Published in final edited form as:

Psychol Med. 2009 May ; 39(5): 785–791. doi:10.1017/S0033291708004200.

The effect of positive mood induction on emotional processing in euthymic individuals with bipolar disorder and controls

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Abstract

Background—Many studies have used negative mood induction techniques to investigate the effect of emotional state on cognitive performance but positive mood induction paradigms have been used less frequently. The objective of this study was to investigate the effect of positive mood induction on emotional processing in euthymic individuals with bipolar disorder (BD) and controls.

Method—Previously, we reported that positive mood induction using a novel technique based on feedback produced a longer-lasting effect in euthymic individuals with BD than controls (Farmer *et al.* 2006). Here we report the effect of mood induction on two tests of emotional processing, the Affective Go/No-go test (AGNG) and the Cambridge Gamble task (CGT), on which BD patients in the manic phase differ in their performance from controls.

Results—Following positive mood induction, bipolar cases exhibited a positive emotional bias on the AGNG and performed more slowly than controls on the CGT, particularly when making more difficult decisions.

Conclusions—These data confirm that positive mood induction is more effective in individuals with BD than controls. They also suggest that alterations in decision making and attentional biases occur even with transient and subtle changes in mood in bipolar disorder.

Keywords

Affective Go/No-go; bipolar disorder; decision making; emotional processing; mood induction; mania

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Declaration of Interest

The participants who agreed to participate in this pilot study had already participated in a case-control genetic study funded by GlaxoSmithKline Research and Development. Anne Farmer and Peter McGuffin have received consultancy fees and honoraria for presentations, chairing, and participating in expert panels, plus travel and subsistence costs from GlaxoSmithKline, Eli Lilly, Bristol-Myers Squibb and Lundbeck. Jonathan Roiser and Barbara Sahakian have performed consultancy work for Cambridge Cognition.

Introduction

Multiple lines of evidence suggest that during the manic phase, patients with bipolar disorder (BD) show altered processing of emotionally relevant information. For example, Murphy and colleagues found that manic BD patients showed a positive bias on an emotional go/no-go test (Murphy *et al.* 1999) and made suboptimal choices and performed more slowly on a gambling game (Murphy *et al.* 2001). More recent studies reported that manic BD patients made poor choices on the Iowa Gambling Task, tending to choose cards from more risky decks (Adida *et al.* in press), and showed poor probabilistic reward learning due to oversensitivity to occasional rewards when choosing stimuli primarily associated with punishment (Pizzagalli *et al.* 2008). Mood-congruent biases in episodic memory and face processing have also been reported in the manic state (Eich *et al.* 1997; Lembke & Ketter, 2002). Such patterns of cognitive performance contrast with those observed in the depressed state and during euthymia in BD patients (Rubinsztein *et al.* 2000, 2006).

Positive mood induction is one tool that can be used to tease apart the relative contributions of state and trait factors in mediating the cognitive changes seen in manic BD patients. One study suggested that euthymic BD patients were less likely to take advice following positive mood induction (Mansell & Lam, 2006). However, no study to date has investigated the effect of positive mood induction on emotional processing in euthymic individuals with BD.

We therefore investigated the effect of positive mood induction on emotional processing in euthymic individuals with BD and healthy controls, using the Affective Go/No-go test (AGNG) and the Cambridge Gamble task (CGT). In contrast to other mood induction studies, which have generally used self-referent emotional memories or films/music with a strong emotional component, we manipulated mood using a simple feedback paradigm. Previously, we reported that euthymic individuals with BD were more sensitive to mood induction using this technique because they exhibited a longer-lasting positive mood than controls following the procedure (Farmer *et al.* 2006). We hypothesized that positive mood induction in euthymic individuals with BD would also induce the same cognitive changes observed in the manic state. Specifically, we predicted that mood induction would elicit a positive emotional bias on the AGNG and impair decision making on the CGT.

Method

Participants

Fifteen participants who had participated in a genetic case-control study of BD and who fulfilled operational criteria for DSM-IV BD-I volunteered to participate in a pilot mood induction study. All BD cases had been interviewed previously using the Schedules for the Clinical Assessment of Neuropsychiatry (SCAN; Wing *et al.* 1990) for psychopathology occurring in their worst episode of mania and their worst episode of depression; their results were entered into the CATEGO5 scoring program (Celik, 2003) to assign a lifetime-ever diagnosis. All BD cases were taking mood-stabilizing medication at the time of the study. The Past History Schedule (McGuffin *et al.* 1986) was administered by telephone to establish whether 19 volunteer age- and sex-matched control subjects had ever suffered or were currently suffering from any psychiatric or neurological disorder. All participants gave written informed consent and were screened with the Beck Depression Inventory (BDI; Beck *et al.* 1961) and the Altman Mania Scale (AMS; Altman *et al.* 1997) by telephone 1 week prior to testing, as well as on the day of the mood induction procedure. This study was approved by the Joint South London and Maudsley National Health Service (NHS) Trust and Institute of Psychiatry Research Ethics Committee.

Procedure

On the day of testing, all participants completed the National Adult Reading Test (NART; Nelson, 1982) to provide a proxy measure of IQ. Participants performed the AGNG and CGT approximately 15 min after completing a mood induction paradigm, and regularly filled out 100-mm mood-rating Visual Analogue Scales (VAS), with 'Sad' on the left and 'Happy' on the right of the scale, to confirm mood elevation (see Fig. 1). The AGNG and then the CGT were performed in the same order by every participant, who also performed a local-global processing task, data for which have been reported previously (Farmer *et al.* 2006).

Mood induction paradigm (Farmer et al. 2006)

An adaptation of the Go task (Johnson *et al.* 2005) was used to achieve mood induction, as described previously (Farmer *et al.* 2006). In brief, participants performed a reaction time test analogous to the rodent 5-Choice Serial Reaction Time Task (Carli *et al.* 1983) in two blocks, each lasting 2 min. On each trial, participants made a speeded response to one of five lights by pressing one of five corresponding buttons. During the first block, participants received no feedback, but at the end of the block they were informed that their response time was 'very fast', irrespective of their actual performance. During the second block, participants were informed that a beep would sound every time they responded accurately and quickly. In fact, the program was set so that subjects were given positive feedback 70% of the time, irrespective of actual performance. As we have reported previously, this procedure resulted in a robust subjective mood enhancement, as assessed using VAS, in both BD cases and controls (see Fig. 1 and Farmer *et al.* 2006).

The AGNG (Murphy et al. 1999)

During the AGNG, positively and negatively toned words were presented randomly at a rate of one every 1.2 s on a computer screen. On each block of 18 words, half were positive and half negative. Participants were required to either make or withhold a response depending on the valence of the word, according to an instruction given at the beginning of the block (i.e. over the whole block participants responded to either positive ('happy') or negative ('sad') target words). There were 10 blocks in total, including two practice blocks at the beginning of the test. The target words changed every two blocks, such that half the blocks were 'shift' blocks (where the targets of the current block were the distractors in the previous block) and half the blocks were 'non-shift' blocks (where the target and distractor words of the current block matched those of the previous block). Outcome measures from this test include correct response latency, number of inappropriate responses (commission errors) and number of misses (omission errors) for each block. Each of these measures was calculated for the happy shift, happy non-shift, sad shift and sad non-shift conditions separately.

The CGT (Rogers et al. 1999)

The CGT is a test of decision making and risk taking. On each trial, 10 boxes appeared of which between one and nine were red and the rest were blue. Participants were required to decide whether a yellow token had been hidden in a blue or a red box. They were then given the opportunity to win points by betting a percentage of their current points total on their decision (either 5, 25, 50, 75 or 95 %). These bet options were presented sequentially in either ascending or descending order; in half of the games the ascending condition was used, and in half the descending condition. Participants played four games, each consisting of nine trials. This represents a slight difference from the original task (Rogers *et al.* 1999), which contained eight games; the number of games was halved for the present study because of the time constraints imposed by the mood induction procedure. Outcome measures from this test include the proportion of choices of the most likely outcome, the percentage of points bet on

trials where the most likely outcome was chosen and the latency to choose the most likely outcome. Each of these measures was calculated for the 6:4, 7:3, 8:2 and 9:1 ratios in the ascend and descend conditions separately.

Statistical analysis

Data were analysed using SPSS version 13 (SPSS Inc., Chicago, IL, USA). Where appropriate, data were transformed prior to analysis, as appropriate, to reduce skew and stabilize variances. However, all of the data reported in the text and figures describe untransformed values. Where test assumptions were met, parametric analyses were used (i.e. *t* tests and ANOVA), with an appropriate correction where the homogeneity of variance assumption was violated.

Data from the AGNG and CGT were analysed using repeated-measures ANOVA. For the AGNG, valence (positive/negative) and shift (shift/non-shift) were entered as within-subjects factors. For the CGT, ratio (6:4/7:3/8:2/9:1) and condition (ascend/descend) were entered as within-subjects factors. Group (BD case/control) was entered as the between-subjects factor in both analyses. As the cases were marginally older than the controls, age was entered as a covariate, where age correlated with the dependent measure in question, to confirm that any differences between the groups were not simply related to age. Proportions of choices of the most likely outcome data on the CGT were not normally distributed, and were analysed using the Mann-Whitney *U* test. Correlations between VAS ratings and performance on the AGNG and CGT were assessed using Pearson's *r*.

Results

The two groups did not differ significantly on any demographic variable other than a slightly increased BDI score on the day of the test in the BD group (see Table 1). However, including BDI score as a covariate in the analyses did not change any of the results. Behavioural data are reported in Table 2. Mood induction using the 'Go' task significantly elevated mood in both groups, an effect that lasted until after the completion of the AGNG and CGT (see Fig. 1).

The CGT

Data from one control were lost, and one BD case made too few choices of the most likely outcome to include their data in the analysis. The BD group responded more slowly on the CGT than controls [$F(1, 30)=8.8$, $p<0.01$, $\eta^2=0.23$], an effect that remained significant when age was included as a covariate [$F(1, 29)=4.8$, $p<0.05$]. This group difference was qualified by a significant group $\times$ ratio interaction [$F(2.8, 82.8)=3.4$, $p<0.05$, $\epsilon=0.83$, $\eta^2=0.1$]. *Post-hoc* analysis including age as a covariate revealed that the BD group responded more slowly than controls at the 6:4, 7:3 and 8:2 ratios ($p<0.05$ for all) but did not differ significantly from the control group at the 9:1 ratio ($p>0.1$) (see Fig. 2). There was also a main effect of ratio [$F(3, 87)=11.6$, $p<0.001$], indicating that participants made their decisions more quickly at lower ratios than higher ratios. No other significant main effects or interactions were identified for latency or percentage bet, other than a main effect of ratio on percentage bet [$F(2.5, 74.1)=60.9$, $p<0.001$], indicating that participants placed higher bets on more likely outcomes. The BD cases and controls did not differ in terms of overall choice of the most likely outcome ($z=1.6$, $p>0.1$).

The AGNG

A significant group $\times$ valence interaction was identified for commission errors on the AGNG [$F(1, 32)=7.8$], $p<0.01$]. Planned comparisons revealed a positive bias in the BD cases, who made significantly more inappropriate responses to positive distractor words than negative

distractor words (i.e. a higher rate of commission errors during 'sad' target blocks than 'happy' target blocks) following mood induction [$F(1, 14=4.7)$, $p<0.05$, $\eta^2=0.25$], whereas controls did not [$F(1, 18=3.1)$, $p=0.1$, $\eta^2=0.15$] (see Fig. 3). All other main effects and interactions were non-significant, other than a main effect of group on latency that was no longer significant when age was included as a covariate.

Relationship between mood and emotional processing measures

There were no significant correlations between performance on the AGNG or CGT and VAS ratings at the time of testing ($p>0.1$ for all).

Discussion

Euthymic individuals with BD exhibited a positive emotional bias and slower decision making compared with controls following positive mood induction. These changes are similar to those apparent in the manic state (Murphy *et al.* 1999, 2001), although Rubinsztein *et al.* (2000) did report a trend towards slower responding on the CGT in euthymic BD patients. However, we did not identify differences between the groups on the CGT in 'risk adjustment' (the extent to which participants altered their betting behaviour as a function of risk) or the quality of decision making, effects that have been reported previously in manic bipolar patients (Murphy *et al.* 2001). These data suggest that individuals with BD and healthy controls respond to positive mood induction in a qualitatively different manner. Although both groups showed an equivalent subjective improvement in mood following the mood induction procedure, as assessed by their subjective mood ratings during testing, their performance on objective tests of emotional processing was very different.

The mood induction paradigm we used was unusual in that it used feedback; more commonly, experimenters have made use of sad narratives or music to induce mood. One advantage of our technique over others is that it lessens the likelihood of cognitive priming, that is the activation of certain memories or beliefs that have nothing to do with the induced mood but that nonetheless may affect task performance. An additional advantage of this procedure is that it could be parametrically manipulated to produce a neutral or even a negative mood state by altering the nature of feedback provided during the Go task.

We did not perform the emotional processing tests both during mood induction and at baseline in the same participant because of concerns that practice effects might confound our results. However, previous studies investigating performance on the AGNG in BD patients reported no difference between euthymic BD patients and controls in terms of emotional bias (Rubinsztein *et al.* 2000), and a positive bias in manic patients (Murphy *et al.* 1999). These findings suggest that emotional biases in BD patients mirror their current emotional state.

Some weaknesses of our study design merit comment. First, we included only 15 BD cases, who were of above-average IQ. These individuals may not be representative of the general BD population, and these results should therefore be treated with caution until independently replicated in a larger sample of more representative BD cases. Second, all BD cases were taking mood-stabilizing medications, which could interact with the effect of mood induction, although it might be expected that their primary effect would be to attenuate the effect of mood induction. Third, because of the lack of a neutral control condition, it is currently unclear whether the latency differences on the CGT are due to state or trait effects in BD. Previous studies investigating CGT performance in BD have reported that patients in the manic and depressed states make decisions significantly more slowly than controls (Murphy *et al.* 2001; Rubinsztein *et al.* 2006), with a trend towards slower responding in the euthymic

state (Rubinsztein *et al.* 2000); another study reported that euthymic BD patients were unimpaired on the Iowa Gambling Task (Clark *et al.* 2002), whereas a more recent study using the same task reported deficits in the manic BD patients (Adida *et al.* in press). In the present study slower decision making was most apparent when the probability of being correct was lower, and unlike in the manic and depressed states, the BD cases in the present study did not exhibit poor quality of decision making on the CGT. We therefore hypothesize that the slowing observed at more difficult decisions on the CGT in the BD cases reflects their difficulty in overcoming the inclination to engage in behaviour with a high potential for negative consequences, which may have been elicited by the mood induction.

The results from both of the tests used in this study provide preliminary evidence that positive mood induction in euthymic individuals with BD is sufficient to re-establish the biases in information processing and disruptions to decision-making behaviour that occur in the manic state. We therefore speculate that such cognitive changes may occur relatively early on during the ascent into mania. Clinicians may be able use these findings during cognitive behavioural therapy to help guide individuals with BD to become aware of the automatic changes to emotional processing that occur during the early stages of mood elevation, and better regulate their mood while their insight is still relatively intact.

References

- Adida M, Clark L, Pomietto P, Kaladjian A, Besnier N, Azorin J, Jeanningros R, Goodwin GM. Lack of insight may predict impaired decision-making in manic patients. *Bipolar Disorders*. in press.
- Altman EG, Hedeker D, Peterson JL, Davis JM. The Altman Self-Rating Mania Scale. *Biological Psychiatry*. 1997; 42:948–955. [PubMed: 9359982]
- Beck AT, Ward CH, Medelson M, Erbaugh J. An inventory for measuring depression. *Archives of General Psychiatry*. 1961; 4:561–571. [PubMed: 13688369]
- Carli M, Robbins TW, Evenden JL, Everitt BJ. Effects of lesions to ascending noradrenergic neurones on performance of a 5-choice serial reaction task in rats: implications for theories of dorsal noradrenergic bundle function based on selective attention and arousal. *Behaviour and Brain Research*. 1983; 9:361–380. [PubMed: 6639741]
- Celik, C. Computer Assisted Personal Interviewing Application for the Schedules for Clinical Assessment in Neuropsychiatry, Version 2.1, and Diagnostic Algorithms for WHO ICD-10 Chapter V DCR and for Statistical Manual IV. World Health Organization; Geneva: 2003.
- Clark L, Iversen SD, Goodwin GM. Sustained attention deficit in bipolar disorder. *British Journal of Psychiatry*. 2002; 180:313–319. [PubMed: 11925353]
- Eich E, Macaulay D, Lam D. Mania, depression and mood dependent memory. *Cognition and Emotion*. 1997; 11:607–618.
- Farmer A, Lam D, Sahakian B, Roiser J, Burke A, O'Neill N, Keating S, Smith GP, McGuffin P. A pilot study of positive mood induction in euthymic bipolar subjects compared with healthy controls. *Psychological Medicine*. 2006; 36:1213–1218. [PubMed: 16707029]
- Johnson SK, Ruggero CJ, Carver CS. Cognitive, behavioral, and affective responses to reward: links with hypomanic symptoms. *Journal of Social and Clinical Psychology*. 2005; 24:894–906.
- Lembke A, Ketter TA. Impaired recognition of facial emotion in mania. *American Journal of Psychiatry*. 2002; 159:302–304. [PubMed: 11823275]
- Mansell W, Lam D. 'I won't do what you tell me!': elevated mood and the assessment of advice-taking in euthymic bipolar I disorder. *Behaviour Research and Therapy*. 2006; 44:1787–1801. [PubMed: 16487480]
- McGuffin P, Katz R, Aldrich J. Past and present state examination: the assessment of 'lifetime ever' psychopathology. *Psychological Medicine*. 1986; 16:461–465. [PubMed: 3726017]
- Murphy FC, Rubinsztein JS, Michael A, Rogers RD, Robbins TW, Paykel ES, Sahakian BJ. Decision-making cognition in mania and depression. *Psychological Medicine*. 2001; 31:679–693. [PubMed: 11352370]

- Murphy FC, Sahakian BJ, Rubinsztein JS, Michael A, Rogers RD, Robbins TW, Paykel ES. Emotional bias and inhibitory control processes in mania and depression. *Psychological Medicine*. 1999; 29:1307–1321. [PubMed: 10616937]
- Nelson, HE. National Adult Reading Test (NART): Test Manual. NFER-Nelson; Windsor: 1982.
- Pizzagalli DA, Goetz E, Ostacher M, Iosifescu DV, Perlis RH. Euthymic patients with bipolar disorder show decreased reward learning in a probabilistic reward task. *Biological Psychiatry*. 2008; 64:162–168. [PubMed: 18242583]
- Rogers RD, Everitt BJ, Baldacchino A, Blackshaw AJ, Swainson R, Wynne K, Baker NB, Hunter J, Carthy T, Booker E, London M, Deakin JF, Sahakian BJ, Robbins TW. Dissociable deficits in the decision-making cognition of chronic amphetamine abusers, opiate abusers, patients with focal damage to prefrontal cortex, and tryptophan-depleted normal volunteers: evidence for monoaminergic mechanisms. *Neuropsychopharmacology*. 1999; 20:322–339. [PubMed: 10088133]
- Rubinsztein JS, Michael A, Paykel ES, Sahakian BJ. Cognitive impairment in remission in bipolar affective disorder. *Psychological Medicine*. 2000; 30:1025–1036. [PubMed: 12027040]
- Rubinsztein JS, Michael A, Underwood BR, Tempest M, Sahakian BJ. Impaired cognition and decision-making in bipolar depression but no ‘affective bias’ evident. *Psychological Medicine*. 2006; 36:629–639. [PubMed: 16420729]
- Wing JK, Babor T, Brugha T, Burke J, Cooper JE, Giel R, Jablenski A, Regier D, Sartorius N. SCAN. Schedules for Clinical Assessment in Neuropsychiatry. *Archives of General Psychiatry*. 1990; 47:589–593. [PubMed: 2190539]

Fig. 1.

Study design and mood ratings. Positive mood induction resulted in increased subjective ratings of happiness in both bipolar disorder (BD) and control groups, as assessed by Visual Analogue Scales (VAS; results reported previously in Farmer *et al.* 2006). Mood induction was performed between VAS 1 and VAS 2. The Affective Go/No-go test (AGNG) and the Cambridge Gamble Task (CGT) were performed between VAS 3 and VAS 5, approximately 15 min following mood induction, during which mood ratings remained elevated. ** Significant elevation in mood relative to VAS 1 at $p < 0.05$. Values represent the mean, error bars standard error of the mean.

Fig. 2. Latency (in ms) on the Cambridge Gamble Task (CGT). Bipolar disorder (BD) cases responded significantly more slowly than controls at more difficult decisions (6: 4, 7: 3 and 8: 2 ratios) but not at the easiest decisions (9: 1 ratio). ** $p < 0.05$; N.S., non-significant. Values represent the mean, error bars standard error of the mean.

Fig. 3. Commission errors on the Affective Go/No-go test (AGNG). Bipolar disorder (BD) cases showed a significant positive bias, making significantly more inappropriate responses to positive words (i.e. on 'sad' target blocks) than negative words (i.e. on 'happy' target blocks), whereas controls did not. ** $p < 0.05$. Values represent the mean, error bars standard error of the mean.

Table 1

Demographic data

	Bipolar disorder	Control	Statistics
<i>n</i> (number male)	15 (5)	19 (16)	$\chi^2_2 < 1$
Age (years)	44.4 (13.4)	35.4 (13.6)	$t_{32} = 1.9, p > 0.05$
NART IQ	119.3 (4.9)	119.4 (4.8)	$t_{32} < 1$
AMS	1.9 (1.8)	1.9 (1.8)	$t_{28} < 1$
Short BDI (1 week before test)	2.6 (2.9)	1.0 (1.8)	$t_{28} = 1.8, p > 0.05$
Long BDI (day of test)	5.0 (6.0)	1.3 (2.7)	$t_{17.2} = 2.2, p < 0.05$

NART, National Adult Reading Test; AMS, Altman Mania Scale; BDI, Beck Depression Inventory.

Values represent the mean (standard deviation).

Table 2

Data from the emotional processing tests

		Bipolar disorder	Control	Statistics
Affective Go/No-go test				
Reaction time	Block type			
	Happy shift	508.9 (12.9)	477.3 (13.7)	-
	Happy non-shift	521.5 (14.3)	482.9 (12.0)	
	Sad shift	516.0 (57.9)	473.7 (53.1)	
	Sad non-shift	519.7 (43.5)	481.2 (58.2)	
Commission errors per block	Happy shift	2.3 (1.7)	2.3 (1.4)	Group $\times$ valence interaction: $F(1, 32)=7.8, p<0.01$
	Happy non-shift	1.7 (1.1)	1.8 (1.4)	
	Sad shift	2.8 (2.0)	1.7 (1.6)	
	Sad non-shift	2.3 (2.0)	1.6 (1.3)	
Omission errors per block	Happy shift	1.5 (3.1)	0.42 (0.90)	-
	Happy non-shift	1.5 (2.9)	0.37 (0.83)	
	Sad shift	1.5 (2.4)	0.26 (0.45)	
	Sad non-shift	1.7 (3.2)	0.42 (0.77)	
Cambridge Gamble task				
Proportion of choices of the most likely outcome	Ratio			
	6:4	0.87 (0.18)	0.94 (0.13)	-
	7:3	0.93 (0.15)	0.96 (0.12)	
	8:2	0.95 (0.16)	1.00 (0.00)	
Percentage of current points bet	9:1	0.94 (0.16)	0.99 (0.01)	
	6:4	41.3 (16.0)	36.0 (12.9)	-
	7:3	48.3 (13.2)	45.9 (15.6)	
	8:2	57.1 (13.6)	60.0 (13.5)	
Latency	9:1	65.1 (11.5)	66.6 (16.1)	
	6:4	3465 (3152)	1709 (485)	Main effect of group: 8.8, $p<0.01$
	7:3	2441 (1258)	1607 (594)	
	8:2	2751 (749)	2049 (811)	Group $\times$ ratio interaction: $F(2.8, 82.8)=3.4, p<0.05$
9:1	3021 (1327)	2699 (1529)		

Values represent the mean (standard deviation).