develop pessimistic views of the future when they make global, stable, and internal attributions about negative life events (Abramson et al., 1989). Consequently, as implicit measures tap automatic associations, it is possible that future research using an IAT assessing RD participants' tendency to associate negative events with these attributional categories would demonstrate the predicted implicit biases.

Explicit Measures

Unlike prior studies (Gemar et al., 2001; Segal et al., 1999; Segal et al., 2006), remitted individuals did not exhibit heightened levels of dysfunctional attitudes relative to healthy controls throughout the study, although both groups displayed increased dysfunctional attitudes after the MI. One possibility for these findings among the remitted sample is that in prior studies the DAS was administered shortly (~5 min) after the MI, whereas in the present paradigm, participants completed the two IATs (~10 min) and mood assessments (~2 min) before completing the DAS. Mood ratings taken at the end of these IATs indicated that participants' negative mood had partially dissipated by this time, and therefore the failure to detect DAS changes between groups may be the result of a relatively less powerful negative mood than was achieved in prior studies. Furthermore, prior studies have used two forms of the DAS to test for pre- and post-MI differences (e.g., Gemar et al., 2001; Segal et al., 2006), while the present study used the same form before and after the MI. This may have reduced our ability to detect changes in dysfunctional attitudes, which represents an important limitation of the present study.

Finally, although no significant differences were found between participant groups on the CSQ, remitted depressed participants displayed a trend for increased negative cognitive styles on the CSQ relative to control participants. This trend is consistent with major theories of depression (Beck et al., 1979; Abramson et al., 1989).

Limitations and Conclusions

The limitations of the present study should be acknowledged. First, the MI induced both a sad mood and increased levels of tension, with an observed trend towards greater tension among remitted participants. Moreover, the remitted sample reported greater levels of explicit anxiety, hopelessness, and depression than control participants. Although several regression analyses indicated that group uniquely predicted implicit bias scores after accounting for the variance associated with these ratings, future studies examining the potential moderating role of self-reported anxiety, tension, hopelessness, and depression in these populations are warranted.

These limitations notwithstanding, the present study provides initial evidence that a reduced and stable automatic tendency to associate the self with happiness may be a distinguishing feature of individuals at increased vulnerability for MDD. Future studies should examine whether this bias is modulated by pleasant mood states, length of the remission period, and/or treatment history (e.g., cognitive-behavioral therapy vs. antidepressants; Segal et al., 2006), and whether this bias predicts future depressive episodes. If predictive, these measures may be incorporated into clinical settings as a more objective measure of attitudes than current self-report questionnaires.

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Footnotes

1. Data on number of prior MDE and mean age of MDD onset were unavailable for six of the 24 remitted depressed participants.
2. To investigate the potential effects of multicollinearity between anxiety measures, hierarchical regression analyses were performed, which entered only one anxiety measure, the STAI-S, as a covariate along with the BDI, BHS, simultaneously in the first step and Group (Remitted, Control) in the second. Importantly, Group remained a significant predictor of pre-MI depression IAT scores ($\beta = 0.53$; $t = 3.47$, $p < 0.001$), even after accounting for differences in baseline symptoms ($\Delta R^2 = 0.22$, $\Delta F(1, 35) = 12.03$, $p < 0.001$). Similar results were found when the STAI-T or the MASQ was used instead of the STAI-S.

Appendix

Stimuli for Depression IAT:

I, Me, Self, Myself, Mine, They, Them, Their, Theirs, Other, Depressed, Helpless, Hopeless, Gloomy, Withdrawn, Smiling, Glad, Cheerful, Joyful, Delighted.

Stimuli for Hopelessness IAT:

Years Ahead, Days Ahead, Tomorrow, Next Week, Next Year, Yesterday, Last Year, Last Week, Days Ago, Years Ago, Smiling, Glad, Cheerful, Joyful, Delighted, Depressed, Helpless, Hopeless, Gloomy, Withdrawn.

Table 1**:** Summary of sociodemographic and self-report measures.

	Control Mean (SD)	**Remitted** Mean (SD)	**Statistics**	***p*-value**
n	23	19		
Age	27.70 (9.02)	26.00 (7.44)	$t(40) = 0.63$	> 0.53
Sex (M/F)	3/20	1/18	$\chi 2(1) = 0.73$	> .0.39
Age of onset	N/A	20.12		
Prior episodes	N/A	2.94		
In remission (yrs)	N/A	4.10 (3.56)		
Education	16.22 (1.85)	15.95 (1.89)	$t(40) = 0.47$	> 0.60
BDI-II	1.35 (2.31)	3.37 (3.32)	$t(40) = -2.24$	< 0.04
BHS	1.48 (1.44)	3.78 (4.02)	$t(40) = -6.49$	< 0.01
STAI-S	32.22 (7.10)	39.95 (12.59)	$t(40) = -2.99$	< 0.01
STAI-T	33.78 (8.41)	42.42 (10.29)	$t(40) = -2.38$	< 0.03
$MASQ_{AA}$	18.61 (2.73)	18.74 (2.45)	$F(4,37) = 1.45$	> 0.23*
$MASQ_{AD}$	46.30 (13.22)	54.95 (9.50)	$F(4,37) = 1.45$	> 0.23*
$MASQ_{GDA}$	14.57 (4.35)	16.47 (4.09)	$F(4,37) = 1.45$	> 0.23*
$MASQ_{GDD}$	16.22 (6.34)	19.53 (6.85)	$F(4,37) = 1.45$	> 0.23*
CSQ_{neg}	3.71 (0.83)	4.27 (1.01)	$t(40) = -1.93$	< 0.07
CSQ_{pos}	4.69 (0.50)	4.80 (0.52)	$t(40) = -0.68$	> 0.50

Note : BDI-II: Beck Depression Inventory – II; BHS: Beck Hopelessness Scale; STAI-S: Spielberger State/Trait Anxiety Inventory – State; STAI-T: Spielberger State/Trait Anxiety Inventory – Trait; MASQ: Mood and Anxiety State Questionnaire; AA: Anxious Arousal; AD: Anhedonic Depression; GDA: General Distress-Anxious Symptoms; GDD: General Distress-Depressive Symptoms; CSQ_{neg}: Cognitive Styles Questionnaire negative subscale; CSQ_{pos}: Cognitive Styles Questionnaire positive subscale. *No group differences emerged from the multivariate test (Hotelling's criterion).

Table 2: Summary of Pearson's correlations between implicit and explicit measures for remitted depressed (n = 19) and control (n = 23) participants.

		Δ Depression IAT	Δ Hopelessness IAT
Δ DAS	Controls	r = 0.26 (ns)	r = -0.14 (ns)
	Remitted	r = 0.41 (*p* = 0.085)	r = -0.25 (ns)
CSQ_{neg}	Controls	r = 0.33 (ns)	r = 0.004 (ns)
	Remitted	r = 0.22 (ns)	r = 0.18 (ns)
CSQ_{pos}	Controls	r = 0.19 (ns)	r = 0.006 (ns)
	Remitted	r = 0.26 (ns)	r = 0.12 (ns)

Note: Δ Depression IAT = (post-MI Depression IAT) – (pre-MI Depression IAT); Δ Hopelessness IAT = (post-MI Hopelessness IAT) – (pre-MI Hopelessness IAT); Δ DAS = (post-MI DAS) – (pre-MI DAS). DAS: Dysfunctional Attitudes Scale; CSQ_{neg}: Cognitive Styles Questionnaire negative subscale; CSQ_{pos}: Cognitive Styles Questionnaire positive subscale

Figure legends

Figure 1: Mean DAS scores. Higher scores indicate greater levels of dysfunctional attitudes. DAS: Dysfunctional Attitude Scale. Error bars indicate standard errors.

Figure 2: Mean D values (and S.E.) for the (**a**) Depression IAT and (**b**) Hopelessness IAT. The more positive the D value, the higher the positive bias towards the self and the future, respectively. IAT: Implicit Association Test. Error bars indicate standard errors.

Figure 1

Figure 2