



DOCTORATE IN CLINICAL PSYCHOLOGY

**A critical review of the literature relating to the behavioural activation system,
Bipolar Disorder and exercise.**

LITERATURE REVIEW

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EXERCISE AND APPROACH MOTIVATION

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Abstract

Research into the benefits of exercise for individuals with Bipolar Disorder (BD) is very limited particularly in relation to hypomania/mania. A majority of research has focused on relieving the symptoms of depression (Blumenthal, & Ong, 2009; Mead et al., 2008; Nahas, & Sheikh, 2011) and hence there are no current guidelines around recommending exercise to individuals during a hypomanic/manic state (NICE, 2006). It has in fact been reported that exercise during a hypomanic/manic state has the potential to be harmful with individuals describing an 'upward spiral' where exercise leads to increased agitation and decreased control (Wright, Armstrong, Taylor, & Dean, 2012)

The Behavioural Activation System (BAS) dysregulation theory (Depue, & Iacono, 1989; Depue, Krauss, & Spont, 1987) is a popular psycho-bio-social model that attempts to explain the difficulties that individuals with BD experience. It has gained a considerable amount of support (Alloy, & Abramson, 2010; Depue, & Iacono, 1989; Urosevic, Abramson, Harmon-Jones, & Alloy, 2008) and may offer an explanation for the 'upward spiral' reported by a number of individuals with a diagnosis of BD in response to certain types and intensities of exercise (Wright, et al., 2012). This review looks to summarise the literature in these areas.

Keywords: Bipolar Disorder, behavioural activation system, behavioural approach system, approach motivation, exercise.

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A critical review of the literature relating to the behavioural activation system, Bipolar Disorder and exercise.

Introduction to the Topic Area

The beneficial effects of exercise on physical health are well researched (WHO, 2010). Furthermore a large amount of research has explored the effects of exercise on mood levels with a number of systematic reviews concluding that exercise can improve depressive symptoms (Blumenthal, & Ong, 2009; Mead et al., 2008; Nahas, & Sheikh, 2011).

Despite these encouraging findings, limited research exists on the effects of exercise for individuals with Bipolar Disorder (BD). A recent systematic review identified a total of 484 articles with only six that quantitatively examined the effects of exercise upon the physical or mental health of individuals with BD (Wright, Everson-Hock, & Taylor, 2009). The current guidelines by the National Institute of Clinical Excellence (NICE) state that there is a “potential for exercise to be both helpful and harmful in mania but there is no research evidence to support either scenario” (p. 390, NICE, 2006). This suggests that very little is known and that making recommendations to increase exercise may be potentially harmful during a hypomanic/manic state.

A recent paper qualitatively investigated the relationship between exercise and BD (Wright, Armstrong, Taylor, & Dean, 2012). A number of individuals with a BD diagnosis reported an ‘upward spiral’ in response to certain types and intensities of exercise. Within the paper, a parallel was drawn between these reports and the behavioural activation system (BAS) dysregulation theory (Depue, & Iacono, 1989; Depue, Krauss, & Spont, 1987; see Appendix B). It was proposed by Wright et al.

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(2012) that certain types and intensities of exercise could act as a possible catalyst for driving individuals with trait BAS sensitivity into an upward spiral. See Figure 1 for an overview.

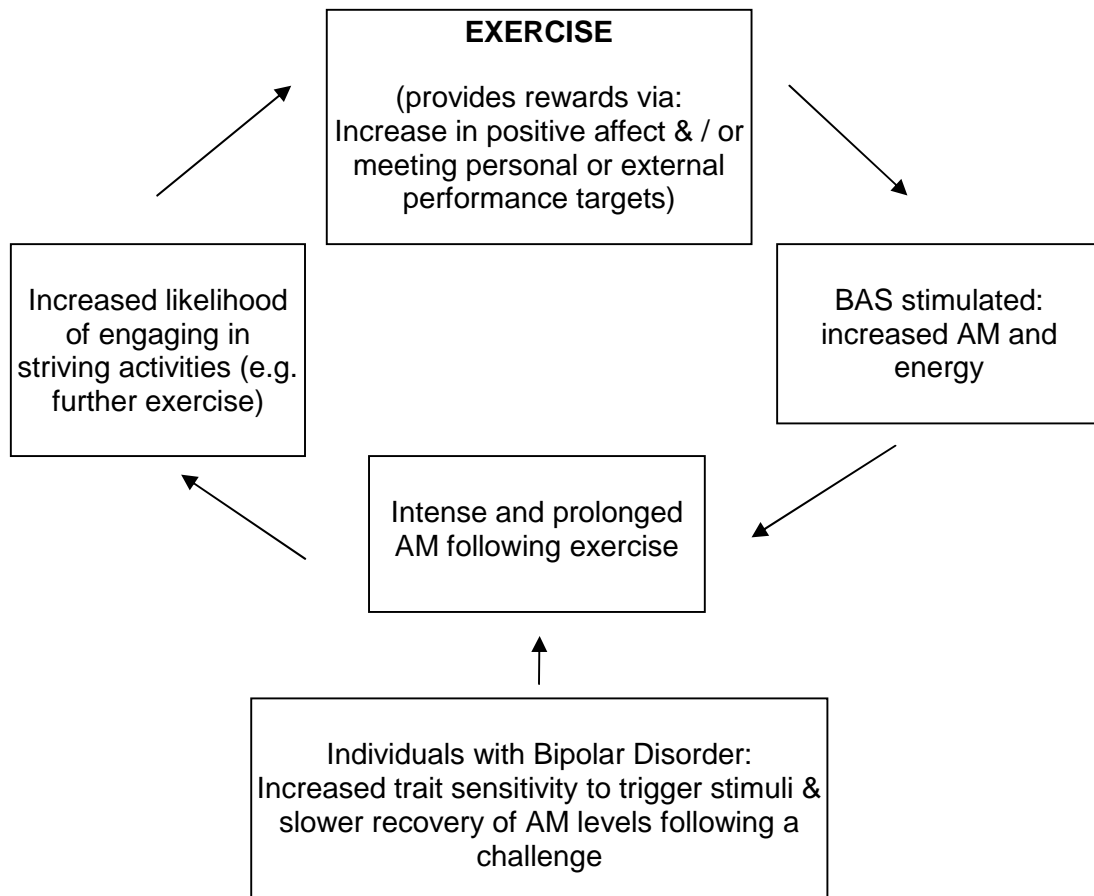


Figure 1. Upward Spiral of Approach Motivation Levels

The BAS dysregulation theory is an integrated model used for understanding the biopsychosocial features of BD (Alloy, & Abramson, 2010). The current review will systematically and critically review the literature around BD, exercise and the BAS dysregulation theory.

Overview of Literature Review¹

The purpose of this review was to look at the existing literature on exercise, BD, and the BAS dysregulation theory. Although the current literature is limited in the area of exercise and BD, a number of parallels can be taken from the plethora of exercise and affect research. The literature on the BAS dysregulation theory and BD is also extensive.

Rationale for Choice of Topic

This review was important for a number of reasons. Firstly, the existing research literature on BD and exercise is limited and few studies have considered how physical activity may impact on the physical/mental health of individuals with BD (Wright et al., 2009). This suggests that further research needs to be carried out in this area starting with an updated review of the current literature.

Secondly, the current guidelines by the NICE recommend exercise for individuals with BD in relation to treating the depressive phase of the disorder and to treat potential weight gain associated with the side effects of medication. However, the guidelines are ambiguous in relation to the interaction between exercise and acute hypomania/mania stating that “Exercise may be a healthy way of using up the excess energy in a person with mania and a useful distraction. However, exercise might further arouse the body physiologically, increasing energy, social contact and self-efficacy, exacerbating manic symptoms and potentially increasing further cardiovascular strain” (p. 390, NICE, 2006).

Finally, the reported findings of Wright et al. (2012) suggest that exercise can have both a calming and an energising effect depending on small distinctions such as the type of exercise engaged in. For example their findings suggest that lower

¹ See Appendix C for further information on the literature search strategy and an overview of the results.

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intensity and more rhythmical exercises are more likely to have a calming affect than more intense or less rhythmical exercises. The BAS dysregulation theory is a popular model for explaining the extreme contrasts in mood and behaviour seen in BD. It may also offer an explanation for the different outcomes reported from different activities.

Definition of Key Terms and Concepts

In order to be clear and explicit in the current review the following section will define the key constructs that will be used in the model.

Behavioural activation system/behavioural approach system (BAS). The BAS is a psycho-biological system controlled by the central nervous system that governs approach motivation (AM) and activates behaviour in response to goals and signals of reward or pleasure (Gray, 1987; 1991). Its basic adaptive function is to ensure that organisms obtain resources (e.g. food, shelter, companionship) and is therefore essential to survival of the individual and the species (Watson, Wiese, Vaidya, & Tellegen, 1999). The physiological underpinnings of the BAS are not clear, however it is thought to be regulated by catecholaminergic pathways (Carver, & White, 1994; Gray, 1991). Activation of the BAS causes an increase in an individual's cognitive activity aimed at promoting goal attainment (Depue, & Iacono, 1989).

Approach motivation (AM). AM can be defined as the energization of behaviour by, or the direction of behaviour toward, positive stimuli (objects, events, possibilities) (Elliott, 1999). It is the process involved when a person takes action towards anything that gives them happiness, pleasure, or joy.

Positive and negative affect. The concept of affect incorporates both individual biological predispositions (traits) and transient fluctuations in mood in

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response to environmental or internal cues (states). Trait affect is how an individual 'typically' feels every day and state affect is how an individual feels over a short period of time, such as a day or a week (Diener, & Emmons, 1984). Affective responses can also be categorized as having either a negative or positive valence (Barrett, & Russell, 1999). This review focuses more on the concept of state affect because it is interested in the changes that occur in response to exercise.

Positive affect (PA) has been closely linked with the underlying motivational system of the BAS (for reviews see Davidson, & Irwin, 1999; Heller, 1993; Tomarken, & Keener, 1998). Due to the much larger amount of research in this area, this was also included in the review.

Search Strategy

Searches were conducted on Web of Science, SciVerse and PubMed electronic databases using the following search terms: 'bipolar disorder AND exercise', 'bipolar disorder AND behavioural approach system', 'bipolar disorder AND behavioural activation system', 'bipolar disorder AND approach motivation', 'exercise AND approach motivation', 'exercise AND behavioural approach system', 'exercise AND behavioural activation system', 'exercise AND intensity AND affect'. Lemmatization was switched on to allow the search engines to include alternative forms of the search term (for example, tooth and teeth). For searches which revealed more than 500 hits the search term 'bipolar' was added within the results to limit these to the most relevant studies and reviews.

Exclusion and Inclusion Criteria

Articles not written in English have been excluded from the review along with all book chapters. The review did not exclude studies based on demographic characteristics of participants such as age, nationality and ethnicity.

Review of the Theoretical and Research Literature

This review will look to summarise the existing research on exercise and BD. It will then focus on the research around the BAS and BD and then BAS and exercise. Finally it will look at the current research on the BAS and goal striving. In total, 7030 articles were identified: 174 of these had relevant titles and 65 had relevant abstracts and content. There was considerable repetition across the three searches and out of the 65 articles identified, 33 were used for the review.

Exercise as an Intervention with Bipolar Disorder

The research on exercise and BD is extremely limited. Of the six studies identified in the systematic review by Wright et al. (2009), none were adequately-powered RCTs. Furthermore, only two studies reported on the use of physical activity as a therapeutic intervention and both of these had methodological limitations that reduce the generalisability of the findings. For example, the first was an unpublished doctoral dissertation by Edenfield (2007 cited in Barbour, Edenfield, & Blumenthal, 2007) involving eight individuals with a diagnosis of BD I or II. Participants were asked to engage in an Exercise Prescription (EP) involving eight 30 minute walking sessions over a two week period and/or a Standard Behavioural Activation (SBA) condition involving 30 minute sessions of chosen sedentary activity in the place of the walking sessions. Participants were randomised into one of four conditions (EP followed by SBA, SBA followed by EP, EP only or SBA only). The results indicated that regular exercise was associated with an overall decrease in depressive symptoms and decrease or no change in mania symptoms.

A second study (Ng, Dodd, & Berk, 2007) examined the effectiveness of a walking group in an Australian psychiatric unit for 98 individuals with a BD diagnosis. Participants engaged in 40 minutes of exercise at any intensity up to five times per

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week. Whilst the two groups did not differ at discharge in clinician ratings of severity or symptom improvement, attendance at the walking group was associated with significantly lower anxiety. Wright and colleagues (2009) concluded the review by reporting that no studies to date had been conducted to examine the effect of physical activity on mania /hypomania.

Following on from this study, Wright et al. (2012) conducted a qualitative study with 25 individuals with a BD diagnosis. From this, three key themes were identified. The first, 'regulating exercise for mood regulation' illustrated how some individuals described using exercise to regulate mood. For example, to lift mood levels if feeling too low or to calm mood if feeling too high. A second theme, 'bringing structure to chaos' described how participants had reported that having a structured exercise program could help to reduce manic symptoms and facilitate clear thinking. This idea of structure was separated into an internal process which encapsulated the inherent structure resulting from exercises that are more rhythmical in nature (i.e. running) and external structure of having a set daily routine.

A third theme, 'exercise as a double-edged sword' resulted from participants reporting that exercise could have both helpful and harmful effects at the same time depending on small distinctions such as mood state at time of the exercise or the type of exercise engaged in.

In another qualitative study of 32 individuals with BD, exercise was a popular self-management strategy identified to maintain or regain wellness. The importance of finding the right type of exercise was highlighted with participants describing a wide variety of activities such as, walking, dance, yoga, snowboarding, and swimming. The location of the exercise was also noted to be important and outdoor activities were often preferred (Suto, Murray, Hale, Amari, & Michalak, 2010).

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In a paper by Goodrich and Kilbourne (2010) anecdotal evidence of exercise as a strategy to manage mood symptoms is provided. Exercise is confirmed as an effective strategy to regulate excess energy and to promote normalisation of the circadian rhythm. The authors stressed the importance of further research and encourage other researchers to use the review by Wright et al. (2009) as “a basic blueprint” (p. 3) to launch clinical studies that could vastly improve the long-term health of individuals with BD.

Finally, Moore, Wright and Taylor (2011) looked to investigate the exercise/hypomania relationship by asking 60 students, selected to represent a spectrum of trait mood variability to participate in moderate intensity exercise. The results indicated, in line with previous research, that participants experienced a significant increase in positive affect following the exercise. Trait mood variability was found to have no impact on the size of this increase in affect but a significant positive correlation was reported between trait mood variability and the likelihood of engaging in risky exercise behaviour.

The Behavioural Activation System and Bipolar Disorder

The BAS dysregulation theory (Depue, & Iacono, 1989; Depue, et al., 1987) proposes that individuals with BD have a BAS that is overly sensitive. This over sensitivity results in large fluctuations in the activation/deactivation of the BAS which is reflected in the symptoms of BD. When vulnerable individuals experience events involving rewards/goal striving the overly sensitive BAS becomes excessively activated resulting in manic symptoms, such as excessive goal-directed behaviour, increased energy, optimism, and euphoria and a reduction in the need for sleep. (Alloy, & Abramson, 2010; Depue, & Iacono, 1989; Urosevic, Abramson, Harmon-Jones, & Alloy, 2008).

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Evidence supporting the BAS dysregulation theory and the idea of trait BAS sensitivity has been provided via three main approaches. The first is through self-report questionnaires looking at individual differences in a particular variable and relating these to future or previous episodes of hypomania/mania. The second has involved the use of self-report measures and the correlation between these and performance on behavioural tasks involving rewards. Finally a third approach has involved the use of electroencephalograms (EEG) in order to look for evidence of a possible correlation between trait BAS sensitivity measured by self report measures and neurological differences.

Studies involving self-report measures. The Behavioural Inhibition System (BIS)/BAS scales (Carver & White, 1994) and the Behavioural Engagement Scale (BES, Krauss, Depue, Arbisi, & Spont 1992) are the most widely used self-report measures. Using these, BAS hypersensitivity has been reported in individuals with BD I (Meyer, Johnson, & Winters, 2001; Salavert et al., 2007), BD II, cyclothymia (Urosevic et al., 2010), and individuals prone to bipolar symptoms (Carver, & White 1994; Meyer, Johnson, & Carver, 1999). Self-report measures have also been used to predict the onset of hypomanic symptoms over a 17 day period (Meyer, & Hofmann, 2005) and longer periods of six months (Meyer et al., 2001) and 33 months (Alloy et al., 2008). Alloy et al. (2006) found that individuals with higher self-reported BAS sensitivity on the BIS/BAS scale were six times more likely to meet the criteria for a diagnosis of BD (50% vs. 8.3%). Individuals with higher self-reported BAS sensitivity and no prior history of BD were still found to be three times more likely to develop BD in the future in comparison to moderate BAS scorers (15.4% vs. 4.4%; Alloy, & Abramson, 2009).

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Studies involving behavioural tasks and self-report measures. A number of studies have demonstrated that individuals with BD exhibited heightened responsiveness to rewards on behavioural tasks. For example, Stern and Berrenberg (1979) examined how hypomania relates to reward responses by providing participants with success feedback. It was found that individuals with a history of hypomania made more internal attributions about their performance and had greater expectations of success on the subsequent task compared to those without a history of hypomania. These results were replicated more recently with current hypomanic symptoms or a lifetime history of hypomania found to be predictive of a greater expectancy of success after reward. It was concluded that the findings offered further support for the idea that the normal tendencies to respond to success by feeling good, expecting further success, and taking on greater challenges are exaggerated amongst individuals with hypomania/mania (Johnson, Ruggero, & Carver, 2005). Other studies have also reported that individuals prone to hypomania/mania exhibit cognitive styles with high BAS relevance such as autonomy, perfectionism (Scott, Stanton, Garland, & Ferrier, 2000), overly ambitious goal striving and goal setting characteristics (Carver & Johnson, 2009; Gruber, & Johnson, 2009; Johnson & Carver, 2006; Johnson et al., 2005; Meyer, & Krumm-Merabet, 2003) and increased cognitive reactions and positive generalisation following successful experiences (Carver, & Johnson, 2009; Eisner, Johnson, & Carver, 2008).

Studies involving electroencephalograms and self-report measures.

Studies measuring prefrontal cortical activation using an EEG, in a state of rest and in response to rewards have been consistent with the BAS hypersensitivity model. It has been reported that greater relative left frontal cortical activity reflects higher BAS

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sensitivity and activation and hence an increased trait tendency to approach or respond to affectively positive stimuli (Carver, 2004; Coan, & Allen, 2003; 2004; Davidson, Jackson, & Kalin, 2000; Harmon-Jones, & Allen, 1997; 1998; Harmon-Jones, Gable, & Peterson, 2010; Harmon-Jones, & Sigelman, 2000; Sobotka, Davidson, & Senulis, 1992; Sutton, & Davidson, 1997). This is in comparison to greater right frontal activity which is reported to correspond with an increased trait tendency to withdraw or respond more to stimuli of a negative affective nature (Tomarken, Davidson, & Henriques, 1990; Wheeler, Davidson, & Tomarken, 1993).

The research specifically for individuals with a diagnosis of BD is consistent with the findings above with increased right frontal activity reported for individuals during a depressive phase (Allen, Iacono, Depue, & Arbisi, 1993) and increased left frontal activity reported during mania (Kano Nakamura, Matsuoka, Iida, & Nakajima, 1992). It has also been reported that individuals with BD exhibit greater relative left frontal cortical activation in response to difficult but rewarding tasks compared to controls with self-reported hypomanic state being positively related to left frontal activation (Harmon-Jones et al., 2008). Finally, further research has demonstrated that individuals with BD exhibit greater left frontal cortical activity than controls even after controlling for BD symptoms, (Harmon-Jones et al., 2010) or during a resting state (Hayden et al., 2008).

The Behavioural Activation System and Exercise

Only two studies looked specifically at the impact of exercise on the BAS. One study found that high scores on the reward subscale of the BAS scale were positively correlated with enjoyment of exercise, and participants with high BAS scores reported having more positive feelings and higher energetic arousal in response to moderate exercise but not in response to hard exercise. The items on

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the reward subscale are designed to assess positive responses to the anticipation of reward, and the results indicate that participants with greater trait sensitivity to cues of impending reward were more likely to report enjoying exercise and were also more likely to experience pleasure during exercise. Within the study, it appears that the impact of negative physiological cues such as shortness of breath or increased heart rate, masked this predisposition to experience positive affect when involved in physical activity at a harder intensity (Schneider, & Graham, 2009). Similar results were found in an earlier study by Hall, Ekkekakis and Petruzzello (2005) where BAS scores were negatively correlated with Rates of Perceived Exertion (RPE) at a moderate intensity but disappeared at higher exercise intensities.

The Behavioural Activation System and Goal Striving

Research into the BAS and goal striving is important because of the goal striving nature of exercise. As well as the documented increases in positive affect (Ekkekakis, Backhouse, Gray, & Lind, 2008), exercise also provides rewards via meeting personal or external performance targets.

A number of studies have reported that life events that involve goal striving/goal attainment that activate the BAS can prospectively predict the onset of hypomanic/manic symptoms. This has been reported over a two-month (Johnson et al., 2000), one-year (Alloy, Abramson, Urosevic, Bender, & Wagner, 2009) and a 27 month period (Johnson et al., 2008). For example, Nusslock, Abramson, Harmon-Jones, Alloy and Hogan, (2007) reported that ten times as many undergraduates with BD studying for and taking an exam developed hypomanic symptoms compared with individuals with BD not taking exams during the same week (42 % vs. 4%). Overall, these findings are consistent with the BAS dysregulation theory which

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proposes that individuals with BD are overly sensitive to environmental cues of potential reward.

Review and Critical Appraisal of the Literature

Limitations of the Current Literature

There are a number of limitations that can be identified from the literature.

Limitations of the behavioural activation system literature. As mentioned, the BAS deregulation theory has a lot of empirical support, however, it has been suggested that the model needs greater specificity and revision. Firstly, the model needs to specify the specific nature of the events that are likely to trigger depression/hypomania. Secondly, to specify the nature of the events that are likely to trigger hypomania/mania with an irritable mood as opposed to a euphoric mood. Finally, it must explain why negative events can predict the onset of both hypomanic/manic and depressive episodes (Urosevic et al., 2008).

Limitations of exercise literature. The literature around exercise and mental health seems to have produced a relatively strong evidence base and broadly supports the hypothesis that exercise can improve mental wellbeing (Whitelaw, Swift, Goodwin & Clark, 2008). However, a huge majority of the literature has focussed on the effect of exercise on anxiety and depression and has neglected more serious mental health conditions such as BD (Goodrich, & Kilbourne, 2010). This gap in the literature is surprising given the ambiguous recommendations made by the NICE (2006). In order to make exercise a safe and recommendable treatment for individuals with BD, it is essential that further empirical research is carried out with this population to establish when it can be helpful and when it may be unhelpful.

Limitations of approach motivation literature. It is clear from reviewing the literature that whilst a lot of studies focus on the effect of exercise on positive affect,

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there are a very limited number that focus on measuring AM specifically. Although the two are related concepts, within the BAS dysregulation model it is the increase in AM levels that are proposed to be correlated with hypomania/mania and therefore this concept needs to be investigated further. Further to this, no studies exist that have looked at the effects of exercise when people are in a state of high AM which would provide an analogous population to an individual in a hypomanic/manic state. This indicates that there is no empirical evidence, even from the general population, that can provide insight into the effects of exercise during a hypomanic state.

Critique of Methodologies Used

The methodologies used within the literature can be critiqued.

Methodologies used to investigate the BAS. As mentioned previously, research into the BAS has been conducted using three approaches. Reviewing the available literature did not uncover any studies that have used all three. The majority of studies used self-report measures (Alloy, & Abramson, 2009; Alloy et al., 2006; Alloy et al., 2008; Carver, & White 1994; Meyer, & Hofmann, 2005; Meyer et al., 1999; Meyer et al., 2001; Salavert et al., 2007; Urosevic et al., 2010). with some studies using both self-report measures and behavioural tasks (Carver, & Johnson, 2009; Eisner et al., 2008; Johnson, & Carver, 2006; Johnson et al., 2005; Gruber, & Johnson, 2009; Meyer, & Krumm-Merabet, 2003; Scott et al., 2000; Stern, & Berrenberg, 1979) and some using an EEG (Coan, & Allen, 2003; 2004; Davidson et al., 2000; Diego et al., 2001; Harmon-Jones & Allen, 1997; Sobotka et al., 1992; Sutton, & Davidson, 1997; Tomarken et al., 1990; Wheeler et al., 1993).

Methodologies used to investigate exercise and mood. Research into the effect of exercise on individuals with BD is a neglected area and hence critical appraisal of the methodologies used is difficult. However, the relationship between

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exercise and affect has received a lot of empirical attention and a plethora of studies exist on this. Therefore a review of the methodologies used for investigating this closely related concept was completed.

Ekkekakis, Parfitt and Petruzzello (2011) provide a comprehensive review of 33 articles published from 1999 to 2009 on the relationship between exercise intensity and affect. All studies involved some type of exercise condition with three involving a sedentary/control condition (Oweis, & Spinks, 2001; Smith, O'Connor, Crabbe, & Dishman, 2002; Tieman, Peacock, Cureton, & Dishman, 2002). All studies involved at least two conditions which differed in intensity but the definitions of low, moderate and high/vigorous (designated heart rates or oxygen uptake rates) varied substantially between the different studies. Sixteen of the studies involved cycling equipment and 17 involved the use of a treadmill for running walking or jogging. All studies incorporate a combination of both self-report measures (such as affect, energetic arousal, anxiety and stress) and psycho-physiological measures (such as heart rate and oxygen uptake).

Conclusions and Clinical Implications

The current review has examined the literature regarding exercise and BD, the BAS and BD, the BAS and exercise and finally the BAS and goal striving. It is clear that strong support exists for the BAS dysregulation theory from studies conducted using a range of designs but this has not yet been extended into the arena of studies that incorporate exercise. Exercise studies have focussed primarily on improving the affect of individuals in clinical and non-clinical settings but have not yet examined the effects of exercise upon hypomanic/manic symptoms.

This review is the starting point in examining the effects of different types and intensities of exercise on individuals prone to hypomania/mania. It has been reported

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in two qualitative studies that the type of exercise engaged in is critical (Suto et al., 2009; Wright et al., 2012) as is the intensity of the exercise and an individual's state of mind at the time of the exercise (Wright et al., 2012). Investigating the interaction between exercise and individuals prone to hypomania/mania and using the BAS dysfunctional theory as an overarching model will provide further insight into this neglected but critical area. This could in turn have an impact on any future recommendations made by the NICE because the current guidelines are ambiguous in supporting or opposing the use of exercise as an intervention for BD.

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