A prospective study of Bipolar Disorder vulnerability in relation to Behavioural Activation, Behavioural Inhibition and Dysregulation of the Behavioural Activation System.

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Abstract

Background

The weak regulation, or "dysregulation", of the Behavioural Activation System (BAS) is implicated in the development and recurrence of bipolar disorder. However, there has been a lack of prospective studies investigating the predictive role of BAS dysregulation in relation to bipolar-vulnerability. Furthermore, no studies have tested the prospective predictive utility of the DYS self-report measure of BAS dysregulation in an analogue sample. The goal of the current study was to redress this gap.

Methods

Participants (n = 127) completed baseline self-report measures of mood symptoms (Internal States Scale: ISS), the Hypomanic Personality Scale (HPS), behavioural activation, inhibition and dysregulation of BAS (BIS/BAS and DYS), and at six months, the Mood Disorders Questionnaire (MDQ).

Results

Linear regression analysis indicated a significant main effect of BAS Dysregulation, and a significant interaction between BIS and BAS Fun Seeking, on prospective MDQ scores whilst controlling for baseline mood symptoms and HPS scores. The interaction effect indicated that the relationship between high BAS Fun Seeking and follow-up MDQ scores was strongest when BIS scores were high, whilst the lowest MDQ scores were observed for a combination of low BAS Fun Seeking and high BIS. However, DYS scores were the stronger predictor of MDQ scores compared to the BAS Fun Seeking and BIS interaction.

Conclusions

Bipolar-vulnerability is prospectively associated with heightened BAS Dysregulation, as measured by the DYS subscale, similar to prior findings in clinical samples. Further research investigating the longer-term associations between BAS Dysregulation with the development of clinically significant bipolar mood symptoms is required.

Keywords: Behavioural Activation, Bipolar Disorder, Dysregulation, Hypomanic Personality, Vulnerability.

1. Introduction

A number of psychological factors which confer vulnerability to bipolar affective disorder have been identified. These include hypomanic personality traits [1], self-appraisal biases [2–4], response styles to positive moods [5], and increased reward sensitivity [6]. Whilst numerous studies have investigated the cross-sectional associations between these factors and the risk for developing bipolar disorder in non-clinical samples [e.g., 2,7], few have investigated these relationships over a longer-term follow-up especially in relation to reward or reinforcement sensitivity. The over-arching goal of the current study was to redress this gap in the research.

Gray's Reinforcement Sensitivity Theory postulates that two motivational neural systems are responsible for co-ordinating behaviour. The first is the Behavioural Activation System (BAS) which is responsible for approach behaviours towards goals and rewards. The second is the Behavioural Inhibition System (BIS) which drives inhibitory and avoidance behaviours in response to potential punishments or non-rewards [8,9]. The BAS and BIS systems have since been applied to explain mood symptoms and the vulnerability to bipolar disorder. The increased activation of the BAS has been associated with increased positive affect, heightened reward sensitivity, impulsivity and hypo/manic symptoms [2,9,10]. In contrast, the BIS has been associated with negative affect, avoidance behaviours, depression and a heightened sensitivity towards potential punishments and non-rewards [2,10,11]. Empirical studies have demonstrated that higher self-reported BAS levels are associated with a greater likelihood of and shorter onset to experiencing bipolar disorder over a twelve month follow-up [12]. High BAS scores are also associated with a higher probability of a lifetime bipolar

disorder diagnosis compared to moderate BAS scores [13], and are also predictive of a shorter time to the onset of hypo/manic episodes in clinical bipolar samples [14].

The BAS sensitivity approach assumes that individuals who score higher on BAS-related assessments are more prone to mania. However, this offers little explanation for how bipolar-vulnerable individuals with high BAS sensitivity would be predisposed to experiencing depressive states typically associated with low-activation and low BAS levels. BAS dysregulation, considered to be caused by low trait regulatory strength in response to environmental stimuli [15,16], provides an explanation for the experience of instability in mood, behavioural engagement and reward sensitivity for bipolar-prone individuals [17]. Weak regulation of the BAS would mean that vulnerable individuals over-respond to rewarding stimuli, experience prolonged periods of activation leading to heightened manic states, with the opposite patterns for BAS over-deactivation and the experience of depression and low behavioural activity.

To assess individual differences in BAS Dysregulation, Holzwarth and Meyer (2006) developed and validated the Dysregulation of BAS subscale (DYS) [16] based on Carver and White's existing BIS/BAS measure [10]. Holzwarth and Meyer reported higher DYS scores for individuals with probable bipolar disorder compared to low-risk controls, and a lack of an association between DYS and current mood [16]. This latter finding is consistent with the hypothesis that DYS would not be expected to be associated with mean mood levels, but rather with increased variability in mood, energy, motivation and locomotor activation reflecting an underlying behavioural dysregulation [15]. Higher DYS scores have also been found in individuals cognitively at risk for bipolar disorder compared to a control group [18].

There has, however, been a lack of prospective studies investigating the predictive role of BIS/BAS sensitivities, particularly the predictive utility of the DYS scale with the prospective vulnerability to bipolar disorder.

The current study had two aims. As the DYS scale has not been used in any prospective studies to date, the first aim was to investigate whether the self-reported dysregulation of BAS (DYS) was a significant predictor of prospective bipolar disorder vulnerability (MDQ) at a six month follow-up compared to other BAS measures. Baseline mood symptoms scores, and those on a personality trait-measure of bipolar-vulnerability, were controlled for in the analyses to ensure that the associations between the BAS-related measures and MDQ were independent of current mood and hypomanic personality characteristics commonly associated with bipolar-vulnerability in analogue samples. Second, to explore the specific nature of the behavioural dysregulation associated with bipolar-vulnerability, we investigated the potential interactions between BAS and DYS with BIS in predicting MDQ scores at six-months. Whilst the weak regulation of BAS, as measured by the DYS scale, should be associated with increased bipolar-vulnerability, it may be that bipolar-proneness is better characterised by a combination of heightened BAS and BIS activation rather than higher DYS scores.

2. Method

2.1 Design

This study used a prospective questionnaire-based design. Participants completed measures of mood, personality, BIS/BAS and DYS at baseline and the MDQ at a six-month follow-up. Scores on the BAS and DYS measures were treated as predictor variables with MDQ scores as the outcome variable. BIS was treated as a potential moderator in the analyses.

2.2 Participants

A sample of 127 students (104 females, 23 males; mean age = 24.30 years, SD = 8.04; 35% of the baseline sample) completed baseline and six-month follow-up assessments. Participants were initially recruited on an opportunity basis at baseline and invited, via email, to complete the follow-up measures. Participants who completed the follow-up assessments reported a higher mean age (M_{age} = 24.29 years, SD = 8.05), compared to non-completers (M_{age} = 21.73 years, SD = 4.90), $t(175.926) = -3.291$, $p < .01$ (adjusted alpha = .005). No between-group differences in baseline mood or bipolar-risk measures were found between completers and non-completers.

2.3 Materials

2.3.1 Baseline Measures

The Behavioural Activation and Inhibition Scales (BIS/BAS)

The 28-item version of the BIS/BAS scales, including the 4-item version of the Dysregulation of BAS (DYS) subscale, was used to assess sensitivity of the behavioural activation and inhibition systems, and instability of the BAS [10,16]. The DYS scale has been used in previous analogue studies [18,19] (Example DYS item: "*There are times in which I get immediately excited when I see an opportunity for something, while in other periods of time this is not the case at all*"). Behavioural Activation System activity is measured by three subscales, including: BAS Drive, which measures the persistent pursuit of rewards ("*When I want something I usually go all-out to get it*"); Fun Seeking, relating to impulsive novelty seeking, pleasure and a desire for new rewards ("*I will often do things for no other reason*

than that they might be fun"); and Reward Responsiveness, measuring responses in anticipation of rewards or after receiving a reward ("*When I get something I want, I feel excited and energised*") [10]. Behavioural Inhibition is measured by a seven-item BIS subscale and captures the anticipation of potential punishments or non-rewards (e.g. "*I worry about making mistakes*") [10]. Participants complete the scales by rating a series of statements relating to each subscale from 1, "Very false for me", to 4, "Very true for me", with scores summed to provide a score for each subscale. The BIS/BAS subscales have demonstrated acceptable-to-good levels of internal reliability (Cronbach αs = .71-.84) [2,16].

The Hypomanic Personality Scale (HPS)

The 48-item HPS was used to assess hypomanic personality traits, relating to bipolar mood symptoms such as mood lability and increased energy [1]. Participants are required to rate whether each item is a true or false representation of their own personality. The HPS has been demonstrated to be predictive of future bipolar mood symptoms in both at-risk and bipolar samples [20,21]. The HPS has demonstrable high internal consistency (Cronbach α = .89) [7].

The Internal States Scale (ISS)

The ISS is a 15-item measure of current bipolar mood symptomatology [22] and includes subscales measuring emotional well-being (ISS-WB), internal and interpersonal conflict (ISS-PC), depression (ISS-D) and activation (i.e., manic symptoms; ISS-A). Participants rate the extent to which they have experienced 15 bipolar symptoms over the past 24 hours using a 0-100 visual analogue scale (0 = "Not at all/Rarely" to 100 "Very much so/Much of the time). ISS scores have been associated with clinician-made ratings of bipolar mood

symptoms [22]. The ISS subscales have demonstrated acceptable levels of reliability (Cronbach αs = .73-.82) [2,7].

2.3.2 Six Month Follow-up Measures

Mood Disorders Questionnaire (MDQ)

Section 1 of the MDQ was used at the 6 month follow up [23]. This is a 13-item self-report screening measure for the lifetime experience of bipolar disorder which has been used as a screening tool in various clinical studies [24–26]. Section 1's items assess recent symptomatic experiences associated with the DSM-IV definitions for mania [27]. Section 1 was used in the current study in line with a prior validation of the MDQ, which indicated that the measure was valid and reliable for identifying individuals with bipolar disorder diagnoses when excluding other sections [28]. For Section 1, participants rate whether they have experienced each symptom in their lifetime (yes = 1; no = 0) with scores summed to produce a total MDQ score (example item: "*Has there ever been a period of time when you were not your usual self and... you felt so good or so hyper that other people thought you were not your normal self or you were so hyper that you got into trouble?*"). Sections 2 and 3 of the MDQ assess the co-occurrence of symptoms from Section 1 and the level of impairment associated with these symptoms. Twiss and colleagues' (2008) analysis indicated that a score of 9 or above on Section 1, excluding Sections 2 and 3, was the optimal cut-off point for identifying individuals at high risk for bipolar disorder whilst maintaining the specificity and sensitivity of the MDQ. The MDQ has previously demonstrated good internal reliability (α = .91) [28].

2.4 Procedure

Participants completed the baseline measures online in a fixed order as part of a larger series of studies [7] and consented to be contacted regarding future studies, including the present study. Participants were invited via email to complete the follow-up measures six months after completing the baseline questionnaire. The follow-up study website contained an information sheet, electronic consent form, and the follow-up questions. The study received ethical approval from the Research Ethics Committee at the University of Manchester.

2.5 Data Analysis

Analyses were conducted using IBM SPSS Version 23. Normality of data distributions were checked via calculation of skewness and kurtosis statistics, review of histograms, and calculation of z-scores to identify potential outliers. There was no indication of non-normal data or outliers on the study measures. Bivariate Pearson's *r* correlations were conducted to investigate associations between the Time 1 mood (ISS scales), hypomanic traits (HPS), behavioural activation (BAS Reward, Drive and Fun Seeking), dysregulation (DYS), and inhibition (BIS) measures, and prospective bipolar-vulnerability at Time 2 (MDQ). A multiple linear regression analysis was conducted to investigate the associations between behavioural activation, inhibition and dysregulation of BAS and MDQ scores at six-month follow-up. Time 1 scores on the HPS and ISS scales were entered into the first block of the regression model to control for variance in MDQ scores associated with baseline hypomanic personality traits and mood symptoms. Mean-centered Time 1 BIS, BAS and DYS scores were entered in Block 2 with interaction terms between BIS and BAS subscales (including BAS Drive, Fun Seeking, Reward Responsiveness, and Dysregulation of BAS scores) entered into Block 3 of the regression model. Follow-up Simple Slopes Analysis using Hayes'

PROCESS macro (Model 1) [29] was used to investigate moderated relationships between BIS and BAS/DYS on MDQ scores as indicated by the regression analysis.

3. Results

Descriptive statistics (Means, SDs, Ranges, Cronbach Alpha statistics) for scores on the self-report measures are presented in Table 1. Thirty-six participants had a score above 9 on the MDQ at the six month follow-up (28.35% of the sample), indicating recent bipolar-relevant experiences [28].

[Table 1 about here]

Bivariate correlations were conducted to explore associations between the Time 1 BIS/BAS and risk measures with MDQ scores at follow-up (see Table 2). Manic symptoms (ISS-Activation) and global psychopathology (ISS-Perceived Conflict) were associated with DYS scores and follow-up MDQ. In terms of BIS/BAS, negative correlations were observed between BIS with manic symptoms (ISS-A), wellbeing (ISS-WB), hypomanic traits (HPS) and BAS Fun Seeking. For BAS, there were positive associations between manic symptoms (ISS-A) with BAS Drive and Fun Seeking, and wellbeing (ISS-WB) with BAS Drive and Reward Responsivity. BAS Reward was negatively associated with depressive symptoms (ISS-D). Positive correlations were observed between scores on the HPS, DYS, and the BAS Subscales with the MDQ. BIS and BAS Reward Responsiveness scores were not significantly associated with MDQ scores at six months.

[Table 2 about here]

A linear regression analysis was conducted to investigate the prediction of MDQ scores at the six month follow-up, whilst controlling for baseline HPS and ISS mood symptoms in the first block of the regression. Scores on the BIS, DYS and BAS subscales were included as predictor variables in Block 2 and interaction terms between BIS and BAS/DYS scales in Block 3 (See Table 3). Collinearity statistics for the main predictor variables (BIS/BAS/DYS) suggested no significant issues with collinearity (Variance Inflation Factors = 1.5-1.9) or with autocorrelation in the model (Durbin-Watson = 2.27).

[Table 3 about here]

The three steps of the model were significant (Step 1: $F(5, 121) = 8.094$, $R^2 = .25$, $p < .001$; Step 2: $\Delta F(5, 116) = 2.95$, $\Delta R^2 = .84$, $p < .05$; Step 3: $\Delta F(4, 112) = 2.75$, $\Delta R^2 = .06$, $p < .05$; Total variance explained at Step 3, $R^2 = .39$). As shown in Table 3, after controlling for baseline mood and hypomanic personality traits, scores on the Dysregulation of BAS scale had a main effect on MDQ scores whilst none of the other BAS or BIS measures were significantly associated with prospective MDQ scores. However, the third step of the regression also revealed a significant interaction effect between BIS and BAS Fun Seeking scores on MDQ scores but there were no interaction effects between BIS and the other BAS measures.

Simple slopes analysis using Hayes' (2013) PROCESS SPSS tool was conducted to interpret the moderated relationship between BAS Fun Seeking and BIS on MDQ scores. The simple slopes analysis indicated that at low levels of BIS, there was a non-significant positive relationship between BAS Fun Seeking and MDQ scores, $b = .16$, 95% CI [-0.17, 0.48], $t =$

0.97, $p = .34$. At the mean value for BIS, there was a significant positive relationship between BAS Fun Seeking and MDQ scores, $b = .44$, 95% CI [0.19, 0.70], $t = 3.41$, $p < .001$. For high levels of BIS, there was also a significant positive relationship between BAS Fun Seeking and MDQ scores, $b = .73$, 95% CI [0.41, 1.04], $t = 4.61$, $p < .001$ (See Figure 1). The lowest MDQ scores were noted for a combination of low BAS-Fun Seeking and high BIS, with highest MDQ scores noted for high BAS-Fun Seeking and high BIS.

[Figure 1 about here]

4. Discussion

There are several key findings from this study. First, this provides evidence that the self-reported dysregulation of the Behavioural Activation System as measured by the DYS scale [16] is predictive of prospective bipolar disorder vulnerability as measured by the Mood Disorders Questionnaire (MDQ). This is the first demonstration of the utility of the DYS scale in predicting bipolar-proneness at a longitudinal follow-up. Second, none of the other BAS or BIS measures had a significant main effect on predicting bipolar-vulnerability at six months. Third, there was an interaction effect between BIS and BAS Fun Seeking scores on prospective MDQ scores, with the lowest MDQ scores associated with a combination of low BAS-Fun Seeking and high BIS, and the highest MDQ scores associated with a combination of high BAS Fun Seeking and high BIS. However, as indicated by the beta values, DYS was the stronger predictor of prospective MDQ scores compared to the BAS Fun Seeking by BIS interaction when controlling for baseline mood symptoms and hypomanic personality traits.

These findings have several implications for theory and the empirical literature. Our results add support to the BAS dysregulation hypothesis' assumption that bipolar-proneness is

characterised by weak behavioural regulation [15,17], rather than just the heightened activation of the BAS as proposed by the BAS sensitivity approach. Prior cross-sectional analogue studies have reported main effects of higher BAS Fun Seeking but lower BIS scores on hypomanic personality trait scores, an index of bipolar-vulnerability [2], with no reported investigation of the potential interactions between BAS facets like Fun Seeking with BIS or the role of DYS scores on prospective bipolar-vulnerability scores. Similar interactions have, however, been reported in clinical samples, where high BIS scores interacted with a higher BAS-Total score to predict a higher likelihood of being diagnosed with bipolar 1 disorder amongst individuals with "softer" bipolar II and bipolar "not otherwise specified" (NOS) diagnoses [30]. Scores on the BAS Fun Seeking subscale were also implicated in the progression to meeting diagnostic criteria for bipolar I and II in the same study [30]. It is possible that the impulsive pursuit of pleasurable rewards and withdrawal of behaviour act as a compensatory mechanism for each other for individuals vulnerable to bipolar disorder, and may explain the interaction effect noted in the present study. For example, the excessive impulsive pursuit of pleasure-associated goals may be compensated by a heightened withdrawal of behaviour (via the BIS) and, vice versa, increased goal-directed fun seeking may compensate low behavioural activity and withdrawal. This would be consistent with previous findings suggesting that a combination of extreme positive and negative appraisals of internal states are characteristic of bipolar disorder [31], with such opposing appraisals leading to conflicting attempts at mood regulation which becomes manifested as increased mood lability [32]. The opposing role of BAS Fun Seeking and BIS may prompt similar dysfunctional attempts at mood regulation leading to increased mood swings, although this hypothesis would require investigation.

From a theoretical perspective, extensions of the BAS dysregulation hypothesis have highlighted the potential interactions between BAS sensitivity and the experience of BAS-activating life events, such as schedule-disrupting and goal-related events [33], in the precipitation of mood swings and symptom exacerbation [17]. The appraisal of positive and negative life events as being relevant to the individual's personal goals may lead to the activation of the already weakly-regulated BAS, further increasing mood lability [17]. The effect of life event appraisals on BAS dysregulation may explain the association between life events and increases in bipolar mood symptoms reported in previous studies [34–36]. However, the effects of appraisals of BAS-disrupting events on BAS dysregulation, mood symptoms, and bipolar-vulnerability amongst non-clinical groups is currently unclear and requires exploration.

There are some limitations to consider with the present research. The study was conducted online with a student sample using a series of validated self-report measures of mood, bipolar-vulnerability and behavioural activation. There was no clinician-made assessment of bipolar disorder diagnosis or symptoms taken at follow-up. The MDQ is a measure of lifetime hypo/manic symptoms [23] and may not have fully captured the experience of more recent hypo/manic symptoms over the follow-up period. There is also a debate regarding the MDQ's ability to discriminate between possible bipolar disorder versus borderline personality and other personality disorders [37,38]. This distinction may be complicated due to the comorbidity and overlapping symptoms associated with bipolar disorder and borderline personality, especially in terms of unstable mood and behaviour [37]. Future analogue studies may require the assessment of possible personality disorders when using the MDQ as a measure of bipolar-vulnerability. Whilst dysregulation of BAS, and the BAS Fun Seeking by BIS interaction effect, were significant predictors of MDQ scores at a six-month follow-up,

whether this association holds over the longer-term and is predictive of participants' progression to receiving clinical diagnoses of bipolar disorder requires further investigation. Assessment of BAS dysregulation was based on a self-report psychometric measure which may only capture the participants' subjective ratings or appraisals of their own BAS regulation. Future studies may consider incorporating more objective, psychophysiological and behavioural assessments of BAS regulation to avoid subjective ratings biases [30,39].

5. Conclusion

Investigations into the contribution of behavioural regulation to the vulnerability to bipolar disorder, in the form of the behavioural activation and inhibition systems, have been limited by cross-sectional designs and the focus on the role of BAS sensitivity rather than BAS dysregulation in determining bipolar-risk. This study investigated the utility of the DYS self-report measure of BAS dysregulation, and the potential interactive effects of measures of behavioural inhibition (BIS) and activation (BAS) on prospective bipolar-vulnerability in an analogue sample. DYS was the strongest predictor of bipolar-vulnerability (as measured by the MDQ) at six months compared to an observed interaction between BAS Fun Seeking and BIS scores. These results provide further support for the BAS Dysregulation hypothesis, rather than the BAS sensitivity approach, as bipolar-vulnerability appears to be associated with a weakly regulated behavioural engagement system towards environmental stimuli [15,17]. The observed BAS Fun Seeking by BIS interaction effect is similar in nature to those noted in clinical bipolar samples [30], and suggests a potential dysfunctional compensatory mechanism between the impulsive pursuit of pleasure-associated rewards (BAS Fun Seeking) and the deactivation of behaviour (BIS). However, the lack of main effects of the BAS measures on bipolar-vulnerability in this study does not support prior suggestions that

bipolar-vulnerability is associated with an elevated BAS alone, rather it is the dysregulation of BAS which is a significant predictor of bipolar-vulnerability.

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Table 1. Means, Standard Deviations, Ranges, and Cronbach Alpha statistics for the mood, bipolar-risk, and reward sensitivity measures

	Mean (SD)	Range	Cronbach's Alpha
Time 1 (Baseline)			
Hypomanic Personality Scale	15.97 (8.49)	2-39	.86
BIS	22.79 (3.37)	13-28	.74
BAS Drive	10.39 (2.22)	5-16	.81
BAS Reward Responsivity	16.57 (2.03)	11-20	.63
BAS Fun Seeking	11.69 (2.26)	4-16	.76
Dysregulation of BAS	11.89 (2.46)	6-16	.80
ISS Activation	120.45 (86.81)	0-355	.76
ISS Depression	49.27 (47.76)	0-195	.83
ISS Perceived Conflict	122.96 (89.93)	0-380	.78
ISS Wellbeing	126.27 (58.26)	0-265	.77
Time 2 (6 months)			
Mood Disorders Questionnaire	6.52 (3.33)	0-13	.80

Key: BAS = Behavioural Activation System; BIS = Behavioural Inhibition System; ISS = Internal States Scale.

Table 2. Bivariate correlations between bipolar mood symptoms, risk and behavioural activation/inhibition measures

	Time 1 Measures					*Time 2 Measures*
	BIS	BAS Drive	BAS Reward	BAS Fun Seeking	DYS	MDQ
Time 1 Measures						
ISS-A	-.25**	.23**	.15	.37**	.34**	.27**
ISS-D	.08	-.17	-.30**	.03	.08	.12
ISS-PC	-.04	.01	-.15	.13	.21*	.26**
ISS-WB	-.37**	.25**	.26**	.15	-.05	-.01
HPS	-.24**	.41**	.33**	.51**	.46**	.48**
BIS		-.10	.05	-.31**	.02	-.13
BAS-D			.48**	.49**	.20*	.18*
BAS-R				.32**	.31**	.11
BAS-FS					.32**	.31**
DYS						.47**

Key: BAS = Behavioural Activation System (D = Drive; R = Reward; FS = Fun Seeking), BIS = Behavioural Inhibition System, DYS = Dysregulation of BAS, HPS = Hypomanic Personality Scale, ISS = Internal States Scale (A = Activation, D = Depression, PC =

Perceived Conflict, WB = Wellbeing), MDQ = Mood Disorders Questionnaire. * $p < .05$, ** $p < .01$ level

Table 3. Results of the linear regression model predicting MDQ scores at 6 months from baseline BIS, DYS and BAS subscale scores

Step	Predictor	B	SE B	β	*t*	CI (95%)
1	ISS-Activation	0.00	0.00	0.06	0.58	-0.01 - 0.01
	ISS-Depression	0.00	0.01	-0.03	-0.29	-0.02 - 0.01
	ISS-Perceived Conflict	0.00	0.00	0.11	0.91	-0.01 - 0.01
	ISS-Wellbeing	-0.01	0.01	-0.10	-0.98	-0.02 - 0.01
	HPS	0.17	0.04	0.44	4.94**	0.10 - 0.24
2	ISS-Activation	0.00	0.00	-0.04	-0.40	-0.01 - 0.01
	ISS-Depression	0.00	0.01	-0.03	-0.26	-0.02 - 0.01
	ISS-Perceived Conflict	0.00	0.00	0.11	0.98	0.00 - 0.01
	ISS-Wellbeing	0.00	0.01	-0.02	-0.21	-0.01 - 0.01
	HPS	0.12	0.04	0.30	2.92**	0.04 - 0.20
	BIS	-0.05	0.09	-0.05	-0.53	-0.22 - 0.13
	BAS-Drive	0.03	0.15	0.02	0.19	-0.26 - 0.32
	BAS-Reward	-0.17	0.16	-0.10	-1.07	-0.49 - 0.15
	BAS-Fun Seeking	0.09	0.15	0.06	0.60	-0.20 - 0.38
	DYS	0.46	0.13	0.34	3.67**	0.21 - 0.71
3	ISS-Activation	0.00	0.00	-0.01	-0.10	-0.01 - 0.01
	ISS-Depression	0.00	0.01	0.03	0.31	-0.01 - 0.02
	ISS-Perceived Conflict	0.00	0.00	0.04	0.33	-0.01 - 0.01
	ISS-Wellbeing	0.00	0.01	0.03	0.28	-0.01 - 0.01
	HPS	0.12	0.04	0.31	3.01**	0.04 - 0.20

BIS	-0.07	0.09	-0.07	-0.82	-0.25 - 0.10
BAS-Drive	0.07	0.14	0.05	0.49	-0.22 - 0.35
BAS-Reward	-0.10	0.16	-0.06	-0.60	-0.41 - 0.22
BAS-Fun Seeking	0.05	0.15	0.03	0.33	-0.25 - 0.35
DYS	0.46	0.12	0.34	3.76**	0.22 - 0.70
BIS x BAS-Drive	0.01	0.04	0.03	0.28	-0.07 - 0.10
BIS x BAS-Reward	0.02	0.05	0.04	0.47	-0.07 - 0.11
BIS x BAS-Fun Seeking	0.10	0.04	0.25	2.40*	0.02 - 0.18
BIS x DYS	-0.03	0.04	-0.07	-0.87	-0.10 - 0.04

Key: BAS = Behavioural Activation System; BIS = Behavioural Inhibition System, DYS = Dysregulation of BAS scale, HPS = Hypomanic Personality Scale, ISS = Internal States Scale. * $p < .05$, ** $p < .01$

Figure 1. Moderation of the relationship between BAS Fun Seeking and MDQ by BIS