Manuscript Details

Manuscript number	JAD_2016_570
Title	Associations between Circadian Rhythm Instability, Appraisal Style and Mood in Bipolar Disorder
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Abstract

Background: Internal appraisal styles, in addition to circadian and social rhythm instability, have been implicated in the development of mood experiences in bipolar disorder (BD), yet potential interactions between these variables remain under researched. Methods: This study used online questionnaires to examine relationships between social and circadian rhythm instability, appraisal style and mood within populations at varying vulnerability for BD. Results: Participants with BD (n=51), and those at behavioural high-risk (BHR; n=77), exhibited poor sleep quality and a stronger tendency to form internal appraisals of both positive and negative experiences compared to non-clinical controls (n=498) and participants with fibromyalgia (n=80). Participants with BD also exhibited a stronger tendency to adopt an internal, negative appraisal style compared to individuals at BHR. Sleep disturbance and internal appraisal styles were significantly associated with low mood in BD. Limitations: Sleep quality and social rhythm stability were assessed using self-report measures only, which may differ from objective measures. Causal relationships between constructs could not be examined due to the cross-sectional design. Conclusions: The findings suggest the importance of attending to internal appraisal styles and sleep quality when working therapeutically with individuals diagnosed with BD. Potential differences in the effect of appraisal style at the state and trait level warrant further exploration.

Keywords	bipolar disorder; appraisal; social rhythms; sleep
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Suggested reviewers	Thomas Meyer, Sheri Johnson, Allison Harvey, June Gruber

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Professor Paolo Brambilla
Editor-in-Chief
Journal of Affective Disorders

28/05/2016

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Dear Prof. Brambilla,

I am pleased to resubmit for publication the revised version of our manuscript entitled
"Associations between Circadian Rhythm Instability, Appraisal Style and Mood in Bipolar
Disorder".

We greatly appreciate the constructive comments proposed by yourself and Reviewer 1, and
have outlined our point-by-point responses to these comments below.

Revisions in the manuscript are highlighted in yellow as requested. We hope that these
revisions and our accompanying responses will be sufficient to make our manuscript suitable
for publication in The Journal of Affective Disorders.

We look forward to hearing from you.

Kind regards,

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<u>Response to Reviewer 1</u>

Comments:

1. The PDF was not properly formatted, with tables displayed before the main text, empty spaces between paragraphs and missing reference list.

Response: An error occurred when the manuscript was converted from a Microsoft Word document to a PDF, which created significant issues with the formatting. I sincerely apologise that this was not corrected before submission. The formatting issues have now been resolved and a complete Reference list has been added following the Conclusion section.

2. The inclusion and exclusion criteria were not clearly described. Obviously different criteria were applied to the different groups but it is left to the reader to sort this out.

Response: Further detail has been added to section 1.2.1 explaining how the different criteria were applied to each group to make this clearer.

3. It is not sufficiently explained how any information was verified, for example that a person did not have a comorbid diagnosis.

Response: Further detail has been added to sections 1.2.1, 1.2.2 and 1.4.2 to emphasize that the presence or absence of any diagnosed conditions (e.g. bipolar disorder, fibromyalgia, schizophrenia, dementia) were identified based upon a self-reported diagnosis from a health professional, i.e. 'Have you ever received a diagnosis of dementia from a health professional?'.

4. It would also be helpful to report the means, SD and range for all measures for comparison with other studies (e.g. MDQ, HPS, and SRM). This way the reader can evaluate whether the online methodology identified a representative sample or not. For example, while the high risk sample is the youngest of the four groups, it is still old for what is usually considered a high risk group. Given that the average age of onset for BD is early 20s, some authors might not even accept their high risk status. When looking at their profile (e.g. ISS, appraisals), they look more like a group of individuals with a hyperthymic temperament that at risk for BD.

Response: The interquartile range, minimum and maximum scores for all outcome variables have now been added to Table 2. to allow for comparison with other studies. However, as the HPS and MDQ were used as screening tools rather than outcome measures, we feel it may appear confusing for the reader to include this information and Table 2. is quite dense already. Furthermore, where the MDQ has been similarly used as a screening tool in other studies, this information is not given (e.g. Owen, Gooding, Dempsey & Jones, 2015; Journal of Affective Disorders).

In relation to the high-risk group, the older average age is likely due to the difference in recruitment approach (i.e. although we promoted the survey across universities, we did not target student populations specifically as is often the case in studies which use the HPS). The

criteria for behavioural high-risk using the HPS is based upon the mean score within a sample, therefore age was not used as an indicator of risk in our study.

5. While the groups differed in gender and age, only gender was included as a covariate in the analyses – why? Was age not related to any of the outcome measures?

Response: *As age did not significantly correlate with any of the study outcome measures, it was not controlled for in the analysis. This is now described in section 1.2.6.*

6. It is stated that variables such as marital status and employment were used as covariates but they are nominal variables. Were they dichotomized before being used as covariates? Or did the authors combine response options and/or use dummy variables?

Response: *Participants' employment and marital status were included as factor variables in the analysis. This is now described in section 1.2.6.*

7. Perhaps this is tangential but I wonder if self-identified BD patients will have higher circadian rhythm stability nowadays given that hardly any webpage and treatment of BD misses to emphasize the importance of stable sleep-wake rhythms and daily routine in the context of BD.

Response: *This is an interesting point, and we agree that the importance of sleep in BD is much more heavily promoted than it once was. However, the sleep quality and social rhythm regularity scores observed in the bipolar group are very similar to those reported by earlier studies (e.g. Harvey et al., 2005 reported a mean global PSQI score of 7.9, whilst Shen et al., 2008 reported a mean Social Rhythm Regularity (MREG) score of 9.07 and a mean Average Frequency (MAVE) score of 5.31).*

8. Retrospective assessments of such routines might also be biased by reporting more stability/regularity that there is (compared to a daily monitoring). Are the authors aware of any studies in this fields which directly compared retrospective versus daily assessments of daily routines (in addition to sleep quality) that would support the use of that 'trait social rhythm measure'?

Response: *A study by Shen et al. (2008) found SRM-T scores to be prospectively associated with state SRM scores four months later in a large sample of bipolar spectrum participants. This is now mentioned in section 1.2.4.2. Furthermore, a study by Monk et al. (1991) found that the number of regular activities reported per week did not differ significantly over a 12-week period for either clinical BD or control participants, which justifies the use of a monthly measure.*

Abstract

Background: Internal appraisal styles, in addition to circadian and social rhythm instability, have been implicated in the development of mood experiences in bipolar disorder (BD), yet potential interactions between these variables remain under researched.

Methods: This study used online questionnaires to examine relationships between social and circadian rhythm instability, appraisal style and mood within populations at varying vulnerability for BD.

Results: Participants with BD (n=51), and those at behavioural high-risk (BHR; n=77), exhibited poor sleep quality and a stronger tendency to form internal appraisals of both positive and negative experiences compared to non-clinical controls (n=498) and participants with fibromyalgia (n=80). Participants with BD also exhibited a stronger tendency to adopt an internal, negative appraisal style compared to individuals at BHR. Sleep disturbance and internal appraisal styles were significantly associated with low mood in BD.

Limitations: Sleep quality and social rhythm stability were assessed using self-report measures only, which may differ from objective measures. Causal relationships between constructs could not be examined due to the cross-sectional design.

Conclusions: The findings suggest the importance of attending to internal appraisal styles and sleep quality when working therapeutically with individuals diagnosed with BD. Potential differences in the effect of appraisal style at the state and trait level warrant further exploration.

Highlights

- Differences in social rhythm stability were not observed between the groups.
- Poor sleep quality and internal appraisal styles may indicate a BD vulnerability.
- Internal appraisal styles and poor sleep quality correlated with low mood in BD.
- Future studies should examine circadian rhythms in BD at the state and trait level.

Associations between Circadian Rhythm Instability, Appraisal Style and Mood in Bipolar
Disorder

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1.1 Introduction

BD is characterized by significant fluctuations in both sleep and physical activity. During

mania, increased motor activity along with a decreased need for sleep are common, whereas during

depression, both insomnia and hypersomnia may be present, along with slowed psychomotor activity

(American Psychiatric Association, 2013). Goodwin and Jamison (2007) propose that risk of

developing BD may be associated with circadian rhythm (CR) instability (i.e. sleep and activity

patterns which are hyper-sensitive to disrupting events), and that the onset of mood episodes in

clinical populations is triggered by circadian rhythm disruption.

The relationship between circadian instability and mood change in BD appears to be bi-

directional (Harvey, 2008), with CR disruption triggering extreme shifts in mood leading to behaviors

which further exacerbate CR disruption. Prospective relationships between CR disruption and bipolar

mood episodes have been reported (Jackson, Cavanagh & Scott, 2003; Murray, 2006; Proudfoot,

Doran, Manicavasagar & Parker, 2011), as well as CR disturbance during euthymia (Gershon,

Thompson, Eidelman et al., 2012; Saunders, Novick, Fernandez-Mendoza et al., 2013; Sylvia, Dupuy,

Ostacher et al., 2012).

CRs are strongly linked to social rhythms, i.e. routines such as getting up, having breakfast

and going to work (Monk, Flaherty, Frank et al., 1990). According to the social zeitgeber hypothesis

(Ehlers, Frank & Kupfer, 1988), social rhythm disturbance disrupts CRs which then triggers bipolar

mood episodes in vulnerable individuals. This is supported by evidence of low social rhythm

regularity within both diagnosed (Sylvia, Alloy, Hafner et al., 2009; Boland, Bender, Alloy et al.,

2012; St-Amand, Provencher, Bélanger & Morin, 2013), and BHR populations (Meyer & Maier,

2006; Bullock, Judd & Murray, 2011).

The process by which CR disturbance triggers mood change remains unclear. Jones (2001)

proposed a multilevel cognitive model of BD which integrated the instability model with principles

from the Schematic Propositional Analogical Associative Representation Systems (SPAARS) model

of emotion (Power & Dalgleish, 1997). The SPAARS model proposes that emotions are generated by

information processed at multiple levels of cognition. Specifically, events cause changes to the analogical system (i.e. the senses), which are interpreted at multiple, interacting levels of cognition resulting in changes in emotional states. Following this model, Jones (2001) suggested that BD is associated with an internal cognitive bias, in which CR disruptions are interpreted as personally relevant. Internal interpretations of this type then trigger extreme mood states, leading to behaviors which cause further CR disruption in a vicious cycle.

Consistent with Jones' (2001) model, people with BD and people at behavioural high-risk tend to form internal appraisals of mood-relevant experiences (Alatiq, Crane, Williams & Goodwin, 2010; Ankers & Jones, 2009; Dodd, Mansell, Bentall & Tai, 2011; Mansell, Paszek, Seal et al., 2011). However, investigations of concurrent relationships between cognitive styles, CR disturbance, and mood in BD are lacking, and only two studies have explored these factors in high-risk populations (Jones, Tai, Evershed et al., 2006; Ankers & Jones, 2009). Research in this area is needed to inform understanding of the development and maintenance of bipolar experiences, and suggest potential avenues for clinical intervention. It is also unclear whether a proposed relationship between CR disturbance and internal appraisal style is unique to BD. To investigate the specificity of this association, we studied a comparison group of people with fibromyalgia, as such individuals exhibit similar CR disruption to that documented in BD (Korszun, 2000; Lineberger, Means & Edinger, 2007).

It was hypothesized that non-clinical controls would demonstrate better sleep quality and social rhythm regularity than the other three groups (i.e. BD, fibromyalgia and high-risk), whilst the two clinical groups (i.e. BD and fibromyalgia) would exhibit similar CR instability (i.e. poor sleep quality and low social rhythm regularity). It was also hypothesized that bipolar and high-risk participants would demonstrate a tendency to form internal appraisals of hypomanic and depressive experiences, with higher mood symptom scores in the bipolar group compared to the other three groups. In line with Jones' (2001) adaptation of the SPAARS model, it was anticipated that internal appraisal style would serve as a moderator in the relationship between rhythm instability and mood, with internal appraisals strengthening this relationship.

1.2 Method

1.2.1 Participants

Participants were recruited via online adverts on internet forums and social media sites, in addition to posters and newsletters circulated around universities across the North West.

Non-clinical controls and BHR individuals were identified based upon their scores on the Hypomanic Personality Scale (HPS; Eckblad & Chapman, 1986). Consistent with previous studies (Ankers & Jones, 2009; Eckblad & Chapman, 1986; Meyer & Hautzinger, 2003), those scoring within the highest decile of the distribution formed the BHR group (i.e. scores of 22 to 48) whilst those scoring no higher than the sample mean plus half a standard deviation (i.e. scores of 0 to 15) formed the non-clinical control group. Bipolar and fibromyalgia participants were identified by a self-reported diagnosis of bipolar disorder or fibromyalgia respectively, by a health professional.

Exclusion criteria were; i) currently working night shifts; ii) a comorbid diagnosis of fibromyalgia (or other chronic pain disorder) and BD (or other severe and enduring mental health problem); and iii) a diagnosis of dementia or physical brain injury.

Additional exclusion criteria for non-clinical participants were; i) a lifetime diagnosis of bipolar disorder, personality disorder or schizophrenia; and ii) a current diagnosis of a chronic pain disorder.

Exclusion criteria for all participants included; i) a lifetime diagnosis of schizophrenia or a personality disorder; ii) a diagnosis of dementia; iii) a diagnosis of a physical brain injury, and; iv) currently working night shifts. In an attempt to control for the effects of clinically significant psychological disorders in the non-clinical and FM groups, participants who reported suffering from any mental health problem in the last 2 years (e.g. anxiety, depression) were excluded from the survey. With the exception of FM participants, any participants who reported a current diagnosis of a chronic pain disorder by a health professional were also excluded.

The Mood Disorders Questionnaire (MDQ; Hirschfeld, Williams, Spitzer et al., 2000) was used to confirm the presence or absence of a self-reported BD diagnosis given by a mental health professional. BHR participants who scored positively were not excluded due to the poor sensitivity of the MDQ within general population samples (Zimmerman & Galione, 2011), and rates of undiagnosed mood disorders in high-risk populations (Bentall, Myin-Germeys, Smith et al., 2011; MacKinnon, Zandi, Cooper et al., 2002; Wals, Hillegers, Reichart et al., 2001).

Non-clinical participants who reported using psychotropic medication such as anti-depressants, or mood stabilisers, and hypnotics, ing medication, were excluded. FMibromyalgia participants taking anti-depressants were not excluded as anti-depressants are commonly prescribed to treat physical symptoms (Carville, Arendt-Nielsen, Bliddal et al., 2008; Häuser, Bernardy, Arnold et al., 2009).

1.2.2 Procedure

The study received ethical approval from the Lancaster North West NHS Research Ethics Committee. Upon visiting the online survey homepage, participants read the study information and consented to take part. A series of eligibility screening questions then followed which served to identify the presence of relevant diagnoses in line with the exclusion criteria (e.g. 'Have you ever received a diagnosis of schizophrenia by a mental health professional?').. Eligible participants provided demographic information (i.e. age, gender, employment status, marital status, medication use), and completed the survey measures.

1.2.3 Data Screening

Figure 1. outlines the procedure for screening survey responses.

Where the same participant had responded to the survey more than once (i.e. duplicates), only the most recent entry was retained. Participants who did not complete any of the core measures were excluded. In line with previous studies (Johnson & Carver, 2012; Johnson & Jones, 2009; Giovanelli, Hoerger, Johnson & Gruber, 2013), four 'catch items' were included in the survey. Data sets which contained at least one incorrect response to a catch item were excluded.

The Mood Disorders Questionnaire (MDQ; Hirschfeld, Williams, Spitzer et al., 2000) was used to confirm the presence or absence of a self-reported BD diagnosis. BHR participants who scored positively were not excluded due to the poor sensitivity of the MDQ within general population samples (Zimmerman & Galione, 2011), and rates of undiagnosed mood disorders in high-risk populations (Bentall, Myin-Germeys, Smith et al., 2011; MacKinnon, Zandi, Cooper et al., 2002; Wals, Hillegers, Reichart et al., 2001).

Non-clinical participants who reported using anti-depressant or mood stabilising medication, were excluded. Fibromyalgia participants taking anti-depressants were not excluded as anti-depressants are commonly prescribed to treat physical symptoms (Carville, Arendt-Nielsen, Bliddal et al., 2008; Häuser, Bernardy, Arnold et al., 2009).

INSERT FIGURE 1. HERE

1.2.4 Measures

1.2.4.1 Measures of Risk for BD

HPS (Eckblad & Chapman, 1986)

The HPS is a 48-item true or false measure assessing hypomanic personality; 'a gregarious and overactive disposition' (Eckblad & Chapman, 1986), including items such as "Sometimes ideas and insights come to me so fast that I cannot express them all", and "When with groups of people, I usually prefer to let someone else be the center of attention". It is a widely used screening tool for

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behavioural risk of BD, and has good test-retest reliability (Pearson's r = 0.81) in addition to high internal consistency (Cronbach's Alpha = 0.87; Eckblad & Chapman, 1986).

MDQ (Hirschfeld et al., 2000)

The MDQ is a screening tool for detecting BD, with good internal consistency within UK samples (Cronbach's Alpha= 0.91; Twiss, Jones & Anderson, 2008). It contains 13 yes/no items relating to symptoms of mania, followed by two questions to assess whether or not the symptoms were experienced within the same period, and what impairment these symptoms caused. For the present study, improvements in sensitivity were prioritized over specificity due to the focus on the bipolar sample over the other three comparison groups. Therefore the Benazzi (2003) scoring algorithm was applied, such that participants had to report experiencing at least 7 of the 13 symptoms of mania within the same time period to score positively on the MDQ, regardless of the associated impairment.

1.2.4.2 Measures of Circadian and Social Rhythm Instability

The Social Rhythm Metric- Trait (SRM-T; Shen et al., 2008)

The original version of the Social Rhythm Metric (SRM; Monk et al., 1990) requires participants to indicate which of 17 activities they have performed that day, including the time they performed them, over an average week. The trait SRM (i.e. the SRM-T) uses the same 17 items, but assesses social rhythm stability over the previous month. Participants indicate which activities they performed regularly (i.e. at approximately the same time over at least 3 days each week) and the frequency with which these activities were performed, ranging from 3 to 7 times per week. Two indices of social rhythm stability are generated; Regularity (REG) and Average Frequency (AVE). REG refers to the number of activities performed regularly each week, ranging from 0 to 17. AVE is calculated by averaging the frequencies of each regular activity. The SRM-T has been widely used to

assess trait social rhythm stability in BD, BHR and non-clinical control samples (Alloy, Boland, Ng et al., 2015; Boland, Bender, Alloy et al., 2012; Sylvia, Alloy, Hafner et al., 2009), and demonstrates acceptable test-retest reliability in both BD and non-clinical control samples (i.e. Pearson's *r* = 0.62; Grandin, Hafner, Gauger et al., 2006). SRM-T scores have also been found to be , and is prospectively associated with state SRM scores and risk of future mood episodes (Shen et al., 2008).

Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds III, Monk, Berman & Kupfer, 1989)

The PSQI consists of 24 items assessing sleep quality over the past month. There are seven subscales (i.e. Sleep Quality, Sleep Latency, Sleep Duration, Sleep Efficiency, Sleep Disturbance, Use of Sleep Medication, and Daytime Dysfunction), which together generate a global PSQI score ranging from 0 to 21. A global score above 5 indicates poor sleep quality (Buysse et al., 1989). The PSQI has high internal reliability (Cronbach's Alpha= 0.83) and good test-retest reliability (Pearson's *r* = 0.85; Buysse et al., 1989).

1.2.4.3 Measures of Appraisal Style

Hypomania Interpretations Questionnaire (HIQ; Jones, Mansell & Waller, 2006)

The HIQ assesses appraisal styles for hypomania-relevant experiences. It consists of 10 statements relating to signs and symptoms of hypomania, followed by an internal and an external appraisal (e.g. "If I felt impulsive, I would probably think it was because; a) I could make rapid decisions and good choices [internal appraisal], b) There are lots of external demands [external appraisal]"). Participants indicate their level of agreement with each appraisal on a 4 point Likert scale ranging from "not at all" to "a great deal", generating two subscale scores for internal and external-normalizing appraisal styles (i.e. the HIQ-H and HIQ-N respectively). Good levels of internal consistency have been reported for the HIQ-H (α = 0.72 to 0.87) and HIQ-N (α = 0.70), within clinical and non-clinical samples (Jones et al., 2006; Jones & Day, 2008).

Interpretations of Depression Questionnaire (IDQ; Jones & Day, 2008)

The IDQ assesses appraisals for depression-relevant events. Adopting the same format as the HIQ, the IDQ consists of 10 statements relating to depressive experiences (e.g. "If I felt that nothing was working out for me I would probably think it was because...") followed by an internal appraisal (i.e. "…I struggle to get anything right in my life") and an external-normalizing appraisal (i.e. "…Too many obstacles are being put in my way at present"). Respondents rate the degree to which they agree with each appraisal, generating an internal appraisal subscale score (IDQ-D) and an external-normalizing appraisal subscale score (IDQ-N). The IDQ-D and IDQ-N have shown excellent internal consistency (i.e. α = 0.90 and 0.91 respectively) within a general population sample (Jones & Day, 2008).

1.2.4.4 Measures of Mood

Internal States Scale (ISS; Bauer, Crits-Christoph, Ball et al., 1991)

This 15-item questionnaire assesses bipolar-relevant mood symptoms. Each item relates to mood states over the last 24 hours, e.g. "Today I feel....", requiring participants to rate their level of agreement on a 100mm visual analogue scale. There are four subscales; ISS-A (Activation), ISS-D (Depression), ISS-PC (Perceived Control) and ISS-WB (Well-Being), where higher scores indicate worse outcome, apart from the ISS-WB. Scores on the ISS-A and ISS-WB discriminate between depressed (i.e. ISS-A < 155, ISS-WB < 125), mixed (i.e. ISS-A $\geq$ 155, ISS-WB < 125), manic/hypomanic (i.e. ISS-A $\geq$ 155, ISS-WB $\geq$ 125), and euthymic (i.e. ISS-A < 155, ISS-WB $\geq$ 125) mood states (Bauer, Vojta, Kinosian et al., 2000). All four subscales have good internal consistency, with alphas in the range of 0.81 to 0.92 (Bauer et al., 1991).

1.2.5 Power

A power analysis was performed in 'R' (R Development Core Team, 2008) based on AVE scores on the SRM-T between euthymic bipolar individuals and non-clinical controls (Shen et al., 2008; Sylvia et al., 2009). Assuming a significance level of .05 and power 0.8, the power calculation indicated that a sample size of 57 per group would be necessary to detect a medium effect (i.e. Cohen's *d*= .53).

1.2.6 Statistical Analysis

Demographic characteristics were compared between groups using the chi-squared test and one-way ANOVA. Significant effects were further explored using post-hoc t-tests. Gender correlated with all outcome variables ($p<.001$), and was therefore a covariate in the main analyses. As age did not significantly correlate with any of the study outcome measures, it was not controlled for in the analysis. Employment status correlated with the PSQI, REG, IDQ-D, and ISS-WB, and was therefore a covariate for between-group comparisons on these measures. Marital status significantly correlated with PSQI, and was therefore controlled for in the between-group comparisons on this measure. Employment and marital status were included as factor variables within the analysis.

Due to the non-normal distribution of scores on the ISS subscales and the internal appraisal/experience subscales of the IDQ and HIQ, non-parametric tests were performed to assess between-group differences and within-group correlations on these measures. To control for the effects of multiple testing, a significance level of $p<.01$ was applied across all comparisons.

Relationships between circadian and social rhythm instability and mood, and internal appraisal style and mood, within the bipolar sample were examined using Spearman's correlation coefficient. To test the potential moderating effect of internal appraisal style in the bipolar sample, multiple regression analyses were performed for each of the four mood outcome variables; firstly

without any interaction terms, and then with interactions between internal appraisal style and rhythm instability included.

Due to the degree of scale variation across measures, variables were standardized prior to the regression analyses to facilitate clearer interpretation. Models were first fitted using data from the bipolar sample, with the intention that any statistically significant effects would then be assessed using data from the other three groups. However, none of the regression models within the bipolar group were significant at the $p<.01$ level.

1.2.7 Missing Data

Incomplete responses to the PSQI (i.e. 11 bipolar, 18 fibromyalgia, 14 high-risk and 70 non-clinical control) and SRM-T (i.e. 2 bipolar, 6 fibromyalgia, 1 high-risk and 29 non-clinical control) were excluded from the analyses. Where participants had missing data for 1 or 2 items on the HIQ (n=33), a value was imputed based on the mean of the completed responses within each group. HIQ data from two non-clinical controls were excluded due to more than 2 items being missing.

1.3 Results

1.3.1 Sample Characteristics

Fibromyalgia participants were oldest on average, followed by BD, non-clinical controls, and BHR participants (see Table 1). All groups significantly differed from one another in age, apart from fibromyalgia and BD participants. Gender distribution differed significantly across the groups, with the highest proportion of females in the fibromyalgia group.

Medications were categorized according to their primary function (i.e. mood stabilizer, anti-depressant, anti-psychotic, hypnotic, and other/physical). A significantly higher proportion of both BD and fibromyalgia participants reported taking medication for physical health problems compared to

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the two non-clinical groups. Compared to the BD participants, a significantly greater proportion of fibromyalgia participants reported taking anti-depressants. However, this is likely related to the additional use of mood-stabilising medication in the bipolar sample only. The highest rates of marriage/civil partnership and unemployment/retirement were observed within the fibromyalgia group.

INSERT TABLE 1 HERE

1.3.2 Between-Group Comparisons

1.3.2.1 Circadian and Social Rhythm Instability

Despite a significant overall group difference in REG scores ($p=.005$), post-hoc comparisons between the groups were not statistically significant. There were also no significant group differences in AVE scores. Non-clinical controls scored significantly lower on the PSQI compared to the other groups, indicating better sleep quality (see Table 2). The highest PSQI scores were observed in the fibromyalgia group, significantly higher than any of the other groups on average. Differences in PSQI between the BD and BHR participants were not statistically significant, and represented a small to medium effect (see Table 3).

1.3.2.2 Appraisal Style

Tendency to form internal appraisals of hypomanic and depressive experiences differed significantly between groups. BD participants scored significantly higher on the HIQ-H compared to non-clinical controls and fibromyalgia participants. The difference in HIQ-H between BD and BHR participants was not statistically significant, and represented a small to medium effect.

BD participants scored significantly higher on the IDQ-D compared to the other groups. Non-clinical controls demonstrated significantly higher HIQ-H scores and lower IDQ-D scores than

fibromyalgia participants, representing medium-sized effects in both cases. No significant group differences were observed regarding scores on the normalizing appraisal subscales of the HIQ and IDQ.

INSERT TABLE 2 HERE

INSERT TABLE 3 HERE

1.3.2.3 Mood

ISS-A scores were significantly higher in the BHR and BD groups compared to non-clinical control and fibromyalgia participants. Additionally, BHR participants demonstrated significantly higher levels of activation compared to BD participants. ISS-A scores between non-clinical controls and fibromyalgia participants did not significantly differ and represented a small effect. Significant group differences in ISS-WB were observed between the clinical and non-clinical groups, with higher ISS-WB in the non-clinical groups.

BD and BHR participants' ISS-D scores did not significantly differ. Non-clinical controls exhibited the lowest ISS-D scores and differed significantly from the other groups, representing a medium to large effect in all cases. Fibromyalgia participants' scores on the ISS-D did not significantly differ from either the BD or BHR participants' scores.

Inspection of the mean ISS-A and ISS-WB scores using the classifications proposed by Bauer et al. (2000), indicate that only the non-clinical controls were euthymic. Both the BD and fibromyalgia groups fell within the threshold for depression, whereas the BHR group's scores were indicative of mania/hypomania.

1.3.3 Bipolar Within-Group Comparisons

1.3.3.1 Relationships between Rhythm Instability and Mood

Correlations between mood symptom measures and measures of rhythm instability for BD participants are presented in Table 4. ISS-WB was negatively correlated with both REG and PSQI scores, whilst all other correlations were not statistically significant.

INSERT TABLE 4 HERE

1.3.3.2 Relationships between Appraisal Style and Mood

HIQ-H scores did not significantly correlate with any of the mood measures (see Table 4). However, the IDQ-D negatively correlated with ISS-WB scores, and positively correlated with ISS-D scores.

INSERT TABLE 5 HERE

1.3.3.3 Moderation Effects

Table 5. displays the interaction term regression coefficients for each mood variable in the BD group. None of the regression equations relating to ISS-WB or ISS-D were statistically significant. For ISS-A, the interaction between HIQ-H and REG was significant at the $p<.01$ level. With every one unit increase in the interaction of the standardized variables, scores on the ISS-A increased by 0.49 points, which is greater than the separate effects of REG (i.e. an increase of 0.04 points) and HIQ-H (i.e. an increase of 0.14 points). The interaction between PSQI and HIQ-H scores demonstrated a similar effect upon ISS-A, although this did not reach significance ($\beta= -.40$, $p=.02$).

1.4 Discussion

1.4.1 Summary of the Findings

Appraisal styles, and both circadian and social rhythm instability, have long been implicated in BD. However, this is the first study to assess how these variables interact within a clinical sample, and consider whether particular appraisal styles and rhythm disturbances are specific to BD.

Differences in social rhythm regularity (REG) between groups demonstrated a trend in the expected direction but was not statistically significant. AVE scores across the four groups were almost identical, suggesting that the average frequency of regular activities is not particularly relevant to BD.

Non-clinical controls exhibited significantly better sleep quality than other participants, corroborating existing evidence of poorer subjective sleep quality in individuals with BD (Harvey, Schmidt, Scarnà et al., 2005; Millar, Espie, & Scott, 2004; Ritter, Marx, Lewtschenko et al., 2012; Talbot, Stone, Gruber et al., 2012), BHR individuals (Ritter et al., 2012), and individuals with fibromyalgia (Osorio, Gallinaro, Lorenzi-Filho & Lage, 2006; Theadom & Cropley, 2008).

We observed similar levels of sleep disturbance in individuals with BD compared to individuals at BHR, corroborating existing findings (Ritter et al., 2012). The two groups were also similar regarding positive, internal appraisal styles, and differed significantly from the non-clinical controls. These findings suggest that a tendency to form internal, positive appraisals of experiences, in addition to poor sleep quality, may represent vulnerability factors in BD. Whilst these findings require replication, they support models which emphasize the importance of sleep disturbance and internal appraisal style throughout the development of BD (Jones, 2001).

As the difference in the HIQ-H scores of bipolar participants and those at behavioural high-risk, compared to fibromyalgia participants, represented particularly large effects, this indicates that hypomanic appraisal styles may be important in differentiating individuals vulnerable to bipolar disorder compared to individuals vulnerable to a similarly chronic condition.

The tendency to form internal appraisals of depressive experiences was much greater in the bipolar group than in the fibromyalgia and high-risk groups. This emphasizes the role of negative cognitions in diagnosed bipolar disorders, corroborating existing evidence (Fletcher, Parker & Manicavasagar, 2014; Kelly, Mansell, Wood et al., 2011; Stange, Hamilton, Burke et al., 2014). However, inspection of the average ISS scores in line with classifications proposed by Bauer et al. (2000), indicates that the bipolar participants may have been borderline depressed when completing the survey. Therefore, negative, internal appraisal styles may have been more strongly activated in the bipolar group due to higher levels of negative affect as suggested by Teasdale's Differential Activation Hypothesis (1983, 1988). This interpretation is supported by observed positive correlations between negative cognitive styles and both the severity and variability of depressive symptoms in people with Bipolar II (Fletcher et al., 2014). It is possible that internal appraisal styles represent state-modulated trait variables in bipolar disorder, i.e. are present throughout all phases of the disorder but become more extreme in response to mood change (Clark & Goodwin, 2004).

Consistent with previous research, all four groups were equally able to access external-normalizing appraisals of experiences (Jones & Day, 2008; Ankers & Jones, 2009; Johnson & Jones, 2009; Dempsey, Gooding & Jones, 2011; Dodd et al., 2011), suggesting that external appraisal styles are not strongly implicated in BD.

We found partial support for the hypothesis that BD participants would demonstrate more intense mood states compared to the three comparison groups. BD participants exhibited significantly higher levels of activation compared to the fibromyalgia and non-clinical control participants, and yet less activation than the BHR participants who met ISS criteria for mania/hypomania. This is surprising given that BHR participants were recruited from a non-clinical population who supposedly do not experience clinical symptoms of mania. It is possible that the results reflect greater mood instability in the BHR group compared to the other three populations, as Hofmann and Meyer (2006) reported a positive correlation between scores on the HPS and instability of affective symptoms. Furthermore, the relatively lower levels of activation in the BD group may reflect treatment effects, as

mood-stabilising medication, in addition to receipt of psychological interventions, have been shown to reduce symptoms of mania in BD (Gitlin & Frye, 2012).

Reported levels of current depression did not significantly differ between the BD participants and those with fibromyalgia. These results indicate higher levels of depression in chronic conditions compared to non-clinical populations, corroborating existing evidence (Barghouti, Yasein & Bani Mustafa, 2013; Rothrock, Hays, Spritzer et al., 2010).

On the whole, relationships between circadian and social rhythm instability and mood symptoms in the bipolar group were not significant. Although subjective well-being demonstrated significant correlations with sleep disturbance and social rhythm regularity, other symptom measures did not. This contrasts with existing evidence of significant relationships between subjective sleep duration and symptoms of both mania and depression in bipolar disorder (Gruber, Miklowitz, Harvey et al., 2011; Kaplan, Gruber, Eidelman et al., 2011). However, as previous studies have tended to measure sleep duration at the state level using daily sleep diaries, the difference in findings may reflect differences in the relationship between mood symptoms and subjective sleep disturbance at the state versus trait level.

Positive, internal appraisal styles were not significantly associated with mood symptoms in bipolar disorder, corroborating similar findings reported by Dodd et al. (2011) in a university student sample. Negative internal appraisal styles on-the-other-hand, did correlate positively with levels of depression, and negatively with well-being. Whilst these findings add support to multilevel approaches (Jones, 2001; Mansell, Morrison, Reid et al., 2007), it is important to note that this is the first study to assess negative, internal appraisal styles in a clinical bipolar sample using the IDQ.

The main aim of the present investigation was to explore the moderating role of internal appraisal styles in the relationship between circadian and social rhythm instability and mood. Social rhythm regularity interacted with positive internal appraisal styles to significantly predict modest increases in activation. A similar trend was also observed regarding the interaction between sleep disturbance and positive internal appraisal style, suggesting that positive internal appraisals may play

an important role in the relationship between circadian rhythm instability and activated mood states in bipolar disorder. However, the small size of these effects, in addition to the absence of similar effects regarding other mood outcomes (e.g. depressed mood), suggests that factors other than appraisal style may also be involved in this complex relationship. Replication and further exploration of these findings is required to understand whether positive, internal appraisal styles only moderate positive states, and if so, why this might be.

1.4.2 Limitations

There are a number of limitations to acknowledge. Firstly, a cross-sectional design was employed therefore it was not possible to examine causal relationships between rhythm instability, internal appraisal style and mood. Secondly, only explicit appraisal styles were assessed. Existing research suggests a potentially important distinction between implicit and explicit cognitive styles (see Knowles, Tai, Jones et al., 2007), which requires further exploration.

Thirdly, assessments of circadian and social rhythm instability were based on self-report. Although the measures employed have been validated in clinical populations, research suggests that assessments of sleep disturbance based on self-report versus objective methods can differ greatly (Buysse, Hall, Strollo et al., 2008). This highlights the need for future studies to employ both subjective and objective measures of sleep disturbance.

Fourthly, it was not possible to confirm the clinical status of participants using validated clinical interviews. We, and therefore we relied on participants self-reporting the presence or absence of a formal diagnosis by a health professional. With regard to establishing a bipolar disorder diagnosis, self-report data was considered alongside scores onfrom the MDQ which has been shown to demonstrate comparable utility with diagnostic interview criteria (Miller, Klugman, Berv et al., 2004; Todd, Jones, Hart & Lobban, 2014).. Although However, concerns have been raised regarding the sensitivity of the MDQ when used within general population samples (Zimmerman & Galione,

2011)~~., the measure has demonstrated~~ comparable utility with diagnostic interview criteria (Miller, Klugman, Berv et al., 2004; Todd, Jones, Hart & Lobban, 2014).

1.4.3 Conclusion

In conclusion, both negative and positive internal appraisal styles are apparent in BD, with negative appraisals demonstrating particular importance in differentiating clinical individuals from those at BHR. The findings of the current study suggest that poor sleep quality, but not social rhythm regularity, is particularly elevated in people with BD and those at BHR. The results suggest that positive internal appraisal styles may moderate the effect of circadian rhythm instability upon activated mood states in people with BD, however this finding demands further exploration within larger populations. Future research should employ objective and subjective assessments of rhythm instability to explore the moderating effect of implicit versus explicit appraisal styles in the relationship between circadian and social rhythm instability, and mood in bipolar disorder.

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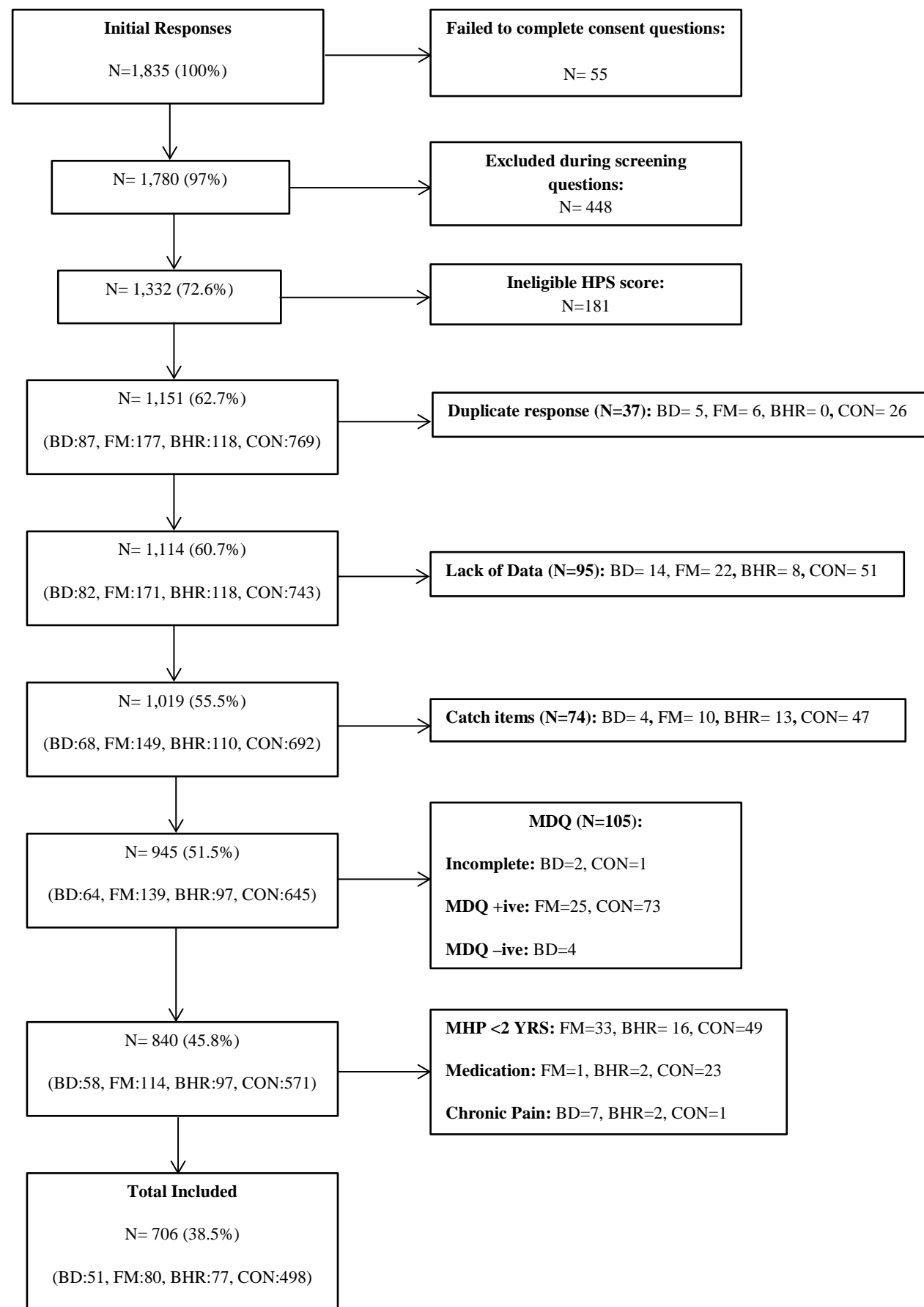doi:10.3109/10673229.2011.614101

Figure 1. Data screening process.

Note: BD= Participants with bipolar disorder; FM= Participants with fibromyalgia; CON= Non-clinical control participants; BHR= Participants at behavioural high risk of developing bipolar disorder; MHP= Mental health problem.

Table 1. Demographic information.

	BD (n=51)	FM (n=80)	BHR (n=77)	CON (n=498)	Group Difference
Age (SD)	42.06 (11.12)	44.82 (9.97)	30.03 (9.97)	36.46 (12.02)	$F(3, 702) = 25.266$, $p < .001$
Gender (%)					
Male	10 (19.6)	6 (7.5)	25 (32.5)	99 (19.9)	$x^2 (3, N=706) = 15.39$, $p < .01$
Female	41 (80.4)	74 (92.5)	52 (67.5)	399 (80.1)	
Marital Status (%)					
Single	15 (29.4)	9 (11.3)	33 (42.8)	163 (32.7)	
Cohabiting	7 (13.7)	13 (16.3)	20 (26.0)	111 (22.3)	
Married/ Civil Partner	21 (41.2)	42 (52.5)	18 (23.4)	183 (36.7)	
Separated/ Divorced/ Widowed	8 (15.7)	16 (20.0)	6 (7.8)	41 (8.2)	$x^2 (9, N=706) = 38.03$, $p < .01$
Employment Status (%)*					
Retired/ Unemployed	13 (25.5)	35 (43.8)	6 (7.8)	13 (2.6)	
Volunteer	10 (19.6)	0	0	5 (1.0)	
Student	2 (3.9)	6 (7.5)	21 (27.3)	97 (19.5)	
Part-Time	9 (17.6)	22 (27.5)	9 (11.7)	83 (16.7)	
Full-Time	17 (33.3)	17 (21.3)	41 (53.2)	300 (60.2)	$x^2 (9, N=706) = 182.63$, $p < .01$
Medication					
Other/Physical	22 (43.1)	51 (63.7)	9 (11.7)	77 (15.5)	$x^2 (3, N=706) = 109.76$, $p < .001$
Anti-Depressant	21 (41.2)	54 (67.5)	-	-	$x^2 (1, N=131) = 7.78$, $p = .005$
Mood Stabiliser	18 (35.3)	-	-	-	
Anti-Psychotic	28 (54.9)	-	-	-	
Hypnotic	4 (7.8)	-	-	-	

Note: BD= Participants with bipolar disorder; FM= Participants with fibromyalgia; CON= Non-clinical control participants; BHR= Participants at behavioural high risk of developing bipolar disorder.

*For the purposes of the chi-squared test, volunteer cases were removed due to the low frequencies.

Table 2. Means, standard deviations and group differences on survey outcome measures.

	BD						FM						BHR						CON						Group Difference
	Mean (SD)	Median	Min.	Max.	IQR	n	Mean (SD)	Median	Min.	Max.	IQR	n	Mean (SD)	Median	Min.	Max.	IQR	n	Mean (SD)	Median	Min.	Max.	IQR	n	
REG	10.5 (3.5)	11	2	17	4.8	40	10.3 (3.5)	10.3	1	15	6.8	60	10.2 (3.4)	10.5	1	15	5	64	11.3 (2.9)	12	0	17	3	393	F(3, 548)=4.31, p=.005
AVE	5.5 (0.7)	5.6	3.8	7	0.9	40	5.7 (0.8)	5.8	3.3	7	1	60	5.5 (0.7)	5.5	3.5	6.7	1.1	64	5.6 (0.7)	5.7	3	7	0.9	391	F(3,550)=0.73, p=0.53
PSQI	8.7 (3.8) a	8	3	17	6	39	13.3 (3.9) b	14	5	19	5	48	7.3 (3.8) a	6	3	17	7	55	5.3 (2.8) c	5	0	15	4	365	F(3,495)=102.51, p<.001
HIQ-H	25.4 (8.5) a	24	11	40	13	49	14.8 (4.1) b	14	10	27	5	75	23.1 (5.5) a	23	13	38	6.3	68	17.1 (4.4) c	17	10	37	6	465	H(3)= 131.48, p<.001
HIQ-N	23.7 (6.0)	23	12	37	8.5	49	21.8 (6.1)	21	10	37	9	75	23.5 (5.1)	24	12	35	6.8	68	22.7 (5.8)	22	10	39	7	465	F(3,652)=1.53, p=.20
IDQ-D	23.6 (9.1) a	25	10	37	17.5	50	15.3 (5.7) b	14	10	34	6.5	80	15.8 (5.5) b	15	10	37	7	77	12.9 (3.9) c	12	10	40	4	498	H(3)= 88.75, p<.001
IDQ-N	24.5 (5.9)	24	13	40	8	50	27.5 (6.3)	27	15	40	10	80	27.4 (6.2)	27	13	40	9	77	26.2 (6.7)	26	10	40	10	498	F(3,700)=2.84, p=.04
ISS-A	122.9 (117.1) a	97.5	0	440	136.3	48	55.0 (64.8) b	30	0	270	95	63	164.3 (89.8) c	165	0	360	130	67	45.5 (50.4) b	30	0	260	75	424	H(3)= 113.43, p<.001
ISS-WB	103.3 (88.0) a	80	0	300	122.5	48	82.0 (58.4) a	80	0	225	85	63	158.9 (68.2) b	161	0	290	100	67	146.0 (62.2) b	142.5	5	300	90	424	H(3)= 65.70, p<.001
ISS-D	71.23 (64.5) a	60	0	200	105	48	56.3 (55.9) a	35	0	200	105	63	40.8 (46.4) a	20	0	180	80	67	24.9 (36.4) b	10	0	192	36.3	424	H(3)=49.13, p<.001

Post-hoc comparison: means with different subscripts differ significantly at p <.01.

Note: BD= Participants with bipolar disorder; FM= Participants with fibromyalgia; CON= Non-clinical control participants; BHR= Participants at behavioural high risk of developing bipolar disorder; Min.= Minimum score; Max.= Maximum score; IQR= Inter Quartile Range; REG= Number of regular activities performed over the past month; AVE= Average frequency with which regular activities were performed over the past month; PSQI= Pittsburgh Sleep Quality Index score; HIQ-H= Internal appraisal subscale of Hypomanic Interpretations Questionnaire; HIQ-N= normalizing appraisal subscale of Hypomanic Interpretations Questionnaire; IDQ-D= Internal appraisal subscale of Interpretations of Depression Questionnaire; IDQ-N= normalizing appraisal subscale of Interpretations of Depression Questionnaire; ISS-A= Activation subscale of Internal States Scale; ISS-WB= Well-being subscale of Internal States Scale; ISS-D= Depression subscale of Internal States Scale.

Table 3. Post-hoc between-group comparisons, effect sizes and 95% confidence intervals for social rhythm regularity, sleep quality, internal appraisal styles, and mood.

	REG			PSQI			HIQ-H			IDQ-D		
	t(df)	d	95% CI	t(df)	d	95% CI	U(df)	d	95% CI	U(df)	d	95% CI
CON vs FM	2.52(451)*	.33	.06 to .60	-13.9(53.89)***	-2.71	-3.06 to -2.36	12096.5(538)***	-.53	-.78 to -.28	14980(576)***	.57	.33 to .81
CON vs BD	1.67(431)	.27	-.06 to .60	-5.44(42.7)***	-1.17	-1.51 to -.83	4577.5(512)***	-1.68	-1.99 to -1.37	4095.5(546)***	-2.32	-2.64 to -2.0
CON vs BHR	2.46(78.5)*	.37	.10 to .64	-3.78(63.6)***	-.68	-.97 to -.39	5958.5(531)***	-1.32	-1.59 to -1.05	12405(573)***	-.70	-.94 to -.46
FM vs BD	-.32(98)	-.06	-.46 to .34	5.58(85)***	1.19	.73 to 1.65	461.5(122)***	-1.71	-2.13 to -1.29	972.5(128)***	-1.15	-1.53 to -.77
FM vs BHR	.10(122)	.03	-.32 to .38	8.02(101)***	1.56	1.11 to 2.0	555.5(141)***	-1.72	-2.10 to -1.33	2798.5(155)	-.09	-.40 to .22
BD vs BHR	.42(102)	.09	-.31 to .49	1.79(92)	.37	-.04 to .78	1468(115)	.33	-.04 to .70	995.5(125)***	1.09	.71 to 1.47

Table 3. *(continued)*

	ISS-A			ISS-WB			ISS-D		
	U(df)	*d*	*95% CI*	*U(df)*	*d*	*95% CI*	*U(df)*	*d*	*95% CI*
CON vs FM	12880.5(485)	-.18	-.44 to .08	6079(485)***	1.04	.77 to 1.31	8398(485)***	-.80	-1.07 to -.53
CON vs BD	5658(470)***	-1.28	-1.59 to -.97	6397.5(470)***	.65	.35 to .95	5690(470)***	-1.16	-1.47 to -.85
CON vs BHR	3635(489)***	-2.07	-2.36 to -1.78	12572(489)	-.21	-.47 to .05	11080.5(489)**	-.42	-.68 to -.16
FM vs BD	916.5(109)***	-.75	-1.14 to -.36	1396(109)	-.29	-.67 to .09	1338.5(109)	-.25	-.63 to .13
FM vs BHR	687.5(128)***	-1.39	-1.77 to -1.0	844.5(128)***	-1.21	-1.58 to -.83	1777.5(128)	.30	-.05 to .65
BD vs BHR	1108(113)**	-.41	-.78 to -.03	922(113)***	-.72	-1.10 to -.34	1183.5(113)*	.56	.18 to .94

Note: REG= Number of regular activities performed over the past month; PSQI= Pittsburgh Sleep Quality Index score; HIQ-H= Internal appraisal subscale of Hypomanic Interpretations Questionnaire; IDQ-D= Internal appraisal subscale of Interpretations of Depression Questionnaire; ISS-A= Activation subscale of Internal States Scale; ISS-WB= Well-being subscale of Internal States Scale; ISS-D= Depression subscale of Internal States Scale; CON= Non-clinical control participants; FM= Participants with fibromyalgia; BD= Participants with bipolar disorder; BHR= Participants at behavioural high risk of developing bipolar disorder.

Post-hoc comparisons were computed using Student's t-test (or Mann-Whitney U where data demonstrated a non-normal distribution). Effect sizes were computed using Cohen's *d*.

*p< .05, **p< .01, ***p< .001.

Table 4. Correlations between outcome measures in the bipolar group.

	REG	AVE	PSQI	HIQ-H	IDQ-D
ISS-A	-.05	-.08	.07	.12	.25
ISS-WB	-.41*	.31	-.41*	.12	-.41*
ISS-D	-.13	-.32	.27	.11	.53**

All correlations are Spearman's *r*.

*p<.01; **p<.001

Note: REG= Number of regular activities performed over the past month; AVE= Average frequency with which regular activities were performed over the past month; PSQI= Pittsburgh Sleep Quality Index score; HIQ-H= Internal appraisal subscale of Hypomanic Interpretations Questionnaire; IDQ-D= Internal appraisal subscale of Interpretations of Depression Questionnaire; ISS-A= Activation subscale of Internal States Scale; ISS-WB= Well-being subscale of Internal States Scale; ISS-D= Depression subscale of Internal States Scale.

Table 5. Regression analyses for activation (ISS-A), well-being (ISS-WB), and depression (ISS-D) in the bipolar group.

	β	95% CI	p
ISS-A			
Predictor			
REG*HIQ-H	0.49	0.22 to 0.77	.001
AVE*HIQ-H	0.18	-0.14 to 0.50	.27
PSQI*HIQ-H	-0.40	-0.74 to -0.06	.02
REG*IDQ-D	0.10	-0.23 to 0.43	.55
AVE*IDQ-D	0.13	-0.23 to 0.47	.48
PSQI*IDQ-D	-0.13	-0.51 to 0.25	.49
ISS-WB			
Predictor			
REG*HIQ-H	0.25	-0.04 to 0.54	.09
AVE*HIQ-H	0.18	-0.10 to 0.47	.20
PSQI*HIQ-H	-0.12	-0.47 to 0.23	.50
REG*IDQ-D	0.21	-0.08 to 0.51	.15
AVE*IDQ-D	-0.07	-0.39 to 0.24	.65
PSQI*IDQ-D	-0.05	-0.41 to 0.31	.77
ISS-D			
Predictor			
REG*HIQ-H	-2.83	-0.62 to 0.05	.09
AVE*HIQ-H	-0.07	-0.41 to 0.28	.69
PSQI*HIQ-H	0.10	-0.27 to 0.47	.59
REG*IDQ-D	-0.29	-0.63 to 0.04	.09
AVE*IDQ-D	0.12	-0.24 to 0.478	.50
PSQI*IDQ-D	0.30	-0.06 to 0.67	.10

Note: ISS-A= Activation subscale of Internal States Scale; ISS-WB= Well-being subscale of Internal States Scale; ISS-D= Depression subscale of Internal States Scale; HIQ-H= Internal appraisal subscale of Hypomanic Interpretations Questionnaire; IDQ-D= Internal appraisal subscale of Interpretations of Depression Questionnaire; REG= Number of regular activities performed over the past month; AVE= Average frequency with which regular activities were performed over the past month; PSQI= Pittsburgh Sleep Quality Index score.

For models including AVE or REG, *n* = 39. For models including PSQI, *n* = 38.