

THE UNIVERSITY OF HULL

Reward-oriented processes in bipolar disorder

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By Nathan Toby Babiker, BSc (hons.)

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Overview of Research Portfolio

This research portfolio comprises three parts. Part one is a systematic review of literature applying behavioural activation system (BAS) theory to manic and hypomanic symptoms. The purpose of this review is to present an outline of BAS theory, including its development over time, and to then provide an objective summary of the strengths and weaknesses of BAS theory as a framework for understanding mania and hypomania.

Part two of this portfolio is an empirical paper. This is a report of an experimental study aiming to investigate differences between bipolar and non-bipolar adults on two tasks. The first task manipulated a reaction-time test to see whether bipolar individuals responded to success and failure differently to non-bipolar individuals. The second task used a reasoning game based on probabilities to assess whether bipolar individuals tend to jump to conclusions more than non-bipolar individuals.

Part three of this portfolio contains the appendixes, where materials relevant to both papers are reproduced as well as a reflective statement and additional information.

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Running head: BEHAVIOURAL ACTIVATION SYSTEM IN MANIA

The role of the behavioural activation system in mania: A systematic review

Nathan T. Babiker

Department of Clinical Psychology, University of Hull

This paper is written in the format ready for submission to Clinical Psychology Review.

Please see Appendix 2.1 for the Guideline for Authors.

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Abstract

Background

Psychological theories of mania remain less developed than those concerning depression. Theorists have linked mania to an underlying neuropsychological vulnerability in the behavioural activation system (BAS), but this hypothesis has only recently begun to be experimentally tested in relation to bipolar disorder. It is suggested that the BAS is active in goal-directed behaviours, and bipolar mania is the manifestation of BAS over-activity.

Methods

A systematic literature review was carried out using PsycInfo, Medline, Embase and Cinahl databases. The keywords used were *behavioural activation system, behavioural approach system, behavioural facilitation system, mania, hypomania, manic and hypomanic*.

Results

Twenty-eight studies were selected for review. A number of research methodologies were used, including electroencephalographic (EEG), laboratory, cross-sectional, prospective and retrospective designs. Participants included individuals with bipolar-spectrum disorders and 'high-risk' individuals identified by high self-reported BAS sensitivity. There was a strong link in the literature between activity in the left frontal cortex and BAS sensitivity. High BAS sensitivity was found to be a predictive factor for manic symptoms in individuals with putative BAS vulnerability than controls. High BAS sensitivity also appeared to predispose individuals to be more reactive to goal-achievement, both in laboratory settings and where the impacts of life events were monitored.

Conclusions

BAS theory could provide an important framework for the understanding of the manic phase of bipolar disorder. A model including specific beliefs, goal-attainment, goal pursuit and BAS sensitivity is proposed in order to clarify the potential mechanism involved. As the effects of goal-striving and goal-achievement within high-risk populations may precipitate manic symptoms, future psychotherapy could aim to provide information and education regarding these risks.

Keywords: mania, behavioural activation system, bipolar disorder

Bipolar disorder is a severe and enduring mental health condition reportedly affecting at least 1% of the population (Grant et al., 2005; Merikangas et al., 2007). The distinctive feature of bipolar disorder is the presence either historically or presently of mania or hypomania, which are characterised by elevated mood, talkativeness, increased psychomotor activity and disturbed concentration (American Psychiatric Association, 1994). Mania in bipolar disorder can have serious consequences to functioning, and tends to lead to hospitalisation (Mansell & Pedley, 2008) with further consequences such as loss of employment.

Theories concerning key processes involved in depression have pervaded the cognitive-behavioural psychology literature for more than 40 years (Beck, 1967; Greenberger & Padesky, 1995; Young, Weinberger, Beck, & Barlow, 2001). As a result, cognitive techniques are widely reported to be efficacious in the treatment of depression (Fava, Rafanelli, Grandi, Conti, & Belluardo, 1998; Strunk & DeRubeis, 2001). Mania on the other hand remains less understood (Mansell & Pedley, 2008). A better understanding of the specific processes in mania would directly benefit the provision of treatment for people with bipolar disorder.

One theory of mania involves the behavioural activation system (BAS) proposed by Gray (1990), also termed the behavioural facilitation system (Depue & Iacono, 1989). This system is thought to form the biological basis of the behavioural, cognitive and affective processes involved in approaching rewards. It was proposed along with the behavioural inhibition system (BIS: Gray, 1990) that acts in opposition to the BAS when the costs of approach are deemed to be high.

The BAS was initially postulated as the site of dysfunction in bipolar disorder (Depue & Iacono, 1989; Gray, 1990). It was noted that mania appeared to manifest itself in

processes that can adaptively serve to motivate an organism towards the achievement of goals, e.g. engagement with the environment, decreased sleep and elevated mood, which were considered to be ‘system outputs’ of the BAS (Depue, Krauss, & Spont, 1987). Mania was therefore seen as a manifestation of BAS overactivity (Depue & Iacono, 1989; Gray, 1990).

Research into the BAS suggests its neural location as the dopamine (DA) pathways leading from the ventral tegmental area (VTA) to the nucleus accumbens (Depue, Luciana, Arbisi, Collins, & Leon, 1994). It is believed that BAS functioning is determined at least in part by genetic factors (Depue & Collins, 1999), and leads to personality traits like impulsivity (Gray, 1990) or extraversion (Depue & Collins, 1999).

Depue and colleagues already had theories that implicated ‘dysregulation’ in key biological systems as a potential cause of psychological disturbance (Depue & Monroe, 1986; Goplerud & Depue, 1985). Their application of this concept to the BAS led to the proposal that the fundamental reward-oriented system in individuals with bipolar disorder was dysfunctional, leading to fluctuations in its activity and larger responses to activation (Depue & Iacono, 1989).

To advance the understanding of the influence of the BAS and BIS, Carver and White (1994) developed the BIS/BAS Scales. The BIS/BAS Scales contain four subscales, one BIS subscale, and three related to the BAS (reward responsiveness, drive, fun-seeking). The BIS/BAS Scales have since been widely used in research studies (e.g. Harmon-Jones & Allen, 1997; Hensch, Herold, & Brocke, 2007; Heponiemi, Keltikangas-Jarvinen, Puttonen, & Ravaja, 2003). Researchers are also beginning to develop these scales to in an attempt to include measures of BAS dysregulation (Holzwarth & Meyer, 2006), and frustration

responsiveness (Wright, 2007). Other measures have been linked to BAS activity, for instance the Hypomanic Personality Scale (HPS: Eckblad & Chapman, 1986).

BAS theory has continued to be utilised by current researchers in bipolar disorder, and applied widely in relation to both mania and depression (Carver, 2004; Carver & Scheier, 1998; Johnson et al., 2008; Johnson, Ruggero, & Carver, 2005; Lam, Wright, & Smith, 2004). This review will examine how BAS theory has been applied to bipolar disorder and draw tentative conclusions concerning the operation of the BAS in the development and maintenance of manic symptoms in particular.

Method

A systematic literature review was carried out of all English language papers relevant to the role of the BAS in mania and hypomania. The aim was to include all studies meeting the inclusion criteria. Initially, electronic reference databases were utilised to gain access to appropriate studies and view their abstracts. The databases accessed were PsycInfo, Medline, Embase and Cinahl. Electronic searching was carried out using the terms *behavioural approach system / behavioural facilitation system / behavioural activation system* (using both American and English spellings of behavioural) where they appeared with the terms *bipolar / mania / hypomania / manic / hypomanic*. Additional studies were obtained by hand searching the reference lists of studies found through electronic searching. Efforts were made to contact relevant authors for further papers appropriate for inclusion. Abstracts for these papers were viewed for relevance, and all articles that were potential candidates for inclusion were acquired in paper form. All papers were reviewed by a single researcher (*NTB*).

The studies were assessed and entered into a spreadsheet detailing their inclusion or exclusion. The main inclusion criteria were (1) English language studies; (2) Studies using empirical methodologies; (3) Studies which tested hypotheses directly relating to BAS theory; and (4) Studies directly applying BAS theory to bipolar mania. The main exclusion criteria were (1) Non-human animal studies; (2) Qualitative or non-experimental papers and book chapters; (3) Studies not concerned with testing mania-associated processes; (4) studies not concerned with the BAS; and (5) review articles.

The initial electronic search yielded 86 papers for consideration. Sixty-four were excluded due to meeting one or more of the exclusion criteria, leaving 22 studies. Additionally, 6 papers were obtained through reference searches and contacting authors, giving a final total of 28 studies published between 1997 and 2008 for inclusion in the

review. A list of the excluded studies and reasons for their exclusion is available in Appendix 3. The quality of the papers included in the review was assessed by manually searching the journals that they originated from, taking into account the journal impact factor, readership, guidelines for inclusion and other structures in place such as peer-review. Following this, the studies were individually appraised to ensure that they identified focused hypotheses and utilised an appropriate and ethical methodology to test them. This assessment of quality control was carried out by the researcher.

A qualitative analysis of the included studies was deemed to be the most appropriate method. Firstly, the studies were organised into a database detailing their authors, participants, methods, hypotheses, main findings and conclusions. The clearest natural grouping criterion for the studies was experimental method. Each methodological group was then manually coded for corresponding, competing, and unique findings, and these were evaluated in relation to participants used, variations in method, and other factors. The researcher's subjective judgement of each finding was carefully cross-checked with all other reference to that finding within the literature base, to ensure as much accuracy when handling the data as possible.

Results

Table 1 gives details of the range of sample types and their demographic data. Studies using a variety of designs, samples and methodologies were included in this review. They fall into four broadly defined groups: 5 papers using an Electroencephalogram (EEG) to directly measure brain functioning (Harmon-Jones et al., 2008; Harmon-Jones et al., 2002; Harmon-Jones & Allen, 1997; Hayden et al., 2008; Hensch et al., 2007); 7 studies concerned with associations between putative BAS activity and other current behavioural or psychological factors (Biuckians, Miklowitz, & Kim, 2007; Krumm-Merabet & Meyer, 2005; Lam et al., 2004; Meyer, Beevers, & Johnson, 2004; Meyer, Johnson, & Carver, 1999; Meyer, Rahman, & Shepherd, 2007b; Meyer & Krumm-Merabet, 2003); 9 studies prospectively investigating measures of BAS activity as predictors of manic symptoms over time (Alloy et al., 2008; Hofmann & Meyer, 2006; Johnson et al., 2008; Johnson et al., 2000; Lozano & Johnson, 2001; Meyer, Johnson, & Winters, 2001; Meyer & Hofmann, 2005; Nusslock, Abramson, Harmon-Jones, Alloy, & Hogan, 2007; Salavert et al., 2007) and one using a retrospective design to investigate a similar hypothesis (Alloy et al., 2006); and 6 experimentally-manipulated laboratory studies (Delancey, 2006; Ernst et al., 2004; Gruber, Johnson, Oveis, & Keltner, 2008; Heponiemi et al., 2003; Johnson et al., 2005; Meyer, Beevers, Johnson, & Simmons, 2007a).

Table 1. Included studies with demographic data and main finding(s)

Author(s)	Group(s)	Mean Age (SD)	Gender	Method	Key Finding(s)
Alloy et al. (2006)	28 High BAS students 24 Mod. BAS students	HBAS: 18.89 (1.07) MBAS: 18.88 (0.80)	HBAS: 64.3% Female MBAS: 87.5% Female	Retrospective	High BAS assoc. with higher likelihood of BPD diagnosis and more previous manic symptoms
Alloy et al. (2008)	136 BP-II/Cyclothymic 157 Control	Clinical: 19.83 (1.67) Control: 19.98 (1.62)	Clinical: 60.7% Female Control: 57.1% Female	Prospective	High BAS sensitivity predicted shorter time to onset of mania / hypomania
Biuckians et al. (2007)	25 Adolescents (BP-I/BP-II/BP-NOS)	14.7 (1.5)	48% Female	Cross-sectional	Higher BAS sensitivity assoc. with less manic symptoms
Delancey (2006)	116 Students	Not reported (Range: 17-26)	58.6% Female	Laboratory	BAS sensitivity not predictive of preferred approach behaviour towards video characters
Ernst et al. (2004)	22 BPD Children 22 Control Children	Clinical: 13.8 (2.3) Control: 13.6 (2.3)	Clinical: 31.8% Female Control: 50% Female	Laboratory	Bipolar group more dissatisfied when failing a reward task and more pleased when they avoided failure, despite lower overall confidence
Gruber et al. (2008)	36 High-risk students 54 Low-risk students	High-risk: 20.28 (2.60) Low-risk: 19.96 (1.52)	High-risk: 79% Female Low risk: 61% Female	Laboratory	Higher positive emotion, irritability and autonomic response to film clips in high mania-risk subjects
Harmon-Jones & Allen (1997)	36 Students	Not reported	Females	EEG	High BAS scores related to higher resting left frontal (LF) cortical activity
Harmon-Jones et al. (2002)	67 Students	Not reported	51.4% Female	EEG	LF cortical activity and self-reported anger raised in response to anger-eliciting audio stimulus
Harmon-Jones et al. (2008)	41 BPD 53 Control	Clinical: 21.63 (0.24) Control: 21.74 (0.21)	Clinical: 61.0% Female Control: 49.1% Female	EEG	Raised LF activity in bipolar group during reward task
Hayden et al. (2008)	59 BPD 44 Control	Clinical: 43 (10.58) Control: 40 (13.17)	Clinical: 61.0% Female Control: 66.0% Female	EEG	Episodic BPD group showed raised LF activity in reward task compared to euthymic BPD and controls; BAS sensitivity not linked to LF activity
Hensch et al. (2007)	87 Healthy Adults	23.3 (2.0)	Males	EEG	BAS self-rating and impulsivity predicted putative serotonin activity
Heponiemi et al. (2003)	95 Healthy Adults	Not reported (Range: 21-36)	48.4% Female	Laboratory	High BAS sensitivity predicted higher positive mood during reward task
Hofmann & Meyer (2006)	54 Healthy Adults	19.69 (0.77)	55.6% Female	Prospective	BAS sensitivity predicted mania and positive and negative mood fluctuations over 28 days
Johnson et al. (2000)	43 BP-I	Not reported (Inclusion: 18-65)	53% Female	Prospective	Goal-achievement life events led to increased manic symptoms

Johnson et al. (2005)	153 Students	Not reported	72% Female	Laboratory	High manic symptoms predicted higher sensitivity to reward, and higher goal-setting following a success
Johnson et al. (2008)	125 BP-I	Not reported (Inclusion: 18+)	50% Female	Prospective	Goal-achievement life events led to increased manic symptoms
Krumm-Merabet & Meyer (2005)	300 High-risk students 1709 Control students	High-risk: 15.06 (0.80) Control: 15.05 (0.78)	High-risk: 57.3% Female Control: 52.5% Female	Cross-sectional	Hypomanic personality was associated with sensation-seeking and aggression
Lam et al. (2004)	143 BP-I 109 Unipolar	Bipolar: 44.3 (12.7) Unipolar: 44.4 (12.8)	Bipolar: 56% Female Unipolar: 55% Female	Cross-sectional	BPD group held higher goal-attainment beliefs than unipolar
Lozano & Johnson (2001)	39 BP-I	42.82 (10.13)	Not reported	Prospective	Self-reported achievement-striving predicted increased manic symptoms over time
Meyer & Hoffman (2005)	59 Healthy Adults	19.7 (0.76)	54.2% Female	Prospective	BAS sensitivity predicted manic symptoms and increases in positive mood over 21 days
Meyer & Krumm-Merabet (2003)	2562 Students	15.07 (0.78)	53.3% Female	Cross-sectional	Hypomanic personality assoc. with optimistic expectations of long-term goal-achievement
Meyer et al. (1999)	357 Students	Not reported	58.3% Female	Cross-sectional	BAS sensitivity predicted current manic symptoms
Meyer et al. (2001)	59 BP-I	43.7 (10.02)	49.2% Female	Prospective	BAS sensitivity, specifically reward-responsiveness, predicted shorter time to mania onset
Meyer et al. (2004)	464 Students	Median: 20	81% Female	Cross-sectional	Hypomanic symptoms linked with optimistic goal-achievement beliefs and more enjoyment of goal pursuit
Meyer et al. (2007a)	461 Students	Median: 20	80% Female	Laboratory	High mania risk assoc. with positive attitude towards goal pursuit, and more likelihood of pursuing risky goals
Meyer et al. (2007b)	100 Healthy Adults	25 (10.21)	77% Female	Cross-sectional	High hypomanic personality scores related to self-reported addictive personality
Nusslock et al. (2007)	68 BPD 91 Control	Clinical: 22.1 (1.8) Control: 22.4 (1.6)	Clinical: 57.4% Female Control: 51.6% Female	Prospective	BPD students taking exams showed more hypomanic symptoms than those not in exams
Salavert et al. (2007)	39 BP-I 38 Control	Not reported	Not reported	Prospective	No link between BAS sensitivity and onset of manic symptoms

Neurological Studies

Activity in the left frontal cortex (LFC) measured with an EEG was used an indicator of BAS activity by the majority of neurological studies (Harmon-Jones et al., 2008; Harmon-Jones et al., 2002; Harmon-Jones & Allen, 1997; Hayden et al., 2008). This trend began with Harmon-Jones and Allen's (1997) finding of higher resting activity in the left frontal than the right frontal cortex in female adults who scored highly on the BAS subscale of the BIS/BAS scales (Carver & White, 1994). Raised LFC activity and self-reported anger in response to a phony radio broadcast was found in a following study (Harmon-Jones et al., 2002), suggesting anger as a BAS-mediated approach behaviour. An advantage of the latter study was the inclusion of male and female subjects, and a greater sample size of 67, compared to 37 in Harmon-Jones & Allen (1997). Bipolar spectrum individuals were also found to have higher LFC activity than controls when presented with a task offering a monetary reward (Harmon-Jones et al., 2008), and LFC activity was higher in both bipolar and control subjects who described their current state as hypomanic (Harmon-Jones et al., 2008). Hayden et al. (2008) reported increased LFC activity in bipolar individuals during a goal-oriented task compared with euthymic bipolar subjects and controls. However, they did not find that self-reports of BAS sensitivity (using the BIS/BAS Scales: Carver & White, 1994) correlated with higher LFC activity in any of the groups tested (Hayden et al., 2008).

In summary, self reports of BAS sensitivity do appear to relate more frequently with higher left frontal than right frontal cortical activity as reported within this literature, although these findings are based on a mixture of non-clinical (Harmon-Jones et al., 2002; Harmon-Jones & Allen, 1997) and clinical (Harmon-Jones et al., 2008; Hayden et al., 2008) populations. When individuals with bipolar disorder have been used there has been insufficient evidence to show direct correlations between Carver and White's (1994) measures of BAS activity and LFC functioning, but there is increasing evidence that the left

frontal cortex is involved in reward-directed processes (Harmon-Jones et al., 2008; Hayden et al., 2008).

An alternative paradigm was also reported using intensity dependence of auditory evoked potentials (IAEP), which are putative indicators of the activity of the neurotransmitter serotonin (Hensch et al., 2007). The fun-seeking subscale of the BIS/BAS scales (Carver & White, 1994) strongly predicted IAEP – and therefore serotonin activity – in a group of 87 adults, as to a lesser extent did a measure of impulsivity, and IAEP correlated with hypomanic personality and hyperthymic temperament (Hensch et al., 2007).

Laboratory Studies

A variety of experimental paradigms have been utilised to test facets of the BAS. Only one study used a bipolar group (Ernst et al., 2004), a potential limitation within the research base. 3 studies explored responses to stimuli designed to elicit BAS activity, such as video-recorded changes in facial expressions (Delancey, 2006), vignettes manipulating incentive versus risk (Meyer et al., 2007a) and film clips depicting emotional occasions (Gruber et al., 2008). In Delancey's (2006) study, self-reported BAS sensitivity was not related to approach behaviours when individuals were asked to indicate their most likely action when confronted with various facial emotions. However, the author argued that there was no evident incentive necessitating approach of the stimuli used (video clips), which, in conjunction with the less-than-real laboratory situation may have been insufficient to elicit BAS activity (Delancey, 2006). Meyer et al. (2007a) reported that within a large sample of students (n=461), more people at risk of mania (measured using the General Behaviour Inventory (GBI): Depue, Krauss, Spont, & Arbisi, 1989) felt pursuit of a goal was likely to be a positive thing. This effect was especially apparent where the threat associated with approach was deemed to be high (Meyer et al., 2007a). This suggests that in mania-

vulnerable individuals specifically, BAS sensitivity might override competing mechanisms aimed at self-preservation, for example the BIS (Gray, 1990). However, these authors use of vignettes brings into question the generalisability of their findings to real approach situations; they might be best viewed as indicative of their participants' opinions of their 'ideal' incentive motivation in the face of competing threats. Gruber et al. (2008) addressed this weakness by monitoring subjects' heart rates whilst they watched film clips depicting a variety of happy, sad and neutral emotional scenes. They used a complex measurement of 'cardiac vagal tone', an autonomic process, as an indicator of positive emotion (Gruber et al., 2008). This variable was related to emotional response to the clips within mania-vulnerable individuals (Gruber et al., 2008). In addition to this they supported the finding by Meyer et al. (Meyer et al., 2007a) that people at risk of mania responded with higher self-reported BAS activity when presented with emotion-eliciting material (Gruber et al., 2008).

Responses to reward were investigated by 3 of the laboratory studies (Ernst et al., 2004; Heponiemi et al., 2003; Johnson et al., 2005). Ernst et al.'s (2004) pilot study reported that bipolar children were generally less confident than same-age controls when faced with a task that involved decision-making based on risk. Accordingly, they indicated more pleasure when they avoided losing than controls; however, they were also more dissatisfied than controls when they did not win, despite their expectations of poorer performance (Ernst et al., 2004). This follows suggestions that BAS sensitivity manifests in larger responses to both achievement and non-achievement of rewards (Carver & Scheier, 1998). One criticism offered by the authors concerns the mood of the bipolar group: most were depressed, and as such these findings could be accounted for in part by negative cognitions concerning failure (Ernst et al., 2004). In another controlled study, high BAS sensitivity predicted positive mood elicited during a task involving the incentive of a monetary reward (Heponiemi et al., 2003). Finally, Johnson et al. (2005) manipulated a reaction speed task to provide positive

feedback and a monetary reward. These researchers found that in individuals with higher manic symptoms, the experience of task success led to an increase in behavioural activity directed at receiving further reward, and furthermore these individuals set themselves harder goals for a subsequent task once they had achieved an initial reward (Johnson et al., 2005).

Cross-sectional Studies

Seven of the 28 papers included in this review used a cross-sectional design to examine the correlations between BAS activity and a number of different factors. Three studies focused on attitudes towards goals in particular. Meyer and Krumm-Merabet (2003) found that although students with a hypomanic temperament (indicative of a highly sensitive BAS) did not perform better in school exams than their peers, they held more 'overly optimistic estimations' of longer-term achievement of goals such as obtaining their dream job, whilst not differing on their estimations concerning short-term goals like exam performance. Lam et al. (2004) found that bipolar patients differed from a unipolar depressive control group in how much they endorsed specific attitudes on the short version of the dysfunctional attitudes scale (DAS 24); in particular, their findings of significantly higher goal-attainment beliefs in the bipolar group appeared to support the theory that bipolar disorder is underpinned by a variation in the system associated with motivation towards goals, the BAS (Lam et al., 2004). Finally, Meyer et al. (2004) discovered correlations between hypomanic symptoms and optimistic beliefs about goal-achievement, and between self-reported high mood and enjoyment of pursuing goals. In summary, the literature tends towards a suggestion that hypomanic symptoms are linked with highly driven beliefs or more optimistic views on one's ability to attain goals (Lam et al., 2004; Meyer & Krumm-Merabet, 2003) and more enjoyment during their pursuit (Meyer et al., 2004), despite evidence suggesting that hypomania does not relate to the necessary abilities required for goal attainment, such as academic performance (Meyer & Krumm-Merabet, 2003).

Two studies provide competing evidence concerning the link between BAS activity and current manic symptoms. Meyer, Johnson and Carver's (1999) study of 357 undergraduate students employed a design where 'high-risk' (high BAS) students were identified and compared to lower risk students using the BIS/BAS Scales (Carver & White, 1994). In their high-risk group, all BAS subscales were significantly associated with current manic symptoms, whereas with low-risk students only the fun-seeking scale was found to relate to manic symptoms (Meyer et al., 1999). This suggests a particular association between the fun-seeking BAS subscale and mania, mirrored in Hensch et al. (2007), discussed earlier. However, using a clinical sample of bipolar adolescents, another study found quite the opposite effect (Biuckians et al., 2007). Using the same measures (BIS/BAS Scales: Carver & White, 1994), these researchers reported that high BAS scores were actually associated with lower overall self-reported manic symptoms (Biuckians et al., 2007). As the mean age of their subjects was 14, one may question the generalisability of their findings to adult populations. Clearly more investigation is needed to ascertain whether the characteristics of paediatric bipolar disorder differ from those found with older samples.

The final two papers in this category broadly concerned risk, such as alcohol / nicotine consumption and aggression (Krumm-Merabet & Meyer, 2005), and addictive tendencies (Meyer et al., 2007b). In a large sample of 4045 students (Krumm-Merabet & Meyer, 2005), scores on the hypomanic personality scale (HPS: Eckblad & Chapman, 1986), a measure of hypomanic traits including mood variability and goal-driven tendencies, were related to sensation-seeking pursuits such as drinking, drug-taking and socialising, as well as fighting; supporting the theory that, in addition to reward motivation, anger is also derived from the BAS (Depue & Iacono, 1989). Meyer et al. (2007b) reported that addictive tendencies were higher within individuals who scored highly on the HPS (Eckblad & Chapman, 1986), and these tendencies were felt towards more common activities such as

internet use and exercise, as well as risky pursuits like substance-misuse. These authors argued that these addictive tendencies may derive from the continual pursuit of rewards that has been suggested to be a function of the BAS (Meyer et al., 2007b).

Prospective / Retrospective Studies

The majority of studies utilised prospective designs where onset of manic symptoms was predicted either by measures of BAS sensitivity (Alloy et al., 2008; Hofmann & Meyer, 2006; Lozano & Johnson, 2001; Meyer et al., 2001; Meyer & Hofmann, 2005; Salavert et al., 2007) or by the occurrence of goal-striving (Nusslock et al., 2007) or goal-attainment (Johnson et al., 2008; Johnson et al., 2000) life events. Meyer & Hofmann (2005) found that over a period of between 2 and 3 weeks, the amount of manic symptoms and positive mood reported by healthy adults was predicted by self-reported BAS sensitivity, and BAS sensitivity also predicted general fluctuations in positive mood consistent with suggestions that individuals prone to manic symptoms experience more general dysregulation in mood (Krauss, Depue, Arbisi, & Spont, 1992). These findings were both repeated in Hofmann & Meyer (2006) although in addition this study found that both positive and negative mood fluctuations over a 28-day period were related to BAS sensitivity, as opposed to being solely related to instability in reported positive mood. Where individuals were followed-up for longer periods of time, it was found that initial self-report of 'achievement-striving' personalities predicted increases in manic symptoms over time (Lozano & Johnson, 2001), again supporting BAS sensitivity as a vulnerability factor for mania. In a 33-month follow-up study, high BAS sensitivity scores also predicted a shorter time to a manic or hypomanic episode (Alloy et al., 2008), a finding similarly reported in Meyer et al. (2001). However, Meyer et al. (2001) found that, along with the total BAS score yielded from the BIS/BAS scales (Carver & White, 1994), the only other subscale capable of predicting mania onset was the reward-responsiveness subscale, which the authors note is consistent with Gray (1990)

and Depue and Zald's (1993) conceptualisation of the BAS. Interestingly, Salavert et al. (2007) did not report a link between BAS sensitivity and observed manic symptoms over an 18-month follow-up period, although lower BAS scores were associated with depressive symptoms.

One study (Alloy et al., 2006) was retrospective in design. These authors collected BAS sensitivity reports from subjects and separated their sample into high-BAS and moderate-BAS groupings, then reviewed their mental health histories (Alloy et al., 2006). Their findings were consistent with the majority of prospective studies reported here; high-BAS subjects were more likely to have been diagnosed with a bipolar-spectrum disorder, and reported more past manic symptoms; in addition, the reward-responsiveness subscale of Carver and White's (1994) BIS/BAS scales was a strong predictor of self-reported hypomanic personality traits (Alloy et al., 2006).

Three papers focused on the effect of goal-achievement or goal-striving on the onset of manic episodes (Johnson et al., 2008; Johnson et al., 2000; Nusslock et al., 2007). Nusslock et al. (2007) looked at manic symptoms in relation to a major 'goal-striving' event, namely students' final exams. They found that preparing for final exams precipitated significant manic symptoms in bipolar students, whereas control students did not experience heightened manic symptoms during this period, and neither did bipolar students not sitting exams (Nusslock et al., 2007). Other life event studies have been carried out by Johnson and colleagues; Johnson et al. (2000) found that in the 2 months following goal-attainment life events, 43 bipolar individuals experienced significant increases in manic symptoms. In a subsequent study with a larger bipolar sample (n=125), this finding was replicated (Johnson et al., 2008). It is also worth noting that Johnson et al. (2008) did not find a relationship between baseline symptoms at the occurrence of the event and the subsequent response, suggesting that this response to goal-attainment events is not limited to manic phases.

Discussion

A growing amount of literature appears to support proposals of earlier theorists (Depue & Iacono, 1989; Gray, 1990) that the BAS is implicated in manic symptoms. A major strength of this literature base is the wide range of methods used to study BAS action, ranging from EEG (e.g. Harmon-Jones et al., 2008; Hayden et al., 2008; Hensch et al., 2007) to naturalistic studies following the course of illness with baseline measures of BAS sensitivity (e.g. Hofmann & Meyer, 2006; Johnson et al., 2008; Johnson et al., 2000).

One must comment on the samples used by the studies reviewed. Of 28, only 12 used bipolar populations (Alloy et al., 2008; Biuckians et al., 2007; Ernst et al., 2004; Harmon-Jones et al., 2008; Hayden et al., 2008; Johnson et al., 2008; Johnson et al., 2000; Lam et al., 2004; Lozano & Johnson, 2001; Meyer et al., 2001; Nusslock et al., 2007; Salavert et al., 2007). The remaining studies used either healthy adults (Hensch et al., 2007; Heponiemi et al., 2003; Hofmann & Meyer, 2006; Meyer et al., 2007b; Meyer & Hofmann, 2005) or recruited solely from student populations (Alloy et al., 2006; Delancey, 2006; Gruber et al., 2008; Harmon-Jones et al., 2002; Harmon-Jones & Allen, 1997; Johnson et al., 2005; Krumm-Merabet & Meyer, 2005; Meyer et al., 2004; Meyer et al., 2007a; Meyer et al., 1999; Meyer & Krumm-Merabet, 2003).

There is a weakness with using high BAS scores as indicative of bipolar disorder in healthy individuals, as this does not control for other biological and cognitive factors specific to bipolar disorder that may operate in conjunction with BAS sensitivity. This approach also places bipolar patients on a continuum with the general population. In normal populations, high BAS sensitivity seems to predict manic symptoms over time (Hofmann & Meyer, 2006; Meyer & Hofmann, 2005), but these may not always be of the magnitude required to fulfill the accepted criteria for a manic episode as defined by the American Psychiatric Association's (1994) Diagnostic and Statistical Manual of Mental Disorders 4th Edition

(DSM-IV). It is therefore possible that high BAS activity can produce behaviours associated with mania, but that other processes in bipolar disorder are necessary to amplify or maintain these effects leading to fully-blown manic episodes. In other words, high BAS sensitivity alone may not be sufficient to produce a manic episode. Furthermore, although BAS theory may give an insight into the factors associated with the onset of manic episodes, what maintains them is largely unclear.

Despite this, there are similarities between bipolar individuals and healthy individuals who score highly on measures of BAS sensitivity, for example both populations show higher LFC activity (Harmon-Jones et al., 2008; Harmon-Jones & Allen, 1997). In fact, one major finding within this literature base is the link between LFC activity and BAS-related processes. The left frontal cortex was studied in some depth, and its activity was found to be raised during reward-striving (Harmon-Jones et al., 2008) and anger (Harmon-Jones et al., 2002). A brain structure associated with the BAS would be expected to be active in such situations (Depue & Iacono, 1989; Gray, 1990). As LFC activity is raised in both bipolar patients and individuals at risk of developing bipolar disorders from normal populations, this would suggest that it is not a neurological dysfunction specific to bipolar disorder, but a characteristic of all individuals with a highly sensitive BAS.

Other similarities were also found between bipolar individuals and individuals with high BAS scores. There is good evidence that highly driven goal-attainment beliefs are a characteristic of individuals at risk of mania (Meyer et al., 2004; Meyer et al., 2007a; Meyer & Krumm-Merabet, 2003) as well as bipolar individuals (Lam et al., 2004). These beliefs can be summarised as optimistic perceptions of one's ability to achieve difficult goals (Lam et al., 2004; Meyer & Krumm-Merabet, 2003) and seeing their pursuit as pleasurable (Meyer et al., 2004; Meyer et al., 2007a). It is interesting to note that these beliefs tend to concern longer-term objectives and do not correlate with the individual's actual abilities (Meyer &

Krumm-Merabet, 2003). There is therefore some evidence to suggest that high BAS sensitivity may affect how an individual perceives their future goals, i.e. that they are likely to be achieved, and therefore motivate the individual towards pursuing them. It would be interesting to assess whether these beliefs are modified if an individual experiences frequent failures in achieving goals, as can often be the case with individuals who experience significant manic episodes (Francis & Gasparo, 1994). One suggestion could be that cognitive biases within bipolar individuals may selectively allow positive experiences to reinforce goal-attainment beliefs, whilst preventing negative experiences from weakening them. Further investigation into how bipolar individuals attribute positive and negative life events would provide some insight into this.

In support of Gray (1990), several studies found that high BAS sensitivity was related to goal-directed processes (Ernst et al., 2004; Heponiemi et al., 2003; Johnson et al., 2005; Meyer et al., 2007a). For example, high BAS sensitivity was found to be an indicator of whether individuals felt likely to approach rewards (Meyer et al., 2007a). Where the benefits of approach are less apparent, this is not found (Delancey, 2006). There is evidence to suggest that BAS sensitivity predicts the intensity of response during reward pursuit (Heponiemi et al., 2003), as well as after achieving a reward (Johnson et al., 2005). Also, bipolar disorder is associated with affective responses to failure, for example greater disappointment when failure occurs, and greater relief when it doesn't (Ernst et al., 2004). Although this is inconsistent with Gray's (1990) model of the BAS, it is in accordance with Carver & Scheier's (1998) view of the BAS as sensitive to non-reward. Broadly, it seems that a highly sensitive BAS predicts larger behavioural and affective reactions in the context of reward, as originally theorised (Gray, 1990). In addition, in individuals where the BAS is highly sensitive, initial successes tend to lead to pursuit of further, more challenging goals (Johnson et al., 2005).

If the BAS is subject to dysregulation as suggested by Depue et al. (1987), it is possible that it is a system ill-equipped to cope with sudden increases in activity as would be expected after goal-achievement. Accordingly, the literature suggests that when goal-achievement events occur naturally they are largely predictive of mania onset (Alloy et al., 2008; Johnson et al., 2008; Johnson et al., 2000; Meyer et al., 2001) with the exception of Salavert et al.'s (2007) finding to the contrary. Equally, in earlier stages of pursuit where goals have not yet been achieved, it appears that bipolar individuals experience higher manic symptoms (Lozano & Johnson, 2001; Nusslock et al., 2007), a finding that is not observed within healthy individuals (Nusslock et al., 2007). These experiences may also serve to reinforce the highly-driven beliefs discussed previously.

There is some tentative evidence to suggest that even in the absence of goal-achievement, high BAS sensitivity predicts manic symptoms, as found by Hofmann & Meyer (2006) and Meyer & Hofmann (2005). However, BAS vulnerability is unlikely to be the sole cause of manic symptoms. If this were the case, it would not explain why individuals with bipolar disorder who report low BAS scores still develop mania (Holzwarth & Meyer, 2006). There is likely to be a more complex interaction involving trait features such as BAS activity, environmental factors like life events (Johnson et al., 2008; Johnson et al., 2000) and wider systemic factors.

The operation of the BAS in mania is linked with goal-directed processes, beliefs, and underlying BAS sensitivity. It appears that if BAS sensitivity is high, an individual may spend more time pursuing goals, particularly when there are early successes (Johnson et al., 2005). This may also be mediated by beliefs that goals are obtainable if they try hard enough (Lam et al., 2004). Additionally, people with a high BAS sensitivity spend more time on pleasurable pursuits (Meyer et al., 2004), even when such activities are risky or dangerous (Krumm-Merabet & Meyer, 2005; Meyer et al., 2007a). Taken alone, excessive pursuit of

pleasurable activities is one of the key features of a manic episode (American Psychiatric Association, 1994). However, in individuals with a highly sensitive BAS, goal-achievement can result in even more manic symptoms (Johnson et al., 2008; Johnson et al., 2000; Nusslock et al., 2007) and increased goal-directed activity (Johnson et al., 2005), furthering the chances of a manic episode.

Future Directions

Longitudinal research appears to show that the HPS (Eckblad & Chapman, 1986) can predict future onset of bipolar disorder amongst normal populations (Kwapil et al., 2000). Primarily, it would seem prudent to carry out similar research using the BIS/BAS Scales, considering the current literature views high BAS scores within the general population as indicators of risk for bipolar disorders (Alloy et al., 2006; Harmon-Jones & Allen, 1997). This could be examined by a longer-term prospective study, taking baseline measures of BAS sensitivity. It has already been demonstrated that large amounts of BAS sensitivity self-ratings are obtainable, especially from student groups (Krumm-Merabet & Meyer, 2005; Meyer et al., 2004). This should provide valuable long-term follow-up data. It would then be predicted that of the sample used, individuals who went on to receive a diagnosis of bipolar disorder would tend to have higher baseline BAS scores.

One observation of current measures (e.g. BIS/BAS Scales: Carver & White, 1994; HPS: Eckblad & Chapman, 1986) is that they require accurate self-report, which relies on insight and could be complicated by changes in cognitive processes during mania and depression. Therefore they may not be reliable during mood episodes, and only applicable to healthy and euthymic samples. One solution to this would be to use LFC activity as a putative indicator of BAS functioning. The additional advantage of using an EEG is it directly measures brain activity, whereas the BIS/BAS Scales (Carver & White, 1994) and

HPS (Eckblad & Chapman, 1986) are reliant on cognitive and verbal ability, and may also be affected by the meanings attributed to the self-report items.

Another direction might be to investigate possible cognitive biases in bipolar disorder, for example how achievement and non-achievement of goals are attributed by the individual, and how they impact on already existing belief structures. High BAS sensitivity might manifest itself in experiencing non-achievement of goals as the effect of an obstruction, leading to anger and frustration (Depue & Iacono, 1989); and successes as a consequence of the skill, perseverance or luck of the individual; as both these beliefs serve to reinforce tendencies to approach goals. If so, future psychological therapies could aim to focus on challenging such beliefs that may serve to maintain excessive goal-pursuit tendencies.

In future, research into BAS sensitivity may give a better insight into how cognitive, behavioural and affective factors interact to produce manic symptoms in both bipolar and normal populations. The results of longer-term studies will provide a clearer idea of how underlying BAS sensitivity manifests itself over time, and whether the BAS is a considerable risk factor for bipolar disorder. If this is the case, models of BAS sensitivity will further psychological understanding that may have positive effects on the treatment of mania.

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Running head: REWARD AND COGNITIONS IN BIPOLAR DISORDER

Behavioural activation, reward frustration and probabilistic reasoning in bipolar disorder

Nathan T. Babiker

Department of Clinical Psychology, University of Hull

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Abstract

There is thought to be a link between characteristic reward-oriented processes in bipolar disorder and dysregulation in the behavioural activation system (BAS). This study aimed to assess differences between bipolar and healthy control individuals in their response to reward, failure and a reasoning task sensitive to data-gathering biases. Participants were 25 adults with bipolar I disorder and 25 healthy controls. Measures of sensitivity to reward and failure were collected during the first task (Go task), which included visual analogue ratings of mood and success expectancy, reaction time of button-pressing, and the difficulty level set by the participant. There were no significant differences between groups following reward feedback or failure feedback on the Go task. Results from the second task showed that bipolar individuals needed less data than controls before making a decision on the emotionally-neutral, difficult version of the task. The results are discussed in relation to current trends in bipolar research.

Bipolar disorder is reported to affect at least 1% of the population (Grant et al., 2005; Merikangas et al., 2007). In 2001 it was named the 5th leading cause of total disability years lived (YLDs) by 15-44 year-olds (World Health Organization, 2001). It is also associated with high suicide rates, particularly where decreases in functioning or alcohol abuse are also present (Dutta et al., 2007). Caring for people with bipolar disorder at risk of suicide is also associated with poorer general health (Chessick et al., 2007). Bipolar individuals are believed to suffer over twice as many lost workdays due to their illness than those with major depressive disorder (Kessler et al., 2006).

Current national guidelines for bipolar disorder advise the use of medication as a first point of treatment (NICE, 2006), however in the early stages of mania drug adherence is low, which can lead to hospitalisation (Keck, McElroy, Strakowski, & Stanton, 1996). In 2002, the management of bipolar disorder cost the National Health Service £199m, contributing to overall societal costs of £2bn (Das Gupta & Guest, 2002). Nevertheless, there have been encouraging developments in the provision of psychological treatments for bipolar disorder (see Scott & Gutierrez, 2004, for a review). In particular, a large scale randomly controlled trial found that the provision of cognitive therapy in addition to medication was more cost-effective than providing medication alone (Lam, McCrone, Wright, & Kerr, 2005). However, it is clear that more understanding of the characteristic processes involved in bipolar disorder is still needed to ensure the provision of better psychological therapies (Lam, Hayward, Watkins, Wright, & Sham, 2005).

Bipolar disorder is distinguished from other mood disorders by the presence of mania or hypomania, yet despite this there are few theories which adequately explain the psychological processes involved in manic or hypomanic episodes (Mansell & Pedley, 2008). Early theories proposed the behavioural activation system (BAS: Gray, 1990), also termed the behavioural facilitation system (Depue & Iacono, 1989; Depue, Luciana, Arbisi, Collins,

& Leon, 1994) as the likely site of dysfunction in mania. The BAS is thought to be the motivational system controlling approach behaviour towards environmentally cued reward, producing activities facilitating engagement with the environment, such as increased mood, locomotor activity and decreased need for sleep (Gray, 1990). It is associated with dopamine (DA) projections, in particular those pathways leading from the ventral tegmental area of the mesencephalon to the nucleus accumbens (Depue & Iacono, 1989).

Depue and Iacono (1989) initially suggested that BAS over-activity resulted in mania. However, it is widely regarded that an overactive BAS is insufficient in itself to account for all occurrences of manic symptoms observed in bipolar individuals (Holzwarth & Meyer, 2006). Instead, Depue and colleagues' research into biological system regulation (Depue & Monroe, 1986; Goplerud & Depue, 1985), has formed the basis of the current view that the BAS is dysregulated in bipolar disorder (Depue et al., 1994; Holzwarth & Meyer, 2006; Johnson et al., 2000; Meyer & Hofmann, 2005). This dysregulation is thought to be characterised by frequent fluctuations in activity and a slower return to homeostasis after a significant challenge (Depue & Monroe, 1986). In bipolar disorder, this could lead to characteristic responses to naturally occurring events such as the achievement of goals (Johnson et al., 2000).

Reward Frustration

Individuals at risk of bipolar disorder have been found to engage in more goal-directed activity on experimental tasks when compared with healthy controls (Hayden et al., 2008), and following a reward, these individuals tend to set higher subsequent goals (Johnson, Ruggero, & Carver, 2005). Even when in remission, individuals with bipolar disorder have been found to directly oppose advice given on a decision-making task following a mood induction (Mansell & Lam, 2006), and have a more prolonged response to experimentally manipulated reward than controls (Farmer et al., 2006).

The current study is in part a replication of the design used by Johnson et al. (2005). These researchers used an affectively neutral reaction-time task to experimentally manipulate reward. Specifically, they gave participants controlled feedback indicating that they were performing well on the task, and rewarded this with a small sum of money (Johnson et al., 2005). Individuals who scored highly on the Hypomanic Personality Scale (HPS: Eckblad & Chapman, 1986), which can predict bipolar disorder (Kwapil et al., 2000), were more likely to set a harder task difficulty for themselves after receiving a reward for their performance (Johnson et al., 2005). This study made two main developments on Johnson et al.'s (2005) paradigm. Firstly, a group of individuals with bipolar disorder and a control group were compared. Secondly, it was extended with an additional phase where participants were informed that they had performed poorly, and not rewarded in order to test their response of goal frustration after goal reward. Participants could also continue the task for as long as they wished, but they were consistently told their performance had not earned them a reward.

Probabilistic Reasoning

There has been some research into a 'jumping to conclusions' bias in individuals experiencing delusions (Freeman et al., 2006; Garety et al., 2005; Garety, Hemsley, & Wessely, 1991; Huq, Garety, & Hemsley, 1988). These studies have found that, compared to healthy and clinically anxious controls, delusional individuals tend to require less information before making a decision based on probabilities (Garety et al., 1991; Huq et al., 1988). Further studies found that when the decision was more personally meaningful, for example it concerned how others might feel about the participant, delusional individuals required even less information before coming to a decision (Dudley, John, Young, & Over, 1997). This decision-making style could be a maintaining factor for rigid delusions (Garety et al., 2005). It is also relevant in bipolar individuals, who are believed to be more impulsive (Swann,

Pazzaglia, Nicholls, Dougherty, & Moeller, 2003) and have a tendency towards responding to material that corresponds with their current mood (Murphy & Sahakian, 2001).

This study incorporated a version of a task used previously (e.g. Dudley et al., 1997; Freeman et al., 2006; Garety et al., 2005). Participants are presented with two jars labelled A and B, with opposing proportions of orange and white beads, e.g. 60:40 white to orange in jar A, and vice-versa in jar B. The participant sees a sequence of beads drawn from the same jar until they are confident they know which jar has been chosen. The general population perform more cautiously on these tasks than individuals with psychosis (Garety & Freeman, 1999). An emotionally-salient version of the task was designed by Dudley, John, Young & Over (1997), where emotive words described as coming from two surveys on public opinions of manic depression replace beads. All three versions of the task were used in the current study. This study also employed a mood induction procedure to investigate mood-dependent differences in responding.

It is hoped that this study will further our understanding of the cognitive processing of bipolar patients, firstly by testing cognitive, behavioural and affective responses to experimentally-manipulated reward, and comparing these to healthy control participants. This might give insight into how goal-directed processes differ between bipolar and healthy individuals. Secondly, investigating jumping to conclusions biases in this study may provide some insight into whether such a data-gathering bias is a characteristic of bipolar patients in remission when compared with normal controls, and whether decision-making style is affected by current mood state.

Hypotheses:

1. Bipolar individuals would respond to reward with increased goal-directed behaviour, indicated by button-pressing speed, elevated mood, and higher goal-setting, as previously reported by Johnson et al. (2005). This would indicate that individuals with

bipolar disorder have a highly sensitive BAS and show a greater response to reward than controls.

2. Bipolar participants would respond more to the removal of reward, indicated by button-pressing speed, elevated mood and higher goal setting, due to their higher goal-attainment beliefs and higher proposed BAS sensitivity.

3. Bipolar participants would need to see fewer beads than controls before making a decision on the Bead task, in particular after a mood induction, indicating that bipolar individuals show mood-related tendencies towards jumping to conclusions.

Method

Participants

Clinical participants were individuals with a diagnosis of bipolar I disorder recruited from community mental health services and voluntary agencies. The main inclusion criteria for clinical participants were:

1. Diagnostic and Statistical Manual of Mental Disorders 4th Edition (DSM-IV: American Psychiatric Association, 1994) categorised bipolar I disorder.

2. Aged 18-65.

3. Beck Depression Inventory (BDI: Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) ≤ 16

4. Bech-Rafaelsen Mania Rating Scale (BMRS: Bech, Rafaelsen, Kramp, & Bolwig, 1978) ≤ 9

The clinical measures used have been fully described below. Bipolar participants were also excluded if they met DSM-IV criteria for a substance dependence disorder within the last 6 months, or had a history of psychotic symptoms not associated with their diagnosis of bipolar disorder.

Control participants were individuals aged between 18 and 65 with no psychiatric history. Potential control participants were excluded if they reported any current or previous psychiatric disorder when recruited by the researcher. Controls were required to fulfil the BDI and MRS inclusion criteria reported above.

Instruments

Structured Clinical Interview for DSM-IV (SCID: American Psychiatric Association, 1994): Bipolar participants' mental health histories were assessed using the SCID. Inter-rater reliability for this measure has been found to be strong in a large sample of patients (Williams, Gibbon, First, & Spitzer, 1992). Interviewers were doctoral trainee clinical psychologists given supervision and specific training in using the SCID by an experienced clinical psychologist and academic professor.

Beck Depression Inventory (BDI: Beck et al., 1961): The BDI is a 21-item self-report measure that assesses the cognitive and behavioural characteristics of depression. In a study of 185 college students it was found to have an internal consistency coefficient of .82 (Gould, 1982). Its content validity is high (Beck, Steer, & Garbin, 1988; Richter, Werner, Heerlein, Kraus, & Sauer, 1998), and it is thought to be a good measure for discriminating depressed and non-depressed subjects in research studies (Kendall, Hollon, Beck, & Hammen, 1987).

Bech-Rafaelsen Mania Rating Scale (BMRS: Bech et al., 1978): This is an 11-item clinician-rated interview assessing the cognitive and behavioural aspects of mania. Inter-rater reliability between 4 raters in Bech et al. (1978) was high ($w = .95$, $p = 0.0001$, $N = 12$), and was reported to show strong sensitivity for symptom severity ($X^2 = 41.95$, $p = 0.001$) (cited from Johnson et al., 2000). The BMRS is included in Appendix 6.1.

BIS/BAS-Fr (Wright, 2007): This is a development of the BIS/BAS Scales (Carver & White, 1994). The BIS/BAS Scales consist of 24 self-report items that yield 4 separate subscales relating to relative sensitivities of the BIS and BAS constructs (Gray, 1990). Seven

items relate to the BIS subscale, and 4 to 'drive', 4 to 'fun-seeking' and 5 to 'reward responsiveness' subscales. The 'drive', 'fun-seeking' and 'reward responsiveness' subscales add up to give a 'BAS total' score (Carver & White, 1994). BIS/BAS Scale scores have been found to relate to high mood during reward pursuit in a previous study (Heponiemi, Keltikangas-Jarvinen, Puttonen, & Ravaja, 2003). In the BIS/BAS-Fr revision, the 4 filler items have been removed, and 5 additional items have been added which encompass a fifth dimension, 'frustration responsiveness' (Wright, 2007). The BIS/BAS-Fr is included in Appendix 6.2.

National Adult Reading Test 2nd Edition (NART: Nelson & Wilson, 1991): An estimated measure of IQ was obtained using the NART. This measure requires the examinee to read aloud and correctly pronounce a list of fifty irregular words, and has been found to be a good indicator of Full-Scale IQ measured by the Wechsler Adult Intelligence Scale (WAIS-R) (Willshire, Kinsella, & Prior, 1991).

Computer Apparatus

Laboratory tasks were designed on a laptop computer using SuperLab software by Cedrus Corporation, licensed to the researcher for academic purposes. This allowed the dependent variables and various within-session ratings to be collected without the researcher intervening. A keyboard was modified to contain only the keys necessary for completion of the task. On-screen visual analogue scales were presented for self reported mood and success expectancy, both were rated on a 1000 pixel line and yielded values from -500 to 500. In the case of mood, this was displayed on screen as a continuum between 'positive (the most positive I have ever felt)' and 'negative (the most negative I have ever felt)'. Concerning ratings of success expectancy, the line ran from 'not successful' to 'very successful'. The reaction time of buttons pressed was collected by the computer, and video stimuli could be presented, again without the researcher's intervention.

Procedure

The majority of the participants received an information sheet by post prior to their participation of the laboratory session. Where this was not the case, they were given time to read through the information sheet when they arrived. They were given the opportunity to ask questions related to the study, and then signed a consent form. Participants completed the BIS/BAS-Fr (Wright, 2007) prior to the laboratory session. Following this the BDI (Beck et al., 1961), MRS (Bech et al., 1978) and NART (Nelson & Wilson, 1991) were administered, as well as the SCID (American Psychiatric Association, 1994) where appropriate. After completing the measures, participants were seated in front of the computer equipment used to administer the laboratory tasks.

Go Task

Participants were first instructed to rate their mood and their expectancy of success. Task instructions for the Go task explained that the object was to press a key on a key pad when a red dot appeared on the screen. Five keys corresponded to locations on the screen; top right, top left, centre, bottom right and bottom left. During blocks, the red dot repeatedly appeared in random locations on the screen. The task incorporated two short practices during the instructions, and then a 1-minute practice block. After the practice, participants were given a one-minute 'performance block' where they were instructed to press buttons as quickly as they could.

Having completed this, participants were instructed that they could win credits for good performance, and when they achieved 50 credits they would win a reward of music and animation. At this point they were asked to select an initial difficulty level from 0-9. They were told that on higher levels, they needed to perform better but their chances of winning credits were higher, whereas on lower levels they did not have to perform as well but were less likely to win credits. The instructions stated that performance was measured by reaction

time when the dot appeared. Participants were then given 4 blocks to win the reward, and that each successive block would be faster than the previous one. The computer increased the speed of the red dot every block. Participants could adjust the difficulty level before each block. Before every block, including practice, participants rated their mood and expectancy of success.

Feedback was manipulated so that participants accrued 34 credits on the first reward block, and 29 on the second, and following this they were given a short animation clip accompanied by music and the word ‘congratulations!’. For the following 2 blocks, the computer gave feedback that the performance level had not been sufficient to win any credits. After the fourth reward block, participants were given an on-screen option to choose more blocks or quit the task. This option prompted the computer to repeat the final reward block, and continue to give failure feedback. Once participants had indicated they wished to end the Go task there was a short break.

Bead Task

Participants were then presented with the Bead task. This began with a mood rating as described above. Following this, the three versions of the task were administered: first with beads in 85:15 ratio, then beads in 60:40 ratio, and finally with words in 60:40 ratio. On the bead versions, a visual representation of the proportions of beads in the jars remained on the screen throughout. In the words version, the instructions stated that they were choosing between two surveys that produced either mainly positive, or mainly negative, words about people with manic depression. Words used by Dudley et al. (1997), which included positive statements like ‘reliable’ and ‘kind’, and negative statements like ‘unfriendly’ and ‘annoying’ were used. Each time the participant was presented with a stimulus they could either make their selection or see another piece of information. The instructions stated that once the participant felt they had been presented with a sufficient amount of information, they should

choose which jar, or survey, the computer had chosen. SuperLab software was configured so that the stimuli were randomly selected in the given ratios, and as such the order of beads / words was not pre-determined. After completing the three versions of the task, participants were then presented with a positive mood induction, which comprised film clips presented on the computer screen. They included a colourful animation and an uplifting scene concerning a man's triumph over oppression. Participants were informed that the purpose of these clips was to put them in a happy mood for a short amount of time. A mood rating was collected following mood induction in order to verify its function. Following the mood induction they completed the three versions of the task again, and then they were instructed that they had concluded the study. Participants were given ample time afterwards to ask the researcher any questions.

Results

Table 2. Means and Standard deviations for demographic and clinical measures

	Bipolar	Control
Age	43.96 (9.69)	39.60 (13.49)
Females	13 (52%)	13 (52%)
NART	16.52 (8.11)	15.04 (7.16)
BDI*	6.88 (5.52)	3.52 (4.00)
BMRS*	1.40 (2.38)	0.08 (0.40)
BAS Total	36.88 (9.37)	39.68 (4.23)
BAS Drive	10.16 (3.15)	10.76 (1.69)
BAS Fun-seeking	11.12 (3.44)	12.32 (1.93)
BAS Reward Responsiveness	15.60 (3.59)	16.60 (2.14)
BAS Frustration Responsiveness	13.36 (3.13)	11.88 (2.60)

* Indicates a significant difference between groups on measure at $p < .05$

The demographic and clinical data for the bipolar and control groups are presented in Table 2. There were no significant differences on measures of age, gender mix, NART estimated IQ or BIS/BAS Scales. There were significant differences on both manic and depressive symptom measures. For depressive symptoms, an independent samples t test showed that bipolar participants scored higher on the BDI than control participants, $t(48) =$

2.47, $p < .05$ (two-tailed); and another independent samples t test indicated that bipolar participants presented with a higher level of manic symptoms, $t(48) = 2.73$, $p < .05$ (two-tailed). Only one of the control participants scored above 0 on the BMRS indicating a negligible incidence of manic symptoms within controls. A t test also revealed a significant difference between groups in baseline mood, with controls rating their initial mood as higher than bipolar participants, $t(48) = -3.18$, $p < .05$ (two-tailed). Pre-testing mood correlated with depressive symptoms (BDI scores) within the group as a whole, $r = -.408$, $p < .05$, and in control participants, $r = -.441$, $p < .05$, but this effect was not found in the bipolar group alone. Pre-testing mood was not associated with manic symptoms (BMRS scores) in either group.

Four of the five BIS/BAS-Fr subscales were associated with current manic symptoms in the bipolar group (BMRS scores); BAS Total, $r = .606$, $p < .001$; Drive, $r = .631$, $p < .001$; Fun-seeking, $r = .558$, $p < .001$; and Reward Responsiveness, $r = .492$, $p < .05$. The Frustration Responsiveness subscale did not correlate with current manic or depressive symptoms in bipolar or control participants. The internal consistency of the BIS/BAS-Fr was better for bipolar than control participants, correlations between BIS/BAS-Fr subscales and other measures are reported in Appendix 4.1.

Go task

Main analysis for the Go task focused on assessing whether there were between-groups differences in response to reward, response to failure, and also the amount of extra blocks chosen.

Table 3. Mean scores and standard deviations for main variables over time

		Mood	Success Expectancy	Difficulty Level	Reaction Time (ms)
	Baseline	61.44 (207.24)	88.92 (195.90)	6.44 (1.76)	603.00 (97.85)
Bipolar (n=25)	Post-Reward	138.48 (225.04)	203.40 (225.39)	7.88 (2.09)	449.64 (45.29)
	Post-Failure	44.72 (224.86)	105.72 (249.57)	7.28 (2.15)	359.94 (90.66)
	Baseline	219.84 (137.97)	115.00 (144.41)	6.44 (1.85)	526.81 (103.78)
Control (n=25)	Post-Reward	252.60 (164.25)	270.32 (158.08)	8.16 (1.80)	427.38 (37.98)
	Post-Failure	195.60 (153.19)	191.76 (185.11)	7.56 (1.81)	369.75 (83.31)

Table 3 shows the mean scores by group on all main dependent variables at baseline, following reward feedback and following failure feedback.

To test for differences between groups in response to reward feedback, four one-way analyses of covariance (ANCOVAs) were carried out on the post-reward value of each dependent variable (mood, success expectancy, difficulty level and reaction time of button pressing), testing the main effect of group. Baseline value of each dependent variable was entered as a covariate in order to account for differences in initial ability. As BDI and BMRS scores were significantly higher in the bipolar group, these were added as covariates on all tests. Pre-testing mood was not included as a covariate as it correlated with BDI Score ($r = -$

.408, $p < .05$). These one-way ANCOVAs indicated that mood ($F(1, 46) = 1.62, p = .209$), success expectancy ($F(1, 46) = .231, p = .633$) and difficulty level selected ($F(1, 46) = .607, p = .440$) directly following reward were not significantly different between groups. Reaction time of button pressing showed a trend towards significance, $F(1, 46) = 2.917, p = .094$, suggesting that bipolar participants' post-reward button-pressing speed tended to be higher than controls, taking into account their baseline performance.

To assess whether there were differences between groups following failure feedback, a response to failure score was calculated for each of the four dependent variables (mood, success expectancy, difficulty level and reaction time of button pressing) using the change between post-reward and post-failure values. These change scores were then entered into four separate one-way analyses of covariance (ANCOVAs), again testing the differences between groups and covarying BDI, BMRS and baseline levels¹. None of the changes following failure feedback were significant on any of the dependent variables: mood ($F(1, 46) = .479, p = .492$), success expectancy ($F(1, 46) = .891, p = .350$), difficulty level selected ($F(1, 46) = .079, p = .780$) and reaction time of button-pressing ($F(1, 46) = .987, p = .326$) did not differ between bipolar and control participants. This suggests that the bipolar and control groups did not respond any differently to the introduction of the failure condition.

Finally, analysis of the amount of extra blocks selected using the Mann-Whitney U test indicated that the difference between the amount of extra blocks chosen by bipolar participants ($M = .56, SD = .712$) and control participants ($M = .88, SD = 1.09$) was not statistically significant $U(25, 25) = 269.50, p = .367$ (two-tailed). Tables of ANCOVA analyses for the Go task are reproduced in Appendix 4.2.

¹Repeated measures ANOVA could have been used as the dependent variables were sampled over 3 time points (e.g. baseline, post-reward, post-failure). Change scores and ANCOVAs were used as this was the method previously used by Johnson et al., (2005), and this study aimed to replicate those researcher's findings in relation to post-reward responses, then look at post-failure responses. In order to do this, separate analyses were made at post-reward and post-failure stages.

Bead Task

Main analyses focused on the between-groups differences on the task variations, and potential between-groups interactions in the differences between pre- and post-mood induction draws. The mood induction procedure produced a significant increase in positive affect, tested using a paired samples *t* test for repeated measures, $t(49) = -2.65, p = < .05$ (two-tailed)².

Mann-Whitney U tests were carried out to test for any differences in amount of beads or words drawn between bipolar and control groups before mood induction. Bipolar participants did choose significantly fewer beads on the 60:40 Bead task than controls, $U(25, 25) = 193.00, p = < .05$ (two tailed), suggesting that on this version of the task they came to a decision quicker. There was no significant difference between the mean draws made by bipolar and control participants on the 85:15 Bead task, $U(25, 25) = 235.50, p = .127$ (two-tailed), or on the 60:40 Words task, $U(25, 25) = 284.50, p = .585$ (two-tailed), before mood induction. Table 4 below summarises the amount of draws in each group before and after mood induction on each version of the task.

² A *t*- Test was used to assess the validity of the mood induction procedure. As there were only two time points (pre- and post-mood induction) to compare, a more complex repeated measures ANOVA was not necessary.

Table 4. Mean draws on task version by group before and after mood induction

		Pre Mood+ (<i>SD</i>)	Post Mood+ (<i>SD</i>)
	Beads 85:15 Draws	2.64 (1.78)	2.60 (2.04)
Bipolar (n = 25)	Beads 60:40 Draws	3.84 (4.91)*	5.24 (5.91)
	Words 60:40 Words	5.72 (8.65)	5.16 (7.98)
	Beads 85:15 Draws	3.48 (2.18)	3.00 (2.12)
Control (n = 25)	Beads 60:40 Draws	5.96 (4.17)*	4.44 (3.55)
	Words 60:40 Words	4.92 (4.05)	5.08 (5.03)

Mood+ = Mood Induction Procedure

* difference between groups was significant at the $p < .05$ level

Three analyses of covariance (ANCOVAs) were carried out to assess any between-subjects effects of mood induction on the three versions of the task. Number of items (beads or words) drawn after mood induction were entered as the dependent variable for each task version, covarying the number of items drawn in the pre mood induction condition of the same version. There were no significant effects of group on the 85:15 Beads condition, $F(1, 47) = .054, p = .817$; the 60:40 Beads condition, $F(1, 47) = 1.132, p = .293$; or the 60:40 Words condition, $F(1, 47) = .931, p = .340$. Tables of ANCOVA analyses for the Bead task are reproduced in Appendix 4.3.

Discussion

This study used experimental tasks to test hypotheses concerning two areas of interest. Firstly, we examined whether bipolar individuals would behave differently to non-clinical adults after achieving, and then subsequently failing to achieve, a set goal on a task. This follows from the behavioural activation system theory that bipolar individuals are more sensitive to reward, and show greater cognitive, behavioural and affective responses to achieving reward in experimental tasks (Farmer et al., 2006; Johnson et al., 2005). Secondly, we investigated whether a probabilistic reasoning task with a varying degree of uncertainty revealed any data-gathering biases specific to bipolar individuals, and not normal controls, following from previous studies finding a tendency to oppose advice when in high mood (Mansell & Lam, 2006), and impulsivity on word tasks (Swann et al., 2003) in individuals with bipolar disorder.

It was hypothesised that on the Go task, bipolar participants would respond more to rewarding task feedback than controls. In fact, this study found no significant differences between groups on response to reward feedback, even when current manic and depressive symptoms were controlled for. This contrasts with previous research comparing the differences in bipolar and control participants following reward and failure (Ernst et al., 2004). It also contraindicates findings in the general population that non-bipolar individuals who are either at risk of mania or displaying sub-clinical manic symptoms show similar increases in positive mood, cognitions and behaviours in response to reward (Hayden et al., 2008; Heponiemi et al., 2003; Johnson et al., 2005). In Hayden et al. (2008), the authors noted that manic symptoms tended to impact negatively on reward task performance. Although our study controlled for the presence of manic symptoms, they were only present in the bipolar group, leading to an extra degree of covariation being applied essentially to only one group.

We also hypothesised that bipolar participants would show greater responses to failure feedback on the Go task. Again, analyses showed that there were no significant differences between groups on any variable between reward and failure conditions. Finally, there were no differences between groups on the amount of extra blocks selected on the Go task. The mean amount of extra blocks chosen in both groups was less than one; only three bipolar and four control participants opted for more than one. A more sensitive measure of task persistence, for example time spent on an open-ended final block, might have uncovered a significant effect here, something that is noted for future research in this area.

A potential confound in the Go task was introduced by increasing the speed of each block successively. This made the task less sensitive to changes in button-pressing speed, as increases in this variable were forced by the task, and subsequently the margin for detecting differences between groups was reduced. However, an advantage of the task design was that it collected multiple dependent variables: mood, success expectancy, level setting and reaction time, so the confounding effect of block speed was unlikely to be the sole reason for the lack of statistical significance in the main effects. It might also be argued that the reward offered (short animation) was not sufficient to produce large changes in task performance, when compared to previous studies that have used money as a reward (Ernst et al., 2004; Farmer et al., 2006; Johnson et al., 2005).

In the Bead task, there was a significant difference in amount of draws at baseline on the 60:40 condition. Analysis indicated that on the version where there was a lower chance of selecting the correct jar, bipolar participants chose significantly less draws than controls. In other words, on the version of the task seemingly requiring the most caution, bipolar participants tended to be more gather less data before making a choice. Interestingly, when emotive words were used in the same proportions, and when the task was easier, there were no differences between groups. It could be that the increased difficulty of the 60:40 task

made it more sensitive than the 85:15 ratio, where the groups were less likely to differ on draws. Also, bipolar patients have been found to be more impaired on cognitive tasks following stress (Ruggero & Johnson, 2006), which may have been an important differentiating factor given the higher difficulty of the 60:40 beads condition. Bipolar and control participants did not behave differently on any version of the Bead task following a mood induction. This may have been due to the artificial nature of the mood induction procedure, which could have produced some demand characteristics in both groups. In future a more cognitively neutral mood induction could be used, such as a positive-feedback Go task with a monetary reward.

The main strength of this study was in comparing bipolar and control participants on a laboratory task, as it allowed the hypotheses made by previous studies using 'at-risk' populations (Gruber, Johnson, Oveis, & Keltner, 2008; Heponiemi et al., 2003; Johnson et al., 2005; Meyer, Beevers, Johnson, & Simmons, 2007) to be tested using adult bipolar patients. This study did not provide any support for suggestions that findings from 'at-risk' populations can be generalised to bipolar individuals. It is possible that normal individuals with hypomanic tendencies are located at the greater extreme of a continuum of positive emotionality (PE) spanning the entire population (Depue et al., 1994), but this variable might not equate exactly to BAS sensitivity, and furthermore BAS sensitivity is unlikely to be the only biological or psychological variable responsible for bipolar disorder (Holzwarth & Meyer, 2006).

In fact, it is of considerable importance that this study did not find any differences between groups on any of the BIS/BAS Scale scores. This contradicts the theoretical view that bipolar disorder is indicated by high BAS activity, and is mirrored by findings that the BIS/BAS Scales do not differentiate clinical populations from non-clinical ones (Hayden et al., 2008; Johnson et al., 2003; Meyer et al., 2001). Also, Holzwarth & Meyer (2006) found

that individuals found to be at risk for bipolar disorder scored higher on the BIS subscale but not any of the BAS subscales. This clearly raises some question about whether BAS vulnerability is likely to be the sole cause of bipolar disorder. Only one study in the recent literature base has found a difference in BAS activity between groups (Salavert et al., 2007). This study used a different measure specifically tailored towards sensitivity to reward and punishment (Sensitivity to Punishment and Sensitivity to Reward Questionnaire: Torrubia, Avila, Molto & Caseras, 2001).

One explanation for this is that the BIS/BAS Scales do not accurately measure the construct proposed in BAS models of bipolar disorder (Meyer et al, 2001; Johnson et al., 2003). This may in part be due to the fact that the BIS/BAS Scales were developed on undergraduate populations (Carver & White, 1994), and consequently they are based upon the characteristics of highly goal-driven and reward-responsive students, who may have altogether different personality structures to bipolar individuals. Another important factor is the presence of previous episodes of depression. In this study, the control group had no history of depression, whereas all of the bipolar group had experienced at least one depressive episode. The bipolar group's BAS self-report may have been affected by the negative cognitions about the self and capability to achieve that can be associated with depression (Beck, 1968). Certainly some items on the BIS/BAS Scales carry an assumption that the rater feels they have the ability to achieve things (in questions such as "If I see a chance to get something I want I move on it right away"), a belief that may be undermined by a history of depressive episodes (Johnson, 2005).

This study did find that BIS/BAS Scale scores correlated strongly with current manic symptoms (see Appendix 4.1), a finding which has been contended in previous studies: Biuckians, Miklowitz & Kim (2007) found that lower BIS/BAS Scale scores were associated with manic symptoms, whereas Meyer, Johnson & Carver (1999) found higher BIS/BAS

Scale scores in individuals experiencing manic symptoms. Additionally, the BIS/BAS Scales were more stably intercorrelated in the bipolar group than in the control group (see Appendix 4.1). There is therefore a small degree of support for theories that propose differences in BAS activity between bipolar and non-bipolar individuals. A logical next step would be to test these contrasts with an additional unipolar depressive control group, in order to assess whether these differences are specific to bipolar disorder.

One weakness of this study was the small sample size, as this was likely to increase the effect sizes needed for statistical significance. Differences between bipolar and non-bipolar individuals are believed to be subtle when bipolar individuals are in remission (Mansell & Pedley, 2008). As a result, future studies could benefit from using highly sensitive measures of difference. Of the tasks used in this study, the Bead task at higher difficulty levels appeared to be the most sensitive measure of difference with the groups used.

The basis for BAS sensitivity theory of bipolar disorder originates from research into ‘at-risk’ populations, and this study’s findings certainly suggest that such a basis is tentative. The hypothesis that bipolar individuals would react more to both reward and failure was not supported. There were certainly methodological confounds introduced with the difficulty of the task increasing over time, as it is difficult to predict how individuals with a history of mental illness respond to increasing task difficulty, except that bipolar individuals are believed to respond to task stress with reduced cognitive performance (Ruggero & Johnson, 2006). Also, as noted before, the reward in this study was perhaps not sufficient to create the kind of BAS activation observed in previous studies (e.g. Johnson et al., 2005). As bipolar individuals are less likely to follow advice when their mood increases (Mansell and Lam, 2006), they may have been opposing the Go task’s suggestion that they should aim to win credits.

However, there is also an argument that the suggestion of a single underlying dysfunction in bipolar disorder, such as the BAS, is an oversimplification. One of the main limitations of BAS theory is that its relevance to bipolar disorder has been assumed: initially by Depue & Iacono's (1989) observations of the similarity between mania and goal-approach behaviours; and following this, by studies of healthy populations deemed to be at risk of bipolar disorder (e.g. Heponiemi et al., 2003; Johnson et al., 2005). It seems to be apparent that the BIS/BAS Scales do not find differences between bipolar and healthy populations, as this was also found in Hayden et al. (2008). Further research is needed to assess other measures such as the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ: Torrubia et al., 2001) which are suggested to be more successful in differentiating bipolar individuals from controls (Salavert et al., 2007), and investigate the factors within the scales that are specifically relevant to bipolar individuals.

The lack of support for BAS based hypotheses in this study suggests that there are more factors contributing to the maintenance of bipolar disorder than reward-motivation. There are some alternative theories to the BAS model of bipolar disorder. Firstly, a large body of research focuses on the effects of biological cycles controlling sleep and other activities, broadly termed circadian rhythms (Wehr, Sack, Rosenthal, Duncan & Gillin, 1983). Theories in this area suggest that bipolar symptoms are caused by disruption of these natural internal cycles, following evidence that humans and animals subjected to sleep disruptions can develop mania-like symptoms such as cognitive disturbances, hallucinations and psychomotor agitation (Healy & Williams, 1989). Circadian cycles can be disturbed by changes in interpersonal relationships or major life events (Meyer et al., 2001). Once normal sleep or arousal cycles are disrupted, it is hypothesised that bipolar individuals become more behaviourally activated, irritable and restless, and as a consequence of this their interpersonal relationships and other activities such as work suffer (Wehr et al., 1983). Jones (2001) goes

on to suggest that in this state, the individual may view their ability to go without sleep as a desirable or extraordinary trait, maintaining the cycle further.

Secondly, Abraham's (1911) psychoanalytic theory, developed by Bentall and colleagues (Lyon, Startup & Bentall, 1999) conceptualises bipolar mania as a defence against an underlying depression – termed the manic defence. There is evidence that even during mania, irritability and anger are the most commonly observed factors (Mansell & Pedley, 2008), which lends some support to suggestions that manic and depressive symptoms often if not always coincide. Thomas & Bentall (2002) propose that the self-esteem of bipolar individuals is subject to large fluctuations over time, and that people with bipolar disorder tend to utilise a coping style that involves rumination and avoidance, but also behavioural risk-taking. These coping strategies are believed to be employed when the individual perceives his current self-perception to be straying away from a sense of an 'ideal' self (Bentall, Kinderman & Manson, 2005). Additionally, Thomas & Bentall (2002) argue that dysfunctional coping strategies such as rumination and risk-taking could have initially caused the unstable self-esteem that they now serve to defend. They suggest that early intervention with people with these coping styles may help to reduce the likelihood that they develop bipolar disorder (Thomas & Bentall, 2002).

Finally, a recent theory developed by Mansell, Morrison, Reid, Lowens & Tai (2007) suggests that bipolar disorder and other psychiatric disorders characterised by mood fluctuations are underpinned by internal conflicts between contradictory cognitions concerning the self and taken to have extreme personal meaning. Their theory focuses on these internal conflicts – for example simultaneous appraisals of the self as both weak and all-powerful – and the individual's constant efforts to resolve them (Mansell et al., 2007). In this model, fluctuating and conflicting internal states occur constantly, even outside of manic episodes. This is supported by findings that bipolar individuals experience mood instability

during remission (Judd et al., 2002). Self-appraisals of symptoms, such as seeing one's flight of thoughts as extreme intelligence, lead to further 'ascent behaviours' which might include beginning a large-scale business plan. These ascent behaviours may then be reinforced by inter-relationships with others, for instance viewing family members' inability to keep up with one's ideas as evidence that they are not intelligent enough to understand (Mansell et al., 2007).

It could be argued that there is an interrelation of the factors summarised above. People who suffer from bipolar disorder often report sleep disturbance as the most common early warning sign of mania (Jackson, 2003), suggesting that disturbed circadian rhythms form an important part of the initial stages of mania. This could also be affected by increased risk-taking (Thomas & Bentall, 2002), and further exacerbated if the individual ignores the advice of others close to them, as found by Mansell & Lam (2006). Goal-directed processes are likely to be risk factors in bipolar individuals who are already highly goal-driven, e. g. those who would already report a highly sensitive BAS, as they would further disrupt sleep patterns, and perhaps lead to more risk-taking behaviours.

Testing reward-oriented processes is of interest in bipolar disorder, as the effect of goal-achievement has been found to impact significantly on the mental health of bipolar patients (Johnson et al., 2008; Johnson et al., 2000). These processes in bipolar individuals could be manifestations of highly driven goal-attainment beliefs (Lam, Wright, & Smith, 2004), as well as indications of underlying biological vulnerability (Depue & Iacono, 1989; Gray, 1990). This study did not find any differences relating to reward-related processes in bipolar disorder, so it is likely that further research is needed to clarify how goal-oriented processes and other factors interact, to give a better understanding of bipolar disorder.

This study found that bipolar individuals employed a bias towards gathering less data before making a decision on a reasoning task. This jumping to conclusions bias has also been

observed previously in delusional populations (e.g. Garety et al., 2005; Freeman et al., 2006). Garety et al. (1991) suggest that this bias occurs within people with delusions because they attach more importance to immediately available environmental information as opposed to prior experience. Alternatively, it has been suggested that this style of hasty decision-making may be as a result of a lower tolerance for ambiguity (Dudley et al., 1997). As there is little or no similar research into these biases in bipolar disorder, only tentative suggestions can be made. It is possible that certain characteristic processes in bipolar disorder are associated with hastiness in data-gathering. For example, following from Mansell et al.'s (2007) suggestion of internal conflict as a driving force for manic symptoms, hasty data-gathering might be seen as a behaviour aimed at promoting the belief that the individual is 'on the ball' and 'quick witted', disproving the conflicting view that they are slow or sluggish.

Two further points of interest should be noted: firstly that a jumping to conclusions bias was observed in remitted bipolar individuals and should therefore be considered a potential area for intervention with these individuals when they are not experiencing clinically significant symptoms. Secondly, that the bias was only apparent during the more difficult version of the task (60:40 ratio), suggesting that as the cognitive demands of the task increase, the individual is more likely to rely on less information. This may be support for Dudley et al.'s (1997) theory that such a data-gathering bias serves to reduce the cognitive demands placed on the individual by ambiguity.

This study indicates that intervening during the remission period of bipolar disorder would be worthwhile. Focusing on jumping to conclusions could form part of a self-management programme, which could include strategies like discussing the potential hazards of hasty decisions, especially where they concern important relationships and risk-taking. There is ample evidence to suggest that disruptions in personal relationships, sleep cycle and medications can lead to the onset of manic symptoms (Mansell & Pedley, 2008), so

individuals could be advised to be especially cautious in such areas, and look for advice from others where necessary. Careful data-gathering, for example weighing up costs and benefits carefully, could be promoted by professionals working with bipolar individuals.

Another area for intervention might be to promote positive approaches to difficult and ambiguous decisions. Bipolar individuals, as theorised with delusional populations (Garety et al., 1991), may be less able to be informed by past experience. The individual may have experienced a succession of failures or distressing experiences as a result of previous episodes (Johnson, 2005), and the difficult feelings associated with such episodes may be complicated. However, these experiences are important reference points for future decisions. Feelings like shame may prevent the individual from recalling the process involved in a past choice and evaluating its effects. In this case, encouraging individuals to acknowledge past experiences in a non-judgemental way might help to better inform future decisions.

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Appendix

Appendix 1. Reflective Statement

Introduction

I consider it to be somewhat fitting that the theoretical underpinnings of my research portfolio are the intrinsic processes that are thought to motivate people towards the achievement of goals. A doctoral degree in Clinical Psychology carries a significant reward with it, and one that I have been keen to earn in a manner that exceeds simply fulfilling the basic requirements. In turn, my degree has provided a magnitude of challenge that I can say with confidence is far outside the realms of my past academic and occupational experiences.

I feel that I have found the task of preparing a research portfolio particularly difficult, especially using quantitative methodology, of which I have had little experience in my post-graduate years. My rationale for carrying out such a study was that I felt that any further neglect of quantitative methods would probably amount to avoidance, and further reduce my confidence in my own abilities to handle anything surpassing simple statistics. I felt that this particular area of weakness was a potential area for development, and I should take an opportunity when presented.

My initial reasons were sufficient to convince me to undertake the project contained within this portfolio, and I am glad to say that over time, my sense of this being a good decision began to grow significantly. I became totally immersed in the design stages of my study, perhaps too much so. I pitched many ideas to my supervisor, some of which now seem so far-fetched that I am both relieved and disappointed they never got past the drawing board.

At the time, my supervisor had commented that I had a good creative mind, although it was also clear that this was perhaps being counterbalanced by a lack of real initiative to get started on the task ahead. I remember wishing that I could stay in the planning stages forever, where my tendencies toward perfectionism, especially where aesthetic, would be best

applied. My supervisor helped me to see that my tendency to stall decisions had a serious impact on my overall timescale.

Learning Exponentially

A feature of preparing a research portfolio for a clinical psychology doctorate, and a process that I have not previously been accustomed to, is the necessity of a large amount of information gathering in a short amount of time. I can relate this to my experiences, successful and otherwise, of teaching myself to use SuperLab, the software package used to design my experimental tasks. I can also relate this to my experience writing my systematic literature review, where in the space of a few weeks I began to feel as though I was developing an area of expertise, albeit limited, in my chosen profession.

Finally, simply the experience of meeting 25 individuals with bipolar disorder, taking mental health histories, spending time talking to them about their first episodes, diagnoses and medication, therapy and other common experiences gave me an incredibly intensive crash-course in the 'real' individuals with bipolar disorder. By this, I mean the people who live within our communities, interact with us and share our lives, as opposed to those reported in studies that I had been avidly reading.

These exponential learning curves have helped me to realise that my capability to learn and remain engaged within a topic area have changed immeasurably since my undergraduate degree, where I had always felt that the best strategy was to treat information as disposable the moment it was no longer likely to be the subject of an upcoming exam or essay.

The BIS/BAS Scales in Relation to the Author

As behavioural activation system (BAS) theory was the main focus of my research portfolio, I felt it completely appropriate to assess my own scores on the BIS/BAS-Fr (Wright, 2007). I did this before obtaining details of how to score the scales, so as to make this as valid an exercise as possible. My values on the various subscales were as follows:

BAS Total	46
Drive	11 (out of 16)
Fun-Seeking	15 (out of 16)
Reward Responsiveness	20 (out of 20)
Frustration Responsiveness	13 (out of 20)
BIS	19 (out of 28)

I then went on to interpret my research experience (a goal-pursuit event) in relation to my BIS/BAS-Fr Scores. Firstly, my drive score, relating to items such as ‘If I see a chance to get something I want I move on it right away’, was only moderate. In contrast, my Fun-Seeking score was one point away from the maximum, and my Reward Responsiveness was the maximum possible score. Fun-Seeking relates to items such as ‘I’m always willing to try something new if I think it will be fun’, and Reward Responsiveness encompasses items like ‘When good things happen to me, it affects me strongly’. The emphasis on Fun-Seeking and Reward Responsiveness over Drive suggests to me that my tendency is towards being driven by positive experience rather than achievement. In practice I have certainly found that the

largest motivating factor for completing my portfolio has been my expectation of how I will feel having successfully completed it.

I am a moderate scorer on the Frustration Responsiveness subscale (e.g. ‘If I have been working hard at something I lose motivation if I don’t get the reward I deserve’), which I feel is representative, given that I have often felt as though there was no reward in sight – and that completing my portfolio would probably never happen anyway (there is no optimism / pessimism scale in the BIS/BAS-Fr, something I feel may be an oversight!).

I scored in the low-moderate range on the BIS scale. Items on this scale include ‘I worry about making mistakes’, and ‘I have very few fears compared to my friends’. I feel that in preparing a research portfolio, I have managed to adequately manage a small amount of baseline anxiety and dread throughout the process, without them becoming overwhelming. I suppose that in this way I have kept my BIS at bay to some extent.

The BIS/BAS-Fr is available in Appendix 7.2.

Selecting Appropriate Journals

I felt that *Clinical Psychology Review*, as a journal specifically publishing review papers, was the most appropriate arena to submit my Systematic Review Paper to. I was struck by the wide variety of articles published within it. I felt that as BAS theory, and manic symptoms for that matter, are broadly relevant to the general population, it was not necessary to submit to a journal specialising in mood disorders.

Journal of Abnormal Psychology’s remit of publishing “articles on basic research and theory in the broad field of abnormal behavior, its determinants, and its correlates” (See Appendix 2.2) seemed to be broadly applicable to my empirical paper.

Appendix 2. Guidelines for Submission to Journals

2.1 – Clinical Psychology Review Author Guidelines

SUBMISSION REQUIREMENTS: Authors should submit their articles electronically via the Elsevier Editorial System (EES) page of this journal (<http://ees.elsevier.com/cpr>). The system automatically converts source files to a single Adobe Acrobat PDF version of the article, which is used in the peer-review process. Please note that even though manuscript source files are converted to PDF at submission for the review process, these source files are needed for further processing after acceptance. All correspondence, including notification of the Editor's decision and requests for revision, takes place by e-mail and via the Author's homepage, removing the need for a hard-copy paper trail. Questions about the appropriateness of a manuscript should be directed (prior to submission) to the Editorial Office, details at URL above. Papers should not exceed 50 pages (including references).

Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, without the written consent of the Publisher.

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Appendix 3. Studies Excluded from Systematic Literature Review Paper

Table 5. List of excluded studies and exclusion criteria met.

Exclusion Criterion	Studies
1. Non-human study	Hodozuka, Tsuda, Hashizume, & Tanaka, 2006; Young, Minassian, Paulus, Geyer, & Perry, 2007
2. Qualitative / non-experimental / book	Fowles & Spaulding, 1994; Green, 1996; Johnson et al., 2006; Maas et al., 1980; Mitterauer, 2000
3. Not testing mania associated processes	Altamura & Morganti, 1975; Benedetti et al., 2008; Holzwarth & Meyer, 2006; Katz et al., 1994; Sosnowski, Nurzynska, & Polec, 1991; Wacker, Heldmann, & Stemmler, 2003
4. Not related to BAS activity in mania	Bauer et al., 2005; Bauer et al., 2003; Blumberg et al., 2005; Bohdjalian et al., 2006; Camacho & Akiskal, 2005; Cargiulo, 2007; Chen, Masana, & Manji, 2000; Colin, Reggers, Castronovo, & Ansseau, 2003; Dantzer, 1990; Dilsaver & Greden, 1984; Flor-Henry, 1986; Namba et al., 2007; Pacheco & Jope, 1996; Petho, 1990; Pickar et al., 1982; Previc, 2006; Reynolds, Beasley, & Zhang, 2002; Rich et al., 2006; Rodenhauser, 1986; Rosenheck, Frank, & Graber, 1987; Ruetsch, Viala, Bardou, Martin, & Vacheron, 2005; Sakurada et al., 2007; Schneier, Blanco, Antia, & Liebowitz, 2002; Silva, Leong, & Weinstock, 1989; Sitland-Marken, Rickman, Wells, & Mabie, 1989; Sobottka et al., 2002; Sonnik & Zazykina, 1987; Strakowski, Adler, Holland, Mills, & DelBello, 2004; Szuba, Hornig-Rohan, & Amsterdam, 1997; Torgersen, Rosseland, & Malt, 1990; Tsai, 2007; Uzelac, Jaeger, Berns, & Gonzales, 2006; Vieta et al., 2007; Wessa et al., 2007; Zeisel, 1986
5. Review article	Bowins, 2008; Cacioppo & Gardner, 1999; Dilsaver & Greden, 1984; Monti-Bloch, Jennings-White, & Berliner, 1998; Solomon, Keitner, Ryan, & Miller, 1998

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Appendix 4. Empirical Paper Data Analyses

4.1 Empirical Paper Baseline Measure Correlations

Table 6. Correlations between baseline measures pre-testing

	Age	BAS T	BAS D	BAS FS	BAS RR	BAS FR	NART	BDI	BMRS	Mood
Age	-	-.265	-.164	-.276	-.284	-.359	-.443*	.160	.189	-.095
BAS T	-.084	-	.903**	.911**	.944**	.590**	.066	-.137	.606**	.123
BAS D	-.236	.723**	-	.710**	.798**	.531**	-.018	.008	.631**	.100
BAS FS	-.040	.799**	.535**	-	.795**	.552**	-.001	-.168	.558**	.005
BAS RR	.056	.685**	.157	.254	-	.546**	.187	-.204	.492*	.228
BAS FR	-.077	.235	.419**	.199	-.046	-	-.013	-.209	.270	-.167
NART	.077	.152	.166	.289	-.091	-.123	-	.039	-.415*	.047
BDI	.307	.254	.340	.350	-.082	.066	.255	-	-.120	-.252
BMRS	-.133	.164	-.094	.181	.234	.010	-.176	-.183	-	.000
Mood	.146	.023	-.204	-.260	.441*	-.157	-.067	-.441*	.239	-

BAS T = BAS Total, BAS D = Drive, BAS FS = Fun-Seeking, BAS RR = Reward Resp., BAS FR = Frustr. Resp.
 Correlations for the bipolar group are reported above the diagonal, controls below the diagonal. (* $p < .05$, ** $p < .001$)

4.2 Go Task ANCOVA Summaries

* indicates $p = < .05$, ** indicates $p = < .001$

Table 7. ANCOVA summary table for effects of group on mood change following reward controlling for depressive and manic symptoms

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (BDI)	11684.61	1	11684.61	.576
Covariate (BMRS)	1090.39	1	1090.39	.054
Main Effect (Group)	32936.99	1	32936.99	.209
Error	932924.92	46	20280.98	

Table 8. ANCOVA summary table for effects of group on success expectancy change following reward controlling for depressive and manic symptoms

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (BDI)	5369.61	1	5369.61	.176
Covariate (BMRS)	2968.48	1	2968.48	.097
Main Effect (Group)	7064.98	1	7064.98	.633
Error	1405649.28	46	30557.59	

Table 9. ANCOVA summary table for effects of group on level setting change following reward controlling for depressive and manic symptoms

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (BDI)	.04	1	.04	.030
Covariate (BMRS)	.11	1	.11	.078
Main Effect (Group)	.83	1	.83	.607
Error	63.04	46	1.37	

Table 10. ANCOVA summary table for effects of group on reaction time change following reward controlling for depressive and manic symptoms

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (BDI)	6476.94	1	6476.94	.766
Covariate (BMRS)	2170.64	1	2170.64	.257
Main Effect (Group)	24672.75	1	24672.75	2.917
Error	389112.20	46	8458.96	

Table 11. ANCOVA summary table for effects of group on mood change following failure controlling for depressive and manic symptoms

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (BDI)	18396.87	1	18396.87	.833
Covariate (BMRS)	23127.05	1	23127.05	1.047
Main Effect (Group)	10584.98	1	10584.98	.479
Error	1016046.05	46	22087.96	

Table 12. ANCOVA summary table for effects of group on success expectancy change following failure controlling for depressive and manic symptoms

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (BDI)	5662.48	1	5662.48	.409
Covariate (BMRS)	6885.29	1	6885.29	.497
Main Effect (Group)	12332.23	1	12332.23	.891
Error	636728.60	46	13841.93	

Table 13. ANCOVA summary table for effects of group on level setting change following failure controlling for depressive and manic symptoms

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (BDI)	.15	1	.15	.250
Covariate (BMRS)	.078	1	.078	.129
Main Effect (Group)	.047	1	.047	.079
Error	27.79	46	.60	

Table 14. ANCOVA summary table for effects of group on reaction time change following failure controlling for depressive and manic symptoms

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (BDI)	5692.93	1	5692.93	.848
Covariate (BMRS)	315.96	1	315.96	.047
Main Effect (Group)	6621.90	1	6621.90	.987
Error	308683.93	46	6710.52	

4.3 Bead Task ANCOVA Summaries

* indicates $p < .05$, ** indicates $p < .001$

Table 15. ANCOVA summary table for effects of group on difference in draws after mood induction, controlling for draws before mood induction, on Beads 85:15 Task

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (Draws before Mood Ind.)	71.31	1	71.31	24.520**
Main Effect (Group)	.16	1	.16	.054
Error	136.69	46	2.91	

Table 16. ANCOVA summary table for effects of group on difference in draws after mood induction, controlling for draws before mood induction, on Beads 60:40 Task

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (Draws before Mood Ind.)	96.08	1	96.08	4.323*
Main Effect (Group)	25.17	1	25.17	1.132
Error	1044.64	46	22.23	

Table 17. ANCOVA summary table for effects of group on difference in words seen after mood induction, controlling for words seen before mood induction, on Words Task

Source of Variance	Sums of Squares	Degrees of Freedom	Mean Square	<i>F</i> -Ratio
Covariate (Words before Mood Ind.)	1864.67	1	1864.67	321.573**
Main Effect (Group)	5.40	1	5.40	.340
Error	272.53	46	5.80	

Appendix 5. Emprirical Study Information Sheet and Consent Form

5.1 Information Sheet

(Form to be printed on headed paper)

Participant Information Sheet (Version 2)
REC Ref: 07/Q1104/57 – Date: 27/06/2007

PARTICIPANT INFORMATION SHEET

Study Title

Performance and Reasoning in Bipolar Disorder (Manic Depression)

Invitation

We would like to invite you to take part in a research study. Before you decide, you need to understand why the research is being done and what it would involve for you.

Please take time to read the following information carefully. Talk to others about the study if you wish. (Part 1 tells you the purpose of this study and what will happen to you if you take part. Part 2 gives you more detailed information about the conduct of the study).

Ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Part 1. General information about this study and participation

Purpose of the study

Bipolar disorder has been treated mainly using mood stabilisers like lithium. However, more recently a number of psychological interventions have been developed for use with bipolar disorder. Although these psychological therapies have been shown to be useful in reducing relapses and stabilising mood, not all people with bipolar disorder respond to them.

This means it is very useful to understand any ways that people with bipolar disorder differ from people without any mental illness. This study will look specifically at any such differences on tasks relating to performance and reasoning.

Understanding characteristic features of people with bipolar disorder could allow for better psychological therapies to be developed that take into account the specific nature of bipolar disorder.

Why have I been invited?

This study is comparing two groups of participants; one group of people with a diagnosis of bipolar disorder but no current symptoms, and one group of people with no history of mental illness. There will be 30 people for each group invited to take part in this study. The aim of the study is to compare how these groups differ in their responses to two computer-based tasks.

Do I have to take part?

It is up to you to decide. We will describe the study and go through this information sheet, which we will then give to you. We will then ask you to sign a consent form to show you have agreed to take part. You are free to withdraw at any time, without giving a reason. This would not affect the standard of care you receive.

What will happen if I take part?

If you agree to take part, someone will contact you and perform a brief interview (less than 30 minutes) over the telephone to make sure that you are suitable for our study. At this point the researcher will ask you to respond to some self-report questionnaires over the phone. These questionnaires are to ascertain that you are not currently experiencing extreme mood symptoms. If the researcher believes that you may have some serious symptoms of a mood disorder you would regrettably be unable to take part in this study, but the researcher would be able to discuss this with you and could advise you of further options for counselling or treatment.

If you meet our inclusion criteria, we will then invite you to come to the University of Hull (or another suitable and closer location), where you will be asked to complete a semi structured interview and some self-report questionnaires, and also two tasks on a computer. The first task will look at your reaction time to a stimulus on the screen. The second task will look at how you use probabilities to make decisions. During the second task you will also be shown some video images whose purpose will be to put you in a happy mood.

The total time taken will be around one and a half hours. The semi-structured interviews will be tape recorded. All tapes will be wiped at the end of the study.

What will I have to do?

The tasks you are invited to do will be presented on a computer screen. You will be inputting responses using a keyboard and keypad. You will not need any skill in typing or any advanced knowledge of computers. Clear instructions will be given as to how this equipment should be used. Additionally you will be asked to answer questions regarding your current and previous mental health, and also take a short vocabulary test.

What are the possible disadvantages and risks of taking part?

We will need to ask you to fill out some self-report questionnaires before you take part, and there is a slight chance that at this point your mood may either be too high or too low for you to take part. If this is the case, then the researcher will be available to discuss where you can go to seek further help or advice. If you show signs of becoming severely distressed or unwell during the experiment, we may have to contact your GP. If this is necessary then we will discuss this with you first.

What are the possible benefits of taking part?

We cannot promise the study will help you directly, but the information we get from this study could help improve the treatment of people with bipolar disorder.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any possible harm you might suffer will be addressed. The detailed information on this is given in Part 2.

Will my taking part in the study be kept confidential?

Yes. We will follow ethical and legal practice and all information about you will be handled in confidence. The details are included in Part 2.

This completes Part 1.

If the information in Part 1 has interested you and you are considering participation, please read the additional information in Part 2 before making any decision.

Part 2. Additional detailed information

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. In this instance please contact Mr Nathan Babiker or Professor Dominic Lam at the Clinical Psychology Department of the University of Hull (01482 464164). If you remain unhappy and wish to complain formally, you can do this through the Research and Development Department of Humber Mental Health Teaching NHS Trust (01482 301723).

In the event that something goes wrong and you are harmed during the research and this is due to someone's negligence then you may have grounds for a legal action for compensation against Humber Mental Health Teaching NHS Trust, but you may have to pay your legal costs. The normal National Health Service complaints mechanisms will still be available to you.

Will my taking part in this study be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves the experimenting site will have your name and address removed so that you cannot be recognised. All tapes of interviews will be labelled with a participant number, and your name and address will be kept separate from the tapes.

If we believe that you are suffering a serious episode of a mental illness we may have to advise your GP, however in such an event we would discuss this with you first.

What will happen to the results of the research study?

We intend to publish the results of this study in scientific journals relevant to the study of psychology and mental illness. If you are one of the participants in this study you will also receive a

summary report of the key findings of this study in lay terms. You will not be identified personally in any publication.

Who is organising and funding the research?

This research is a student project which counts towards a doctoral degree in clinical psychology (ClinPsyD). It is being organised by a doctoral student, Mr Nathan Babiker, and supervised by Professor Dominic Lam at the Department of Clinical Psychology, University of Hull.

Who has reviewed this study?

All research in the NHS is looked at by independent group of people – called a Research Ethics Committee – to protect your safety, rights, wellbeing and dignity. This study has been reviewed and given favourable opinion by Hull and East Riding Research Ethics Committee.

Please ask if you require any further information.

Contact:

Mr Nathan Babiker	(01482) 464106	N.T.Babiker@psy.hull.ac.uk
Professor Dominic Lam	(01482) 464164	

5.2 Consent Form

(Form to be printed on headed paper)

CONSENT FORM – Version 2

Title of Project: **Performance and reasoning in bipolar disorder**

Name of Investigator: **Mr Nathan Babiker**

Supervisor: **Professor Dominic Lam**

Please Initial
Box

1. I confirm that I have read and understand the information sheet dated 27/06/2007 (Version 2) for the above study.

2. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

3. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.

4. I give permission for information about my participation in this study to be given to my GP if necessary.

5. I agree to take part in the above study.

Name of Participant

Signature

Date

Name of Researcher

Signature

Date

Appendix 6. Non-Copyrighted Materials

6.1 Bech-Rafaelsen Mania Rating Scale

A. Observer rated scale

1. Activity: Motor

0 – Not Unusual

1 – Slight or doubtfully increased motor activity (e.g. lively facial expression)

2 – Moderately increased motor activity (e.g. lively gestures)

3 – Clearly excessive motor activity, on the move most of the time, rises once or several times during interview

4 – Constantly active, restlessly energetic. Even if urged, the patient cannot sit still

2. Activity: Verbal

0 – Not unusual

1 – Somewhat talkative

2 – Very talkative, no spontaneous intervals in conversation

3 – Difficult to interrupt

4 – Impossible to interrupt, completely dominates the conversation

3. Flight of Thoughts

0 – Not present

1 – Somewhat lively descriptions, explanations and elaborations without losing the connection with the topic of the conversation. The thoughts are thus still cohesive.

2 – Again it is occasionally difficult for the patient to stick to the topic, he is distracted by random associations (often rhymes, clangs, puns, pieces of verse or music)

3 – The line of thought is regularly disrupted by diversionary associations

4 – It is difficult or impossible to follow the patient's line of thought, as he constantly jumps from one topic to another.

4. Voice/Noise Level

0 – Not unusual

1 – Speaks somewhat loudly without being noisy

2 – Voice discernible at a distance, and somewhat noisy

3 – Vociferous, voice discernible at a long distance, is noisy, singing

4 – Shouting, screaming; or using other sources of noise due to hoarseness

5. Hostility/Destructiveness

0 – No signs of impatience or hostility

1 – Somewhat impatient or irritable, but control is maintained

2 – Markedly impatient or irritable. Provocation badly tolerated

3 – Provocative, makes threats, but can be calmed down

4 – Overt physical violence; physically destructive

6. Mood Level (Feeling of Well-Being)

0 – Not unusual

1 – Slightly or doubtfully elevated mood, optimistic, but still adapted to situation

2 – Moderately elevated mood, joking, laughing

3 – Markedly elevated mood, exuberant both in manner and speech

4 – Extremely elevated mood, quite irrelevant to situation

7. Self-Esteem

0 – Not unusual

1 – Slightly or doubtfully increased self-esteem, for example occasionally over-estimates his own habitual capacities

2 – Moderately increased self-esteem, for example, overestimates more constantly his own habitual capacities or hints at unusual abilities

3 – Markedly unrealistic ideas, for example, that he has extraordinary abilities, powers or knowledge (scientific, religious etc.), but can briefly be corrected

4 – Grandiose ideas which cannot be corrected

8. Contact (Intrusiveness)

0 – Not unusual

1 – Slightly doubtful meddling, for example, interrupting or slightly intrusive

2 – Moderately meddling and arguing or intrusive

3 – Dominating, arranging, directing, but still in context with the setting

4 – Extremely dominating and manipulating, not in context with the setting

9. Sleep (Average of past 3 nights)

0 – Habitual duration of sleep

1 – Duration of sleep reduced by 25%

2 – Duration of sleep reduced by 50%

3 – Duration of sleep reduced by 75%

4 – No sleep

10. Sexual Interest

0 – Habitual sexual interest and activity

1 – Slight or doubtful increase in sexual interest and activity, for example, slightly flirtatious

2 – Moderate increase in sexual interest and activity, for example, clearly flirtatious

3 – Marked increase in sexual interest and activity; excessively flirtatious, dress provocative

4 – Completely and inadequately occupied by sexuality

11. Decreased work ability

0 – Not present

1 – Slightly or doubtfully increased drive, but work quality is slightly down as motivation is changing, and the patient is somewhat distractible

2 – Increased drive, but motivation clearly fluctuating. The patient has difficulties in judging his own work quality and the quality is indeed lowered. Frequent quarrels at work

3 – Work capacity clearly reduced; the patient occasionally loses control. He must stop work and be written off sick. If hospitalised, he can participate for some hours per day in ward activities

4 – The patient is (or ought to be) hospitalised and is unable to participate in ward activities

Score Interpretation Guide

0 – 5 No Mania

6 – 9 Hypomania (mild)

10 – 14 Probable Mania

15+ Definite Mania

Bech, J., Rafaelsen, O. J., Kramp, P. & Bolwig, T. G. (1978). The Mania Rating Scale: Scale construction and inter-observer agreement. *Neuropharmacology*, 17, 430-431.

6.2 BIS/BAS-Fr Scale

	Very False	Somewhat False	Somewhat True	Very True
1. Even if something bad is about to happen to me, I rarely experience fear or nervousness.				
2. I go out of my way to get things I want.				
3. When something good I am expecting doesn't happen, I feel less enthusiastic about life for a while.				
4. I'm always willing to try something new if I think it will be fun.				
5. When I'm doing well at something, I love to keep at it.				
6. When I get something I want, I feel excited and energized.				
7. Criticism or scolding hurts me quite a bit.				
8. When I want something I usually go all-out to get it.				
9. I will often do things for no other reason than that they might be fun.				
10. When I don't get what I want, I lose interest in my day-to-day tasks.				
11. If I see a chance to get something I want I move on it right away.				
12. I feel pretty worried or upset when I think or know somebody is angry at me.				
13. If I have been working hard at something I lose motivation if I don't get the reward I deserve				
14. When I see an opportunity for something I like I get excited right away.				
15. I often act on the spur of the moment.				
16. If I think something unpleasant is going to happen I usually get pretty "worked up."				
17. When good things happen to me, it affects me strongly.				
18. I feel worried when I think I have done poorly at something important.				
19. When an event I am looking forward to is cancelled, I lose the energy to arrange an alternative.				
20. I crave excitement and new sensations.				
21. When I go after something I use a "no holds barred" approach.				
22. I have very few fears compared to my friends.				
23. It would excite me to win a contest.				
24. When circumstances prevent me from achieving an important goal, I find it hard to keep trying.				
25. I worry about making mistakes.				

Rating the BIS/BAS-Fr:

Score 1 for Very False, 2 for Somewhat False, 3 for Somewhat True, 4 for Very True

Drive Subscale: Items 2, 8, 11 & 21

Fun-Seeking Subscale: Items 4, 9, 15 & 20

Reward Responsiveness Subscale: Items 5, 6, 14, 17 & 23

Frustration Responsiveness Subscale: Items 3, 10, 13, 19 & 24

BIS Subscale: Items 1, 12, 16, 18, 22 & 25

BAS Total Score: Drive + Fun-Seeking + Reward Responsiveness

(BIS/BAS Scales)

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*, 67, 319-333.

(BIS/BAS-Fr)

Wright, K. (2007). *An Investigation of the significance of minor mood change in the euthymic phase of bipolar I disorder*. Unpublished PhD Thesis, Institute of Psychiatry, King's College, London.