Investigating the Impact of Repetitive and Variable Low-Intensity Exercise on Mania-Relevant Symptoms Following Approach Motivation Induction

Submitted by Rachel Stirland to the University of Exeter as a thesis for the degree of Doctor of Clinical Psychology, May 2017

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SCHOOL OF PSYCHOLOGY

DOCTORATE IN CLINICAL PSYCHOLOGY

LITERATURE REVIEW

Dysfunctional Assumptions in Individuals with Bipolar Disorder: A Systematic Review

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[1] See Appendix A for guidance for authors

Abstract

Background: Dysfunctional assumptions are believed to contribute to depressive, and possibly (hypo)manic, symptoms in people with a bipolar disorder diagnosis (BDD). Over the last 20 years, the nature of these assumptions in BDD has been explored, with a focus on identifying their mood-state dependency, prevalence and specificity in this clinical population.

Method: A systematic review was conducted to evaluate and summarise the current research regarding dysfunctional assumptions in individuals with a BDD. Peer-reviewed journal articles were identified using EBSCO E-Journals, Embase, Ovid MEDLINE, PsycINFO and Web of Science databases. Studies comparing individuals with a BDD in different mood-states and to unipolar depressed and non-clinical populations were included.

Results: Twenty-two case-control and experimental studies were reviewed. There was some evidence that individuals with a BDD accessed more dysfunctional assumptions than 'healthy' controls, with a low, and possibly high, mood-state exacerbating this. There was little evidence of differences between unipolar and bipolar populations.

Limitations: This review only included peer-reviewed journal articles and there was no second rater available for study selection or quality checks.

Conclusions: Individuals with BDD appear to report more dysfunctional assumptions than non-clinical populations, although there is little evidence that this is BDD-specific. This has implications for theoretical models of cognitive vulnerability and psychological interventions in BDD. Further research is needed to address these questions.

Keywords: Bipolar disorder, depression, dysfunctional assumptions, mood-state

Introduction

Overview of the Literature

By definition, individuals with a diagnosis of bipolar disorder (BD) experience periods of high ('manic' or 'hypomanic') and low ('depressive') mood, which have a significant impact on their functioning (American Psychiatric Association [APA], 2013). Different cognitive theories have been proposed to explain these extremes in mood. Although originally developed as an explanatory model of unipolar depression (UD), Beck's cognitive theory has been extended to those with bipolar disorder diagnoses (BDD) who experience depression and (hypo)mania (Beck, 1967, 1976; Lam, Jones, Hayward, & Bright, 1999; Newman, Leahy, Beck, Reilly-Harrington, & Gyulai, 2002). In this model, positive and negative self-schemas developed in childhood act as a filter through which experiences are organised and interpreted, which leads to cognitive biases. Certain life events are more likely to activate negative self-schemas, causing the individual to think negatively about self, the world and the future, which triggers depressive symptoms. On the other hand, life events that activate extreme positive schemas and therefore cognitions will lead to manic symptoms and associated behaviours (see Figure 1).

Conversely, some have argued that the same dysfunctional beliefs underlie depressive and (hypo)manic episodes. Neale (1988), for example, described a 'manic defence', where symptoms result from (and protect against) activation of these negative beliefs. Bentall and colleagues have extended this theory by proposing that these individuals engage in risk-taking and distraction to avoid depression, which contributes to their manic symptoms (e.g., Knowles, Tai, Christensen, & Bentall, 2005; Thomas & Bentall, 2002).

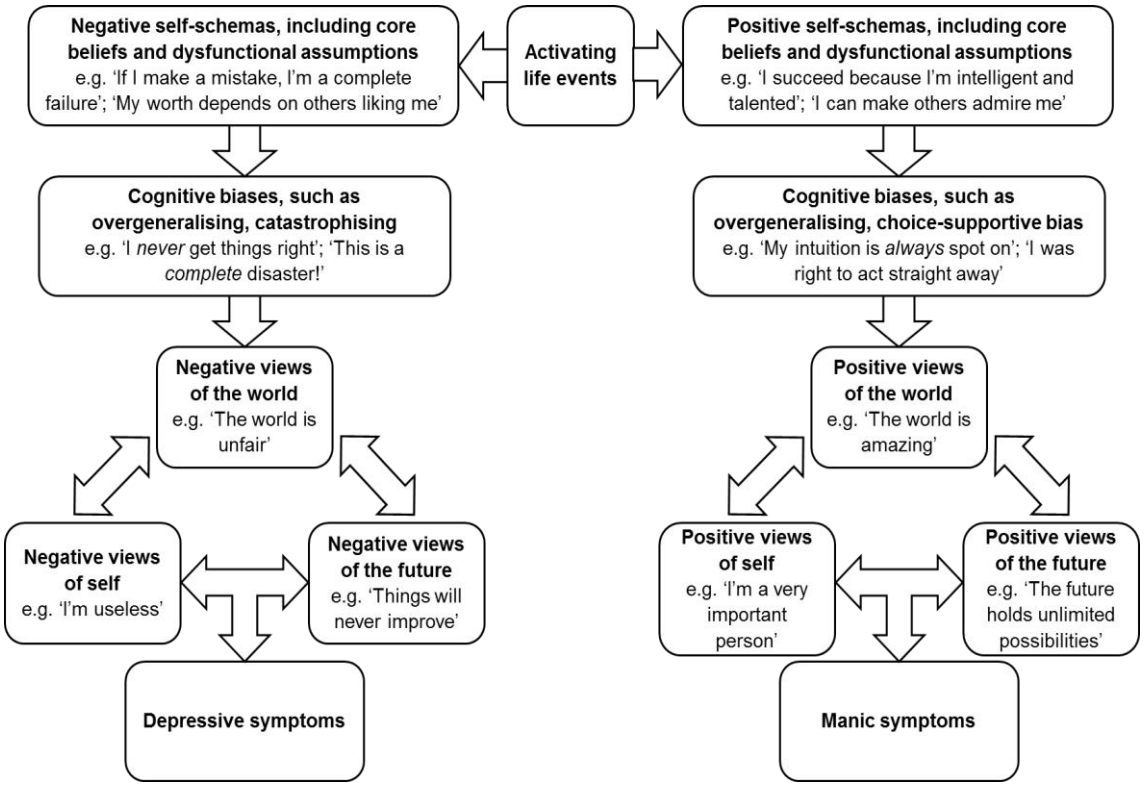

Figure 1. Schematic based on Beck's (1967, 1976) cognitive theory of bipolar disorder.

In a review of the literature on cognitive styles in BD, Alloy and colleagues (2005) found evidence that individuals diagnosed with UD and BD display similar patterns of negative cognition, supporting the Beckian view of depression in BD. The authors note some differences between these groups, however, with preliminary evidence of more cognitions related to goal-attainment, autonomy, and perfectionism in those with BDD compared to individuals with UD and non-clinical controls. This might be linked to behavioural activation system (BAS) sensitivity, hypothesised to be heightened in individuals with BDD (Depue & Iacono, 1989). Alternatively, these findings might simply reflect significant differences in study design, including the measures used and mood-state of participants (Alloy et al., 2005).

As with the opposing theories about self-beliefs in BD, there are differing views about the circumstances under which mood-relevant beliefs might be accessed or remain inactive. In UD populations, it has been suggested that dysfunctional attitudes are mood-state dependent, with individuals only able to access and report them when low in mood (Miranda & Persons, 1988). Supporting this hypothesis, Miranda, Gross, Persons and Hahn (1998) found that remitted-depressive women reported more dysfunctional attitudes than never-depressed women only after negative mood induction. When (hypo)manic, individuals might present with a similar cognitive profile (Neale, 1988) or endorse fewer negative attitudes than when depressed (Beck, 1967). Preliminary evidence suggests the mood-state dependency theory of cognition applies to individuals with BDD, although further investigation is required (Alloy et al., 2005).

Purpose of the Review

The purpose of this systematic review was to explore the existing literature regarding the nature of dysfunctional assumptions in individuals with BDD. Specifically, the focus was on establishing whether dysfunctional assumptions in individuals with BDD are stable or mood-dependent, and whether they differ from non-clinical controls. Moreover, the specificity of dysfunctional assumptions in BD was explored by comparing individuals with BD and UD diagnoses. Although a review of the psychosocial risk factors, including cognitive style, in BD was conducted by Alloy and colleagues (2005), this was published over 10 years ago and was not systematic in nature. It was therefore important to conduct an updated review of the literature.

A range of cognitive constructs were discussed by Alloy and colleagues (2005), whereas the focus of this review was on dysfunctional assumptions only. The inclusion of only one cognitive construct allowed for a somewhat matched comparison across studies, focusing on differences between clinical groups and mood-states rather than forms of cognition. Automatic thoughts are more easily identified than deeper level assumptions, though they are typically fleeting and state-dependent. Conversely, dysfunctional assumptions are believed to be stable, pervasive and trait-like cognitions that underlie the difficulties seen in BD, with the possibility of activation outside symptomatic episodes (Leahy, 1996). It is likely, therefore, that identifying and addressing maladaptive assumptions will have a more significant impact on psychological wellbeing than focusing only on surface-level thoughts. Exploring the current evidence for such assumptions will have implications for future clinical practice.

Defining Key Terms and Concepts

Dysfunctional assumptions. Maladaptive schemas are operationalised as dysfunctional assumptions or self-worth contingencies that increase an individual's vulnerability to depression (Leahy, 1996; see Figure 1). In this review, these were measured using different versions of the Dysfunctional Attitude Scale (DAS; Weissman & Beck, 1978) with various subscales used to categorise the attitudes. Depending on the DAS used, the assumptions are characterised as relating to: achievement; goal attainment; dependency; perfectionism; need for approval; autonomy; tentative attitude; and self-control. All subtypes were included in this review.

Bipolar disorder. The term bipolar disorder (BD) is used broadly to include any presentation that meets the criteria for a bipolar spectrum disorder

as described in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; APA, 2013). Due to its inclusion in one study, 'schizoaffective disorder' is also included in this review. It is characterised by major depressive and/or manic episodes, alongside generally continuous psychotic features (APA, 2013).

Objectives

To investigate whether dysfunctional assumptions in BD populations are mood-state dependent and differ from other clinical and non-clinical populations.

Review Method

The PRISMA Statement (Moher, Liberati, Tetzlaff, Altman, & Altman, 2009) was used to guide the review method, particularly when identifying search and selection strategies and for reporting data. Using the PRISMA Statement supports a more thorough and transparent assessment of the literature being reviewed, particularly risk of bias (Moher et al., 2009; Liberati et al., 2009).

Eligibility Criteria

The PICOS framework was used to guide the inclusion and exclusion criteria, as this is beneficial in search strategies (Schardt, Adams, Owens, Keitz, & Fontelo, 2007).

Population. For a study to be included, at least one population within it had to be individuals with clinician-rated BDD (type I, II or both). Cyclothymic disorder, BD NOS and schizoaffective disorder were also included if some individuals in the sample population had BD I or II diagnoses. Unless controlled

for, studies of individuals with comorbid diagnoses were excluded, as were those with only non-clinical or sub-clinical populations. There were no participant age limits.

Interventions and comparisons. Although most studies were case-control and involved no intervention, those that induced different mood-states were included. Studies that compared BD populations to each other, non-clinical and UD populations were included.

Outcomes. The outcomes included implicit or explicit measurements of dysfunctional assumptions using any version of the DAS. Studies that had only investigated automatic thoughts, information processing biases, attributional style, personality, self-esteem, schemas and appraisals of internal states were excluded.

Study design. No study designs were excluded.

Information Sources

Literature searches were conducted between September 2016 and February 2017 using electronic databases and scanning article reference lists. The databases used were: EBSCO E-Journals; Embase; Ovid MEDLINE; PsycINFO; and Web of Science. Articles had to be translated into English and published in peer-reviewed journals. There were no publication age limits.

Search Strategy

The terms entered into each database are displayed in Table 1.

Table 1

Search terms entered into all databases

OR		OR
bipolar disorder; bipolar affective disorder; bipolar illness; manic depressi*; bipolar depressi*; bipolar I; bipolar II; mania; manic; hypomania; hypomanic; cyclothymia; cyclothymic; bipolar mani* disorder; affective psycho*; psycho* mania; manic-depressive psycho*; bipolar spectrum disorder; hyperthymia; hyperthymic	AND	dysfunctional assumption*; dysfunctional belief*; dysfunctional attitude*; underlying assumption*; underlying rule*; conditional rule*; conditional belief*; intermediate belief*; maladaptive assumption*; maladaptive rule*; maladaptive belief*; unconditional rule*

Study Selection and Data Extraction

After removing duplicates, study titles and abstracts were screened using the PICOS criteria. Those that appeared to meet criteria were read in full to verify this, and relevant data were extracted using a proforma (Appendix B). Any reasons for exclusion at this stage were noted (see Figure 2). Limited resources meant a second reviewer was not available.

Risk of Bias

Risk of bias was checked in each study using the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (National Heart,

Lung and Blood Institute, 2014).[2] No studies were excluded due to poor quality; the results, however, informed the synthesis. Due to limited resources, a second quality rater was unavailable.

Results

Study Selection

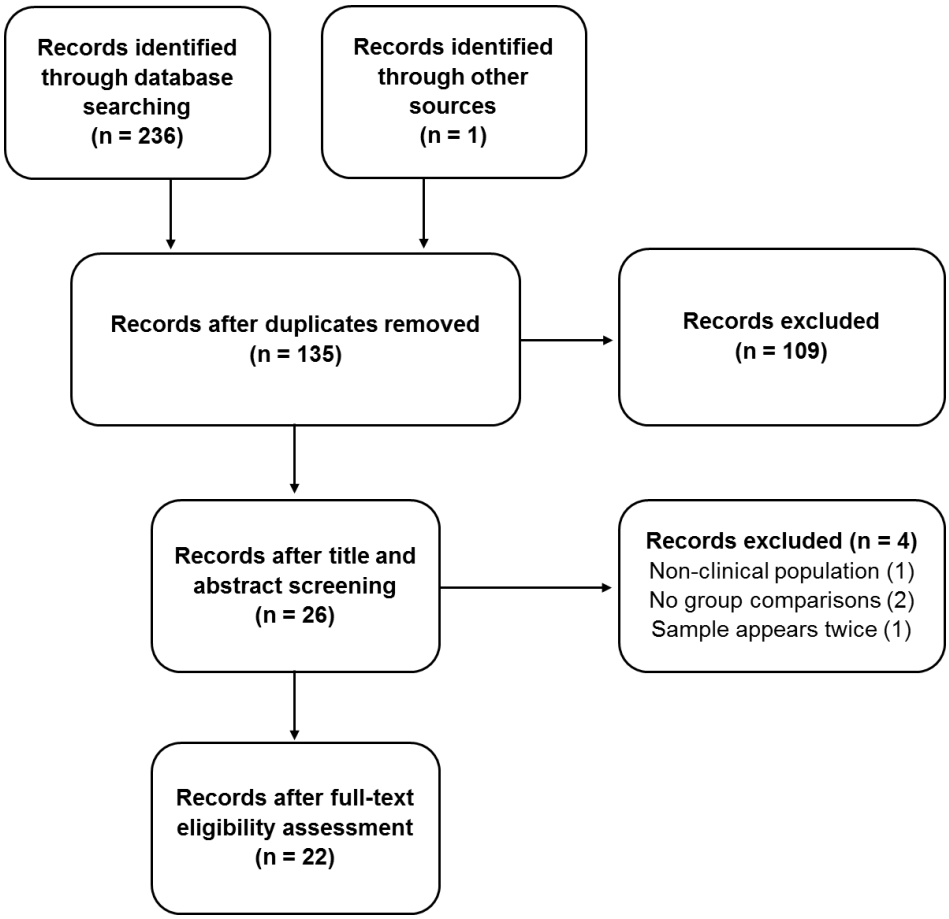

Figure 2. Different stages of study screening adapted from the PRISMA flow diagram (Moher et al., 2009).

Figure 2 illustrates the number of studies at each stage of screening. Of twenty-two studies reviewed, eight compared mood-states within BD, 18 compared BD and non-clinical populations, and 12 compared BD and UD

[2] See Appendix C for list of questions, rationale and table of quality checks

groups. Three of these studies were experimental, while the remaining 19 were case-control. In terms of the DAS used, one study included an implicit version only, one compared implicit and explicit versions, and the other 20 studies used only explicit versions (see Table 2 for details of study characteristics). Some studies used other outcome measures, though these are not reported here as they did not meet PICOS criteria. The results of studies identified as higher quality and with lower risk of bias were given more weight than those deemed to be lower quality and at higher risk of bias when synthesising the data.

Comparing Mood-States within Bipolar Disorder

When comparing BD groups with different symptomology, four studies compared those in a depressive episode to euthymic and/or (hypo)manic individuals. Reilly-Harrington et al. (2010) and Scott and Pope (2003) found higher DAS scores in depressed than hypo(manic) or euthymic individuals, while Jabben and colleagues (2012) found higher DAS achievement scores for depressed than euthymic participants. Although Thomas, Bentall, Knowles, and Tai (2009) found no significant differences between depressed, manic and euthymic BD groups in dysfunctional sentence completions, this should be treated with caution due to the risk of bias (see Appendix C). Four studies also compared (hypo)manic individuals to those who were euthymic. Three of these found no significant group differences in DAS total score (Lex, Meyer, Marquart, & Thau, 2008; Reilly-Harrington et al., 2010) or sentence completions (Thomas et al., 2009), whereas Scott and Pope (2003) found higher DAS scores in hypomanic than euthymic individuals. This significant finding could be due to Scott and Pope's (2003) good control of potential confounds.

Table 2

Characteristics of studies included in the systematic review

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating[3]
Alatiq et al. (2010)	Case-control	Mood disorder outpatients' clinic (bipolar only) and community 40 remitted bipolar patients vs 20 remitted unipolar patients vs 20 'healthy' controls	*Diagnosis:* MINI *Symptoms:* HAMD, YMRS *Cognitions:* DAS 24 (achievement, goal attainment, dependency, anti-dependency)	No sig difference in DAS total or subscale scores between bipolar disorder and unipolar depression, **Cohen's *d*s = 0.51** (total), **0.40** (goal attainment), **0.36** (achievement), **0.49** (dependency), **0.19** (ant-dependency)**,** or between bipolar and control groups, **Cohen's *d*s = 0.42** (total), **0.01** (goal attainment), **0.60**, (achievement), **0.58** (dependency), **0.61** (anti-dependency).	Poor

[3] Study quality was reviewed using the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (National Heart, Lung and Blood Institute, 2014; Appendix C).

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Batmaz et al. (2013)	Case-control	Turkish training and research hospital 70 bipolar (I or II) depressed patients vs 189 unipolar depressed individuals vs 120 non-clinical controls (friends or relatives of hospital staff)	*Diagnosis:* MINI (Turkish version), WHIPLASHED Mnemonic, MDQ (Turkish version) *Symptoms:* MADRS, YMRS (Turkish version), BDI (Turkish version) *Cognitions:* DAS 40, Turkish version (perfectionist attitude, need for approval, autonomous attitude, tentative attitude)	DAS total score was sig higher in bipolar group than for controls, **Cohen's *d* = 1.07,** and was sig higher for bipolar than unipolar group only when controlling for confounding variables, **Cohen's *d* = 0.32.** Need for approval was sig higher in the bipolar than unipolar, **Cohen's *d* = 0.43** and control groups, **Cohen's *d* = 1.06.** Perfectionism was sig higher in the bipolar than control group, **Cohen's *d* = 0.86.**	Fair
Coulston et al. (2013)	Case-control	Outpatient clinic at university teaching hospital 77 euthymic bipolar patients vs 96 euthymic unipolar patients	*Diagnosis:* MINI or CIDI-Auto, MDQ *Symptoms:* DASS, STAI, BFNE *Cognitions:* DAS 40	No sig difference in DAS between bipolar and unipolar groups. Effect size could not be calculated.	Fair

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Fletcher et al. (2013)	Case-control	Community and outpatient clinic 114 individuals with bipolar II disorder vs 94 with bipolar I disorder vs 109 with unipolar recurrent major depression vs 100 controls with no mood disorder history	*Diagnosis:* MINI *Symptoms:* ISS, QIDS-SR, ASRM, STAI (state) *Cognitions:* DAS 24 (achievement, dependency, self-control; Lam et al.'s [2004] achievement, goal attainment and dependency subscales)	Bipolar I and II groups had sig higher DAS total, $\boldsymbol{\eta^2 = .08}$, achievement, $\boldsymbol{\eta^2 = .10}$, and dependency scores, $\boldsymbol{\eta^2 = .05}$, than controls. Only bipolar I participants had sig higher self-control, $\boldsymbol{\eta^2 = .03}$, and goal attainment, $\boldsymbol{\eta^2 = .02}$, than controls. There were no sig differences between bipolar subgroups and the unipolar group. These results remained the same when anxiety and psychological therapy were controlled for.	Fair
Fuhr et al. (2014)	Case-control	Outpatient clinic and community 53 euthymic individuals with bipolar disorder (I or II) vs 58 euthymic individuals with major depressive disorder vs 53 controls with no history of affective disorder	*Diagnosis:* SCID-I *Symptoms:* YMRS, HAMD, BDI *Cognitions:* DAS, type unclear (achievement, dependency)	When controlling for age, there was no sig difference in DAS total score between bipolar and unipolar groups or controls, **Cohen's $\boldsymbol{\omega^2 = .045}$.** When controlling for age and mania, dependency was sig higher for the bipolar group than controls, but not sig different from the unipolar group, **Cohen's $\boldsymbol{\omega^2 = .043}$**.	Good

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Goldberg et al. (2008)	Case-control	Outpatients and inpatients 34 manic individuals with bipolar disorder vs 35 depressed individuals with unipolar depression vs 29 non-clinical controls	*Diagnosis:* SCID-I *Symptoms:* HAMD, YMRS *Cognitions:* DAS 40 (performance evaluation, approval by others)	DAS total score was sig higher for the bipolar manic group than controls, **Cohen's *d* = 0.40**, but sig lower than the unipolar depressed group, **Cohen's *d* = 0.67**. DAS performance evaluation was sig lower for the bipolar manic than unipolar depressed group, **Cohen's *d* = 0.74**.	Poor
Jabben et al. (2012)	Case-control	Inpatients, outpatients and community (The Netherlands) 77 individuals with bipolar disorder (60 euthymic vs 17 depressed) vs 39 first-degree relatives of patients with bipolar disorder vs 61 non-clinical controls	*Diagnosis:* based on RDC (method unknown) *Symptoms:* HAMD, YMRS, BPRS *Cognitions:* DAS 24 (achievement, goal attainment, dependency)	DAS goal attainment was sig higher for depressed bipolar participants than for controls, **Cohen's *d* = 0.99**. DAS achievement was sig higher for depressed bipolar participants than for euthymic bipolar participants, **Cohen's *d* = 0.91**, relatives, **Cohen's *d* = 1.20** and controls, **Cohen's *d* = 1.31.**	Fair

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Jones et al. (2005)	Case-control	Community, outpatient clinics 118 euthymic individuals with bipolar I disorder vs 265 euthymic individuals with major recurrent depression vs 268 euthymic non-clinical controls	*Diagnosis:* SCAN *Symptoms:* BDI *Cognitions:* DAS 24 (achievement, dependency, self-control)	When controlling for depression, DAS total, achievement and dependency scores were sig higher for the bipolar group than for controls **Cohen's *d*s = 0.99** (total), **1.04** (achievement), **0.76** (dependency), but not for the unipolar group, **Cohen's *d*s = 0.50** (total), **0.44** (achievement), **0.34** (dependency). When depression was not controlled, DAS total was sig higher for unipolar than bipolar.	Good
Lex et al. (2011)	Case-control	Austrian medical university and hospital outpatients (bipolar disorder groups), community (controls) 15 hypomanic individuals with bipolar I disorder vs 26 individuals with remitted bipolar I disorder vs 22 non-clinical controls	*Diagnosis:* IDCL *Symptoms:* BDI (German version), MRS, MES *Cognitions:* DAS 30, German version	Hypomanic group had sig higher DAS total score than controls, η_p^2 **= .11,** but not remitted group. This reduced to a non-sig trend when BDI was controlled, η_p^2 **= .08**.	Fair

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Lex et al. (2008)	Case-control	Austrian medical university outpatients (bipolar group), community (controls) 22 individuals with remitted bipolar I disorder vs 19 non-clinical controls	*Diagnosis:* SCID-I *Symptoms:* BDI (German version) *Cognitions:* DAS 30, German version	The bipolar group had higher DAS total scores than the controls, but this did not reach sig, **Cohen's *d* = 0.62.**	Fair
Mansell et al. (2011)	Case-control	Community 16 'remitted' individuals with bipolar I disorder (episode < 2yrs) vs 14 'recovered' with bipolar I disorder (episode > 2yrs) vs 22 with 'remitted' major depression vs 16 with previous non-clinical hypomanic episode vs 22 individuals with no psychiatric history	*Diagnosis:* SCID-I *Symptoms:* ISS *Cognitions:* DAS 24 (achievement, goal attainment, dependency)	No sig group differences for DAS total or subscale scores, **Cohen's *d*s for total = 0.28** (remitted bipolar vs unipolar), **0.14** (remitted bipolar vs non-clinical hypomanic), **0.47** (remitted bipolar vs non-clinical), **1.03** (recovered bipolar vs unipolar), **0.82** (recovered bipolar vs non-clinical hypomanic), **0.22** (recovered bipolar vs non-clinical).	Fair

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
O'Garro-Moore et al. (2015)	Case-control	University students 48 individuals with bipolar disorder (II, cyclothymia or NOS) vs 50 individuals with comorbid bipolar and anxiety disorder vs 43 non-clinical controls matched by gender, age and ethnicity	*Diagnosis:* GBI, SADS-L *Symptoms:* BDI, HMI *Cognitions:* DAS 40 + 24 (approval by others, performance evaluation/perfectionism)	There was a sig difference between the groups for DAS perfectionism. Planned contrasts showed there was no sig difference between the bipolar only group and controls, **Cohen's *d* = 0.35**.	Good
Perich et al. (2001)	Case-control	Community (and outpatients?), research register, university faculty 90 euthymic individuals with bipolar disorder (I, II or NOS) vs 36 individuals with remitted major depression vs 66 non-clinical controls	*Diagnosis:* SCID-I, CIDI-Auto *Symptoms:* DASS, STAI, ISS *Cognitions:* DAS 24 (achievement, goal attainment, dependency)	After controlling for comorbid anxiety disorder, DAS dependency and achievement were sig higher in the bipolar than the unipolar group, **Cohen's *d*s = 0.78** (dependency), **0.77** (achievement), and the control group, **Cohen's *d*s = 1.16** (dependency), **1.29** (achievement). When not controlling for anxiety disorder, the bipolar group scored sig higher for goal attainment than the controls, **Cohen's *d* = 0.73**.	Fair

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Reilly-Harrington et al. (1999)	Case-control	University undergraduates 49 individuals with bipolar disorder (I, II or cyclothymia) vs 97 individuals with unipolar depression vs 23 healthy controls	*Diagnosis:* GBI, SADS-L *Symptoms:* BDI *Cognitions:* DAS 40	There were no sig group differences for DAS total score at baseline and this was not influenced by depression status, **Cohen's *d*s = 0.16** (bipolar vs unipolar depression), **0.46** (bipolar vs. controls).	Fair
Reilly-Harrington et al. (2010)	Case-control	Community or outpatients? 394 individuals with bipolar disorder (including schizoaffective diagnosis) – 19 (hypo)manic vs 94 depressed vs 27 mixed vs 211 recovered/ing vs 43 'roughening'	*Diagnosis:* ADE, MINI (Plus Version 5.0) *Symptoms:* MADRS, YMRS *Cognitions:* DAS 40	Participants in a mixed episode and those currently depressed had sig higher DAS scores than the manic/hypomanic and euthymic groups, **Cohen's *d*s = 0.80** (mixed vs manic/hypomanic), **0.62** (depressed vs. manic/hypomanic)**, 0.81** (mixed vs euthymic), **0.56** (depressed vs. euthymic)	Fair

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Scott & Pope (2003)	Case-control	Outpatients 77 individuals with bipolar disorder (38 depressed vs 13 hypomanic vs 26 remitted) vs 16 individuals with unipolar depression	*Diagnosis:* Semi-structured interview (Scott, Garland & Moorhead, 2001) *Symptoms:* ISS *Cognitions:* DAS 40 (need for approval, perfectionism)	No sig difference was found between the bipolar and unipolar groups for DAS total or subscale scores, **Cohen's *d*s = 0.06** (total), **0.02** (need for approval), **0.01** (perfectionism). There were sig differences in DAS total score (but not subscales) between bipolar subgroups, with participants currently depressed scoring highest, followed by currently hypomanic, **Cohen's *d* = 0.21,** and remitted participants, **Cohen's *d* = 0.21.**	Good
Scott et al. (2000)	Case-control	Patients (inpatient or outpatient – unknown), volunteers (controls) 41 euthymic individuals with bipolar disorder I vs 20 non-clinical controls (spouses and friends of patients)	*Diagnosis:* Based on DSM-IV criteria (method unknown) *Symptoms:* HAMD, MRS, BDI *Cognitions:* DAS 40 (need for approval, perfectionism)	The bipolar group had significantly higher DAS scores than the controls, **Cohen's *d*s = 0.94** (total), **1.44** (perfectionism), **0.74** (need for approval). Only the difference in perfectionism remained after controlling for demographics and depression. Perfectionism had good sensitivity and specificity when used for group classification.	Fair

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Stange et al. (2015)	Case-control	University students 83 with bipolar disorder (II, cyclothymia, NOS) vs 89 non-clinical controls, matched by gender, age and ethnicity	*Diagnosis:* GBI, SADS-L, IPDE *Symptoms:* BDI, HMI *Cognitions:* DAS 40 (total, extreme positive, extreme negative)	The bipolar group had sig higher DAS total scores than the controls, **Cohen's *d* = 0.82**. They also had fewer extreme positive attitudes, **Cohen's *d* = 0.46**.	Fair
Thomas et al. (2009)	Case-control	Inpatients and outpatients (bipolar group), college students (controls) 55 individuals with bipolar disorder (14 depressed vs 30 manic vs 11 in remission) vs 44 students	*Diagnosis:* no structured interview to confirm diagnosis *Symptoms:* HDRS+MRS scale (bipolar group only) *Cognitions:* Sentence stem completion task (implicit measure based on DAS)	There were sig more positive completions on the task in the manic group, **Cohen's *d* = 0.79**, depressed group, **Cohen's *d* = 0.98,** and remitted group than for controls, **Cohen's *d* = 1.09**.	Poor

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Babakhani & Startup (2012)	Experimental (sad & happy mood inductions)	Community and outpatients (bipolar group), research register (controls) 49 euthymic individuals with bipolar disorder (I or II) vs 37 non-clinical controls, matched for gender and age	*Diagnosis:* SCID-I, GBI *Symptoms:* BDI, ISS, VAS *Cognitions*: DAS 24 (achievement, goal attainment, interpersonal)	DAS total and subscale scores were sig higher after sad than happy induction in the bipolar group, **Cohen's *d*s = 1.08** (achievement), **0.80** (interpersonal), **0.84** (goal attainment). Difference between scores was sig larger for the bipolar than control group. Achievement score after both inductions was sig higher for the bipolar group than controls, **Cohen's *d*s = 0.85** (sad), **0.58** (happy).	Fair
Lomax & Lam (2011)	Experimental (positive mood induction)	Community, outpatients 30 individuals with bipolar I disorder vs 30 with no history of affective disorder (non-clinical control group)	*Diagnosis:* SCID-I *Symptoms:* BDI, MRS, PANAS, VAS *Cognitions:* DAS 24 (achievement, goal attainment, dependency, anti-dependency), Sentence stem completion task	DAS scores were sig higher in the bipolar group than for controls, **Cohen's *d*s = 0.67** (total), **0.68** (achievement), **0.85** (dependency). Pre-induction, there were more dysfunctional sentence completions in the bipolar group than for controls, **Cohen's *d*s = 0.65** (total), **0.53** (autonomy), **0.80** (dependency). After positive mood induction, the only difference that remained sig was for autonomy, **Cohen's *d* = 0.53.**	Fair

Study	Design	Setting and Participants	Exposure and Outcome Measures	Results	Quality Rating
Wright et al. (2005)	Experimental (positive & negative mood induction)	Community 40 euthymic individuals with bipolar I disorder vs 40 euthymic individuals with unipolar depression vs 40 individuals with no history of affective disorder	*Diagnosis:* SCID-I *Symptoms:* BDI, VAS, MRS *Cognitions:* DAS 24 (achievement, goal attainment, dependency)	With baseline depression/mood controlled, there were no sig DAS differences between groups in low mood **Cohen's *d*s of DAS total = 0.04** (vs unipolar), **0.39** (vs controls), or high mood conditions, **Cohen's *d*s = 0.17** (vs unipolar), **0.05** (vs controls). After high mood induction, DAS total score sig reduced in the unipolar and control, but not bipolar group. There were no group differences following low mood induction. Those in the bipolar group who had previously received CBT showed a smaller increase in DAS total than those who had not, **Cohen's *d* = 0.11**.	Fair

Note. ADE = Affective Disorder Evaluation, ASRM = Altman Self-Rating Mania Scale, BDI = Beck Depression Inventory, BFNE = Brief Fear of Negative Evaluation Scale, BPRS = Brief Psychiatric Rating Scale, CIDI-Auto = Composite International Diagnostic Interview, DAS = Dysfunctional Attitude Scale, DASS = Depression Anxiety Stress Scales, DSM = Diagnostic and Statistical Manual of Mental Disorders, GBI = General Behavior Inventory, HAMD = Hamilton Rating Scale for Depression, HMI = Halberstadt Mania Inventory, IDCL = International Diagnostic Checklists, ISS = Internal State Scale, MADRS = Montgomery-Asberg Depression Scale, MDQ = Mood Disorder Questionnaire, MES = Bech-Rafaelson Melancholia Scale, MINI = Mini-International Neuropsychiatric Interview, MRS = Bech-Rafaelson Mania Rating Scale, PANAS = Positive and Negative Affect Schedule, QIDS-SR = Quick Inventory of Depressive Symptomatology-Self-Report, RDC = Research Diagnostic Criteria, SADS-L = Schedule for Affective Disorders and Schizophrenia (lifetime version), SCAN = Schedules for Clinical Assessment in Neuropsychiatry, SCID-I = Structured Clinical Interview for DSM disorders, STAI = State-Trait Anxiety Inventory, VAS = Visual Analogue Scale, YMRS = Young Mania Rating Scale

To investigate state-dependency further, three studies with mood inductions were reviewed. Although Babakhani and Startup (2012) found that BD individuals' DAS total and subscale scores were significantly higher after sad than happy mood induction, the lack of DAS baseline or neutral-state induction scores makes it difficult to ascertain whether happy mood induction reduces, maintains or increases dysfunctional attitudes. In a similar study by Wright, Lam, and Newsom-Davis (2005), dysfunctional assumptions were retained, following high mood induction, whereas they significantly increased after low mood induction. Conversely, Lomax and Lam (2011) found that dysfunctional sentence completions (apart from autonomy subtype) significantly reduced for BD participants following positive mood induction. Baseline depression was not controlled for, however, which might have confounded the results. Overall, these findings provide some evidence for more dysfunctional attitudes in BD depression compared to (hypo)mania and euthymia, with the possibility that they are more prevalent in (hypo)mania than euthymia as well. Given the disparate findings for naturally-occurring and induced positive mood, however, this area warrants further investigation.

Comparing Bipolar Disorder and Non-Clinical Populations

Different mood-states. Of the studies comparing individuals with BDD to non-clinical controls, nine investigated naturally-occurring mood-states. While Batmaz, Kaymak, Soygur, Ozalp, and Turkcapar (2013) found that depressed bipolar participants had higher DAS total, need for approval and perfectionism than controls, the depressed BD group in Jabben et al.'s (2012) study had higher DAS goal attainment and achievement scores than controls. Goldberg, Gerstein, Wenze, Welker, and Beck (2008) and Lex, Hautzinger and

Meyer (2011) found that manic and hypomanic (respectively) BD groups had significantly higher DAS total scores than controls, although this reduced to a non-significant trend when controlling depression in Lex et al.'s (2011) study. Manic and depressed BD groups in Thomas and colleagues' (2009) study also made significantly more dysfunctional sentence completions than controls. As Batmaz and others (2013) controlled for baseline depression and mania, there is some evidence that the group difference is not solely attributable to symptoms.

Four studies have compared euthymic controls to BD groups that were, at least partly, symptomatic. Two of these found no significant difference in DAS scores between the potentially symptomatic BD group and euthymic non-clinical controls (O'Garro-Moore, Adams, Abramson, & Alloy, 2015; Reilly-Harrington, Alloy, Fresco, & Whitehouse, 1999). On the other hand, Fletcher, Parker, and Manicavasagar (2013) found BD groups had significantly higher DAS total, achievement and dependency scores than controls, with BD I (not II) participants higher in self-control and goal attainment than controls (Fletcher et al., 2013). Moreover, Stange et al. (2015) found BD participants had more dysfunctional attitudes and fewer extreme optimistic attitudes than controls.

The disparate findings could be due to baseline differences in BD symptomology between studies. Although the BD group had higher depression and hypomania scores than controls in Reilly-Harrington et al's (1999) study, the majority were classified as euthymic. In O'Garro-Moore and colleagues' (2015) study, group baseline symptoms were unavailable for comparison, whereas group differences in Fletcher et al. (2013) and Stange et al.'s (2015) studies were significant at baseline. Moreover, Fletcher and colleagues (2013) found group DAS differences even when controlling for depression, hypomania,

anxiety and psychological therapy status. This provides further evidence that individuals with BD have more dysfunctional attitudes than non-clinical controls, which cannot be attributed to symptom differences alone.

Comparative mood-states. To investigate whether differences remain when groups are in a similar mood-state, studies comparing euthymic BD populations to non-clinical controls were reviewed. Of these nine studies, three found no significant group differences in DAS total or subscale scores (Alatiq, Crane, Williams, & Goodwin, 2010; Mansell et al., 2011; Wright, et al., 2005). In a non-significant trend, Lex, Meyer, Marquart, and Thau (2008) found that the BD group had higher DAS total scores than non-clinical controls.

In four of the five remaining studies, the BD group scored significantly higher for DAS dependency than controls (Fuhr, Hautzinger, & Meyer, 2014; Jones et al., 2005; Lomax & Lam, 2011; Perich, Manicavasagar, Mitchell, & Ball, 2011). In Jones et al.'s (2005) and Lomax and Lam's (2011) studies, the BD group also had significantly higher DAS total and achievement scores than controls. Perich and colleagues (2011) found higher achievement scores in the BD group as well, with a difference in goal attainment only significant when not controlling for anxiety disorder diagnosis. Using different subscales, Scott, Stanton, Garland, and Ferrier (2000) found significantly higher perfectionism in the BD group than controls, even after controlling for potential confounds.

The disparity in these findings can be explained in several ways. One possibility is that a genuine difference exists between euthymic individuals with BDD and those without, which Alatiq et al. (2010), Mansell et al. (2011) and Wright et al. (2005) failed to find. A possible area of bias is the lack of control over mania and depression in Alatiq and others' (2010) study, despite

significant group differences in these symptoms. It could be that depression and/or mania were 'masking' any group differences in DAS, although these symptoms might be expected to conflate differences rather than reduce them. In support of this hypothesis, Fuhr and colleagues (2014) found the difference in DAS dependency was only apparent when controlling for mania. On the other hand, Wright et al. (2005) found no group differences in mania at baseline, and Mansell and colleagues (2011) controlled for ISS activation; the lack of group DAS difference cannot be attributed to mania in these studies.

Another possibility is that no genuine group differences in dysfunctional assumptions exist and the significant findings are instead methodological artefacts. Jones and others (2005) note, for example, that their controls were at low risk of a mood disorder, which means they might not be representative of the general population. In the other studies, however, the same inclusion and exclusion criteria were applied to BD and control groups, with variables matched (or statistically controlled) between groups in most studies. Given the good quality of Jones et al. (2005) and Fuhr et al.'s (2014) studies, there appears to be some evidence that individuals with BDD continue to hold more dysfunctional assumptions, particularly relating to dependency and achievement, than non-clinical controls even when euthymic.

To investigate whether this pattern changes when both groups are in high or low mood-states, three mood induction studies were reviewed. Babakhani and Startup (2012) found that individuals with BDD had significantly higher DAS total and achievement scores after sad and happy mood inductions than controls, with a larger DAS difference between sad and happy mood inductions (sad>happy) in the BD group than for controls. The nature of any group differences is hard to identify, however, due to the lack of baseline

measures or neutral induction comparison. Wright and colleagues (2005) found that DAS scores reduced for non-clinical, but not BD, participants following high mood induction, whereas there was no group DAS difference following low mood induction. Conversely, Lomax and Lam (2011) found that baseline group DAS differences were mostly eliminated following positive mood induction, leaving only a difference in DAS autonomy between groups. In all three studies, it might be that individuals' moods were not elevated enough by the positive induction to increase activation of attitudes. Nevertheless, this provides some preliminary evidence for differences in dysfunctional assumptions between individuals with and without BDD when high and low in mood.

Comparing Bipolar Disorder and Unipolar Depression Populations

To explore whether higher levels of dysfunctional attitudes are specific to BD or reflective of general psychopathology, studies comparing individuals with BD and UD diagnoses were reviewed. Of the seven studies comparing euthymic participants, six found no significant group differences in DAS total or subscale scores (Alatiq et al., 2010; Coulston et al., 2013; Fuhr et al., 2014; Jones et al., 2005; Mansell et al., 2011; Wright et al., 2005). Only Perich et al. (2011) found that DAS dependency and achievement were significantly higher in the BD than UD group, which might have been caused by the higher state and/or trait anxiety identified in the BD group. Because Coulston and colleagues (2013) found no group differences and the other studies did not measure it, the role of anxiety in dysfunctional attitudes cannot be established.

Six studies investigated the differences between BD and UD groups when potentially symptomatic, with three finding no significant group differences (Fletcher et al., 2013; Reilly-Harrington et al., 1999; Scott & Pope, 2003). In

Goldberg et al.'s (2008) study, BD manic participants had significantly lower DAS total and performance evaluation scores than UD depressed participants. These findings should be treated with caution, however, as the potential level of bias in this study is unknown (see Appendix C). Batmaz and colleagues (2013) found significantly higher DAS scores in a BD depressed than UD depressed group only when controlling for potential confounds, including depression and mania. The BD group also had higher DAS approval scores, regardless of covariate inclusion. Moreover, Wright and colleagues (2005) found that DAS total, achievement and goal attainment scores reduced for UD, but not BD, participants following high mood induction. There were no group differences following low mood induction, with individuals in both groups who had previously received cognitive-behavioural therapy showing a smaller increase in DAS than those who had not, though this was only a trend in the UD group.

The lack of group differences in Fletcher et al. (2013), Reilly-Harrington et al. (1999) and Scott and Pope's (2003) studies could be explained by the inclusion of mixed BD presentations, making matched comparisons with the UD groups problematic. The proportion of euthymic individuals was greater in the BD than UD group in Reilly-Harrington et al's (1999) study, for example. On the other hand, the disparate findings could be due to a confounding factor(s), such as the type of DAS used. In Batmaz et al.'s (2013) groups, there were differences in the number of participants currently receiving pharmacological (BD>UD) and psychological treatments (BD<UD), which were not controlled for and could have contributed to the DAS difference. Conversely, Fletcher and colleagues (2013) controlled for differences in therapy, Scott and Pope (2003) controlled for age of onset and medication use, and Reilly-Harrington et al.'s (1999) sample had low, but matched, numbers receiving treatment, which could

explain the absence of group DAS differences. Wright and colleagues' (2005) finding that therapy can influence changes in DAS suggests that this is an important factor to consider. Based on these findings, there is little evidence at present that BD and UD populations hold different dysfunctional attitudes.

Discussion

Summary of evidence

The literature reviewed here provides some evidence for the mood-state dependency (Miranda & Persons, 1988) of dysfunctional attitudes in BD. Depressed mood appears to be a risk factor for dysfunctional assumption activation, although the impact of (hypo)mania remains unclear. It could be that heightened mood is a smaller, albeit substantial, risk factor. Whether this is due to attitude activation increasing during (hypo)mania, or a lack of attitude reduction as seen in UD and non-clinical groups remains to be seen (Wright et al., 2005). Both explanations would be consistent with the 'manic defence' hypothesis of BD (Neale, 1988), rather than Beck's (1967, 1976) cognitive model.

There was also some evidence for the stability of dysfunctional attitudes in BD, with individuals reporting these more than non-clinical controls even when euthymic. The differences were particularly notable in dependency- and achievement-related assumptions, but not goal attainment, which is surprising given the hypothesised BAS sensitivity in BD (Depue & Iacono, 1989). It could be that goal attainment-related attitudes are only activated when anxious or depressed, or in certain BD populations (Fletcher et al., 2013; Jabben et al., 2012; Perich et al., 2011).

There was little evidence to show that this vulnerability was BD-specific, when compared to UD populations. Significant findings may be attributable to group differences in assumption-relevant factors, such as pharmacological and psychological treatments. The similarity between groups provides further support for theories of comparable depressogenic cognitions in unipolar and bipolar groups (e.g., Beck, 1967; Lam et al., 1999; Thomas & Bentall, 2002). It should be noted, however, that Wright et al. (2005) did find significant group differences when positive mood-state was induced, suggesting that these cognitions might remain activated in those with BDD as part of a 'manic defence' (Neale, 1988). Moreover, the DAS might not be sensitive enough to detect differences between BD and UD groups (Hill, Oei, & Hill, 1989; Mansell et al., 2011).

Strengths/Limitations

The reviewed literature had several strengths. Sample sizes were generally good, ranging from 11 to 268, with most groups containing 20+ participants. Five studies reported power calculations and/or effect sizes. Most studies included highly reliable and valid procedures and measures of diagnosis, mood and dysfunctional attitudes, although some used alternatives (sentence completion task and mood inductions) that require more testing to establish this.

Despite these strengths, several limitations were observed. Though there was some control over potential bias through matching and controlling for demographic and symptom-related confounds, few studies acknowledged the limitations of statistically "controlling for" group differences (Miller & Chapman, 2001). Moreover, many did not identify or match clinical groups on age of

onset, number of episodes/hospital admissions, pharmacological or psychological treatment, which can influence dysfunctional attitudes (e.g., Ball et al., 2006; Fava, Bless, Otto, Pava, & Rosenbaum, 1994; Scott et al., 2000). Only a few studies took account of anxiety levels, which might have also biased any findings (e.g., Coulston et al., 2013).

Although most were validated and reliable, different exposure and outcome measures have been used across studies, including different types of DAS (with various subscales). Significant DAS differences might therefore be a measurement artefact. Additionally, most studies used self-report symptom measures, which can bias results. A substantial number did include at least some clinician-rated measures, however. A final concern is regarding the lack of (reported) researcher blinding. Knowledge of participants' diagnoses could have led to researcher bias in clinician-rated outcomes and/or their interactions to participants. Future research should consider these areas of potential bias when investigating dysfunctional attitudes in clinical and non-clinical populations.

There were also limitations in the review method. The lack of inter-rater check means the conclusions drawn could be based on unreliable data quality assumptions, although using an objective tool reduced the likelihood of biased data interpretation. Moreover, the inclusion of only peer-reviewed articles means that caution must be taken when generalising the findings to other settings, given the possibility of publication bias.

Conclusions

This review has explored the nature of dysfunctional assumptions in BDD, focusing on comparisons between mood-states, and with non-clinical and

UD populations. Despite shortcomings, the literature provides some evidence that individuals with BDD report more dysfunctional beliefs than non-clinical controls, though this vulnerability does not appear to be BD-specific. Moreover, depressed mood, in particular, seems to increase risk of dysfunctional assumption activation for these individuals. The circumstances under which this vulnerability occurs require further investigation. Although there is more evidence to support 'manic defence' theories of (hypo)mania (e.g., Neale, 1988) than the Beckian model (e.g., Beck, 1967) at present, additional research into different (induced and naturally-occurring) mood-states will provide a better understanding, and contribute to theories, of BD and (hypo)manic states. Another area to consider is the impact of 'comorbid' factors, such as anxiety or personality characteristics (Stange et al., 2015), on dysfunctional attitudes. Moreover, possible differences between individuals with BD and UD diagnoses could be explored using implicit (e.g., sentence completion task) and other measures of dysfunctional attitudes. Understanding the nature of dysfunctional assumptions in those with BDD specifically, including risk and protective factors, has important implications for clinical practice, particularly the selection of appropriate psychological interventions.

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Appendix A

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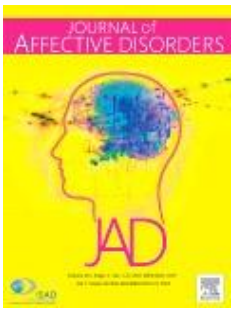

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DESCRIPTION

The Journal of Affective Disorders publishes papers concerned with affective disorders in the widest sense: depression, mania, mood spectrum, emotions and personality, anxiety and stress. It is interdisciplinary and aims to bring together different approaches for a diverse readership. Top quality papers will be accepted dealing with any aspect of affective disorders, including neuroimaging, cognitive neurosciences, genetics, molecular biology, experimental and clinical neurosciences, pharmacology, neuroimmunoendocrinology, intervention and treatment trials.

AUDIENCE

Journal of Affective Disorders is interdisciplinary and aims to bring together different approaches and fields including biochemistry, pharmacology, endocrinology, genetics, statistics, epidemiology, psychodynamics, classification, clinical studies and studies of all types of treatment for a diverse readership.

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Description

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Reference to a dataset:

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Appendix B

Data Extraction Proforma

Reference Number

Title

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Source

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Objective

Target group

Setting

Population

Study population

Sampling method

Power Calculation?

Entry and exclusion criteria

Representative of sample

Size of intervention and control groups

Comparability of intervention and control groups

Description of Intervention

Experimental intervention (including timescale and any aspects of complexity)

Control (including timescale and any aspects of complexity)

Outcomes: Measures and Instruments

Timing of measures

Nature of measures

Baseline

Instruments used

Were instruments validated?

Length of follow up

Study Design

Study Quality

Method of randomisation

Method of allocation concealment

Blinding of assessors

Intention to treat analysis

Raw means and standard deviations presented at baseline

Raw means and standard deviations presented at follow up

Results

Means and SDs of primary outcomes by group

Means and SDs of primary outcomes by group

Attrition (D/O) from study and from intervention and control groups

What statistical tests were used?

Conclusions

Author's conclusions

Reviewer's commentary

Generalisability of findings

Other comments

Appendix C

Questions from the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (QATOCCS; National Heart, Lung and Blood Institute, 2014)

1. Was the research question or objective in this paper clearly stated?

2. Was the study population clearly specified and defined?

3. Was the participation rate of eligible persons at least 50%?

4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?

5. Was a sample size justification, power description, or variance and effect estimates provided?

6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?*

7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?*

8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?

9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?

10. Was the exposure(s) assessed more than once over time?*

11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?

12. Were the outcome assessors blinded to the exposure status of participants?

13. Was loss to follow-up after baseline 20% or less?*

14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?

*These questions are not included in the table, as they were deemed to be non-applicable for the studies in this review

Rationale:

This assessment tool was chosen, as it was specifically designed to assess areas of potential bias in observational cohort and cross-sectional studies, which the majority of the studies included in this review are. Other assessment tools were considered (e.g., Critical Appraisal Skills Programme [CASP] Checklists; The Cochrane Collaboration's tool, Higgins et al., 2011), but were not deemed to be appropriate for assessing risk of bias for these types of studies. The CASP Cohort Study Checklist (CASP, 2017) was not available at the time that quality checks were conducted for this review.

Table of study quality check based on questions from the QATOCCS

Study Quality Check										
Authors	Research question/ objective clearly stated?	Study population clearly specified/ defined?	Participation rate of eligible persons at least 50%?	Same recruitment population and inclusion/ exclusion criteria?	Sample size justified, power or effect size estimates provided?	Different exposure levels measured?	Exposure measures defined, valid and reliable?	Outcome measures defined, valid and reliable?	Outcome assessors blinded?	Potential confounds measured and controlled?
Alatiq et al. (2010)	Yes	Lack of details	Unknown	Slightly different recruitment populations Similar criteria?	Power calculations	No	Yes	Yes	Unknown	Age controlled; not meds, depression or mania
Batmaz et al. (2013)	Yes	Yes – very clear	Unknown	Yes	No	No	Yes	Yes	Unknown	Symptoms controlled; not meds, therapy, etc.

Authors	Research question/ objective clearly stated?	Study population clearly specified/ defined?	Participation rate of eligible persons at least 50%?	Same recruitment population and inclusion/ exclusion criteria?	Sample size justified, power or effect size estimates provided?	Different exposure levels measured?	Exposure measures defined, valid and reliable?	Outcome measures defined, valid and reliable?	Outcome assessors blinded?	Potential confounds measured and controlled?
Coulston et al. (2013)	Yes	Yes – very clear	Unknown	Yes	No	No	Yes	Yes	Unknown	All confounds controlled
Fletcher et al. (2013)	Yes	Yes	Unknown	Yes	Effect sizes	Yes – type I, type II	Yes	Yes	Unknown	All confounds controlled
Fuhr et al. (2014)	Yes	Yes	Yes	Yes	Power and effect sizes	No	Yes	Yes	Yes	Confounds controlled; not meds
Goldberg et al. (2008)	Yes	Yes	Unknown	Yes, but criteria not clear	No	No	Yes	Yes	Unknown	Symptoms not controlled, but correlations checked

Authors	Research question/ objective clearly stated?	Study population clearly specified/ defined?	Participation rate of eligible persons at least 50%?	Same recruitment population and inclusion/ exclusion criteria?	Sample size justified, power or effect size estimates provided?	Different exposure levels measured?	Exposure measures defined, valid and reliable?	Outcome measures defined, valid and reliable?	Outcome assessors blinded?	Potential confounds measured and controlled?
Jabben et al. (2012)	Yes	Yes	Unknown	Yes, but different criteria	No	Yes – depression, euthymia	Yes	Yes	Unknown	Some controlled; not symptoms?
Jones et al. (2005)	Yes	Yes	Yes	Different recruitment populations Some criteria differences	Power calculations	No	Yes	Yes	Unknown	Age and symptoms controlled; not episodes, admissions, etc.
Lex et al. (2011)	Yes	Yes	Unknown	Different recruitment populations	Effect sizes	Yes – hypomania, euthymia	Yes	Yes	Unknown	Depression controlled; not mania. Matched on meds used. Excluded if previous therapy

Authors	Research question/ objective clearly stated?	Study population clearly specified/ defined?	Participation rate of eligible persons at least 50%?	Same recruitment population and inclusion/ exclusion criteria?	Sample size justified, power or effect size estimates provided?	Different exposure levels measured?	Exposure measures defined, valid and reliable?	Outcome measures defined, valid and reliable?	Outcome assessors blinded?	Potential confounds measured and controlled?
Lex et al. (2008)	Yes	Yes	Yes	Yes	Effect sizes	No	Yes	Yes	Unknown	Depression not controlled. Matched on meds used. Excluded if previous therapy
Mansell et al. (2011)	Yes	Yes	Unknown	Different recruitment populations Different criteria, but expected due to groupings	Power calculations	Yes – different bipolar groups	Yes	Yes	Unknown	Age and symptoms controlled; not meds or episodes
O'Garro-Moore et al. (2015)	Yes	Yes	Yes	Yes, apart from criteria that needed to be different	No	Yes, though not relevant here	Yes	Yes	Unknown	Ethnicity and symptoms controlled

Authors	Research question/ objective clearly stated?	Study population clearly specified/ defined?	Participation rate of eligible persons at least 50%?	Same recruitment population and inclusion/ exclusion criteria?	Sample size justified, power or effect size estimates provided?	Different exposure levels measured?	Exposure measures defined, valid and reliable?	Outcome measures defined, valid and reliable?	Outcome assessors blinded?	Potential confounds measured and controlled?
Perich et al. (2001)	Yes	Yes	Yes	Different recruitment populations Different criteria	No	Yes – anxiety disorder diagnosis	Yes	Yes	Unknown	Anxiety disorder and symptoms controlled, meds not
Reilly-Harrington et al. (1999)	Yes	Yes	Unknown	Yes	No	Yes – depression, hypomania, euthymia	Yes	Yes	Yes	Symptoms not controlled?
Reilly-Harrington et al. (2010)	Yes	Yes	Unknown	Yes	No	Yes – depression, hypo/mania mixed, euthymia	Yes	Yes	Unknown	Potential confounds not controlled

Authors	Research question/ objective clearly stated?	Study population clearly specified/ defined?	Participation rate of eligible persons at least 50%?	Same recruitment population and inclusion/ exclusion criteria?	Sample size justified, power or effect size estimates provided?	Different exposure levels measured?	Exposure measures defined, valid and reliable?	Outcome measures defined, valid and reliable?	Outcome assessors blinded?	Potential confounds measured and controlled?
Scott & Pope (2003)	Yes	Yes	Yes	Yes	No	Yes – depression, hypomania, euthymia	Yes	Yes	Unknown	All confounds controlled
Scott et al. (2000)	Yes	Yes	Unknown	Method of recruiting groups unclear	No	Yes	Yes, though unclear how diagnosed	Yes	Unknown	Age, IQ and depression controlled
Stange et al. (2015)	Yes	Yes	Unknown	Yes	No	No	Yes	Yes, though DAS extremes not validated	Unknown	Some symptoms controlled
Thomas et al. (2009)	Yes	Lack of details	Unknown	Details of recruitment and criteria unknown	No	Yes – depression, mania, euthymia	Yes	Yes	Unknown	Symptom, age and IQ correlations checked, not controlled

Authors	Research question/ objective clearly stated?	Study population clearly specified/ defined?	Participation rate of eligible persons at least 50%?	Same recruitment population and inclusion/ exclusion criteria?	Sample size justified, power or effect size estimates provided?	Different exposure levels measured?	Exposure measures defined, valid and reliable?	Outcome measures defined, valid and reliable?	Outcome assessors blinded?	Potential confounds measured and controlled?
Babakhani & Startup (2012)	Yes	Yes	Yes	Possibly different recruitment populations and criteria	No	Yes – induced high and low mood	Yes, though different diagnostic interviews for groups	Yes	Unknown	Age and symptoms controlled
Lomax & Lam (2011)	Yes	Yes	Unknown	Different recruitment populations and criteria	No	Yes – induced high mood	Yes	Yes	Unknown	Depression not controlled
Wright et al. (2005)	Yes	Yes	Yes	Yes	No	Yes – induced high and low mood	Yes	Yes	Unknown	Symptoms and therapy controlled, not hospital

SCHOOL OF PSYCHOLOGY

DOCTORATE IN CLINICAL PSYCHOLOGY

EMPIRICAL PAPER

Investigating the Impact of Repetitive and Variable Low-Intensity Exercise on Mania-Relevant Symptoms Following Approach Motivation Induction

Trainee Name:	**Rachel Stirland**
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	Clinical Psychologist, University of Exeter

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[4] See Appendix A for guidance for authors

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Abstract

Background: Exercise is recommended as a non-pharmacological intervention for individuals with a bipolar disorder diagnosis (BDD). Although physical activity can be beneficial for reducing depressive symptoms, there is preliminary evidence that high-intensity exercise can exacerbate (hypo)mania-related symptoms. Risks associated with other forms of exercise remain unknown.

Method: To investigate the potential risks and benefits of low-intensity exercise, non-clinical participants were asked to either copy repetitive movements (*n* = 20), copy variable movements (*n* = 20) or watch variable movements (*n* = 21), following approach motivation induction. Hypomania-like symptoms, positive affect and approach motivation were measured pre-, during and post-task. Trait behavioural activation system (BAS) sensitivity was measured as a moderating factor.

Results: There were no group differences in symptom change over time. BAS sensitivity did not moderate this relationship.

Limitations: A predominantly student population with low average trait BAS sensitivity was studied. The reliability and validity of the approach motivation induction, mania measure and physical activity task are uncertain.

Conclusions: It is unclear whether different types of low-intensity exercise are of risk or benefit for individuals prone to (hypo)mania. This area requires further investigation.

Keywords: Bipolar disorder, hypomania, mania, exercise, approach motivation

Introduction

Bipolar disorder (BD) is a diagnosis given to individuals who have experienced periods of 'mania' (or 'hypomania') and 'depression' (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013). Approximately 1-2% of the population will be diagnosed with BD over their lifetime (Royal College of Psychiatrists, 2015). As well as the debilitating effect these experiences can have on someone's daily functioning and emotional wellbeing, a diagnosis of BD is associated with poorer physical health (National Institute for Health and Care Excellence [NICE], 2014). These individuals are three times more likely to have type II diabetes and an increased risk of cardiovascular mortality than people in the general population (Calkin, Gardner, Ransom, & Alda, 2013), which is similar to rates for individuals given other serious mental health diagnoses (e.g. de Hert et al., 2011). Due to these physical health concerns, NICE (2014) has recommended offering a physical activity programme alongside healthy eating to those with a BD diagnosis, particularly if they are taking antipsychotic and long-term medication, as this is associated with increased risk of physical illness (Correll, Detraux, De Lepeleire, & De Hert, 2015).

Moreover, physical activity is increasingly being considered as a non-pharmacological treatment for individuals diagnosed with BD, perhaps due to multiple studies showing the positive effects exercise can have in depression (Josefsson, Lindwall, & Archer, 2014; Stanton & Reaburn, 2014). There is some preliminary evidence that exercise can improve emotional wellbeing in those with BD. Sylvia and colleagues (2013) found that giving participants a cognitive behavioural therapy-based intervention with exercise, nutrition and wellbeing modules improved their exercise levels, diet and depressive

symptoms. However, the study only had five participants and no control or comparison condition, making it difficult to draw generalisable conclusions from the results. In addition, the combination of three modules means the existence and extent of any unique contribution of physical activity cannot be identified.

In a pilot study, Ng, Dodd, and Berk (2007) also looked at the effect of exercise on mental wellbeing in those diagnosed with BD who were admitted to a mental health unit. They found that people who regularly attended a walking group self-reported reduced depressive, stress-related and anxiety symptoms compared to 'non-attenders', although clinician-rated measures showed no group differences. There are some methodological issues with the study, which could have biased the data, including a small sample size, retrospective data collection and self-selecting groups. Despite these limitations, the authors present some preliminary evidence that physical activity could be beneficial for those with a diagnosis of BD, particularly in terms of reducing anxiety symptoms.

Several authors have proposed theories regarding the mechanisms of change underlying the beneficial effects of exercise. "Rizzo and colleagues (2014), for example, have argued that the progressive cognitive impairments and pathophysiological changes found in individuals with a diagnosis are consistent with an 'accelerated aging model', with exercise helping to counteract the aging process and preserve these abilities. This idea is supported by Kucyi, Alsuwaidan, Liauw, and McIntyre (2010), who propose that the neurocognitive-enhancing effects of aerobic exercise could reduce the deficits consistently found in those diagnosed with BD. The specific mechanisms involved in this, however, remain unknown. The potentially beneficial effects of exercise for individuals diagnosed with BD could be due to: biological changes, such as

neurogenesis via brain-derived neurotrophic factor (e.g., Sylvia, Ametrano, & Nierenberg, 2010; Szuhany, Bugatti, & Otto, 2014) or changes in metabolism and immune-inflammatory functioning (e.g., Alsuwaidan, Kucyi, Law, & McIntyre, 2009); psychological factors, such as increases in self-efficacy and self-esteem (Ng et al., 2007); or a combination of different factors.

As well as a dearth of literature on the underlying mechanisms of change, there has been little research into the specific application of physical activity as an intervention, particularly when and how it should and should not be implemented. This is concerning given that exercise is currently recommended as a treatment by NICE (2014) without any acknowledgement of the potential harm it could cause. There appears to be an assumption that the evidence base for other mental health diagnoses, such as depression, can simply be applied to BD. Despite some overlaps in symptomology, however, findings for the benefits of exercise in those diagnosed with depression cannot be easily translated into recommendations for those diagnosed with BD. As stated in the DSM-5 (American Psychiatric Association, 2013), individuals must have experienced at least one episode of (hypo)mania to be given a BD diagnosis. It could be the case that physical activity remains beneficial during depressive, but is contraindicated during (hypo)manic, phases perhaps making mania-related symptoms worse via one of the aforementioned mechanisms of change. Increasing self-esteem through exercise, for example, could be problematic for someone who already has inflated self-worth and grandiosity.

Several researchers have raised similar concerns about the risk of physical activity for those with a diagnosis of BD (e.g., Thomson et al., 2015; Wright, Everson-Hock, & Taylor, 2009), particularly given some of the theoretical models proposed to explain common BD presentations. Depue and

colleagues (Depue & Iacono, 1989; Depue, Slater, Wolfstetter-Kausch, Klein, Goplerud, & Farr, 1981), for example, suggest that BD symptoms are explained by a dysregulated Behavioural Activation System (BAS). The BAS is a neurobiological system responsible for approach motivation (AM), where a stimulus is perceived as goal-relevant and rewarding, and behaviour is directed towards it (Gray, 1990). Attainment of the goal or reward stimulates the BAS further and maintains approach behaviour. They argue that a highly sensitive BAS could lead to the onset and maintenance of a (hypo)manic state because events are more likely to be interpreted (or created) as BAS activation-relevant, leading to more extreme responses in BAS activity, such as increased mood, energy and motivation levels (Urosević, Abramson, Harmon-Jones, & Alloy, 2008).

There is empirical evidence for this proposed link between BAS sensitivity and (hypo)mania. In undergraduates 'at risk' of a mood disorder (determined using a clinical screening measure), BAS sensitivity, particularly the BAS 'fun seeking' subscale, predicted current manic symptoms (Meyer, Johnson, & Carver, 1999). In another study, BAS scale scores did not correlate with mania symptoms in individuals diagnosed with BD I, although BAS total and reward responsiveness predicted symptom intensification over two-year follow-up (Meyer, Johnson, & Winters, 2001). The authors suggest that the unexpected results when compared to Meyer and colleagues' (1999) findings could be due to methodological differences. Further evidence for the link between BAS sensitivity and BD symptomology comes from Alloy and colleagues (2012a), who found that never-diagnosed adolescents with high BAS sensitivity were more likely to be diagnosed with BD at follow-up than those with moderate BAS sensitivity. Moreover, this sensitivity appears to

predict progression of symptomology from that associated with 'softer' to more severe BD diagnoses (Alloy et al., 2012b). Fun seeking was most predictive of progression in both studies, supporting Meyer and colleagues' (1999) findings.

Goal-attainment events and AM have been shown to increase hypomanic symptoms in those diagnosed with BD II and cyclothymia (Nusslock, Abramson, Harmon-Jones, Alloy, & Hogan, 2007), and manic symptoms in those diagnosed with BD I (Johnson et al., 2000). It could be argued that engaging in exercise is a form of goal-striving and often leads to goal-attainment, making it more likely that a BAS response will be triggered and increase positive affect, energy and motivation (Wright, Armstrong, Taylor, & Dean, 2012). If the proposed response of the dysregulated BAS in individuals diagnosed with BD is as predicted (Urosević et al., 2008), the BAS response to physical activity will be heightened and prolonged.

There is preliminary evidence to support the suggestion that physical activity is associated with AM and mania-related symptoms. Lowenstein, Wright, Taylor, and Moberly (2015) investigated the effect of exercise on AM, arousal and affect in a non-clinical student population. Following AM induction, these factors increased during vigorous exercise, but reduced during moderate exercise and no exercise. Unexpectedly, trait hypomania was not a significant moderator of these effects, although this could be because trait hypomania and induced AM were not 'extreme' enough in this sample. Despite this, the results show that intensive exercise can increase AM, which could be problematic for those with a vulnerability to (hypo)mania.

In a qualitative study, Wright and colleagues (2012) conducted semi-structured interviews with individuals diagnosed with BD, to investigate their

experiences of the relationship between their symptoms and physical activity. Around half the participants believed that exercise could have a negative, rather than regulatory, effect on manic symptoms, with most perceiving exercise as both harmful and helpful (a 'double-edged sword'). The majority also expressed some fear that physical activity might trigger a manic episode or exacerbate a current one. Despite these concerns, participants also acknowledged that certain types of exercise can help to reduce high levels of arousal. Rhythmic activity, for instance, was seen as particularly beneficial. Embodiment theories (e.g., Michalak, Burg, & Heidenreich, 2012; Niedenthal, 2007) can help to explain this potentially calming effect of physical movement. These accounts suggest that there are strong bidirectional connections between the motor, sensory, affective and cognitive systems, such that activating one system will activate others. Activation of cognitive knowledge or emotions, therefore, will affect someone's bodily state, just as a particular physical state will influence thoughts and feelings.

Although there is no specific research investigating the role of embodiment for individuals diagnosed with BD, multiple studies have explored how bodily states relate to depression. Michalak and colleagues (2009), for example, have shown that gait patterns are different in patients experiencing a major depressive episode and never-depressed individuals. Even when symptoms have remitted, a difference between previously-depressed individuals and never-depressed controls has still been found (Michalak, Troje, & Heidenreich, 2011). Furthermore, studies have shown that depressed mood and associated behaviours can actually be caused by certain body positions and movements (Michalak et al., 2012). While this research suggests that certain types of physical activity might contribute to symptoms of depression,

others have shown that bodily movements can help alleviate these. Koch, Morlinghaus, and Fuchs (2007), for example, found that psychiatric inpatients' depression scores were reduced significantly more by engaging in group dancing than listening to music, or cycling in pairs (matched physiological arousal). It could be that exercising in a group, rather than the specific dance movements, contributed to depressive symptom reduction.

The existing literature supports the idea that movement type is just as important, if not more so, than activity intensity in regulating mood and associated symptoms. From an embodiment perspective and consistent with Wright et al.'s (2012) qualitative findings, one might predict that low-intensity rhythmic and repetitive movements (such as walking or swimming lengths) will reduce thought speed and have a calming effect on emotions. Conversely, erratic and variable movements (such as dancing, playing catch), even when low-intensity, may increase thought speed, which has been associated with heightened emotional arousal and mania-related symptoms (e.g., Pronin & Wegner, 2006). It is important, therefore, to investigate the impact of movements on (hypo)mania in more detail. As noted by Wright and colleagues (2012), identifying what type of activity can reduce, as well as exacerbate, symptoms will be particularly beneficial. Bearing in mind Lowenstein et al.'s findings (2015) that high-intensity exercise increased symptoms, it was decided that investigating the impact of low-intensity physical activity when in a state analogous to hypomania (through AM induction) would allow comparison of different qualities of movement without intensity confounding the results.

Aims, Research Questions and Hypotheses

Aims

The primary aim of the current study was to investigate whether different types of movement have an impact on individuals' mania-related symptoms when in a heightened AM state. A secondary aim was to investigate whether trait BAS sensitivity moderates these main effects.

Research Questions

The primary research question for the study was: 'Will positive affect, AM and mania-like symptoms change differentially following repetitive and variable movement interventions after AM induction?' A secondary research question was: 'Will trait BAS sensitivity moderate these changes?'

Hypotheses

1. Due to evidence supporting embodiment theories, BAS activation and the lived experiences of those with BD diagnoses (e.g. Lowenstein et al., 2015; Michalak et al., 2012; Wright et al., 2012), it was predicted that following AM induction, positive affect, AM and mania-like symptoms would:
    a) decrease over time for participants making repetitive movements, relative to participants making variable movements
    b) increase over time for participants making variable movements, relative to a non-movement control condition
2. As BAS scores have been found to correlate with current manic symptoms and positive affect (Meyer et al., 1999; Meyer & Hofmann, 2005), it was predicted that participants' trait BAS sensitivity would moderate the relationships predicted in hypothesis 1, such that the predicted differences would be greater in those with higher levels of BAS sensitivity.

Method

A pilot study was conducted to assess the feasibility and acceptability of the planned procedure (see Appendix B). Details of the main study are reported here.

Design

An experimental 3 x 4 mixed design was used, with movement condition (routine copy, variable copy, variable watch) as the manipulated between-subjects factor, time (T2, T3, T4, T5) as the within-subjects dependent variable, and BAS sensitivity as a between-subjects moderator. The dependent variable was 'mania' score (Behavioral Engagement Scale; Krauss, Depue, Arbisi & Spoont, 1992; and mania-relevant symptoms).

Participants

Sample characteristics. Of the 116 people sent invitations for an online screening survey (see Procedure for details), 61 were included in the final analysis (see Figure 1 for details). Forty-one participants identified as female and 20 as male. Ages ranged from 18 to 58 (M = 22.8, SD = 8.3). The majority were currently at university (n = 45), while six had completed undergraduate degrees and ten had completed postgraduate studies. On average, participants had spent 14.5 years in education (SD = 3.4). 50 people described themselves as white, with 23 classifying themselves as white British, 13 as white English, one as white Scottish and Welsh, one as white Irish, one as other white British and eight as other white ethnic background, including Australian, German, Lithuanian, French and Polish. Five participants were Asian (two Indian) and six were Chinese.

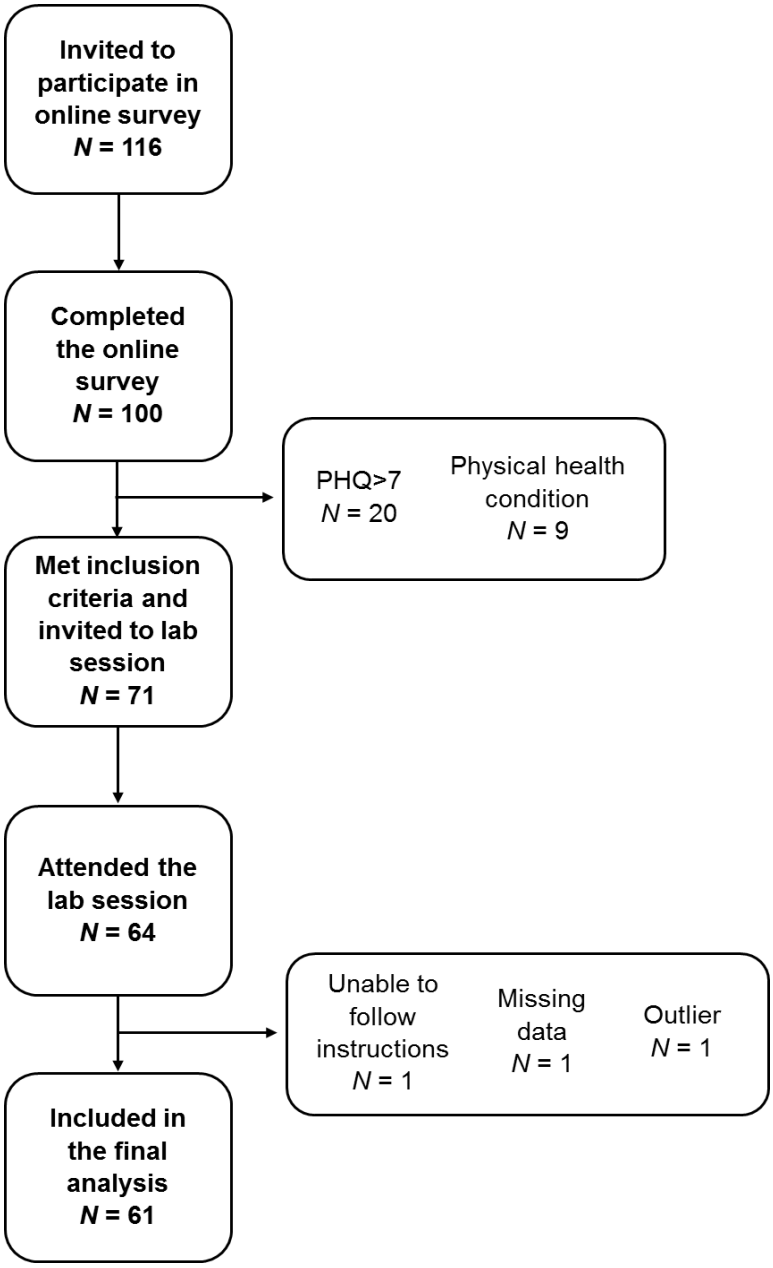

Figure 1. Schematic of overall procedure with excluded participants

Inclusion/exclusion criteria. Participants were invited to take part in the lab study if they were aged 18 or over and could read and write English. Participants were excluded after the screening process if they: scored above 7 on a measure of current depressive symptoms; had ever received a BD

diagnosis; identified any physical health conditions that could make exercise risky.[5]

Recruitment methods. Participants were predominantly recruited via advertising at the University of Exeter, through flyers and the online Psychology Research Participation System (SONA; https://exeter-psychology.sona-systems.com/). Undergraduate psychology students were offered course credits for participation, although other students and staff members could take part. Further recruitment was undertaken within the researcher's social network, offered only to those who had no prior knowledge of the study.

Materials[6]

Baseline measures

1) ***Patient Health Questionnaire Depression Scale*** (PHQ-8; Kroenke & Spitzer, 2002). The PHQ-8 is an eight-item self-report measure used to identify the presence and severity of depressive symptoms on a 0-3 scale. It has been modified from the PHQ-9 (Kroenke, Spitzer, & Williams, 2001), with item nine (thoughts regarding self-harm and suicide) removed. The PHQ-8 has good validity and reliability as a diagnostic tool for current depression (Kroenke & Spitzer, 2002). It was used in this study as a baseline measure of depressive symptoms, allowing comparison between conditions, and to screen out participants who might currently be depressed (score > 7). A yes/no question asking if the person had ever been given a BD diagnosis was added to the end of the questionnaire. Internal

[5] Two participants completed the screening procedure based on the pilot study exclusion criteria (see Appendix B). Because all other participants were scoring significantly above threshold on the mania screening tool, it was deemed to be an over-sensitive measure of current mania in a student population and was replaced with the BD diagnosis question.
[6] See Appendix C for copies of the measures used.

consistency was α = .86 for all participants who completed the PHQ-8 and α = .54 for those included in the main analysis.

Altman Self-Rating Mania Scale (ASRM; Altman, Hedeker, Peterson, & Davis, 1997). The ASRM is a five-item self-report measure for identifying the presence and severity of manic symptoms on a 0-4 scale. It has good validity and reliability (Altman et al., 1997), compares well to other self-rating mania scales (Altman, Hedeker, Peterson, & Davis, 2001), and is recommended as a symptom severity assessment tool (Miller, Johnson, & Eisner, 2009). It was used in this study as a baseline measure of mania symptoms, allowing comparison between conditions. Internal consistency was α = .85 for all participants who completed the ASRM and α = .86 for those included in the main analysis.

Physical Activity Readiness Questionnaire for Everyone (PAR-Q+; Warburton, Jamnik, Bredin, & Gledhill, 2011a). The PAR-Q+ is a seven-item self-report measure for assessing the possible risks of exercise based on responses to yes/no health questions. The PAR-Q+ has high reliability over time, and sensitivity and specificity for diagnosing hypertension (Warburton, Bredin, Jamnik, & Gledhill, 2011b). It was used in this study to screen out participants who might be physically at risk when engaging in exercise.

Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985, 1997). The four items of the GLTEQ assess self-reported frequency of engaging in different exercise intensities. It has good reliability over time and validity when compared with physiological and other self-report measures (Godin & Shephard, 1985; Jacobs, Ainsworth, Hartman, & Leon, 1993; Miller, Freedson, & Kline, 1994). It was used in this study as a baseline

measure of participants' exercise habits, allowing comparison between conditions.

Behavioural Activation System (BAS) Scale (Carver & White, 1994). The BAS is a 13-item self-report measure of trait BAS sensitivity, consisting of three 1-4 point subscales (Drive, Fun seeking, Reward responsiveness). In this study, lower scores indicate higher BAS sensitivity. The BAS scale has good reliability and validity as a measure of BAS sensitivity that correlates well with, but is distinguishable from, existing measures of similar traits (Carver & White, 1994; Jorm et al., 1998). It was included in this study to compare trait BAS sensitivity between conditions, and it was investigated as a moderating variable. Internal consistency for participants included in the main analysis was α = .70 for BAS Drive, α = .68 for BAS Fun seeking, α = .61 for BAS Reward, and α = .80 for BAS total score.

Dependent variables

Borg Rating of Perceived Exertion Scale (RPE; Borg, 1998). The RPE is a single-item 15-point scale for assessing perceived exertion, and was used in this study to measure perceived exertion within and between conditions across time. It correlates well with physiological measures of actual exertion (Chen, Fan, & Moe, 2002) and is a useful instrument for self-regulating exercise (e.g. Ciolac et al., 2015).

2) ***Heart rate (HR).*** Heart rate was measured with a Polar Electro WearLink chest monitor to gain an objective measure of physical exertion, which could be compared with perceived exertion. This transmitted HR readings to a separate wrist monitor (Polar RS800CX). Measurements were taken at baseline, during the cognitive test and at T2, T3, T4, T5, T6, and T7 (see

Figure 2). At each timepoint, HR was viewed for approximately 15 seconds on the wrist monitor and the average HR within this timepoint was recorded.

Behavioral Engagement Scale (BES; Krauss et al., 1992). The BES is a five-item self-report measure of state AM and behavioural engagement. BES total score is calculated as the mean of five 1-10 point scales (energy, optimism, mood, thought liveliness, and excitement). Higher scores indicate more behavioural engagement. It was used in this study to assess changes in approach motivation within and between conditions across time. Its high internal consistency over time (Wright, Lam, & Brown, 2008) was replicated in this study, with Cronbach's alpha across and within conditions ranging from .74 to .83 at baseline. The BES was deemed to be sufficiently reliable to be included in the main analyses.

Mania-relevant symptoms (MRS). This measure was developed by Lowenstein and colleagues (2015), using five constructs originally utilised by Pronin and Wegner (2006): perceived thought speed; positive mood;[7] and mania-like symptoms of energy,[8] feelings of power,[9] and creativity/inspiration.[10] These symptoms were measured on a 1-9 scale. Reliability and validity have not been explicitly tested, although the constructs capture symptom increases following approach motivation induction (Lowenstein et al., 2015; Pronin & Wegner, 2006). Cronbach's alpha was calculated for each construct at all timepoints across and within conditions. Internal consistency for participants at baseline was α = .78 for mood, α = .66 for energy, α = .85 for feelings of power, α =.67 for creativity/inspiration, and α = .85 for total score. Given the poor

[7] 'Positive mood' includes excitement, enthusiasm and happiness
[8] 'Energy' includes alertness, jitteriness, tiredness, attentiveness and activeness
[9] 'Feelings of power' includes strength, powerfulness and determination
[10] 'Creativity/inspiration' includes creativity, insightfulness and inspiration

internal consistency of energy and creativity/inspiration over time, only MRS thought speed, mood and power were included in the main analyses of this study, to capture changes in MRS within and between conditions.

Manipulations

Approach motivation induction procedure. To increase levels of AM, participants took part in a task used by Pronin and Wegner (2006), adapted from Velten's (1968) original mood induction procedure. Instructions explaining the task were presented in written and spoken format (Appendix C). Using Microsoft PowerPoint, participants were required to read 56 increasingly elated statements. Each statement was presented in black Arial Rounded 44-point font and appeared one letter at a time against a yellow background, moving from the bottom of the screen to the middle. They moved at a speed of 40 ms per letter with a delay of 320 ms between slides. This procedure increases perceived thinking speed, positive mood and mania-related symptoms in comparison to a 'slow' reading version (Pronin & Wegner, 2006).

Physical activity task. Two types of video were created using Alice version 2.2 software (www.alice.org), a programming environment that is used to generate 3D animations.

Routine condition. An animated 3D woman was programmed to complete 33 repetitions of six low-intensity arm movements, always in the same order during each repetition. Participants randomly allocated to the routine copy condition (n = 20) copied these arm movements.

Variable conditions. This set of videos involved the same animated woman and six low-intensity arm movements, but in a random order decided by a random number generator (www.randomizer.org). Twenty-one different

movement orders were programmed. Participants were allocated to a variable copy condition (*n* = 20), in which they copied the movements, or a variable watch control condition (*n* = 21), in which they only watched the movements. One person from each of conditions viewed the same version of the variable video (matching between conditions), although no video was viewed by two people within the same condition.

Every video created contained 198 movements and lasted approximately 10 minutes. The videos were displayed on a Samsung SyncMaster 460PXn monitor. Participants were recorded during the task using a Panasonic SDR-H90 video camera to check movement adherence.

Cognitive effort test. Participants were asked to count backwards in threes from 100 at the same time as watching or copying the arm movements for one minute during the physical activity task. They were told there would be a simultaneous task during the explanation of the procedure, but were not given the details of this until immediately before it began. The number of correct and incorrect responses was recorded. Cognitive performance was calculated by subtracting the number of incorrect answers from correct answers, with lower scores indicating greater cognitive load. The aim of this was to compare cognitive effort of the physical activity task across conditions.

Procedure

Prior to recruitment, further ethical approval was sought and granted from the university's Ethics Committee on two occasions due to methodological changes in the study (Appendix E). Individuals requested to participate in the study by email or signing up on SONA. First, they were invited to complete the online survey, which included an information sheet, consent form, PHQ-8+,

ASRM, PAR-Q+, demographic questions, GLTEQ and BAS scale. If individuals scored above cut-off on the PHQ-8+ (>7 or 'yes' to BD diagnosis) or PAR-Q+ ('yes' to any question), they were automatically excluded from the study and sent to a debrief page explaining this. If individuals scored below cut-off, they were asked to complete all baseline measures before being sent to a different page.[11] These individuals were invited to take part in the lab-based session.

Figure 2 shows the procedure for this session. Participants were provided with information on the study, confidentiality and right to withdraw before informed consent was obtained. Participants affixed the chest monitor and completed paper versions of the BES and MRS. Baseline HR was taken approximately one minute after the HR monitor was attached to allow for stabilisation. Subsequently, participants were given written and spoken instructions regarding the approach motivation induction and physical activity task (Appendix C). After approach motivation induction, participants' HR and responses to the RPE, BES and MRS were recorded by the researcher.

All individuals were asked to stand during the physical activity task, whether copying the movements or not. The video recording was started for participants who consented to this, and the physical activity task began. From 2 minutes 15 seconds to 3 minutes 15 seconds into the task, participants were asked to count backwards in threes (the cognitive effort test) and their responses were recorded. The researcher recorded HR at the beginning of the cognitive test. The movement video lasted 10 minutes, but was paused at three and a half minutes and seven minutes for participants' HR, RPE, BES and MRS responses to be recorded. These variables were noted again 30 seconds after

[11] See Appendix C for information sheets, consent forms, measures and debriefs

the video ended (10.5 minutes), at the 14-minute mark, and after a four-minute relaxation exercise (Appendix C), to check for any residual mania-related symptoms. At the end of the session, participants were given a verbal and written debrief and the opportunity to ask any questions.

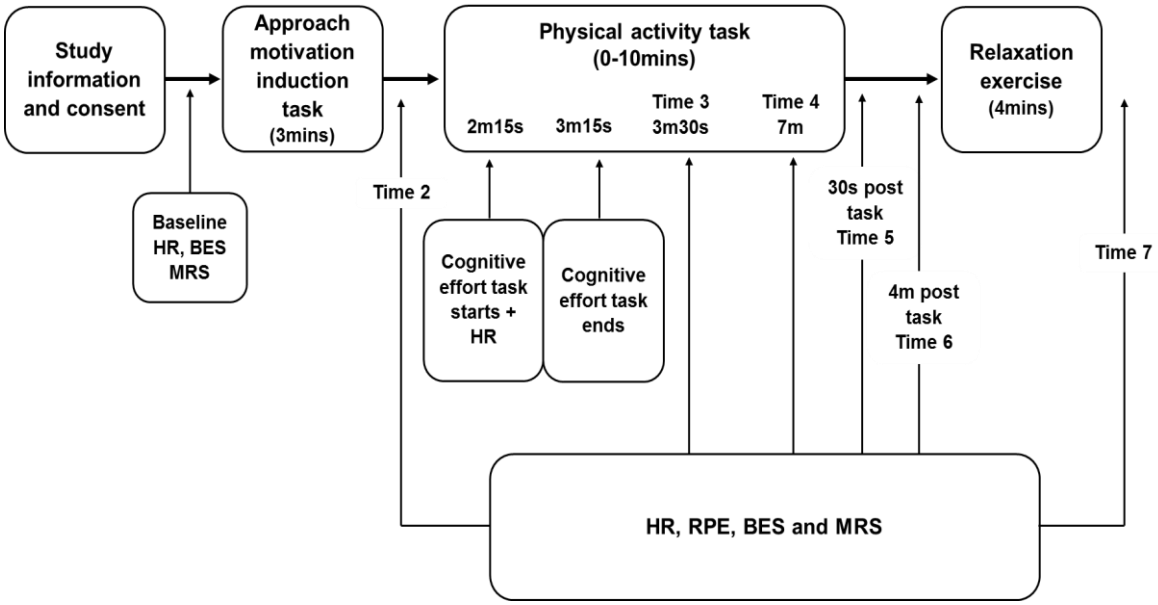

Figure 2. Schematic of the lab-based procedure.

Statistical Analysis

Data was analysed using IBM SPSS Statistics (Version 23) for Windows 10. Normality of variable distributions and the presence of outliers were checked visually using histograms, boxplots, P-P and Q-Q plots for data combined across and within each condition on all measures, apart from gender, marital status and ethnicity (see Appendix F for details). Variables that deviated from normality were analysed non-parametrically. Prior to testing the main hypotheses, several different analyses were conducted. To check movement adherence, a one-way analysis of variance (ANOVA) and two Mann-Whitney U tests were carried out, with inter-rater reliability of judges' ratings ascertained using Cronbach's alpha. Internal consistency and correlations within and

between the BES and MRS were investigated using Cronbach's alpha and Pearson correlation coefficients respectively, to identify which variables should be included in the main analyses. The baseline measures were analysed using chi-square test of independence for categorical data, independent-samples Kruskal-Wallis for non-parametric ordinal data and one-way ANOVA for parametric data, to identify any group differences.

The effect of approach motivation induction and condition on the dependent variables was analysed using mixed ANOVAs. A Spearman's rho correlation coefficient was used to identify any significant correlations between HR and RPE. This was followed up by a mixed-design ANOVA for HR, to see whether this changed differentially over time depending on movement condition, and Friedman tests to see whether RPE significantly changed over time in each condition. Both were followed up with post-hoc tests using adjusted alpha levels.

A doubly-multivariate ANOVA, with time and mania score (BES + MRS thought speed, mood and power) treated as dependent variables and condition as the between-subjects factor, and a doubly-multivariate analyses of covariance (ANCOVA), with BAS added as a covariate, were conducted to test recovery over time following AM induction. Because multivariate analysis of variance does not require assumptions of sphericity or homogeneity of variance and covariances to be met, tests of these are not reported here. For the other analyses, these tests will only be reported when assumptions have been violated and corrections made. Unless otherwise reported, alpha levels were set at $p < .05$.

Results

Movement Adherence

Although all participants were video recorded if they gave consent, only videos of those in the routine copy and variable copy conditions were checked for movement adherence. This was defined as carrying out approximately the same movement as was shown, with errors being identified as making an incorrect arm movement, using the incorrect arm, or missing the movement entirely. Seventeen people in the routine condition and 14 in the variable condition consented to being recorded. To allow participants to become accustomed to copying the movements, those that were made within the first 38 seconds of video (two cycles in the routine condition) were not included in the adherence check. Because it was recognised that participants might struggle to copy movements during the cognitive test, these were also not included in the analysis. The final number of movements available to be copied was calculated by subtracting the movements during the first 38 seconds of video and the cognitive test from 198 (the total number of movements). Table 1 displays this number, along with the errors made and percentage of correct movements, for each condition.

A one-way ANOVA showed no significant difference between conditions for the number of movements copied, $F(1, 29) = .53$, $p = .47$. One Mann-Whitney U test showed no significant difference between conditions for the percentage of correct movements ($U = 106.5$, $p = .44$).

Table 1

Movement adherence for routine copy and variable copy conditions

Condition		*M*	*SD*	Min.	Max.
Routine -	no. of moves copied	165.59	1.18	163	168
	no. of errors made	0.18	0.53	0	2
	% correct moves	99.89	0.32	98.8	100
Variable -	no. of moves copied	165.14	2.18	162	171
	no. of errors made	0.43	0.94	0	3
	% correct moves	99.74	0.56	98.2	100

Note. M = mean, *SD* = standard deviation, Min. = minimum, Max. = maximum

A second rater was randomly assigned eight videos to check inter-rater reliability and intraclass correlation coefficients (ICC) between the two raters were calculated. Reliability was high for the number of moves copied (ICC = .93, $p < .01$) and ratings were identical for the number of errors made (ICC = 1).

Baseline Comparisons

Several chi-square tests of independence were conducted comparing gender (female, male), ethnicity (White, Asian, Chinese) and GLTEQ regular intense exercise (rarely/never, sometimes, often) in the three conditions (routine copy, variable copy, variable watch). All of these were non-significant (*p*s > .30). Independent-samples Kruskal-Wallis tests showed no significant differences among conditions for age, ASRM, or GLTEQ strenuous, moderate and mild exercise (*p*s > .10). A series of one-way ANOVAs showed no

significant condition differences for PHQ-8, years in education, BAS subscales and total, baseline BES, HR, thought speed, mood and power (*p*s > .05).

Approach Motivation Induction Check

To check that the AM induction had the desired effect on HR, BES and MRS, a series of mixed-design ANOVAs were conducted, with timepoint (baseline, T2) as the within-subjects variable and condition as the between-subjects variable. None of the interactions between condition and time were significant for HR, BES and MRS (*p*s > .20), although the main effect of time for all variables was. Table 2 shows HR, BES and MRS scores at baseline and T2. HR at T2 was significantly higher than baseline, $F(1, 58) = 6.94$, $p = .01$, $\eta_p^2 = .11$. BES at T2 was significantly higher than at baseline, $F(1, 58) = 70.78$, $p < .001$, $\eta_p^2 = .55$. Thought speed at T2 was significantly higher than at baseline, $F(1, 58) = 22.73$, $p < .001$, $\eta_p^2 = .28$. Mood at T2 was significantly higher than at baseline, $F(1, 58) = 23.98$, $p < .001$, $\eta_p^2 = .29$. Power at T2 was significantly higher than at baseline, $F(1, 58) = 6.94$, $p = .01$, $\eta_p^2 = .11$. This suggests that AM induction had the desired effect on participants, increasing their state behavioural engagement, mania-relevant symptoms and physiological arousal.

Table 2

Heart rate and mania at baseline and time 2 across conditions

	Baseline		Time 2	
	M	*SD*	*M*	*SD*
HR	79.2	13.6	83.1	13.0
BES	6.5	0.7	7.2	0.8
Thought speed	5.0	1.0	5.7	1.2
Mood	5.3	1.2	5.9	1.0
Power	5.0	1.3	5.3	1.3

Note. HR = heart rate, BES = Behavioral Engagement Scale, *M* = mean, *SD* = standard deviation.

Exertion and Effort Checks

The correlations between HR and RPE across and within conditions were checked using Spearman's rho correlation coefficient. They were found to be significantly correlated across conditions at T4, $r_s(59) = .28$, $p = .03$, and T5, $r_s(59) = .31$, $p = .01$, but these correlations were non-significant within conditions (ps > .10).

A mixed-design ANOVA with time (eight levels) as a within-subject factor and condition as a between-subject factor was conducted to test whether HR changed across all time points and whether this differed between conditions. Mauchly's test of sphericity was significant, $W(27) = .28$, $p < .001$, suggesting that the assumption of sphericity had been violated; Greenhouse-Geisser corrections are reported. There was a main effect of time on HR, $F(4.74, 275) = 59.84$, $p < .001$, $\eta_p^2 = .51$, and a significant interaction between HR and condition, $F(9.48, 275) = 2.64$, $p = .005$, $\eta_p^2 = .08$. There was no main effect of

condition, $F(2, 58) = 2.83$, $p = .07$, $\eta_p^2 = .09$. Figure 3 displays the changes in HR across time for each condition.

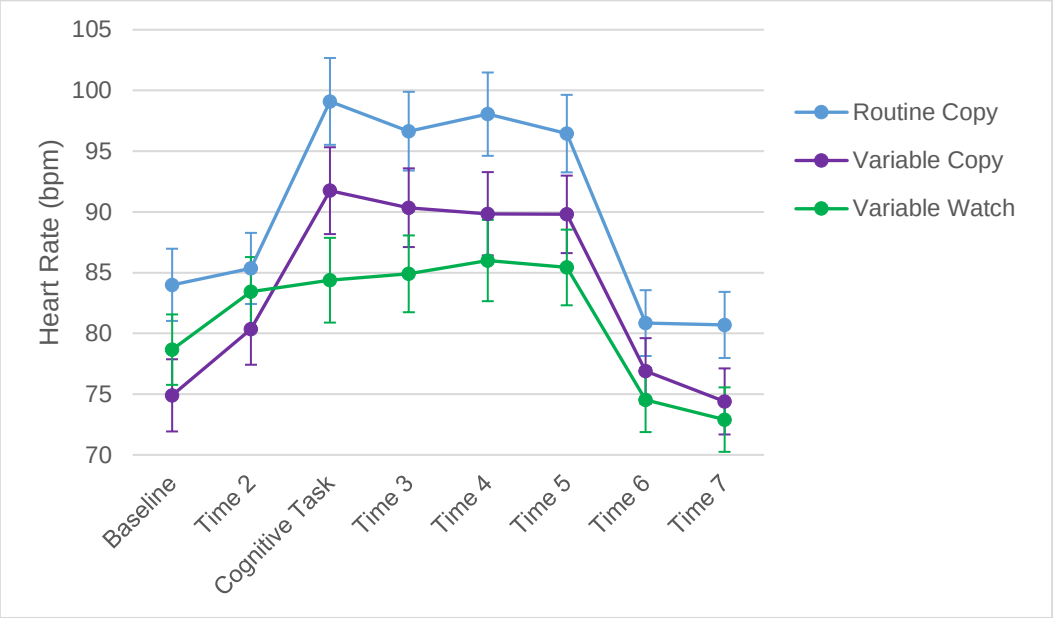

Figure 3. Mean heart rate across time for each condition. Standard errors are represented by error bars. *Note.* bpm = beats per minute.

Post-hoc analysis using a Bonferroni-corrected alpha level of .0006 was conducted to identify any significant changes in HR within conditions (see Appendix F for details). There were no significant changes in HR during the physical activity task for any condition (*p*s > .25), although reductions in HR from during the task (cognitive test, T3, T4, T5) to post-task (T6, T7) were significant (*p*s < .0001, η_p^2s > .54) for all conditions. Participants in the routine and variable copy conditions had significantly higher HRs during the cognitive test compared to baseline and T2, and at T3, T4 and T5 compared to T2 (*p*s < .0004, η_p^2s > .50), but the variable watch participants did not. There were also significant increases in HR from baseline to T4 in the routine and variable copy conditions (*p*s < .0002, η_p^2s > .56). Only those in the variable watch condition

had significantly lower HRs at T6 and T7 compared to T2 (*p*s < .0001, η_p^2s > .56).

Because HR and RPE were not significantly correlated within conditions, Friedman tests using a Bonferroni-corrected alpha level of .017 were conducted to assess the change in RPE over time for each condition (see Figure 4 for the medians and interquartile ranges). There were significant changes in RPE over time in the routine copy, $X^2(5) = 71.23$, $p < .001$, variable copy, $X^2(5) = 64.14$, $p < .001$, and variable watch conditions, $X^2(5) = 51.67$, $p < .001$. Post-hoc analysis was conducted using several Wilcoxon signed-ranks tests and a Bonferroni-corrected alpha level of .006. RPE significantly increased from T2 to T3 in all conditions (*p*s < .001), significantly decreased from T3 to T4 in the variable watch condition ($p = .001$), and significantly decreased from T5 to T6 in the routine and variable copy conditions ($p < .001$).

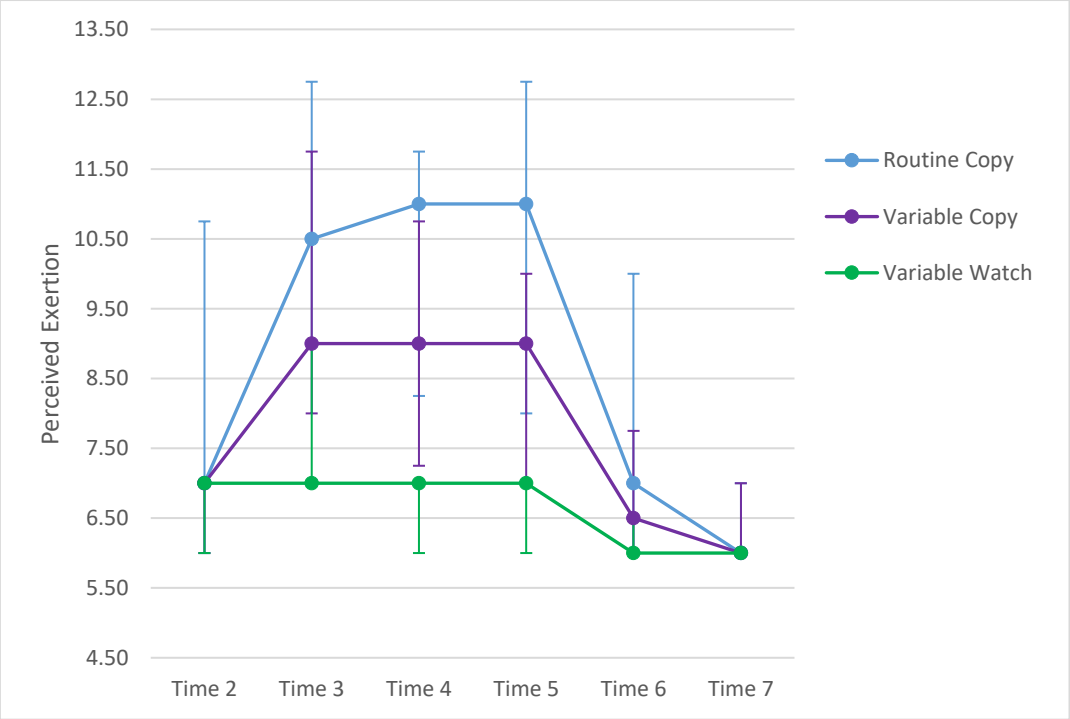

Figure 4. Median rating of perceived exertion (RPE) across time for each condition. Interquartile ranges are represented by error bars.

The pattern of change across time for RPE was similar to that of HR in the routine copy and variable copy conditions, with both increasing at the beginning of the physical activity, stabilising during and reducing at the end. There was little change in the variable watch condition, suggesting that these participants were exerting themselves the least. Moreover, the participants' exertion levels stabilised during the physical activity task, as might be expected during low-intensity exercise. Despite there being different patterns of exertion in the conditions, there was no significant difference in performance among conditions on the cognitive test, $X^2(2) = 0.90$, $p = .64$, suggesting that they did not differ in cognitive effort required during the physical activity task.

BES and MRS Correlations

The correlations between BES and MRS subscales for thought speed, mood and power at each timepoint were checked across and within conditions using Pearson correlation coefficients. They ranged from weak ($r = .14$) to strong ($r = .87$), with the majority of scores falling in the moderate range ($.50 < r < .70$). Because all correlations were below .90, BES and MRS subscales could be entered into the main analysis as individual scores were correlated, but not multicollinear.

Main Hypothesis Testing

Hypothesis 1. A doubly-multivariate ANOVA was conducted to test the hypothesis that AM and mania-like symptoms would show differential patterns of change over time depending on condition. Measures of mania (BES, MRS thought speed, mood and power), and time (2, 3, 4, 5) were included as within-subjects variables, with condition (routine copy, variable copy, variable watch)

as the between-subjects variable. Over all conditions, mania changed significantly across time, $F(3, 56) = 6.84$, $p = .001$, $\eta_p^2 = .27$, with overall scores tending to reduce from T2 to T3 and T4 then remain stable at T5 (see Appendix F, Table F4). There was a significant time by mania by condition interaction, $F(18, 102) = 1.71$, $p = .049$, $\eta_p^2 = .23$, but the time by condition, mania by condition and time by mania interactions were non-significant (ps > .10, η_p^2s < .14). The difference among groups was also significant, $F(2, 58) = 4.80$, $p = .01$, $\eta_p^2 = .14$, with post-hoc analysis using a Bonferroni-corrected alpha level of .02 showing the routine condition had a higher mean mania score than the variable watch condition ($p < .01$).

To see which measures of mania were contributing to the significant time by mania by condition interaction further, a series of repeated-measures ANOVAs were run for each measure of mania and for each of the critical contrasts between particular pairs of conditions separately, with time (2, 3, 4, 5) as the within-subjects variable and condition (routine copy vs variable copy; variable copy vs variable watch) as the between-subjects variable (see Figure 5). A Bonferroni-corrected alpha level of .013 was used. There were no significant main effects of condition or time by condition interactions for any of the mania measures (ps > .08). The hypothesis that positive affect, AM and mania-like symptoms would increase in the variable copy relative to routine copy and variable watch conditions was not supported.

Figure 5. Mean mania score across time for each condition. Standard errors are represented by error bars. *Note.* BES = Behavioral Engagement Scale.

Hypothesis 2. Because of the high internal consistency of the total scale, BAS total score was included in the main analysis. A doubly-multivariate analysis of covariance, with BAS as a between-subjects covariate, was conducted to test the hypothesis that trait BAS sensitivity influences the relationship between condition, time and mania. The model was built with time, mania and time x mania interaction entered as within-subjects variables, and condition, BAS and condition x BAS interaction as between-subjects variables. All two-way interactions between the within-subjects and between-subjects variables were included which allowed analysis of the four-way interaction between time, mania, condition and BAS. All interactions and the main effect of BAS were non-significant (ps > .1, η_p^2s < .15). This does not support the hypothesis that BAS score would moderate the relationship between movement condition and positive affect, AM and mania-like symptoms.

Discussion

The present study compared the impact of repetitive and variable low-intensity movements on individuals' AM, positive affect and mania-like symptoms (termed 'mania') when in a heightened AM state. The aim of this was to explore whether the type, rather than intensity, of physical activity reduces, maintains or increases these symptoms when in a state analogous to hypomania. This has important implications for individuals who are prone to experiencing problematic (hypo)manic episodes, such as those with a diagnosis of BD, in terms of identifying which forms of exercise might be beneficial, as well as those that could be risky.

The Impact of Movement on Mania

Following AM induction, it was predicted that mania (AM, positive affect and mania-like symptoms of energy and power) would decrease over time in the repetitive copy relative to variable copy condition, and increase over time in the variable copy relative to variable watch condition. The results did not support these predictions. There were no group differences across time for any of the mania constructs, although there was a higher overall mania score (averaged across time) in the routine condition than the variable watch condition. Given that a stimulus must be interpreted as goal-relevant and rewarding to elicit and maintain a BAS response (Depue & Iacono, 1989; Gray, 1990), it could be that copying repetitive movements stimulated BAS activation compared to only watching variable movements. This finding should be treated with caution, however, as the video content was not matched between these conditions.

Although there was no evidence that copying repetitive movements exacerbated participants' hypomania-like state, it did not reduce their symptoms relative to the variable copy condition as predicted. Embodiment theorists have argued for the existence of two-way causal relationships between motor, cognitive, sensory and affective systems (e.g., Michalak et al., 2012; Niedenthal, 2007), with some evidence for these bidirectional connections in depression (e.g., Michalak et al., 2009, 2011). It was predicted, therefore, that following slow, repetitive movements would have a calming effect on emotions, which is consistent with Wright and colleagues' (2012) findings regarding helpful exercise in BD. Physical exertion during the routine movement task might have been too great to have this calming effect on mania-relevant symptoms, however, while a lack of exertion could account for the lower overall mania score in the no-movement condition.

It might also be the case that even low-intensity repetitive exercise involves goal-striving and goal-attainment, which is enough to trigger a BAS response and increase (or maintain) mania-relevant symptoms (Wright et al., 2012). As predicted by embodiment theories (Michalak et al., 2012; Niedenthal, 2007), the increase in physical exertion for participants copying repetitive movements might have maintained the cognitive and affective systems' responses. Moreover, copying the repetitive movements might have been too easy for participants and not required their full attention. This lack of focus might have prevented the exercise from being calming. As one participant in this condition reported, "I wasn't thinking about the moves anymore. I could think about lots of things I need to get done instead, which made my thoughts go faster".

Surprisingly, mania did not increase in the variable copy condition relative to the routine copy or variable watch conditions as was predicted. It could be that the variable movements were not complex or erratic enough to elicit racing thoughts and therefore increase symptoms. The similar cognitive effort required across tasks supports this assertion. As in the routine condition, participants' physical exertion when copying variable movements might have maintained the cognitive and affective systems' responses. Moreover, the movements could have been rewarding, which maintained BAS activation (Wright et al., 2012).

The Impact of BAS Sensitivity

The prediction that trait BAS sensitivity would moderate the relationship between type of movement and mania was not supported. This was surprising given that previous research has shown BAS sensitivity to be a good predictor

of current mania and positive affect (Meyer et al., 1999; Meyer & Hofmann, 2005). It could be that participants in this study did not have high (or varied) enough trait BAS sensitivity to influence this relationship. They had lower average scores on all BAS subscales than the students in Carver and White's (1994) original study, with a mean BAS total score of 25.9 out of a possible 52. A less sensitive BAS might also have affected participants' response to the AM induction and physical activity tasks, with less BAS activation leading to a decrease (or lack of increase) in mania symptoms.

Limitations

There were several limitations to the study. Participants were predominantly university students, which means that any findings are difficult to generalise beyond this population (Henrich, Heine, & Norenzayan, 2010). Due to the lower than expected BAS sensitivity and PHQ-8 scores (based on the exclusion criteria), extra caution should be exercised when drawing any conclusions in relation to clinical populations, such as individuals with a BD diagnosis. Additionally, the sample size was not large enough to adequately power the study, particularly when testing the main hypothesis using the doubly-multivariate ANOVA.[12] There was a non-significant pattern in the data, such that mania appeared to be maintained across time in the routine condition, decreased slightly in the variable copy condition and decreased more in the variable watch condition. Perhaps this difference would have been statistically significant with a larger sample size.

Although the AM induction procedure appeared to have the desired effect by increasing participants' AM, physiological arousal and mania-like

[12] See Appendix F for a-priori power calculations.

symptoms, this might not have been large enough to produce group differences in response to the physical activity task. The procedure has been shown to increase thought speed, positive affect and mania-related symptoms in other studies (Lowenstein et al., 2015; Pronin & Wegner, 2006), though its reliability and validity as an AM induction requires further testing. This limitation applies to the use of the MRS questionnaire as well. It could be that this measure was not sensitive enough to capture important changes in mania-relevant symptoms. Moreover, some participants scored close to ceiling on this measure following AM induction, which might have prevented identification of significant mania increases during the movement task. The constructs in the MRS require further reliability and validity testing.

A final consideration was in the design of the physical activity task. As already noted, the movements in the variable conditions might not have been complex or varied enough to influence mania. On the other hand, some participants might have found the movements difficult to follow, making the results invalid. Though movement adherence was good when checked, this might not have been the case for the nine participants in these conditions who did not consent to being recorded. Additionally, the variable and routine movements might not have been representative of low-intensity exercise that people typically engage in, which makes it difficult to draw conclusions regarding real-life activities. Although a 10-minute video length was chosen based on feedback from the pilot study, this might not have been long enough to produce significant group differences in mania. Moreover, pausing the video to record symptoms could have influenced the impact of the task on mania, particularly as some people were not moving for several minutes. Arguably, this is also not representative of ‘typical’ exercise.

Future Research

It is recommended that future research focuses on exploring the impact of different forms of exercise on (hypo)mania in more depth. Some of the methodological limitations described above could be overcome by conducting a similar study using longer periods of continuous physical activity, with participants rating their AM, positive affect and mania-like symptoms while maintaining movement. Mania-like symptoms and mood, in particular, may be recorded using different constructs that are more sensitive to capturing changes in these. Different, and perhaps more complex, low-intensity movements could be chosen on the basis that they more closely reflect real-life exercise. The research could be extended into naturalistic settings, for example, by daily monitoring of individuals' engagement with different types of exercise and their associated symptoms.

Moreover, studying a more diverse sample would be beneficial. It might be the case that low-intensity movements have an activating effect when there is more variance in trait BAS sensitivity in the study sample, and this warrants further examination. Although this area requires additional investigation with non-clinical populations at present, future research could focus on identifying whether different types of exercise are risky for those who are prone to (hypo)manic episodes, such as individuals with a diagnosis of BD. There is a possibility that high-intensity exercise will exacerbate (hypo)mania symptoms in this population (Lowenstein et al., 2015), and it would be beneficial to see whether variable, as opposed to repetitive, movements have an additive effect in medium- and high-intensity exercise for 'at risk' individuals.

Conclusions

This study found no evidence that copying variable movements increases AM, positive affect and mania-like symptoms relative to only watching these and copying repetitive movements. If anything, repetitive movements were more likely to have a maintaining effect on these factors, while watching movements reduced them. Trait BAS sensitivity did not moderate this relationship. Although these findings would suggest that low-intensity physical activity might be safer for individuals prone to (hypo)manic episodes, this area requires further investigation. Research should explore various combinations of exercise type and intensity with different samples, to identify what might be beneficial or risky for individuals in terms of their emotional wellbeing.

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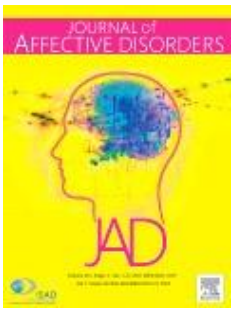

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Appendix B

Pilot Study

Prior to recruitment, ethical approval was sought and granted from the University of Exeter's School of Psychology Ethics Committee (Appendix E). Trainee clinical psychologists at the University of Exeter were recruited via email. The six female participants were presented with information on the study, confidentiality and right to withdraw, and were asked to provide written consent to take part (Appendix C). They completed the Patient Health Questionnaire Depression Scale, Altman Self-Rating Mania Scale and the Physical Activity Readiness Questionnaire for Everyone to check they met the same inclusion and exclusion criteria as in the main study. The only difference in the pilot study was that participants had to score below six on the measure of mania to be included, and were not asked about a diagnosis of BD.

The testing procedure in the pilot study was identical to the main study, apart from the following differences. The only measures used other than the screening questionnaires were a modified version of the Manic Symptoms Questionnaire (thought speed, happy, excited, tired, frustrated, bored) and the Borg Rating of Perceived Exertion Scale, which were completed before and after the approach motivation induction task and at 3.5, 7, 10.5 and 14 minutes after the movement video started. Additionally, participants were only randomly allocated to the repetitive or variable copy condition, not the variable watch. Feedback was also gathered at the end of the session to check acceptability.

Pilot Study Information Sheet

PARTICIPANT INFORMATION SHEET (PILOT)

The impact of movement on hypomania-like symptoms

Lead Researcher: Rachel Stirland, Clinical Psychologist in Training, University of Exeter

Rs546@exeter.ac.uk

You are being invited to take part in a pilot research study. Before you decide whether or not you wish to take part, it is important for you to understand why the study is being done and what it will involve. Please read the information below carefully to help you make this decision. Please let the researcher know if you have any questions about the information provided.

What is the purpose of the study?
We are interested in exploring the relationship between physical activity and bipolar disorder, particularly the impact that different types of movement can have on mood, energy and motivation. We are conducting this pilot study to make sure the method used is acceptable and informative. It will help us make informed decisions about how to run the main study.

What will be involved?
After reading this information and signing the consent form, you will be asked to fill in some brief questionnaires and your heart rate will be taken. You will then be asked to complete a computer task where you will be required to read sentences as they appear on a screen. Following this, you will be allocated to one of two experimental groups, where you will be asked to watch a video of an animated person moving and to copy their movements as closely as you can. Throughout the study, you will be asked some of the same questions again and your heart rate will be taken a few times. The study will take an hour to an hour and a half.

All your personal information and study data will be kept confidential, using codes instead of names, and stored in a secure place. Any identifiable data about you will be removed from the study write-up. General information about participants, such as average age, gender and questionnaire scores, will be presented instead.

Do I have to take part?
No. Participation is voluntarily and it is entirely up to you whether you take part or not. If you decide to take part, you will be asked to fill out a consent form. You have the right to withdraw your participation in the study at any time,

without having to give a reason. If you would like to do this, please contact the lead researcher so your data can be removed.

What are the possible risks and disadvantages of taking part?
You will be required to give up an hour to an hour and a half of your time to complete the study, although you will receive money or course credits for taking part. You might find some of the questions asked distressing or difficult to answer. Additionally, you might find that your mood or alertness changes somewhat after the study. The researcher is available to discuss any concerns you have with them and will check you are okay before leaving. They will also encourage you to contact your GP or a mental health professional if you are still distressed or upset at all.

What are the possible benefits and advantages of taking part?
You will be helping us to understand more about the impact physical activity can have on bipolar disorder. This information could prove beneficial in creating interventions to help those with bipolar disorder. You will receive course credits or money for taking part.

What will happen to the results of the study?
This study is intended to form part of a doctoral thesis. The aim is also to get it published in an academic journal. As noted above, no personal information about participants will be included. If you would like further information on the main results of the study, please contact the lead researcher.

If you would like to participate or wish to discuss the study further you can contact:
Lead Researcher: Rachel Stirland, Clinical Psychologist in Training, University of Exeter
Email: rs546@exeter.ac.uk
Research Supervisors: Kim Wright and Nick Moberly
Email: K.A.Wright@exeter.ac.uk or N.J.Moberly@exeter.ac.uk

Ethical approval has been obtained from the University of Exeter's Psychology Department Ethics Committee. If you have any concerns about this study, please email Lisa Leaver, the Chair of the Psychology Department Ethics Committee at l.a.leaver@ex.ac.uk.

Thank you for reading this information sheet.

Pilot Study Feedback Form

I found copying the movements:

- Too easy
- Easy
- A little challenging but manageable
- Too challenging – for most of the time I could not follow them

Additional comments:

The exercise at the end made me feel:

- Very on edge, anxious or agitated
- A little on edge, anxious or agitated
- No different
- A little calm, soothed or relaxed
- Very calm, soothed or relaxed

Additional comments:

Please add any additional feedback about any aspects of the procedure below:

Appendix C

Study Poster

UNIVERSITY OF EXETER

INTERESTED IN HOW EXERCISE AFFECTS YOUR FEELINGS?

Earn 1.5 credits by taking part in a DClin project looking at the relationship between physical activity, emotions and physiology

EVENING AND WEEKEND TIMESLOTS AVAILABLE IN JANUARY!

You will be sent a set of screening questionnaires to complete online, which will check the study suitability. You will then be invited to a lab session, where you will be asked to complete a computer task, watch and respond to an animated person's movements, and to complete another short exercise at the end. Throughout the study, you will be asked to fill in some questionnaires and physical measures of your heart rate will be taken. The session will take up to an hour. You will receive 0.5 credits for the screening and a further 1 credit for the lab session

If you are **18 or over**, do **not** have a **diagnosis of bipolar disorder** or **physical health concern** which makes exercise unsafe, and are **not** currently experiencing a **high level of distress**, please contact the lead researcher:

Rachel Stirland
(Trainee Clinical Psychologist)
rs546@exeter.ac.uk

Physical activity, emotions and physiology
rs546@exeter.ac.uk (Rachel)

Main Study Online Information and Consent Screens

Physical activity, emotions and physiology

You have been invited to take part in a research study, involving an online survey and a lab-based session. Your participation in this study is completely voluntary and you can withdraw at any time. Please read the information below carefully to help you decide whether you want to participate or not. Please contact the lead researcher using the contact details below if you have any questions about the information provided.

You have been invited to complete some online questionnaires to check whether the study 'Physical activity, emotions and physiology' is suitable for you to take part in. These questionnaires should take no more than 20 minutes to complete. Please note that all questions in the online survey are mandatory. If there is any question you do not want to answer, please exit the survey (this will withdraw your participation). Your responses are kept confidential by storing your data in a secure place with the participant code you were given.

In the lab-based session, we will be exploring the relationship between physical activity, emotional feelings and physiological responses. You will be asked to asked to complete a computer task and respond to a video of an animated person's movements. You'll also be asked to fill in some brief questionnaires and your heart rate will be recorded throughout the study. This will take an hour to an hour and a half to complete.

Thank you for taking the time to read this information. If you are still interested in taking part in this study, please continue to the next page.

Contact details:

Lead Researcher: Rachel Stirland, Clinical Psychologist in Training, University of Exeter

Email: rs546@exeter.ac.uk

Research Supervisors: Kim Wright and Nick Moberly

Email: K.A.Wright@exeter.ac.uk or N.J.Moberly@exeter.ac.uk

Consent form

*Please select the statements below to confirm you have read and understood the information provided and consent to participating in this study. If you do not wish to take part, please exit the survey.

	Please select if you agree
I confirm that I have read and understood the information provided. I have had the opportunity to consider the information and ask questions about it	○
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason	○
I understand that the information I provide will be kept confidential and secure	○
I agree to take part in the study	○

Main Study Lab Session Information Sheet

PARTICIPANT INFORMATION SHEET (MAIN)

Movement and Mood

Lead Researcher: Rachel Stirland, Clinical Psychologist in Training, University of Exeter

Rs546@exeter.ac.uk

You are being invited to take part in a research study. Before you decide whether or not you wish to take part, it is important for you to understand why the study is being done and what it will involve. Please read the information below carefully to help you make this decision. Please let the researcher know if you have any questions about the information provided.

What is the purpose of the study?
We are interested in exploring the relationship between physical activity, emotional feelings and physiological responses.

What will be involved?
After reading this information and signing the consent form, you will be asked to fill in some brief questionnaires and physical measures of your heart rate will be taken. You will then be asked to complete a computer task in which you will be required to read a series of sentences as they appear on a screen. Following this, you will be asked to watch a video of an animated person moving and respond to this in a particular way depending on the group you've been assigned to. We would like to video record you responding to the animation in order to check that you have followed the instructions given. Because we are interested only in your movements, we will not record your face (the camera will be positioned behind you). Once this has been checked by the lead researcher and a supervisor, the recording will be destroyed. You can, however, opt out of being video recorded. Throughout the study, you will be asked some of the same questions again and your heart rate will be taken a few times. You will complete another short exercise at the end. The study will take approximately one hour.

All your personal information and study data will be kept confidential, using codes instead of names, and stored in a secure place. Confidentiality will only be broken in exceptional circumstances, such as you or someone else being at immediate serious risk. If confidentiality does need to be breached, it will be discussed with you at the time of testing. Any identifiable data about you will be removed from the study write-up. General information about participants, such as average age, gender and questionnaire scores, will be presented instead.

Do I have to take part?
No. Participation is voluntary and it is entirely up to you whether you take part or not. If you decide to take part, you will be asked to fill out a consent form. You have the right to withdraw your participation in the study at any time, without having to give a reason. If you would like to do this, please contact the lead researcher so your data can be removed.

What are the possible risks and disadvantages of taking part?
You will be required to give up an hour to an hour and a half of your time to complete the study, although you will receive money or course credits for taking part. Because they ask about your mood, it is possible that you might find some of the questions distressing or difficult to answer. However, you do not have to answer any question that you do not want to. Additionally, you might find that your mood or alertness changes somewhat after the study. The researcher is available to discuss any concerns you have with them and will check you are okay before leaving. They will also encourage you to contact your GP or a mental health professional if you are still distressed or upset at all.

What are the possible benefits and advantages of taking part?
You will be helping us to understand more about the impact physical activity can have on emotions and physiological responses. Ultimately, this information could prove beneficial in creating interventions to help those with mood disorders, such as bipolar disorder. You will receive course credits or money for taking part.

What will happen to the results of the study?
This study is intended to form part of a doctoral thesis. The aim is also to get it published in an academic journal. As noted above, no personal information about participants will be included. If you would like further information on the main results of the study, please contact the lead researcher.

If you would like to participate or wish to discuss the study further you can contact:
Lead Researcher: Rachel Stirland, Clinical Psychologist in Training, University of Exeter
Email: rs546@exeter.ac.uk
Research Supervisors: Kim Wright and Nick Moberly
Email: K.A.Wright@exeter.ac.uk or N.J.Moberly@exeter.ac.uk

Ethical approval has been obtained from the University of Exeter's Psychology Department Ethics Committee. If you have any concerns about this study, please email Lisa Leaver, the Chair of the Psychology Department Ethics Committee at l.a.leaver@ex.ac.uk.

Thank you for reading this information sheet.

Main Study Lab Session Consent Form

UNIVERSITY OF EXETER

PARTICIPANT CONSENT FORM

Movement and Mood

Lead Researcher: Rachel Stirland, Clinical Psychologist in Training, University of Exeter

Rs546@exeter.ac.uk

Please initial boxes

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. ☐

3. I understand that the information I provide will be kept confidential and secure, and I will not be identifiable in any publications resulting from the project. ☐

4. I agree to take part in the above study. ☐

5. I agree to be video recorded for the study. Please note you can still take part in the study without being video recorded. ☐

_____	_____	_____
Signature	Name (print)	Date

Thank you for your participation.

Demographics

Date:_____ **Participant Number**_____

1. **Gender:** Male ____ Female ____
2. **Age:** _____ years

Date of Birth _____/_____/_____ day month year

3. **Current marital status: (please tick all that apply)**

____ married with spouse

____ living with partner

____ separated

____ divorced

____ widowed

____ in an intimate relationship but not living together

____ never married

4. **Highest level of education reached: (please tick any that apply)**

____ Left school before 16

____ Finished school at 16

____ Finished school at 18

____ Attended/attending university or equivalent

____ Completed university or equivalent

____ Completed postgraduate qualification

Total number of years of education completed _____ years

If the above options do not fit exactly (e.g. you left education at 16 and then returned as a mature student), please specify here:

……
……
……
……
……
……

5. Ethnicity:

What is your ethnic group? (please tick as many boxes as you feel apply to you)

1☐White

11 ☐ British (white)

111☐ English

112☐ Scottish

113☐ Welsh

114☐ Other British (white) - please specify

...……...……..……

12 ☐ Irish

13 ☐ Any other White background - please specify

……..……..

2☐ Mixed

21 ☐ White & Black Caribbean

22 ☐ White & Black African

23 ☐ White & Asian

24 ☐ Any other Mixed background - please specify

……

3☐ Asian, Asian British, Asian English, Asian Scottish or Asian Welsh

31 ☐ Indian

32 ☐ Pakistani

33 ☐ Bangladeshi

34 ☐ Any other Asian background - please specify

……

4☐ Black, Black British, Black English, Black Scottish or Black Welsh

41 ☐ Caribbean

42 ☐ African

43 ☐ Any other Black background - please specify

……..……..….

5☐ Other ethnic background

51 ☐ Chinese

52 ☐ Middle Eastern/North African

53 ☐ Any other background - please specify

……

Patient Health Questionnaire (PHQ-8; Kroenke & Spitzer, 2002)

Over the **last 2 weeks**, how often have you been bothered by any of the following problems?
*(circle **one** number on each line)*

How often during the past 2 weeks were you bothered by...	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself, or that you are a failure, or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed. Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3

Altman Self-Rating Mania Scale (ASRM; Altman, Hedeker, Peterson & Davis, 1997)

LEVEL 2—Mania—Adult*

*Altman Self-Rating Mania Scale (ASRM)

Name: _____ **Age:** ____ **Sex:** ❑ Male ❑ Female **Date:**_____

If the measure is being completed by an informant, what is your relationship with the individual receiving care? _____

In a typical week, approximately how much time do you spend with the individual receiving care? _____ hours/week

Instructions: On the DSM-5 Level 1 cross-cutting questionnaire you just completed, you indicated that *during the past 2 weeks* you (the individual receiving care) have been bothered by "sleeping less than usual, but still having a lot of energy" and/or "starting lots more projects than usual or doing more risky things than usual" at a mild or greater level of severity. The five statement groups or questions below ask about these feelings in more detail.

1. **Please read each group of statements/question carefully.**
2. Choose the one statement in each group that best describes the way you (the individual receiving care) have been feeling for **the past week**.
3. Check the box (✓ or x) next to the number/statement selected.
4. **Please note:** The word "occasionally" when used here means once or twice; "often" means several times or more and "frequently" means most of the time.

		Clinician Use
Question 1		**Item score**
❑ 1	I do not feel happier or more cheerful than usual.	
❑ 2	I occasionally feel happier or more cheerful than usual.	
❑ 3	I often feel happier or more cheerful than usual.	
❑ 4	I feel happier or more cheerful than usual most of the time.	
❑ 5	I feel happier of more cheerful than usual all of the time.	
Question 2		
❑ 1	I do not feel more self-confident than usual.	
❑ 2	I occasionally feel more self-confident than usual.	
❑ 3	I often feel more self-confident than usual.	
❑ 4	I frequently feel more self-confident than usual.	
❑ 5	I feel extremely self-confident all of the time.	
Question 3		
❑ 1	I do not need less sleep than usual.	
❑ 2	I occasionally need less sleep than usual.	
❑ 3	I often need less sleep than usual.	
❑ 4	I frequently need less sleep than usual.	
❑ 5	I can go all day and all night without any sleep and still not feel tired.	
Question 4		
❑ 1	I do not talk more than usual.	
❑ 2	I occasionally talk more than usual.	
❑ 3	I often talk more than usual.	
❑ 4	I frequently talk more than usual.	
❑ 5	I talk constantly and cannot be interrupted.	
Question 5		
❑ 1	I have not been more active (either socially, sexually, at work, home, or school) than usual.	
❑ 2	I have occasionally been more active than usual.	
❑ 3	I have often been more active than usual.	
❑ 4	I have frequently been more active than usual.	
❑ 5	I am constantly more active or on the go all the time.	
	Total/Partial Raw Score:	
	Prorated Total Raw Score:	

Physical Activity Readiness Questionnaire for Everyone (PAR-Q+; Warburton, Jamnik, Bredin, & Gledhill, 2011a)

2014 PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	**YES**	**NO**
1) Has your doctor ever said that you have a heart condition ☐ OR high blood pressure ☐?	☐	☐
2) Do you feel pain in your chest at rest, during your daily activities of living, **OR** when you do physical activity?	☐	☐
3) Do you lose balance because of dizziness **OR** have you lost consciousness in the last 12 months? Please answer **NO** if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? **PLEASE LIST CONDITION(S) HERE:** _____	☐	☐
5) Are you currently taking prescribed medications for a chronic medical condition? **PLEASE LIST CONDITION(S) AND MEDICATIONS HERE:** _____	☐	☐
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer **NO** if you had a problem in the past, but it ***does not limit your current ability*** to be physically active. **PLEASE LIST CONDITION(S) HERE:** _____	☐	☐
7) Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985, 1997)

Godin Leisure-Time Exercise Questionnaire

Considering a **7-Day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your **free time** (write on each line the appropriate number).

Times Per Week

a) **STRENUOUS EXERCISE**
(HEART BEATS RAPIDLY)
(i.e. running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling) _____

b) **MODERATE EXERCISE**
(NOT EXHAUSTING)
(i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing) _____

c) **MILD EXERCISE**
(MINIMAL EFFORT)
(i.e. yoga, archery, fishing from river band, bowling, horseshoes, golf, snow-mobiling, easy walking) _____

2. Considering a 7-Day period (a week), during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

OFTEN	SOMETIMES	NEVER/RARELY
1. ☐	2. ☐	3. ☐

Behavioural Activation System (BAS) Scale (Carver & White, 1994)

Each item of this questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all the items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Choose from the following four response options:

1 = very true for me
2 = somewhat true for me
3 = somewhat false for me
4 = very false for me

3. I go out of my way to get things I want.
4. When I'm doing well at something I love to keep at it.
5. I'm always willing to try something new if I think it will be fun.
7. When I get something I want, I feel excited and energized.
9. When I want something I usually go all-out to get it.
10. I will often do things for no other reason than that they might be fun.
12. If I see a chance to get something I want I move on it right away.
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.
18. When good things happen to me, it affects me strongly.
20. I crave excitement and new sensations.

21. When I go after something I use a "no holds barred" approach.
23. It would excite me to win a contest.

Borg Rating of Perceived Exertion Scale (RPE; Borg, 1998)

The Borg RPE (Rating of Perceived Exertion) Scale

Overview:

The RPE (Rating of Perceived Exertion) was developed by Borg to describe a person's perception of exertion during exercise. Dr Borg is an Emeritus Professor at Stockholm University.

Exertion	RPE
no exertion at all	6
extremely light	7
	8
very light	9
	10
light	11
	12
somewhat hard	13
	14
hard (heavy)	15
	16
very hard	17
	18
extremely hard	19
maximal exertion	20

Behavioral Engagement Scale (BES; Krauss et al., 1992)

A.

1. Exuberant vitality, surging with energy

2. Vigorous, extremely energetic

3. Active, lively, animated

4. Fresh, slightly energetic

5. Fairly fresh, adequate energy

6. Slightly tired, somewhat lacking in energy

7. Rather tired, lethargic, not much energy

8. Very fatigued, sluggish

9. Tremendously weary, hard to keep going

10. Utterly exhausted, entirely worn out, practically at a standstill

B.

1. Everything is possible for me

2. Extremely optimistic

3. Very confident about things

4. Feel self-assured, things seem good

5. Feel adequate about myself and prospects

6. Slightly discouraged about things

7. Little confidence in things, about my abilities

8. Feel inadequate, nothing seems to be going right

9. Extremely pessimistic about everything

10. Everything seems bleak and futile, feel totally inept

C.

1. Elated, euphoric, ecstatic

2. Tremendous delight and happiness

3. Cheerful, in high spirits

4. Pretty good

5. O.K.

6. A little bit low

7. In low spirits, somewhat sad and blue

8. Clearly depressed

9. Very depressed, feels painful

10. Utter depression and gloom

D.

1. Thoughts are literally racing through my head

2. I have rapid, penetrating ideas

3. Thoughts come quickly and effortlessly

4. Thoughts are fairly quick and clear

5. My mind is alert

6. Not particularly alert

7. Thoughts are slow, takes longer to pick up on things

8. Thoughts are sluggish

9. My mind feels dull and monotonous

10. My mind is stagnant, dead, nothing moves

E.

1. Passionately absorbed in the world's excitement

2. Excited, stimulated, great zest for life

3. Enthusiastic about life

4. Motivated and interested in things

5. Somewhat interested in things

6. Not very enthusiastic about things

7. Generally unenthusiastic about life

8. Apathetic, unmotivated

9. No real interest or desire for anything

10. Nothing is interesting - not even family or friends.

Mania-relevant symptoms (MRS)

Sometimes people have the feeling that their thoughts are coming slowly, and other times people feel that their thoughts are 'racing'. What do you feel the speed of your thoughts are now?

Very slow				Moderate Speed				Very fast
1	2	3	4	5	6	7	8	9

How much do you currently feel excited?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	2	3	4	5	6	7	8	9

How much do you currently feel enthusiastic?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	2	3	4	5	6	7	8	9

How much do you currently feel happy?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	2	3	4	5	6	7	8	9

How much do you currently feel alert?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	2	3	4	5	6	7	8	9

How much do you currently feel jittery?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	2	3	4	5	6	7	8	9

How much do you currently feel tired?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	2	3	4	5	6	7	8	9

How much do you currently feel attentive?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	2	3	4	5	6	7	8	9

How much do you currently feel active?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

How much do you currently feel strong?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

How much do you currently feel powerful?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

How much do you currently feel determined?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

How much do you currently feel creative?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

How much do you currently feel insightful?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

How much do you currently feel inspired?

Very slightly		A little		Moderately		Quite a bit		Extremely
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Computer Task Instructions

During this computer task, you will see a series of statements presented one letter at a time on the screen. I would like you to read each word of each sentence in your head as it appears and then attempt to respond to the feeling suggested by each statement. Try to think of yourself as definitely being and moving into that state. When you're ready to begin, click the mouse once, and the study will begin. And remember, as soon as words start to come up on the screen, you should be reading them.

Relaxation Exercise

Mindfulness of the breath

Settle into a comfortable sitting position. Gently close your eyes. Bring your awareness to the level of physical sensations by focusing your attention on the sensations of touch and pressure in your body where it makes contact with the floor and whatever you are sitting on. Now that you are sitting comfortably, place both feet flat on the floor about shoulder's width apart and rest your hands on your legs. Now what we can do is just gently focus on our breathing. As you breathe try to allow the air to come down into your diaphragm – that's just at the bottom of your ribcage in the upside down 'V'. Feel your diaphragm, the area underneath your ribs, move as you breathe in and out. Just notice your breathing and play an experiment with your breathing. Breathe a little faster or a little slower until you find a breathing pattern that, for you, seems to be your own soothing, comforting rhythm. It is like you are checking in, linking up, with the rhythm within your body that is soothing and calming to you. Now we can spend 30 seconds or so just focusing on our breathing, just noticing the breath coming down into the diaphragm, your diaphragm lifting and then the air moving out, through your nose. Sometimes it's useful to focus on the point just inside the nose where the air enters. So, in through your mouth and out from your nose. Just focus on that for 30 seconds…….. What did you notice? You may have noticed that actually, although it was only 30 seconds, your mind might have wandered off. When you first do this kind of breathing focusing, it can be quite surprising just how much your mind does shift from one thing to another. This is all very normal, natural, and to be expected. All you are doing is allowing yourself to notice when your mind wanders and then, with kindness and gentility bring your attention back to focus on your breathing. That's it. Notice and return.

Example Main Study Debrief Sheet

PARTICIPANT DEBRIEFING SHEET (MAIN)

The impact of movement on hypomania-like symptoms

Lead Researcher: Rachel Stirland, Clinical Psychologist in Training, University of Exeter

Rs546@exeter.ac.uk

What is the purpose of the study?
We are interested in exploring the relationship between physical activity and bipolar disorder, particularly the impact that different types of movement can have on mood, energy and motivation. Although physical activity has been shown to be useful when people are experiencing a low or depressed mood, little research has been done into the effect of such activity on mania or hypomania. Mania is defined as "a distinct period of abnormally and persistently elevated, expansive or irritable mood, lasting at least one week", with at least three symptoms (or four if only irritable mood) of inflated self-esteem of grandiosity, decreased need for sleep, more talkative, flight of ideas or racing thoughts, or distractibility (American Psychiatric Association, 2013). Hypomania is similar, although the period only has to last four days and does not cause significant impairment.

It is thought that some types of physical activity might actually increase and prolong symptoms of hypomania or mania, whilst other types might be helpful for reducing these symptoms and actually have a calming effect on individuals (e.g. Thomson et al., 2015; Wright, Everson-Hock, & Taylor, 2009). We were particularly interested in investigating how different low intensity upper body movements would impact on mood, energy and motivation.

Why this procedure?
The computer task requiring you to read sentences was designed to increase your thought speed, mood, energy and motivation levels. We asked you to complete questionnaires and took your heart rate to check that this task had worked. We wanted to see how long these effects lasted depending on the movement video you watched. One group watched a 'repetitive movement' video and copied the moves. The other two groups watched a 'variable movement' video, with one group copying moves and the other just observing. We continued to ask you questions and check your heart rate to assess how the long the increases in your mood, energy and motivation levels were lasting. Time was given at the end to allow these effects to return to baseline. We hope the results of the study will help us understand whether repetitive or variable low intensity movements are harmful or helpful when experiencing hypomania-like symptoms.

What happens now?

Thank you for participating in this study. This study is intended to form part of a doctoral thesis and to be published in an academic journal. As explained previously, no personal information about participants will be included. If you would like further information on the main results of the study or to withdraw your data at any time, please contact the lead researcher using the detail below.

It is not predicted that this study will have any lasting effects. However, if you are concerned about the impact the study has had on your psychological or physical wellbeing, please contact the lead researcher and/or research supervisors using the details below. You may like to contact your GP or another healthcare professional as well as or instead of the researchers. You might also find the following services helpful:

- Student Health Centre - visit http://www.exeterstudenthealthcentre.co.uk/
- University Wellbeing Services – visit http://www.exeter.ac.uk/wellbeing/about/
- Voice (Confidential information and listening service) – for info and support visit https://www.exeterguild.org/voice/, phone 01392 724000 between 8pm and 8am Sun-Wed, or email exetervoice@googlemail.com
- Samaritans – visit http://www.samaritans.org/, phone 116 123 or email jo@samaritans.org
- Mind – visit http://www.mind.org.uk/, phone 0300 123 3393 or text 86463
- University Wellbeing Information Directory (WID) - visit http://wid.exeterguild.com/

Contact details:

Lead Researcher: Rachel Stirland, Clinical Psychologist in Training, University of Exeter
Email: rs546@exeter.ac.uk
Research Supervisors: Kim Wright and Nick Moberly
Email: K.A.Wright@exeter.ac.uk or N.J.Moberly@exeter.ac.uk

Ethical approval has been obtained from the University of Exeter's Psychology Department Ethics Committee. If you have any concerns about this study, please email Lisa Leaver, the Chair of the Psychology Department Ethics Committee at l.a.leaver@ex.ac.uk.

Appendix D

Cronbach's alpha for BES and MRS

To check the internal consistency of the BES, Cronbach's alpha was calculated at all timepoints across and within conditions. George and Mallery's (2003) recommendations for acceptable scores were followed. Cronbach's alpha ranged from .53 to .93, with all bar one score deemed 'acceptable' (>.70) and the majority of scores falling into the 'good' category (>.80). These findings suggest the BES was sufficiently reliable to be included in the main analyses.

To check whether the subscales of the MRS were internally consistent, Cronbach's alpha was calculated for the MRS mood, energy, power and creativity scales at all timepoints across and within conditions. For mood, Cronbach's alpha ranged from .67 to .95, with all bar one score 'acceptable' (>.70). For energy, Cronbach's alpha ranged from .21 to .81, with the majority 'poor' (<.60). For power, Cronbach's alpha ranged from .67 to .96, with all bar one 'acceptable' (>.70). For creativity, Cronbach's alpha ranged from .54 to .93, with two 'poor' (>.50) and five 'questionable' (>.60). Given these findings, only MRS mood and power were included in the main analyses.

Appendix E

Ethical Approval

Wed 08/06/2016, 09:54
Stirland, Rachel
Inbox

Ethical Approval system

Your application (2016/1284) entitled The impact of movement on hypomania-like symptoms has been accepted

Please visit http://www.exeter.ac.uk/staff/ethicalapproval/

Please click on the link above and select the relevant application from the list.

Emails regarding changes to ethics application:

From: Stirland, Rachel
Sent: 28 September 2016 11:28
To: Leaver, Lisa
Subject: Ethics application

Hi Lisa,

I'm emailing you regarding some changes to my ethics application **2016/1284 (rev2)** for my study 'The impact of movement on hypomania-like symptoms'. I have been piloting the study over the summer and would like to make some small changes to the procedure as a result. These are:

- Completing the screening process via Limesurvey. Participants will contact me for a unique code to input on Limesurvey. They will complete the screening questionnaires and if not able to continue the study, will be presented with the debriefing information i.e. services they might find helpful for support. If they meet the inclusion criteria, they will complete a further set of questionnaires on Limesurvey (the baseline measures).
- I am planning to do some testing on Sundays and will be following the lone worker policy for the Mood Disorder Centre i.e. letting my supervisor know when I've finished testing someone, contacting them if concerned about risk, etc.
- I will still be collecting heart rate data during the main study, but will be using slightly different equipment (wireless lab equipment rather than watch) due to problems with the pilot equipment.

- I have added in info on participants being video recorded to the information sheet, as this wasn't previously stated (see attached form). I give them the option to take part, but not be recorded. This is reflected in the consent form (see attached).

I think that's everything. Let me know if it is okay to make these changes and I'll go ahead and make the study live.

Thanks,
Rachel

Leaver, Lisa

Tue 18/10/2016, 09:38

Dear Rachel,
I'm sorry that it has taken me so long to reply – I am happy with these changes – you have covered all the required ethical adjustments and so this is fine. I'll keep your email on file as a record.
Best wishes
Lisa

Lisa Leaver
Senior Lecturer in Animal Behaviour
University of Exeter
Ext: 4641
http://psychology.exeter.ac.uk/staff/index.php?web_id=lisa_leaver
Washington Singer, University of Exeter, Exeter, EX4 4QG

Second set of changes:

Stirland, Rachel

Wed 23/11/2016, 13:55

Hi,

I just wanted to flag up what I've added to the application form. I've put a line on the question about bipolar disorder being asked in the 'Participants' section (Track B). The question is in the online survey and appears after the PHQ8. I've also written what the question is in the 'brief description of methods and measurements' section (Have you ever been given a diagnosis of bipolar disorder?). I have also uploaded the screen that contains the PHQ8 questionnaire and BD diagnosis question, but don't know if you will be able to display this or if only I can?

Let me know if you need any further information.

Thanks,

Rachel

Wed 23/11/2016, 11:14

Ethical Approval system

Your application (2017/1434) entitled The impact on movement on hypomania-like symptoms (revision of 2016/1284) has been referred

Please visit http://www.exeter.ac.uk/staff/ethicalapproval/

Please click on the link above and select the relevant application from the list.
The reviewer's comments will explain what you have to do before you submit your application again

Final ethical approval:

Sun 27/11/2016, 08:24
Stirland, Rachel
Inbox

Ethical Approval system

Your application (2017/1434) entitled The impact on movement on hypomania-like symptoms (revision of 2016/1284) has been accepted

Please visit http://www.exeter.ac.uk/staff/ethicalapproval/

Please click on the link above and select the relevant application from the list.

Appendix F

Power calculations

Power analyses were conducted for all hypotheses using G*Power. There were no effect sizes reported in the literature discussed previously; therefore, a medium effect size was assumed in all calculations. The MANOVA within-between interactions results produced the largest suggested sample size. For a medium effect size (Cohen's f^2) of .15, with 80% power and an alpha level of .05, 306 participants were recommended in the main study. For the ANOVAs, 78 participants were recommended.

Checking data assumptions

Participant 15 had missing baseline data and participant 62's HR at T5 was identified as a significant outlier following visual checks of the data. Neither of these could be satisfactorily corrected for and the participants were removed from any further analysis, leaving 61 participants (routine copy: n = 20, variable copy: n = 20, variable watch: n = 21) in the main analysis. The following variables deviated from a normal distribution when checked across and within conditions: age; ASRM; all GLTEQ scores; RPE; cognitive task performance; errors when copying movements; and percentage of correct movements. These variables were analysed non-parametrically as deviations could not be normalised through data transformation.

Levene's test was used to check homogeneity of variance across conditions for the same variables. The difference in variance between conditions for RPE was significant at all timepoints (ps < .05). It was also significant for HR at T2, $F(2, 58) = 3.34$, $p = .04$, with further analysis using Hartley's test (Pearson & Hartley, 1954, as cited in Field, 2009) confirming that the homogeneity of variance assumption had been violated (routine copy = 269.40, variable watch = 87.96, Fmax > 2.5:1). The difference in variance between conditions for MSQ+ thought speed at T7 also approached significance, $F(2, 58) = 3.05$, $p = .055$, with Hartley's test confirming this violation (variable copy = 2.95, variable watch = .99, Fmax > 2.5:1). These will be considered in the event of conducting specific between-group comparisons at these timepoints.

Heart rate changes across time (post-hoc tests)

Follow-up repeated measures ANOVAs were conducted to compare each of the following timepoint in each condition: T2 vs cognitive task; T2 vs time 3; and T5 vs T6. An adjusted *p*-value of .006 was used. HR was significantly higher during the cognitive task than at T2 for the routine copy, $F(1, 19) = 33.08$, $p > .001$, and variable copy conditions, $F(1\ 19) = 21.9$, $p < .001$, but not the variable watch condition, $F(1, 20) = .4$, $p = 53$. HR remained higher at time 3 in comparison to T2 for the routine copy, $F(1, 19) = 39.64$, $p < .001$, and variable copy conditions, $F(1, 19) = 34.36$, $p < .001$, while the difference remained non-significant for the variable watch condition, $F(1, 20) = 72$, $p = .41$. There was a significant reduction in HR between T5 and T6 for all three conditions (routine copy – $F(1, 19) = 31.68$, $p < .001$; variable copy – $F(1, 19) = 46.5$, $p < .001$; variable watch – $F(1, 20) = 23.85$, $p < .001$).

Tables displaying frequencies, medians and means of baseline measures

Table F1

Frequency of nominal baseline measures in each condition

		Condition		
		Routine Copy	Variable Copy	Variable Watch
Gender	Female	14	11	16
	Male	6	9	5
	Not specified	0	0	0
Ethnicity	White	16	17	17
	Asian	3	1	1
	Chinese	1	2	3
Regular Intense Exercise (GLTEQ4)	Often	6	10	8
	Sometimes	9	4	8
	Rarely/never	5	6	5

Table F2

Median and interquartile range of baseline measures (not normally distributed) in each condition

		Condition		
		Routine Copy	Variable Copy	Variable Watch
Age	Median	19.00	20.50	19.00
	1st Q	18.25	19.00	18.00
	3rd Q	24.75	30.00	20.00
	IQR	6.50	11.00	2.00
Altman Self-Rating Mania Scale	Median	9.00	8.00	7.00
	1st Q	5.00	6.25	5.00
	3rd Q	12.75	12.00	11.00
	IQR	7.75	5.75	6.00
Strenuous Exercise (GLTEQ1)	Median	1.00	2.00	2.00
	1st Q	0.00	0.00	0.50
	3rd Q	3.00	4.00	3.00
	IQR	3.00	4.00	2.50
Moderate Exercise (GLTEQ2)	Median	2.00	2.00	2.00
	1st Q	1.00	1.00	0.00
	3rd Q	2.75	4.00	4.50
	IQR	1.75	3.00	4.50

		Condition		
		Routine Copy	Variable Copy	Variable Watch
Mild Exercise (GLTEQ3)	Median	3.50	3.00	3.00
	1st Q	2.25	1.00	1.00
	3rd Q	7.00	6.00	7.00
	IQR	4.75	5.00	6.00

Table F3

Mean scores and standard deviations of baseline measures (normally distributed) in each condition

		Condition		
		Routine Copy	Variable Copy	Variable Watch
PHQ8	*M*	2.15	2.15	3.33
	SD	1.57	1.93	1.96
Years in education	*M*	14.55	15.42	13.67
	SD	2.54	3.56	3.75
BAS Drive	*M*	9.10	9.35	9.38
	SD	1.74	2.18	1.91
BAS Fun seeking	*M*	8.00	8.15	8.67
	SD	2.36	1.63	2.12

		Condition		
		Routine Copy	Variable Copy	Variable Watch
BAS Reward responsiveness	*M*	8.40	8.70	8.05
	SD	1.70	2.66	1.03
BAS Total	*M*	25.50	26.20	26.10
	SD	4.85	4.29	4.39
Baseline BES	*M*	4.36	4.49	4.54
	SD	0.78	0.77	0.50
Baseline MRS Thought Speed	*M*	5.10	4.85	5.14
	SD	0.85	1.23	1.01
Baseline MRS Mood	*M*	5.60	5.30	5.11
	SD	1.14	1.25	1.06
Baseline MRS Power	*M*	5.42	5.05	4.68
	SD	1.19	1.39	1.21
Baseline HR	*M*	84.00	74.90	78.67
	SD	17.50	10.55	10.75

Table displaying means of variables used in main hypothesis testing

Table F4

Combined and separate mania scores at each timepoint

	All Conditions	Routine Copy	Variable Copy	Variable Watch
Mania	***M (SD)***	***M (SD)***	***M (SD)***	***M (SD)***
Time 2	6.0 (0.9)	6.2 (0.7)	6.0 (1.1)	5.8 (0.9)
Time 3	5.8 (0.9)	6.1 (0.7)	5.9 (0.9)	5.4 (0.9)
Time 4	5.6 (0.9)	6.1 (0.8)	5.6 (0.9)	5.2 (0.9)
Time 5	5.6 (1.0)	6.1 (0.9)	5.8 (0.9)	5.1 (0.9)
BES				
Time 2	7.2 (0.8)	7.3 (0.7)	7.2 (0.9)	7.0 (0.8)
Time 3	7.0 (0.7)	7.1 (0.6)	7.2 (0.7)	6.7 (0.7)
Time 4	6.8 (0.7)	7.1 (0.7)	6.8 (0.7)	6.6 (0.7)
Time 5	6.8 (0.8)	7.3 (0.7)	6.7 (0.9)	6.4 (0.7)
Thoughts				
Time 2	5.7 (1.2)	6.0 (1.0)	5.8 (1.4)	5.5 (1.0)
Time 3	5.4 (1.3)	5.7 (1.1)	5.4 (1.5)	5.1 (1.4)
Time 4	5.3 (1.3)	5.5 (1.5)	5.3 (1.1)	5.0 (1.3)
Time 5	5.4 (1.4)	5.5 (1.4)	5.9 (1.2)	4.8 (1.4)
Mood				
Time 2	5.9 (1.0)	6.1 (0.9)	5.8 (1.2)	5.7 (1.0)
Time 3	5.7 (1.0)	6.1 (0.9)	5.9 (1.0)	5.2 (0.9)
Time 4	5.5 (1.1)	6.2 (0.8)	5.5 (1.2)	4.9 (0.9)
Time 5	5.4 (1.3)	6.1 (1.0)	5.4 (1.3)	4.7 (1.0)

	All Conditions	Routine Copy	Variable Copy	Variable Watch
Power				
Time 2	5.3 (1.3)	5.7 (0.8)	5.3 (1.5)	5.0 (1.4)
Time 3	5.2 (1.3)	5.6 (0.1)	5.3 (1.3)	4.7 (1.3)
Time 4	5.0 (1.3)	5.6 (1.2)	5.0 (1.3)	4.4 (1.3)
Time 5	5.0 (1.5)	5.5 (1.3)	5.1 (1.6)	4.4 (1.4)

Note. BES = Behavioral Engagement Scale, *M* = mean, *SD* = standard deviation.

Appendix G

Dissemination Statement

All participants who took part in the study and asked to be sent information about the results will be emailed a brief summary of the study findings. The results of the thesis will also be presented to peers and research supervisors in June 2017 at the University of Exeter. It is hoped that it can be submitted for publication in a peer-reviewed journal, such as the Journal of Affective Disorders, although it might need to be combined with another study (or studies) and submitted for publication at a later date.