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Thought Suppression in Patients with Bipolar Disorder

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Abstract

Suppression of negative thoughts has been observed under experimental conditions among patients with major depressive disorder (MDD), but has never been examined among patients with bipolar disorder (BD). Patients with BD (n = 36), MDD (n = 20), and healthy controls (n = 20) completed a task which required unscrambling 6-word strings into 5 word sentences, leaving out one word. The extra word allowed the sentences to be completed in a negative, neutral, or "hyperpositive" (manic/ goal-oriented) way. Participants completed the sentences under conditions of cognitive load (rehearsing a 6-digit number), reward (a bell tone), load and reward, or neither load nor reward. We hypothesized that patients with BD would engage in more active suppression of negative and hyperpositive thoughts than controls, as revealed in unscrambling more word strings into negative or hyperpositive sentences. Under conditions of load or reward, and in the absence of either load or reward, patients with BD unscrambled more negative sentences than controls. Under conditions of reward, patients with BD unscrambled more negative sentences than patients with MDD. Patients with BD also reported more use of negative thought suppression than controls. These group differences in negative biases were no longer significant when current mood states were controlled. Finally, the groups did not differ in the proportion of hyperpositive sentence completions in any condition. Thought suppression may provide a critical locus for psychological interventions in BD.

Keywords

Thought Suppression; Reward; Hyperpositive Thinking; Mental Control Theory; cognitive biases

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Introduction

Most cognitive theories of mood disorder assume that there are critical cognitive vulnerabilities that are an enduring feature of people with a history of depressive disorders, even when in remission. However, in major depressive disorder (MDD), it has been difficult to confirm the presence of negative schemas when patients are no longer depressed (Ingram, Miranda, & Segal, 1998). Instead, negative schemas are most reliably observed when remitted patients with a history of depression start to experience a worsening of mood (Miranda & Persons, 1988). Wenzlaff & Bates (1998) have argued that the negative schemas characteristic of depression are being actively *suppressed* in a process of mental control when patients with MDD are in remission. Patients with MDD often report that they try to suppress negative thoughts to maintain a desirable mood or repair an undesirable one (Wegner & Wenzlaff, 1996; Wenzlaff, 1993).

The mental control theory (Wegner & Wenzlaff, 1996) proposes an interaction between two systems: an intentional operating process that seeks to promote preferred emotional states and direct attention away from unwanted material, and an ironic monitoring system which searches for signs of failure to reach the intended state. When the capacity of the operating system is occupied or distracted by stress or challenge, the monitoring system takes over, filling consciousness with the products of its own search. Mental control then works against itself, bringing to mind unwanted contents. Correspondingly, the detection of negative cognition requires disruption of the process of mental control (Wenzlaff & Bates, 1998).

In a study of depressed, at-risk, and non-depressed college students, Wenzlaff & Bates (1998) asked participants to unscramble 6-word strings into 5 word sentences, leaving one word out. The sentences could be completed with either a positive or negative valence (e.g., “looks the future bright very dismal”). Students at risk for depression could not be distinguished from normal controls on the proportion of negative sentences produced during the task. However, when a cognitive load was introduced - rehearsing a 6-digit number while unscrambling the sentences - the at-risk students produced more negative sentences than the healthy controls. At-risk students also reported a greater use of thought suppression as a coping mechanism. Thus, experimental disruption of mental control by introducing a cognitive load may reveal latent cognitive vulnerabilities among persons with or at risk for depression. The current article aims to investigate whether similar processes operate in bipolar disorder (BD).

Little is known about the role of thought suppression in patients with BD. In a study of acutely ill patients with BD (Lyon, Startup, & Bentall, 1999), manic patients endorsed more positive words to describe themselves than bipolar depressed patients, and had higher internality, stability, and globality scores for positive situations. Nonetheless, on a free-recall task, they recalled as many negative words as bipolar depressed patients. Winters & Neale (1985) found that remitted BD patients reported levels of self-esteem similar to those of healthy controls. Indirect measurements, however, demonstrated that patients with BD were more likely than controls to attribute failure situations to themselves, a style frequently observed among patients with MDD (e.g., Alloy et al., 1999). In a study of students at risk for BD, negative attributional styles and dysfunctional attitudes interacted with life events to predict increases in depressed *or* hypomanic symptoms (Reilly-Harrington, Alloy, Fresco, & Whitehouse, 1999).

People at high risk for mania use more defensive responses to threatening experimental tasks (such as writing about one’s own mortality) than do those at low risk for mania (Johnson, Joiner, & Ballister, 2005). Goldberg, Gerstein, Wenze, Welker, & Beck (2008) found that core beliefs among bipolar patients appear to be negativistic even during manic phases. These results can be interpreted in light of the “manic defense” theory in which manic symptoms are seen as protecting the patient from depressive thoughts or feelings of loss. The manic defense may

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represent an extension of the process of thought suppression observed in patients with MDD. Thought suppression may achieve the immediate goal of masking and avoiding negative thoughts which, among patients with BD may lead to mood elevation, excessive optimism and feelings of invulnerability. However, the ironic process of thought suppression may intensify negative cognitions under conditions of stress or challenge (Wegner, 1994; Wegner & Wenzlaff, 1996).

The first objective of this study was to compare the thought suppression process in remitted and partially remitted patients with BD, patients with a history of MDD, and healthy controls using a modified version of Wenzlaff and Bates's (1998) Scrambled Sentence Task (SST). We hypothesized that both patients with BD and MDD would engage in active suppression of negative thoughts as a way of gaining control over their mood states. This tendency would be revealed in unscrambling more sentences in the negative valence (rather than neutral or positive valence) than controls under conditions of cognitive load. We also predicted that BD and MDD patients would report more use of negative thought suppression in their day-to-day lives than controls, and that those who reported more negative thought suppression would unscramble more negative sentences on the SST.

The second aim was to determine whether the thought-suppression/ironic process hypothesis could be extended to the phenomenon of "hyperpositive thinking." Patients with BD are thought to overestimate the rewards and underestimate the risks of a challenging situation (e.g., investing in a new business scheme) because these situations may engage the behavioral activation system (Alloy et al., 2006; Johnson, 2005; Lam, Wright, & Smith, 2004). We hypothesized that patients with BD, when in remission or partial remission, would suppress thoughts that signal great accomplishment, excessive optimism, or risk underestimation (e.g., "I like doing risky things;" "I always reject others' advice") because these thoughts may signal the onset of a new manic or hypomanic episode. These thoughts would be expected to become more frequent under conditions of cognitive load. To test this hypothesis, we extended the Scrambled Sentence Task to include sentences that could be completed in a neutral or a hyperpositive (manic, grandiose) way.

The third aim concerns the moderating effects of reward on thought suppression. Elevated reward sensitivity (Johnson, Fulford, & Eisner, in press; Meyer, Johnson, & Winters, 2001) and heightened ambitions (Johnson, Eisner, & Carver, 2009) have been observed among patients with BD during periods of euthymia. Life events involving goal attainment (Johnson et al., 2000; Johnson et al., 2008), overly confident views of self (Lam, Wright, & Sham, 2005), and excessive goal engagement (Lozano & Johnson, 2001) are prospectively associated with elevations in manic symptoms within bipolar I samples. Consequently, we predicted that among outpatients with BD, but not among patients with MDD, negative or hyperpositive thought suppression would be more frequent under conditions of reward opportunity. To test this hypothesis, we added an additional condition in which participants were rewarded for completing sentences during the Scrambled Sentence Task.

Method

Participants

The participants (N = 76) were 36 patients with remitted or partially remitted bipolar I or II disorder (BD group), 20 patients with a history of major depressive disorder (MDD), and 20 healthy controls (HC). Bipolar patients were recruited from the outpatient mood disorders clinic of the Warneford Hospital, Oxford University, Oxford, UK, or from community advertisements posted in the city of Oxford or on the internet. Patients with MDD and healthy controls were recruited from community advertisements or internet postings. This study was approved by the Oxfordshire Research Ethics Committee.

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Patients with BD met the following eligibility criteria: (1) age 18 – 70 yrs; (2) good understanding and comprehension of English; (3) a DSM-IV-TR (American Psychiatric Association, 2000) referral diagnosis of bipolar I or bipolar II disorder, as verified by a trained clinical psychologist using the MINI International Neuropsychiatric Interview (Sheehan et al., 1998); (4) no fully syndromal mood episodes or substance abuse or dependence disorders in the past 3 months; and (5) a score below 16 on the Hamilton Rating Scale for Depression (HRSD; Hamilton, 1960) and below 12 on the Young Mania Rating Scale (YMRS; Young, Biggs, Ziegler, & Meyer, 1978). Hence, patients could have mild to moderate symptoms but could not be in an acute mood episode. The patients with MDD met the same eligibility criteria, with the exception that the MINI diagnosis was lifetime MDD by the DSM-IV-TR and current HRSD scores below 16. The healthy controls had no current or past history of a DSM-IV-TR diagnosis.

Of 40 patients with diagnoses of BD who were referred by their psychiatrists, 24 consented to the study and were included. Additionally, 29 patients with BD responded to community advertisements; of these, 16 consented and were included. The procedures were piloted with the first four patients with BD who were not included in the final sample (N = 36; 17 with BD I, 19 with BD II). For the MDD and control groups, 141 volunteers initially contacted the research team; of these, 96 were no longer interested after receiving the study information sheet. Thus, 45 volunteers were interviewed and met the inclusion criteria for the MDD or HC groups. An additional 5 were excluded on the basis of the first interview (for example, HRSD scores ≥ 16), leaving 20 in the MDD group and 20 in the HC group.

Procedures

All study volunteers arrived at a research office and read and signed a University Ethics Committee approved informed consent form. Demographic information such as age, marital status, occupation, current medications, and history of psychiatric treatments was obtained. Next, a trained Ph.D.-level research diagnostician administered the MINI diagnostic interview, the HRSD, the YMRS, and the modified SST (see below).

MINI International Neuropsychiatric Interview

The MINI is a structured interview with screening questions regarding each of the DSM-IV major Axis I disorders (e.g., mood, psychotic, substance abuse, anxiety, ADHD), followed by yes/no questions about each individual symptom. The MINI has strong reliability and validity data in relation to the Structured Clinical Interview for DSM Diagnoses (Sheehan et al., 1998), with interrater reliabilities ranging from 0.89–1.0 (Kappas) for the diagnoses of MDD and BD (N = 370).

HRSD and YMRS

Following the MINI, the diagnostician conducted semi-structured interviews concerning the participant's mood state in the past 1–2 weeks, including probes regarding how frequently each symptom had occurred, its duration, and its severity. The HRSD contains 17 items scaled from 0 to 4. The YMRS contains 11 items scaled from 0 to 8. The interrater agreement between two Ph.D.-level independent evaluators (DJM and YA) based on 15 conjoint ratings of patients and controls in this sample was high (HRSD items, $K = .73$; YMRS items, $K = .82$).

Scrambled Sentence Task

The SST, a paper-pencil task, consisted of six-word sentences which the subject was asked to unscramble to form five-word sentences, leaving one word out. The original 60 sentences (Wenzlaff & Bates, 1998) could be completed such that the resulting five-word sentences conveyed either negative/depressive content or neutral/ mildly positive content (e.g., "am life

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improving my ruining I”). An additional 60 sentences with *hyperpositive* (manic/goal-directed) content were constructed for this study through consulting self-report scales of manic cognition (e.g., Beck, Colis, Steer, Madrak, & Goldberg, 2006; Mansell & Jones, 2006). These new sentences could be completed in either a negative or a hyperpositive way (“Am winner born am loser I”; “Hopeless feel nowadays powerful I very”) or in a hyperpositive or neutral way (“Very ideas appropriate my original are”; “Always works taking sometimes chances out”). Figure 1 illustrates these distinctions.

All 120 sentences were then reclassified by four raters as depressive/neutral (53 of the 60 sentences from the Wenzlaff and Bates [1998] set), negative/hyperpositive (33 sentences, including 3 reclassified from the Wenzlaff and Bates set), and 29 hyperpositive/neutral sentences. The interrater reliability for these classifications was 92% (K = .87). Five sentences were excluded because their affective valence was ambiguous, leaving a final set of 115 sentences. After the sentences were scrambled, they were randomly organized within four tasks, each containing between 28–30 sentences, and each containing equal proportions of sentences with negative/neutral (46%), negative/hyperpositive (29%), or hyperpositive/neutral (25%) content ($\chi^2(6) = 3.09$, $p = .80$).

The research diagnostician began by reading the following instructions:

“You will be asked to unscramble sentences to form statements. Each of the scrambled sentences contains six words. Unscramble five of the words in each sentence by placing a number over each of the five words indicating the proper order (example given). Each sentence can be unscrambled into more than one statement, but you should choose only one statement to unscramble - the first one which comes to mind.”

The four SST conditions were then presented to participants in counterbalanced order, with the following instructions given before each sentence set. They were given up to 6 min. to complete each set.

Condition 1, No Load/No Reward (NL/NR)—Participants were instructed to unscramble as many sentences as possible, as quickly as they could (as above).

Condition 2, No Load/Reward (NL/R)—The instructions were identical to the NL/NR condition except the subjects were told “you will hear a reward bell for every four items you finish. Try to work fast so you can achieve as many bell sounds as you can.” The experimenter then chimed a “mindfulness bell” (a bell with a pleasing tone) after every four sentence completions.

Condition 3, Load/No Reward (L/NR)—Participants were told, “I will give you a 6-digit number to remember. Keep this number in mind as you work on your sentences. You will be asked to recall it later.” Subjects were then given a 6-digit number (e.g., 469827) and asked to complete another sentence set. At the end of the task, they were asked to recall the number. The experimenter recorded the number of digits recalled in the correct order.

Condition 4, Load/Reward (L/R)—Participants were asked to perform as in condition 2, and were given reward bells after completing every four items. They were simultaneously asked to hold a different 6-digit number in mind. Once again, they were asked to recall the number after completing the sentences.

Upon completing the SST, participants rated (1) the *frequency of their use of negative thought suppression* as a coping strategy, using Likert scales ranging from 1–7 (where *1= never, 7= all the time*): “In the past month, *how often* have you tried to suppress (i.e., keep out of mind)

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unwanted negative thoughts and feelings?” and (2) the *success of negative thought-suppression* as a strategy (where *1= not at all successful, 7 = very successful)*: “In the past month, *how successful* have you been in suppressing (i.e., keeping out of mind) unwanted negative thoughts and feelings?’’ Participants also made ratings on 1 – 7 scales of the frequency or success of positive thought suppression (i.e., keeping out of mind any cheerful, optimistic, or highly confident thoughts) over the past month.

Results

Sample Characteristics

The patients with BD were older (M = 40.8, SD = 13.3) than the healthy controls (M = 29.6, SD = 16.0) (p = .01) but did not differ in age from the patients with MDD (Table 1). The HC participants were more likely (75%) to be students than the participants with BD (28%) or MDD (30%) (p =.003). The patients with BD were more likely than patients with MDD to be taking psychiatric medications (77% versus 25%; p = .001). No differences were found between the groups in general cognitive ability as assessed by Raven’s Progressive Matrices (Table 1).

There were no differences between the bipolar I (n = 17) and II (n = 19) patients on any of the demographic or symptom variables in Table 1. Thus, the bipolar I and II patients were combined into one group (n = 36) for the primary analyses.

Number of Sentences Completed on the SST

First, we examined the overall number of sentences completed under the four experimental conditions using a 2 × 2 × 3 (no load/load; no reward/reward; bipolar, MDD, or HC) factorial ANOVA. There was a main effect of the load manipulation ($F(1,73) = 67.25$, $p < .001$). Post-hoc comparisons using the Holm-Bonferroni sequential rejective method (Holm, 1979) indicated that regardless of diagnostic group, participants completed more sentences under no-load as compared to load conditions ($p < .05$). There was also a main effect of reward ($F(1,73) = 8.37$, $p = .005$), indicating that subjects completed more sentences under reward than under non-reward conditions. Number of sentence completions was treated as the denominator when comparing groups on the proportion of negative or hyperpositive sentence completions.

Negative and Hyperpositive Sentence Completion Scores

For each participant, two proportion variables were calculated: (1) the *proportion of negative sentence completions* in each SST condition, calculated as the number of negative-hyperpositive and negative-neutral sentences completed in the negative (depressive) direction, divided by the total number of completed sentences in that condition; and (2) the *proportion of hyperpositive sentences* completed in each condition, calculated as the number of hyperpositive-neutral sentences completed in the hyperpositive (manic) direction, divided by the total number of completed sentences in the relevant condition.

There was no effect of sentence type (negative/neutral versus negative/hyperpositive) on the proportion of sentences completed in the negative direction in any of the participant groups (main effect of sentence type, $F(1,73) = .84$, p =.36; sentence type x group interaction, $F(2,73)$ =.45, p = .64). However, there was a main effect of sentence type (negative/hyperpositive versus hyperpositive/neutral) ($F(1,73) = 79.67$, p =. 001), and a two way interaction between sentence type and group ($F(1,73) = 12.06$, p = .001) on hyperpositive sentence completions, indicating that when given negative/hyperpositive sentences, healthy control participants completed more in the hyperpositive direction than participants with BD (Holm-Bonferroni corrected $p < .05$). To adjust for these differences, the percentage of hyperpositive sentences was calculated as the proportion of sentences completed in the hyperpositive direction only when subjects were given hyperpositive/neutral options (e.g., “Superior most I’m others to

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equal"). The negative/hyperpositive sentences were included only when calculating the total proportion of negative sentence completions. Neither negative nor hyperpositive completion scores were correlated with participants' age, gender, Raven Progressive Matrices Scores, or student/nonstudent status (for all, $p > .05$; $N = 76$).

Was the Load Manipulation Successful?

Prior to testing the primary hypotheses, we examined whether participants in the three groups differed in their ability to recall the 6-digit number after the L/NR or L/R tasks. A 2 (L/NR, L/R) × 3 (BP, MDD, HC) factorial ANOVA showed that the BD patients recalled fewer digits than the controls in the L/NR condition ($F(2, 75) = 3.08$, $p = .05$) but not in the L/R condition ($F(2, 75) = 1.84$, $p > .10$). Hence, we conducted secondary analyses comparing the groups on the proportion of negative or hyperpositive sentence completions in the load conditions using only the 54 participants (BD, 21/36 [58.3%]; MDD, n= 15/20 [75.0%]; HC, n = 18/20 [90.0%]) who recalled 5 or more digits.

Do Bipolar Patients Unscramble More Negative Sentences Under Load and Reward Conditions?

The primary study hypothesis was that BD patients would complete proportionately more sentences in the negative direction than healthy controls under conditions of cognitive load, and more sentences in the negative direction than either MDD or healthy control subjects under conditions of reward. To test this hypothesis, we conducted a 2 × 2 × 3 analyses of variance (ANOVA), with no-load/load and no-reward/ reward as within subject variables and group (BD, MDD, HC) as the between subjects variable; the percentage of negative sentence completions was the dependent variable.

There was a three-way interaction between load, reward, and group ($F(2,73) = 4.11$, $p =.02$), indicating that in the absence of load and reward (the NL/NR condition), the participants with BD produced a greater proportion of negative sentences than the healthy controls (Holm-Bonferroni corrected $p < .05$; Cohen's d statistic =.87) but did not differ significantly from the participants with MDD ($p > .05$; see Fig. 2). [1] The BD participants also produced a greater proportion of negative statements in the reward-only condition (NL/R) than the HC (corrected $p < .05$, $d = 1.32$) and the MDD participants ($p < .05$, $d = .80$). The MDD group did not differ from the HC group in either the NL/NR or the NL/R condition (*ps* > .05).

Consistent with the hypotheses, in the load-only condition (L/NR), both the bipolar and MDD groups produced higher proportions of negative sentences than the healthy controls (BD vs. HC, $d = 1.49$; MDD vs. HC, $d = .83$; corrected ps < .05). The BD and MDD groups did not differ significantly ($p > .05$). Group differences were also observed in the combined load and reward condition (L/R), in which the bipolar and MDD groups produced higher proportions of negative sentences than the healthy controls (BD vs. HC, $p < .05$; $d = 1.33$, MDD vs. HC, $p < .05$, $d = .97$), but did not differ from each other ($p > .05$).

Were Differences in Negative Sentence Completions Due to Baseline Levels of Negative Bias?

Responses to the NL/NR condition were conceptualized as each subject's baseline level of negative or hyperpositive bias during the SST task. To rule out the possibility that significant

[1]Because proportional scores are often skewed, Lipsey & Wilson (2001) recommend using arcsine transformations prior to conducting ANOVAs. The three-way interaction between diagnostic group, load and reward for proportion scores was of similar magnitude when negative completion scores were arcsine-transformed ($F(2,73) = 4.45$, $p = .015$). Moreover, the effect size for the bipolar/healthy control comparison in the NL/NR condition was virtually identical when using arcsine-transformed (Cohen's $d = .85$) and untransformed scores ($d = .87$) (*p*s < .05).

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differences between groups in the load and reward conditions were due to initial differences in baseline NL/NR scores, we calculated an *impairment index* for each subject in each of the remaining three conditions (NL/R, L/NR, and L/R), calculated as a percentage difference score from the NL/NR condition. For example, to determine the effect of reward on negative sentence completions in the NL/R condition, a reward impairment index was calculated as the percentage of negative completions in the NL/R condition subtracted from the percentage of negative completions in the NL/NR condition. The use of difference scores to control baseline differences is recommended over analyses of covariance when subjects are not randomly assigned to groups (Dallal, 2005).

Similar to the results of the factorial ANOVAs, there was a significant difference between the groups in degree of impairment due to the load manipulation (F(2,73) = 3.68, p =.03; Figure 3). The omnibus difference remained significant after controlling for age ($p < .05$) and Raven Progressive Matrices scores ($p < .05$). Holm-Bonferroni corrected post-hoc comparisons indicated that the bipolar group showed a more depressive bias due to the load manipulation than the HC group ($p < .05$; Cohen's d = .71), but the MDD and HC groups did not differ ($p > .05$). Participants with BD and MDD did not differ in load impairment scores (p > .05).[2]

There was also a significant difference between the groups in impairment due to the reward manipulation (F(2,73) = 4.02, p =.02; Figure 3). This omnibus result remained robust after controlling for age (p=.03) and Raven Progressive Matrices scores (p =.003). The group difference was attributable to the higher reward impairment index scores in the BD than the HC group (corrected $p < .05$; d= .79); the remaining pairwise group comparisons did not reach significance ($p > .05$). Finally, the group comparison in impairment scores in the load plus reward (LR) condition did not reach significance (F(2,73) = 2.70, p =.07).[3]

Effects of Current Mood

The HRSD and YMRS scores were square root transformed to adjust for positive skew. A comparison of the three groups revealed an omnibus difference in transformed HRSD scores (F (2, 73) = 20.74, $p < .0001$). Pairwise group contrasts with Holm-Bonferroni adjustments indicated that the BD (untransformed M = 6.2, SD = 5.4) and MDD (M = 4.0, SD = 2.9) groups each had higher (p < .05) HRSD scores than the HC group (M = 0.65, SD = 1.1), but did not differ from each other ($p > .05$). As expected, the BD group had higher mean YMRS scores (untransformed M = 4.3, SD = 4.4) than the MDD (M = .95, SD = 1.4) and HC groups (M = 0.40, SD = .75) (F(2, 75) = 11.7, $p < .001$).

An analysis of covariance revealed that diagnosis was no longer significantly associated with negative sentence completion scores in the baseline NL/NR condition (F(2,73) = 1.61, p = .21) once HRSD scores were covaried; HRSD scores were independently associated with negative completion scores (F(1, 72) = 11.18, $p < .002$). The group differences in the load impairment index (F(2,72) = 2.36, p = .10) and the reward impairment index (F(2,72) = 2.52, p = .09) were weakened by inclusion of HRSD scores in the ANOVA models, although the effect sizes for these pairwise comparisons were similar to ANOVA comparisons that did not include HRSD scores as covariates (load impairment: 70 versus .71; reward impairment: .77 versus .79).

YMRS scores bore no relationship to the negative sentence completion variables (for all, $p > .10$). The greater proportion of negative sentence completions in the BD than the HC group

[2]When the group comparisons on the load conditions were repeated using only the participants who correctly recalled 5 or more of the 6 digits, the difference between the bipolar and HC groups in the load impairment index remained significant ($p < .05$).

[3]The pattern of group differences was identical when impairment scores were arcsine-transformed: load impairment scores, F(2,73) = 3.66, p = .03; reward impairment scores, F(2, 73) = 4.02, p = .02; and load/ impairment scores, F(2, 73) = 2.70, p = .07.

within the NL/NR condition was not affected by covarying YMRS scores (F(2,72) = 5.23, *p* < .01; d = .94). However, the group differences in load impairment scores (F(2,72) = 2.38, *p* =.10; d = .50) and reward impairment scores (F(2,75) = 2.13, *p* = .13; d = .65) became nonsignificant once YMRS scores were covaried.

Do Bipolar Patients Unscramble More Hyperpositive Sentences Under Load and Reward Conditions?

Next, we tested the hypothesis that, when given hyperpositive/neutral sentence options, the bipolar patients would react to cognitive load and reward by completing more sentences in the hyperpositive direction. A 2×2×3 ANOVA was conducted with no-load/ load and no-reward/ reward as within subject variables and group (BD, MDD and HC) as the between-subjects variable. The results show a main effect of reward (F(1,73) = 12.48, *p* = .001). Under reward conditions, all participants produced more hyperpositive statements than under non-reward conditions. However, no group differences or group by condition interactions were observed in this analysis (Table 2). Inclusion of HRSD or YMRS scores in ANCOVA models did not affect the results (all *p*s > .05).

Do Patients with Bipolar Disorder Report Higher Levels of Thought Suppression Than Comparison Groups?

There were significant differences between the groups in the self-reported frequency of negative thought suppression, based on a 1–7 Likert-type rating (Table 3; F(2,73) = 4.87, *p* =. 01). The BD group reported more frequent use of negative thought suppression than the controls (corrected *p* < .05) but not the MDD group (*p* > .05). There was also a significant difference between groups in self-reported success in suppressing negative thoughts (F(2,72) = 7.52, *p* = .001), with both the bipolar group and the MDD group (*p* < .05) reporting less success than the HC group. However, these differences could be largely attributed to current mood states: when depressive symptoms (HRSD) were covaried, the group differences in frequency ratings (F(2,72) = .25, *p* > .10) and success ratings (F(2,72) = 2.13, *p* > .10) were no longer significant.

There was also significant difference between groups in the self-rated *frequency of positive thought suppression* (F(2,73) = 3.63, *p* = .03). The patients with BD reported a significantly higher frequency than the patients with MDD (*p* < .05) but not the controls (*p* > .05). The difference between BD and MDD patients in the frequency of self-reported positive thought suppression was no longer significant when YMRS scores were covaried (F(2,72) = 2.18, *p* > .10).

Does Self-Reported Negative Thought Suppression Predict Performance on the SST?

We predicted that (1) frequent use of negative thought suppression would be associated with a greater tendency to complete negatively-valenced sentences during the SST, and (2) these associations would be strongest in the bipolar and MDD groups, especially under load and reward conditions. We examined this hypothesis in multiple regression models, in which the independent variables were diagnosis and self-reported negative thought suppression scores (centered), and their interaction. The dependent variables were the proportion of negative sentences produced in the four conditions.

Indeed, greater self-reported frequency of negative thought suppression was related to a greater proportion of negative sentence completions across conditions, independent of diagnostic group (F (1, 70) = 12.62, *p* < .001). In contrast, self-reported success in suppressing negative thoughts was related to fewer negative sentence completions across conditions and diagnoses (F(1,69) = 6.05, *p* = .016). There were no significant interactions between diagnosis and self-reported frequency or success of negative thought suppression in predicting negative sentence completions in any condition (all *ps* > .10).

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Next, we sought to determine whether the self-reported frequency of thought suppression affected the observed group differences in the proportion of negative sentence completions. We used ANCOVAs to compare the groups on the load and reward impairment indices while including the frequency, and separately, the success of negative thought suppression as covariates. The group differences in the baseline (NL/NR) condition – in which BD participants completed proportionately more negative sentences than controls - remained significant when the frequency of negative thought suppression was covaried ($F(2,72)=3.33$, $p=.04$; d = .58), but dropped to a marginally significant level when success scores for negative thought suppression were covaried ($F(2,71) = 3.07$, $p = .05$; d = .54).

The proportional difference between the BD and HC groups in impairment due to the load manipulation was no longer significant when the self-reported frequency of negative thought suppression was covaried ($F(2,72) = 2.29$, $p=.11$; d = .57) but remained significant when success ratings were covaried ($F(3,74)=3.40$, $p = .04$; d =.77). Finally, the finding of greater reward impairment in the BD relative to the MDD or HC groups was weakened by covarying the frequency of negative thought suppression ($F(3,75) = 3.02$, $p < .06$; d = .72). This group difference remained statistically reliable when success ratings were covaried ($F(2,71) = 4.41$, $p = .016$; d = .89).

Discussion

This study examined the role of thought suppression in masking negative and hyperpositive thoughts among outpatients with bipolar disorder. Patients with BD produced more negative sentences during an implicit, automatic processing task (the no load/no reward SST) than healthy controls, whereas patients with a history of MDD did not differ from either group. However, when mental control was disrupted by a cognitive load (rehearsing a 6-digit number), both the bipolar and MDD patients completed more negatively-valenced sentences than the controls. Thus, both groups of patients with mood disorders were biased toward negative material when mental control was depleted. These group differences were no longer significant once mood state scores were covaried.

Although patients with BD reported more frequent use of negative thought suppression in the past month than the controls, they also reported being less successful in suppressing negative material. Thus, the negative biases observed in BD might be the result of ineffective mental control. This hypothesis is consistent with the positive correlation in the full sample between the self-reported frequency of negative thought suppression and the proportion of negative sentence completions across conditions, and the inverse correlation between the self-reported success of negative thought suppression and the proportion of negative sentence completions. Moreover, differences between patients with BD and healthy controls in negative sentence completions due to the load manipulation became nonsignificant when the self-reported frequency of negative thought suppression was covaried.

These findings add to a body of literature suggesting that, like patients with MDD, patients with BD show negative cognitive biases during implicit cognitive processing tasks (Kerr, Scott, & Phillips, 2005; Lyon et al., 1999; Wenzlaff & Bates, 1998; Winters & Neale, 1985). Future research should examine whether negative thought suppression among patients with BD is the end result of less effective mental control or a greater negativity bias in attention or memory relative to healthy persons or persons with other psychiatric disorders.

The differences in negative thought suppression among the groups were attributable in part to current mood symptoms. Severity of concurrent mood symptoms cannot be fully disentangled from DSM-IV diagnoses: patients with BD rarely present for treatment or research in full remission. Indeed, patients with BD spend approximately half of the weeks of their lives in

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syndromal or subsyndromal states of illness, particularly depression (Judd et al., 2002). Other studies have found that the negativity of cognitive styles is related to the severity of depression in both bipolar and major depressive illness, and that cognitions appear to be more negative during depressive periods than euthymic periods (Cuellar, Johnson, & Winters, 2005; Knowles, Tai, Christensen, & Bentall, 2005; Seligman et al., 1988; Thomas & Bentall, 2002). Furthermore, negative cognitive styles and low self-esteem predict increases in depression over time among bipolar patients (Johnson & Fingerhut, 2004; Johnson, Meyer, Winett, & Small, 2000). When combined with residual mood symptoms, less effective mental control – or alternatively, a greater negativity bias - may put patients with BD at increased risk for earlier recurrences of depression.

A secondary purpose was to examine whether thought suppression extended to the hyperpositive thinking (excessive optimism, extreme self-confidence and risk underestimation) often characteristic of BD. We predicted that patients with BD would suppress hyperpositive thoughts whose presence could evoke memories of prior manic, mixed or hypomanic episodes. Indeed, patients with BD reported more use of positive thought suppression than patients with MDD, although this group difference disappeared once concurrent levels of mood elevation (YMRS scores) were controlled. In the SST, there were no differences among the groups in the proportion of hyperpositive/neutral sentences completed in the hyperpositive direction. In fact, when asked to unscramble sentences with either negative or hyperpositive content, the healthy controls were more likely than the patients with BD to complete the sentences in the hyperpositive direction.

Possibly, the hyperpositive sentences used in this study may have reflected normative optimism and positive self-esteem rather than manic grandiosity and inflated self-confidence. Alternatively, the positively-biased cognitions often described in bipolar disorder may be mainly a feature of the prodromal or active periods of mania or hypomania rather than the remitted states. Current theories of cognition in bipolar disorder emphasize the interaction of positive and negative information processing biases in predicting how different symptom states (e.g., mania, mixed episodes, depression with hypomania) develop over time among different patients (Mansell & Pedley, 2008).

Finally, we examined the role of rewards in the processing of negative and positive information. Considerable evidence suggests that bipolar patients experience greater cognitive reactivity to positive stimuli than other psychiatric or healthy comparison groups (Johnson, 2005; Lam et al., 2004). Bipolar patients or students at risk for BD report higher levels of reward responsiveness and elevated success expectancies relative to controls (Johnson et al., 2009; Meyer, Johnson, & Carver, 1999), which in turn are associated with increases in manic symptoms over time (Johnson et al., 2000; Meyer et al., 2001). We found evidence to support our hypothesis that a simple reward – a bell rung following every 4 sentence completions - would disrupt mental control in the BD group and yield higher proportions of negative sentence completions. Like the load manipulation, reward may have increased the accessibility of negative thoughts in the bipolar group. Unlike load, however, reward was associated with a greater number of sentence completions in all groups. Moreover, the proportion of hyperpositive/neutral sentences completed in the hyperpositive direction increased in the reward conditions, suggesting that when faced with this choice, rewards bias participants toward a more optimistic outlook.

These findings suggest that the effects of reward in increasing negative cognition among bipolar patients cannot be easily explained by mental control theory alone. Rewards may engage confidence and goal pursuit among patients with BD but also bring to mind memories of failure in achievement situations and feelings of low self-worth (Alloy et al., 2005; Eisner,

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Johnson, & Carver, 2008). Self-worth appears to be more reactive to sudden mood shifts among persons with bipolar disorder than among healthy persons (Johnson, 2005).

Some studies have found that individuals with BD or at risk for BD are characterized by high drive/incentive motivation, ambitious goal-setting, conscientiousness, and perfectionism, and are more likely to become depressed under achievement failure circumstances (Alloy et al., 2005; Lozano & Johnson, 2001). Possibly, reward activates self-discrepancy processes (i.e., mismatches between actual self and idealized views of the self; Higgins, Bond, Klein, & Strauman, 1986) and failure beliefs when a goal is perceived to be difficult to obtain, which may in turn lead to decreased goal-setting, lower expectancies of success, a reduction in goal-oriented behaviors, and negative mood. Patients with bipolar disorder may be more likely than healthy controls to engage in self-criticism to motivate themselves, which may result in negatively biased thoughts during a reward task. The small amount of evidence suggests that bipolar and unipolar patients are equally self-critical when in remission (Eisner, Johnson & Carver, 2008; Rosenfarb, Becker, Kahn & Mintz, 1998). These are issues that deserve further study, especially using laboratory paradigms that go beyond self-report questionnaires to include implicit processing tasks under conditions of reward or failure.

Several limitations of the study warrant comment. First, the scrambled sentences tasks did not involve a direct manipulation of thought suppression. The correlation between frequency of negative thought suppression and the proportion of negative sentence completions in the SST suggests some degree of consistency in the construct across measurement methods. Nonetheless, it is possible that we simply measured the conditions under which negative interpretation biases occur. In an experimental manipulation, Beevers & Meyer (2008) randomly assigned college students to a dysphoric mood induction or a control condition, and then gave thought suppression instructions during a writing exercise (i.e., to not have negative thoughts during the exercise versus writing freely about a topic). The instructions to suppress negative thoughts increased the accessibility of negative thoughts even after the participants' dysphoric mood had lifted. Studies that directly manipulate thought suppression may clarify the role of this process in bipolar and other clinical populations.

Second, it did not prove feasible to obtain a cross-sectional sample of patients with BD or MDD who were entirely free of symptoms. As is common in outpatient samples of bipolar I and II patients (Judd et al., 2002; Perlis et al., 2006), the participants had mild-to-moderate levels of subsyndromal depression. It remains uncertain whether we would have found group differences in negative thought suppression among patients who were asymptomatic. Indeed, reward sensitivity diminishes when a person experiences even mild depressive symptoms (Meyer et al., 2001). Examining the longitudinal association between changes in thought suppression, reward, and mood would clarify the direction of effects between these domains of functioning in BD.

Third, the patients with BD were more likely to be undergoing pharmacotherapy than the patients with MDD, and may have been more severely ill than their MDD counterparts. It was also not possible to rule out the influential effects of common comorbid conditions (or their correlated treatments) - such as borderline personality disorder or attention deficit/hyperactivity disorder - on task performance. Moreover, the healthy controls were younger and more likely to be students than the mood disorder groups. Although age and Raven Progressive Matrices scores did not appear to explain the group differences, our design should be replicated in studies that use patient and control samples matched on a pairwise basis on demographic variables that might affect performance on the SST.

Fourth, only 58% of the patients with BD achieved adequate recall of the digits in the load task, which could imply failure to engage with the task. Nonetheless, the key results concerning

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negative thought suppression were observed in the subsample of participants who recalled 5 or more of 6 digits. It is possible that the patients with BD had more memory impairment than the MDD or healthy control subjects, such that the load demands of the task were satisfied in this subsample. On the other hand, memory impairment may have generated greater frustration and pessimistic attributions among the participants who had difficulty recalling the digits in the load tasks. Indeed, BD patients show significant neuropsychological impairment even when euthymic (Clark, Kempton, Scarnà, Grasby, & Goodwin, 2005; Schretlen et al., 2007). Cognitive load manipulations that do not rely heavily on memory rehearsal strategies (e.g., distraction) would test the generalizability of the present findings.

Finally, the reward bell, although containing a pleasing “wind chime” tone, may not have been experienced as a positive incentive stimulus by some of the participants. Our finding that all groups completed more sentences under reward than non-reward conditions does suggest that the bell served its function as a reward (a stimulus that increases the frequency of a behavior). Nonetheless, future studies should examine the effects of more ecologically valid reward opportunities (e.g., praise, money, public recognition, immediate success feedback) – some of which have been successfully simulated in experimental studies of goal pursuit (Johnson, 2005) - on the level of thought suppression among bipolar and MDD patients. Including measures of reward sensitivity (e.g., the Behavioral Activation Scales; Depue, Kleinman, Davis, Hutchinson, & Krauss, 1985) may further clarify important mediating variables in these reward pathways (Alloy et al., 2008; Johnson, 2005).

Investigating treatments whose objective is to reduce thought suppression may help clarify the role of these processes in recovery from mood episodes or risk for recurrences. Controlled trials of cognitive behavioral therapy (CBT) for BD have yielded less consistent results than trials of CBT for MDD, suggesting that cognitive theories of depression cannot be automatically translated into theories about the cognitive underpinnings of BD (Hollon et al., 2002; Miklowitz & Scott, 2009). Preliminary data suggest that mindfulness-based cognitive therapy (MBCT) may be effective in alleviating depression and anxiety symptoms among patients with BD (Miklowitz et al., in press; Williams et al., 2008). MBCT is associated with reductions in self-reported negative thought suppression among individuals with past depression and suicidality (Hepburn et al., 2009). Demonstrating that MBCT or similar interventions reduce thought suppression in BD, and in turn alleviate symptoms, would help establish the primacy of this cognitive process in the pathways between life stress and outcome in bipolar disease.

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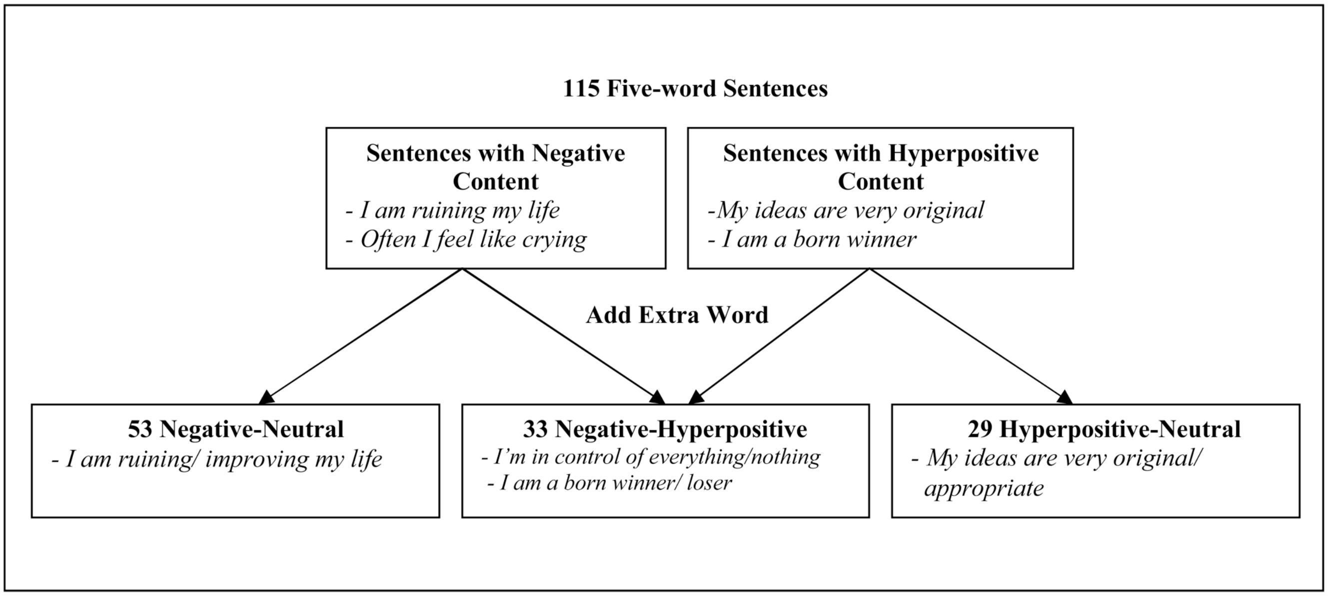

Figure 1.
Construction of the Scrambled Sentence Task set.

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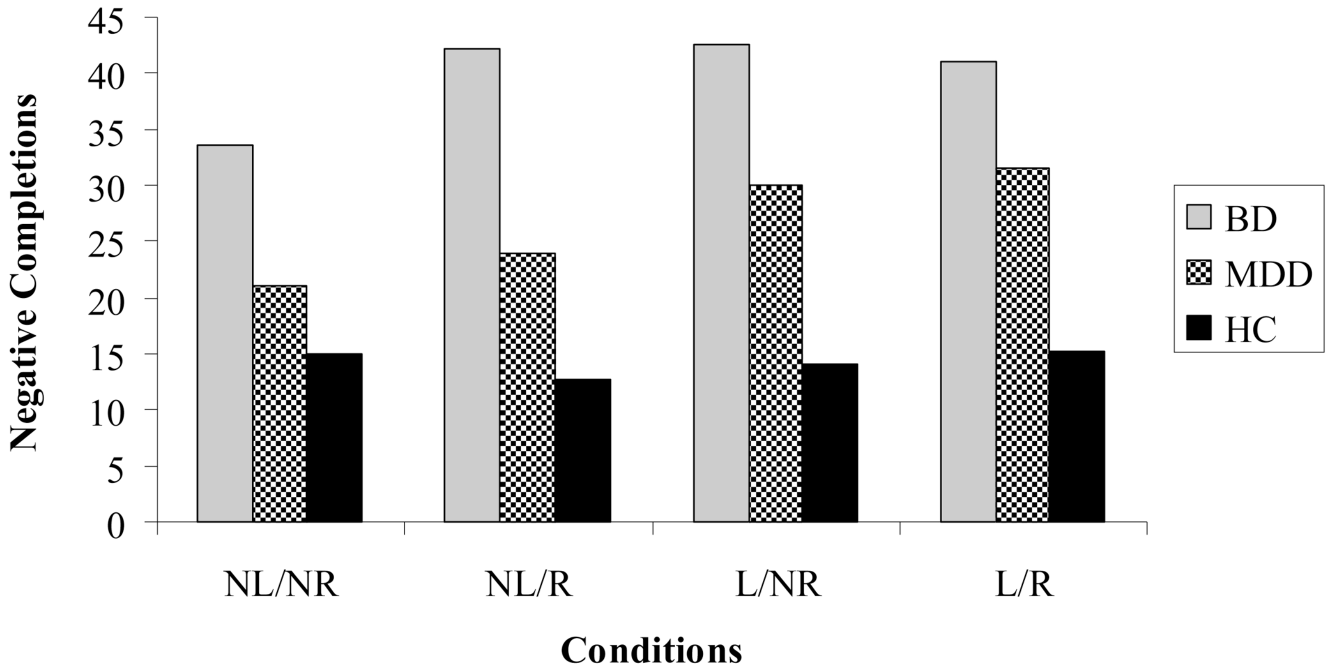

Figure 2.
Percentage of negative sentence completions (number of sentences completed in the negative direction divided by total number of sentences completed) by groups and task conditions. BD = bipolar disorder, MDD = major depressive disorder, HC = healthy control. There was a three-way interaction between load, reward, and group ($F(2,73) = 4.11$, $p = .02$).

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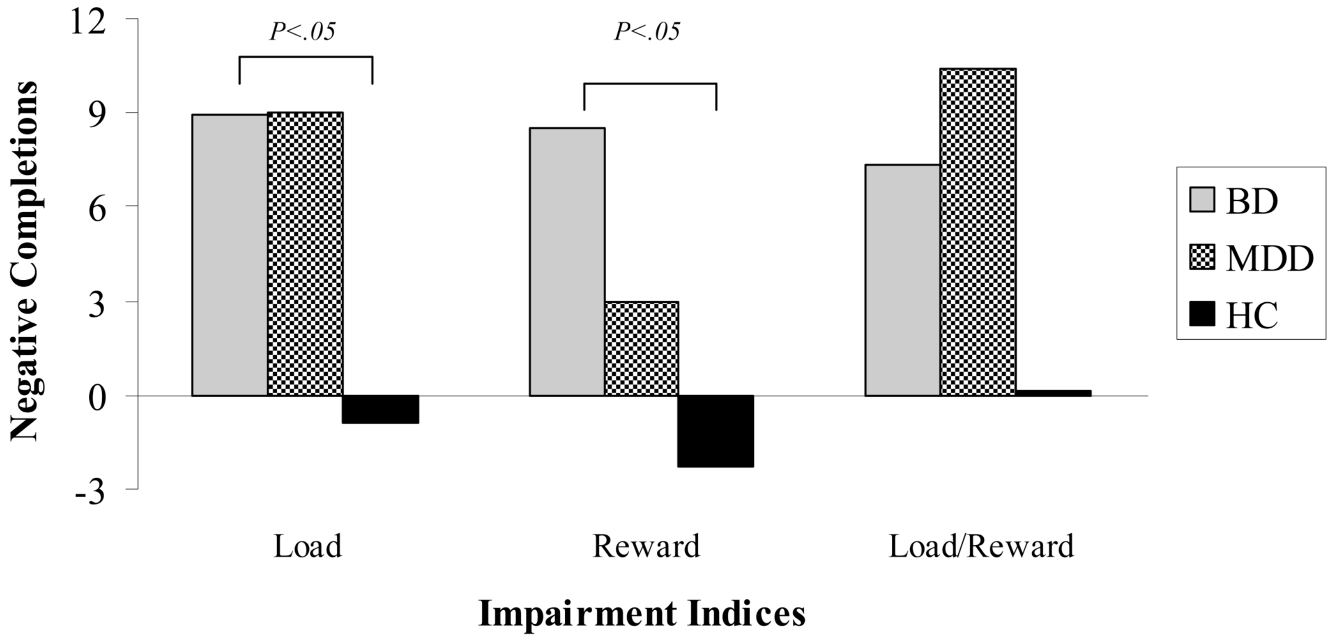

Figure 3.
Impairment indices by groups. Impairment indices were calculated as a percentage difference score between the L/NR, NL/R, and L/R conditions and the NL/NR condition. Load = impairment index due to load (L/NR – NL/NR). Reward = impairment index due to reward (NL/R – NL/NR); Load/Reward = impairment index due to load and reward (L/R - NL/NR). There were significant differences between the groups in degree of impairment due to the load manipulation ($F(2,75)=3.68$, $p=.03$) and the reward manipulation ($F(2,75)=4.02$, $p=.02$).

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Table 1

Sample Description (N = 76)

	BD (n=36)	*MDD* (n=20)	*HC* (n=20)	*Group Difference* *(P-value)*
Age *(SD)*	40.8 (13.3)[a]	34.5 (13.0)[ab]	29.6 (16.0)[b]	*.02*
Age on completing education *(SD)*	22.3 (5.2)	20.06 (3)	19.5 (3.0)	*.09*
Gender, no. male *(%)*	14 (39)	8 (40)	10 (50)	*.71*
Married, no. (%)	6 (17)	2 (10)	3 (15)	*.19*
Occupation, no. (%)				
Student	10 (28)	6 (30)	15 (75)	*.003*
Employee	16 (44)	12 (60)	3 (15)	
Unemployed	10 (28)	2 (10)	2 (10)	
Currently taking medication, no. (%)	28 (78)	5 (25)	0 (0)	*.001*
Raven Matrices Score	9.5 (1.9)	10.6 (.99)	10.5 (2.1)	*.07*
Age at illness onset, yrs (SD)	20.4 (10.0)	19.8 (7.9)	--	.85[1]
Depressive episodes, no. (SD)	5.6 (6.2)	3.1 (1.9)	--	.15[1]
Longest episode (mos.)	10.3 (11.0)	8.0 (8.5)	--	.44[1]

Note. BD = bipolar disorder, MDD = major depressive disorder, HC = healthy control. Means with different superscripts differed significantly at $p < .05$ using Bonferroni-corrected post-hoc comparisons. P-values refer to χ^2 or *t*-tests.

[1]Refers to the comparison of the BD and MDD groups only.

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Table 2

Percentage of Hyperpositive Completions by Groups Across Conditions

	BD M (SD) (n=36)	MDD M (SD) (n=20)	HC M (SD) (n=20)
NL/NR	38.9 (24.9)	41.0 (25.8)	43.5 (23.5)
NL/R	50.9 (22.6)	48.4 (15.9)	55.3 (22.3)
L/NR	50.2 (24.8)	45.8 (20.3)	41.5 (19.5)
L/R	49.8 (31.2)	55.6 (21.7)	53.7 (25.0)

Note. NL/NR: no-load/ no-reward; NL/R: no-load/ reward; L/ NR: load/ no reward; L/R: load/ reward. BD = bipolar disorder, MDD = major depressive disorder, HC = healthy controls.

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Table 3

Group Comparisons on Self-Ratings of Thought Suppression

	BD M (SD) (*n* = 36)	**MDD M (SD) (*n* = 20)**	**HC M (SD) (*n* = 20)**	**Group Comparison (*p* value)**
Negative TS				
Frequency	4.06 (1.66)[a]	3.73 (1.80)[a,b]	2.60 (1.63)[b]	*.01*
Success	3.61 (1.13)[a]	4.03 (1.44)[a]	5.18 (1.92)[b]	*.001*
Positive TS				
Frequency	2.32 (1.47)[a]	1.45 (0.83)[b]	1.65 (1.3)[a,b]	*.03*
Success	2.94 (1.46)	2.59 (2.0)	2.60 (1.61)	>*.10*

Note. TS = Thought suppression; BD = bipolar disorder, MDD = major depressive disorder, HC = healthy control. Means with different superscripts differed significantly at p <.05 using Holm-Bonferroni-corrected post-hoc comparisons.