Emotion Regulation Strategies in Mania Risk:
A Systematic Review.

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Objectives: Difficulties in emotion regulation may contribute to the development of mania. This review aimed to assess how emotion regulation strategies reported by individuals at risk of mania compare with clinical and non-clinical controls.

Methods: Search terms relating to mania risk and emotion regulation were entered into three databases. Sixteen studies were included.

Results: Mania risk was typically associated with overall endorsement of emotion regulation strategies, particularly dampening, and positive and negative rumination.

Conclusions: Findings were limited by overall lack of evidence for individual strategies, lack of consideration of key mediating factors and reliance upon self-report designs.

Introduction

Clinical staging models hold the central hypothesis that the development of psychological disorders, such as bipolar disorder, follows a progression pathway from “at risk”, to a prodromal period, and transition to diagnosable bipolar disorder (e.g., Berk et al., 2007). As mania is the defining feature of bipolar disorder (APA, 2013), research on mechanisms related to mania risk is crucial for understanding potential risk factors. Understanding the precursors of bipolar disorder identifies potential areas for the development of targeted treatments for prevention and early intervention (Berk et al., 2007). Research on premorbid risk factors (whether biological, environmental or psychological) necessarily involves undiagnosed populations using accepted indicators of mania risk, in the same vein as influential research on factors that characterise high risk of psychosis (e.g., Ruhrmann et al., 2010).

In studies investigating vulnerability to bipolar disorder, mania risk is conceptualised as familial, where an individual’s first-degree relative has a diagnosis of bipolar disorder (heritability is estimated at 80%; Logotheti, Chatziioannou, Venizelos & Kolisis, 2019), or behavioural, where an individual exhibits emerging mood symptoms (e.g. Scott et al., 2016) or elevated levels of hypomanic personality traits (e.g. over confidence, gregariousness, energetic behaviour; Eckblad & Chapman, 1986). While heritability is clearly an important risk factor, behavioural high-risk measures such as the Hypomanic Personality Scale (HPS; Eckblad & Chapman, 1986) predict future manic episodes and transition to bipolar disorder (Kwapil et al., 2000). A review (Waugh, Meyer, Youngstrom & Scott, 2014) found that trait measures were typically a more reliable indicator of mania risk than those investigating high mood symptoms in

non-clinical populations. As such, trait measures such as the HPS are commonly used as a proxy measure of mania risk.

Given the disturbances to both negative and positive emotion regulation seen in bipolar disorder (for a review, see Dodd, Lockwood, Mansell & Palmier-Claus, 2019), particular interest has been directed towards whether the strategies individuals employ to regulate their emotions are associated with mania risk. Emotion regulation strategies are defined as “processes individuals engage in to initiate, maintain, intensify, or eliminate mood states” (Gross, 1998, p. 275) and are commonly classified as adaptive and protective (e.g. reappraisal) or maladaptive and contributing to risk (e.g. rumination; Aldao, Nolen-Hoeksema, & Schweizer, 2010). Much of the existing literature typically examines the role of regulation of negative affect and its consequences for wellbeing. For example, a meta-analysis (Aldao et al., 2010) reported that anxiety, depression, eating and substance relate disorders were most strongly associated with putatively maladaptive strategies such as rumination and suppression, while putatively adaptive strategies (e.g. reappraisal and acceptance) were less strongly related.

Regulation of positive affect is increasingly understood as being important for mental health and wellbeing. A review suggested a transdiagnostic disturbance in positive emotion regulation in emotional disorders (Carl, Soskin, Kerns & Barlow, 2013). For example, anxiety and depression were characterised by excessive avoidance and downregulation of positive affect.

The evidence suggests that difficulties in emotion regulation are apparent across psychopathology, particularly in regard to rumination, which has been identified as contributing to a number of mental health conditions (e.g. Wahl et

al., 2019). Early emotion regulatory models of bipolar disorder have typically focused on the role of negative emotion regulation, such as rumination, as in theories of depression (e.g. Response Styles Theory; Nolen-Hoeksema, 1991). However, contemporary research has begun to highlight the importance of responses to positive and activated mood states in bipolar disorder, and evidence suggests that positive emotion regulation is particularly problematic for individuals at risk of mania (Gruber, Kogan, Mennin & Murray, 2013). For example, a measure for responses to positive affect (Feldman, Joormann & Johnson, 2008) was developed specifically with mania risk and bipolar disorder in mind. To complement measures of rumination and risk-taking in response to negative emotion, this measures propensity to engage in *positive* rumination (e.g., focusing on how good positive emotion feels) and dampening of positive emotions (e.g., thinking good feelings will not last). Along with ruminating on negative emotions, both positive rumination and dampening differentiate people with bipolar disorder from non-clinical controls, and are associated with poorer outcomes in people with bipolar disorder (Dodd et al., 2019). These are therefore potential mechanisms of change for psychological interventions for bipolar disorder. In order to inform the development of targeted interventions for people who may be at risk of developing bipolar disorder in the future, there is a substantial need for research investigating whether these emotion regulation strategies relate to mania risk in non-clinical populations, whether tendencies to engage in maladaptive emotion regulation strategies differentiate people at mania risk from controls who did not meet risk criteria, and if they distinguish risk of mania from vulnerability to other disorders. Additionally, research with risk groups helps to disentangle whether maladaptive emotion regulation is a

contributing factor of developing mania, or the result of previous experience of clinically significant mood episodes.

An integrative cognitive model of mood swings and bipolar disorder (Mansell, Morrison, Reid, Lowens & Tai, 2007) suggests that these regulatory attempts are driven by appraisals of internal states, such that a positive appraisal of high mood would drive upregulating strategies, whereas a negative appraisal of that same mood state would drive downregulating strategies. Given that bipolar disorder is characterised by episodes of excessive low and high mood (APA, 2013), putatively maladaptive emotion regulation strategies are linked to bipolar disorder (Dodd et al., 2019), and disturbances to both positive and negative emotion regulation are emphasised by contemporary psychological models, there is a clear theoretical and clinical justification for investigating both negative and positive emotion regulation as potential risk factors underlying vulnerability to developing bipolar disorder. As such, the aim of this review was to synthesise findings across studies investigating associations between mania risk and tendencies to use positive and negative emotion regulation strategies.

Method

Search Strategy

A systematic search was conducted across three databases (PsycARTICLES, Scopus, and Web of Science), identifying peer reviewed articles published between January 1980 and July 2018. Search terms relating to mania risk (mania risk, bipolar risk or hypomania) and emotion regulation strategies (emotion regulation, mood regulation, affect regulation, response style,

rumination, amplify or dampening) were based on author's knowledge of emotion regulation in bipolar disorder. Sensitivity checks were conducted to ensure search terms captured key articles previously identified during scoping searches. Reference lists of relevant reviews were also screened (Mansell & Pedley, 2008; Townsend & Altshuler, 2012; Kelly, Dodd & Mansell, 2017).

Eligibility

All study designs were eligible for inclusion if they included quantitative measures of emotion regulation strategies used to regulate either positive or negative affect and either a familial or an established, validated measure of behavioural high-risk for mania (e.g. Hypomanic Personality Scale, Eckblad & Chapman, 1986 or the General Behaviour Inventory, Depue et al., 1989).

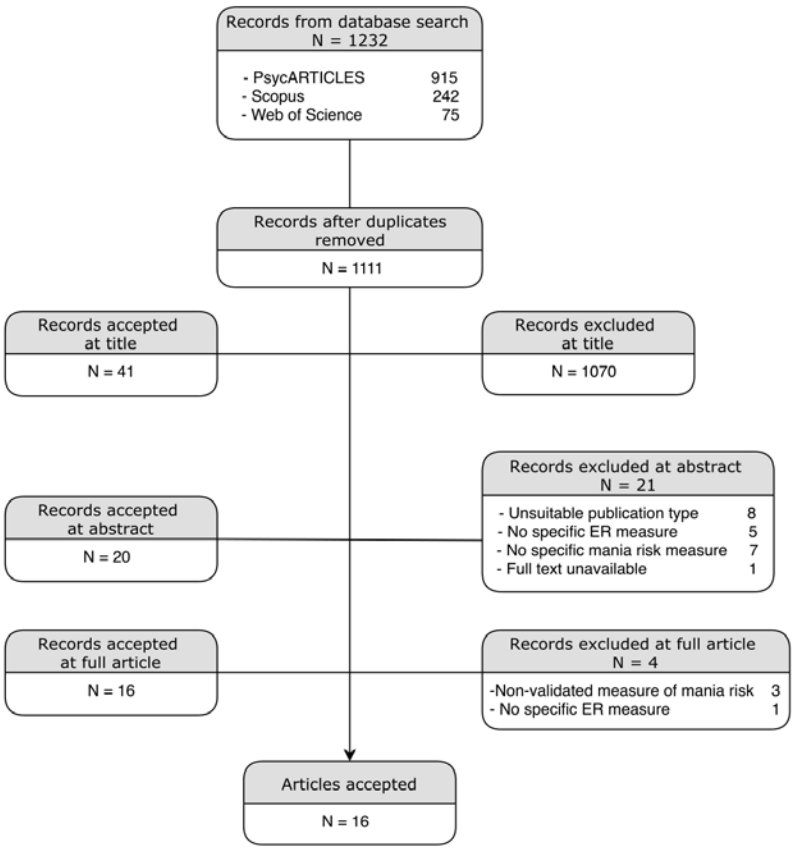
Studies were excluded if they; assessed general emotion regulation (e.g. ability to regulate) rather than use of specific strategies, had not been peer reviewed, were not available as full text, did not present novel empirical data (e.g. reviews, meta-analyses, protocols), or were not available in the English language.

Screening

All articles identified across the three databases (PsycARTICLES, Scopus, Web of Science) were collated (*n* = 1,232). At each stage (title, abstract and full text), articles were independently screened by CMc and AD, and reviewers met to discuss any discrepancies in the screening lists. Agreement percentages were calculated, and inter-rater reliability was quantified using cohen's kappa (*k*). After excluding duplicates (*n* = 121), 1,111 articles were screened at title. 1070 were excluded, and 41 were screened at abstract (85.4%, *k* = .92), with a

further 21 excluded (88.5%, *k* = .85). The remaining articles (*n* = 20) were screened at full text level and four were excluded (87.5%, *k* = .52), resulting in a final total of 16.

Study quality assessed following recommendations from Petticrew and Robets (2006). Each study was rated as high, medium or low quality based on: i) the relevance of the research question to the aim of the review; ii) the internal validity of the study (i.e. how well controlled the study was and the robustness of inferences of causality); iii) external validity of the study (i.e. the generalisability of findings); and iiii) potential ethical implications of the study. Criteria were individually rated on a scale from one (low) to three (high) and mean scores calculated for overall quality. Papers were not excluded based on



quality scores.

Figure 1 details the full screening process

Results

Study and Sample Characteristics

Table 1 displays associations between mania risk and emotion regulation strategies within correlational designs (*n* = 11).

Table 1: Associations between mania risk and emotion regulation strategies within behavioural studies

		+ive	null
Regulating PA			
Dampening		1, 2, 3, 4, 5, 7, 9	--
Positive Rumination		1, 2, 3, 4, 5	--
	Emotion-focused	1, 2, 3, 4, 5	9
	Self-focused	1, 2, 3, 4, 5	9
Positive urgency		6	--
Savouring		--	1
Regulating NA			
Acceptance		--	10
Active coping		--	4
Adaptive coping		8	--
Brooding		2	--
Catastrophizing		--	10
Dangerous activities		4, 11	--
Distraction		11	--
Other-blaming		--	10
Planning for the future		--	10
Positive Refocusing		--	10
Putting into perspective		--	10
Reappraisal		10	--
Reflection		2	--
Risk-taking		8, 11	--
Rumination		2, 8, 10, 11	4

Self-blame	--	10

1 - Carver & Johnson, 2008; 2 - Dempsey, Gooding & Jones, 2011; 3 - Feldman, Joormann & Jonson, 2008; 4 - Fisk, Dodd & Collins, 2015; 5 - Fulford, Johnson & Carver, 2008; 6 - Giovanelli, Hoerger, Johnson & Gruber, 2013; 7 - Johnson & Jones, 2009; 8 - Knowles, Tai, Christensen & Bentall, 2005; 9 - Raes, Daems, Feldman, Johnson & Gucht, 2009; 10 - Steel, 2015; 11 - Thomas & Bentall, 2002.

Table 2 details case-control studies comparing tendencies to use emotion regulation strategies in those at familial risk and non-clinical controls (*n* = 4). *Table 2* also displays studies comparing those at behavioural high risk and controls who do not meet risk criteria (*n = 1*).

Table 2: Emotion regulation strategies in case-control studies

	BD>UR	BD>HC	BD>UR>HC	BD=UR=HC	BD=UR	BD<UR	UR<HC	CBP>CC	CBP=CC	CBP<CC	Other
Acceptance	--	--	--	1, 3	--	--	--	--	--	--	--
Active coping	--	--	--	--	--	--	--	--	--	4	--
Catastrophizing	1, 3	1	--	--	--	--	--	--	--	--	--
Distraction	--	--	--	--	--	--	--	--	--	--	2 - *HR displayed more activation in the left inferior parietal cortex than LR*
Other-blaming	--	--	--	1, 3	--	--	--	--	--	--	--
Positive reappraisal	--	--	--	1	3	--	3	--	--	--	2 - *HR displayed more amygdala activation than LR group.*
Positive refocusing	--	--	--	1, 3	--	--	--	--	--	--	--
Putting into perspective	--	--	--	3	--	1	--	--	--	--	--
Refocus on planning	--	--	--	1, 3	--	--	--	--	--	--	--
Risk-taking	--	--	--	--	--	--	--	5	4	--	--
Rumination	3	--	1	--	--	--	--	--	4	5	--
Self-blame	3	--	1	--	--	--	--	--	--	--	--

BD = Bipolar, UR = Unaffected Relative, HC = Healthy Control; CBP = Children of Bipolar Parents, CC = Control Children.
1 - Green, Lino, Hwang, Sparks, James & Mitchell, 2011; 2 - Heissler, Kanske, Schonfeld & Wessa 2013; 3 - Kanske, Schonfelder, Forneck & Wessa, 2015; 4 - Pavlickova, Turnbull, & Bentall, 2014; 5 - Pavlickova, Turnbull, Myin-Germeys & Bentall, 2015

In 69% of studies the sample population was university students. Two studies included participants under the age of 18. Based on the quality assessments

outlined above, correlational designs were rated as medium and case-control designs were considered high quality.

How does mania risk relate to reported use of emotion regulation strategies?

Strategies used to regulate positive affect were only investigated in behavioural high-risk studies. Of these strategies, dampening was most commonly investigated (*n* = 7, see *Table 1*), and was consistently related to mania risk within these cross-sectional designs, with small to medium effects. Positive rumination (including emotion-focused and self-focused subscales) was also frequently associated with higher mania risk *(n* = 5; small to medium effects), however one study also reported no correlation between these variables (Raes, Daems, Feldman, Johnson & Gucht, 2009). This contradictory finding may be the result of including individuals from a wider age range (18 – 76), whereas the other studies to investigate this relationship typically included samples of participants closer to the peak age of onset (i.e. 18 – 25; Scott et al., 2017). This highlights the potential influence of the developmental stage of the sample. Linked to positive rumination, another amplifying response to positive emotion, mood-based rash action (positive urgency) was positively associated with mania risk, with a medium to large effect size (Giovanelli, Hoerger, Johnson & Gruber, 2013), while savouring positive emotion (a more adaptive response to positive emotion) did not relate to risk (Carver & Johnson, 2009).

Of strategies used to regulate negative affect, rumination was most often investigated. Within behavioural high-risk designs, four cross-sectional studies reported positive associations with measures of mania risk (small to medium

effects), with just one null finding (Fisk, Dodd & Collins, 2015). Brooding and reflection, more passive forms of rumination, were also associated with risk, with small to medium effects (Dempsey, Gooding & Jones, 2011). Rumination was also frequently assessed within familial risk studies. Unaffected relatives (children of people with bipolar disorder who did not themselves have a diagnosis of a mood disorder) reported using rumination more often than healthy controls (large effects), but did not endorse rumination as highly as people who had a diagnosis of bipolar disorder (Green et al., 2011; Kanske, Schonfelder, Forneck & Wessa, 2015). These studies were in adult offspring of people with bipolar disorder, and findings in adolescents (ages 13 to 19) were more variable. A prospective study found that children of parents with bipolar disorder reported using rumination less often than controls (small effect; Pavlickova, Turnbul, Myin-Germeys & Bentall, 2015), while a cross-sectional study found no group difference; however, affected children of parents with bipolar disorder (i.e. those who met diagnostic criteria for mood disorder) reported greater rumination that unaffected children (Pavlickova, Turnbull & Bentall, 2014). This highlights the importance of controlling for current symptoms, and for looking at other risk indicators over and above family history.

Of putatively maladaptive strategies, risk-taking and tendencies to engage in dangerous activities in response to low mood were positively related to mania risk in all four behavioural studies to investigate these associations, with medium to large effects (see *Table 1)*. Within familial risk designs, risk-taking produced mixed findings, with one prospective study finding children of bipolar parents reported greater risk-taking than control children (medium effect; Pavlickova et al., 2015), while a cross-sectional study (Pavlickova et al., 2014)

found no difference between these groups. These differences between risk groups may suggest that risk taking and tendencies to engage in dangerous activities are more relevant to the personality traits that characterise behavioural risk (i.e. hypomanic personality) than genetic risk factors.

Catastrophising was not associated with behavioural mania risk, however this was only assessed in one study (Steel, 2015). Within familial designs, participants with bipolar disorder reported greater catastrophising than unaffected relatives, with medium and large effects (as well as healthy controls, large effect; Green et al., 2011), but unaffected relatives were similar to controls (Green et al., 2011; Kanske et al., 2015). Self-blame was also not associated with behavioural risk but was again only investigated in one study (Steel, 2015). However, familial risk was associated with this response to negative affect, with two studies suggesting that those with diagnosed bipolar disorder reported more self-blame than unaffected relatives (medium and large effects; Green et al., 2011; Kanske et al., 2015), and unaffected relatives reported more than controls (medium effect; Green et al., 2011). Blaming others was not related to behavioural (Steel, 2015) or familial (Green et al., 2011) measures of risk.

Of putatively adaptive strategies for regulating negative emotion, distraction was assessed across study designs investigating associations with behavioural risk, with consistent findings. One cross-sectional study found distraction positively correlated with mania risk (medium to large effect; Thomas & Bentall, 2002), while a study using fMRI data to assess distraction during an experimental task found high-risk participants displayed greater activation in the left inferior parietal cortex than the low-risk group (large effect; Heissler, Kanske, Schonfelder & Wessa, 2013). This suggests that distracting attention

away from positive stimuli is more difficult for those at greater mania risk. There was also a reappraisal condition within this study, and high-risk participants demonstrated less successful downregulation of amygdala activity compared with low-risk participants when using reappraisal in response to negative stimuli, suggesting that reappraisal is more effortful for those at higher risk (large effect; Heissler et al., 2013). Particular credence should be given to the strength of the evidence provided by this study, given the triangulation of data from experimental paradigms and behavioural self-report of the use of these strategies. Mania risk was also positively associated with self-reported tendencies towards using reappraisal in a further study (medium effect; Steel, 2015). Two familial risk studies also assessed use of reappraisal, with both finding no difference between participants with bipolar disorder and unaffected relatives (Green et al., 2011; Kanske et al., 2015); one study suggested that unaffected relatives report less positive reappraisal than controls (small effect; Kanske et al., 2015), while the other found no difference (Green et al., 2011). Across two studies looking at adaptive coping, one reported a positive association with mania risk (small effect; Knowles et al., 2005) whereas the other did not find any association between these constructs (Fisk et al., 2015). In relation to familial risk, children of parents with bipolar disorder reported less adaptive coping than controls (medium effect; Pavlickova et al., 2014), however this was only investigated in one study. Putting into perspective was not associated with behavioural risk but this was only assessed in one study (Steel, 2015). Within two familial studies to investigate this strategy, one suggested unaffected relatives endorsed putting into perspective less often than people with diagnosed bipolar disorder (small to medium effect; Green et al., 2011),

while unaffected relative and controls did not differ (Green et al., 2011; Kanske et al., 2015). Acceptance was not associated with behavioural (Steel, 2015) or familial risk (Green et al., 2011; Kanske et al., 2015). Planning for the future and positive refocussing were not related to behavioural risk but were also only investigated in one study (Steel, 2015). Positive refocusing and refocussing on planning were not associated with familial risk (Green et al., 2011; Kanske et al., 2015).

Discussion

This review aimed to present a systematic account of associations between emotion regulation strategies and mania risk. Overall, mania risk was associated with increased tendencies to engage in emotion regulation strategies, particularly purported maladaptive strategies.

Strategies used to regulate positive affect were only investigated within behavioural studies. Dampening was consistently associated with risk across all studies that assessed this relationship. Positive rumination was also typically associated with risk, while savouring was not. Research with at-risk groups helps address a major limitation of literature examining emotion regulation in individuals with bipolar disorder in delineating whether the tendency to endorse less adaptive regulation strategies is the result of experiencing clinically significant mood episodes, or if these mood instabilities occur as a consequence of maladaptive emotion regulation. These findings tentatively suggest the latter, in that positive regulation strategies that are typically considered to be problematic for individuals with bipolar disorder (due to experiences with excessively highly activated mood states) are also related to

mania risk, whereas more adaptive responses to elevated mood (i.e. savouring) are not related to mania risk. Given the theoretical significance of these responses to positive affect, further research, particularly using familial risk is warranted.

A number of strategies were examined in both behavioural and familial risk studies. Rumination was most commonly investigated, with a similar pattern of findings across risk paradigms. Both present mostly positive associations, with medium to large effects, consistent with the Response Styles Theory (Nolen-Hoeksema, 1991) which suggests that ruminating on negative affect exacerbates depression. Within case-control studies, individuals with bipolar disorder reported greatest endorsement of rumination, followed by those considered to be at risk, with controls being least likely to report use of this strategy. Children of bipolar parents who themselves also met diagnostic criteria for a mood disorder also reported greater rumination than those who did not. This may suggest that a greater tendency to ruminate in response to negative affect is related to mania risk and becomes more frequent as individuals transition to experiencing a first clinically significant mood episode and thereafter a diagnosis of bipolar disorder. Similarly, an interesting pattern of findings was present for catastrophising as individuals with diagnosed bipolar disorder reported significantly higher instances than unaffected relatives and controls, but relatives did not differ from controls. Tentatively this may suggest that some strategies may be more apparent when an individual has a history of clinically significant mood episodes. Mixed findings were also apparent for risk-taking and tendencies to engage in dangerous activities, with mostly positive associations across both risk paradigms, with medium to large effect size. A

medium to large effect was also reported for positive urgency (i.e. mood based rash action in response to elevated positive affect, which is conceptually similar to both risk-taking and other amplifying strategies such as positive rumination). This is of particular relevance to mania risk as investigations of the consequences of manic episodes frequently cite impulsivity and engagement in risky behaviour (e.g. Thomas, Knowles, Tai & Bentall, 2007). Large effects were also reported for other maladaptive strategies, such as catastrophising, while effect sizes for purportedly adaptive strategies, such as adaptive coping, were typically small to medium.

A number of strategies were only investigated in one study; it is therefore not possible to synthesise findings and draw firm conclusions about the associations between mania risk and strategies such as savouring and more adaptive strategies (e.g., reflection).

Limitations and future directions

Overall, case-control designs were considered to be of high quality whereas correlational designs were rated as medium; however, the pattern of findings was relatively consistent across studies, regardless of quality scores. Within case-control designs, conditions were generally well-matched for age and gender. Only one study (Pavlickova et al., 2015) reported controlling for current symptoms, however, given the mixed findings present across the literature, this is an important factor to consider.

With the exception of one of the prospective studies, all studies were cross-sectional. The pattern of findings was relatively consistent across these

study designs, with the two main exceptions; within the prospective study at-risk participants reported more risk-taking and less rumination than controls over time (Pavlickova et al., 2015), but these differences were not present cross-sectionally (Pavlickova et al., 2014). While this research provides insight into which emotion regulation strategies relate to bipolar disorder, and which may also be precursors to its development, it does not allow for inference about the direction of causality between mania risk and emotion regulation difficulties. Additionally, as trait measures of risk also capture mood lability, it is difficult to address this with cross-sectional research. There remains a substantial need for well-controlled longitudinal studies investigating whether endorsement of emotion regulation strategies predicts mania risk, and if the interaction between emotion regulation and mania risk predicts poorer mood outcomes, including transition to the first clinically significant episode of mania; this would provide the most definitive evidence. Only one study (Pavlickova et al., 2015) used experience sampling methods (ESM). ESM is a structured diary method in which participants provide “systematic self-reports at random occasions during normal daily life” (Csikszentmihalyi & Larson, 2014). This format allows for easy collection of multiple snapshots of rich data, commonly including reports of mood and symptoms, and well as contextual information. ESM has successfully been used in numerous studies to assess mood patterns in both clinical (e.g. Myin-Germeys et al., 2003) and non-clinical samples (e.g. Sperry & Kwapil, 2017). It is suggested that particular credence should be given to findings from ESM studies as they are generally considered to be higher in ecological validity, allowing for investigation of “real life” regulation processes, as emotional experiences are recorded within naturally occurring everyday contexts (Gruber,

Kogan & Murray, 2013). ESM would also allow for identification of possible discrepancies between trait and state measures of emotion regulation, as well as assessment of emotion regulation repertoires and regulatory flexibility across contexts.

With the exception of two fMRI investigations (Heissler et al., 2013; Kanske et al., 2015), all studies relied exclusively on self-report accounts of affect and regulatory attempts. While this allows for assessment of perceived experiences, findings rely on the assumption that participants can recognise and articulate these processes (while emotion regulation can be automatic; e.g. Gao, Chen, Long, Yang & Yuan, 2018). However, deficits in ability to identify and label emotions are common across a range of psychological disorders, including bipolar disorder (Flynn & Rudolph, 2010). It is therefore possible that mixed findings present between studies are a reflection of difficulties in reporting mood and regulatory attempts rather than actual deficits in mood control, raising questions as to the overall validity of self-reported emotion regulation within this population.

In some instances, familial risk studies relied on self-reported parental diagnosis and behavioural studies used self-reported trait vulnerability measures, with all but one study using the Hypomanic Personality Scale. Although this demonstrates some level of consistency, and these methods do have their strengths, there remains a need for better operationalisation of risk criteria and the exploration of potential risk factors within groups who meet these criteria. Using staging models as a framework, various criteria are being established that combine a range of clinically relevant factors (e.g. being at the peak age of onset for bipolar disorder (i.e. 18 – 25), cyclothymia co-occurring

with depression, subthreshold mania, and depression co-occurring with familial history of bipolar disorder; Scott et al., 2016). However, to date, studies on emotion regulation have considered singular examples of risk (e.g. family history of bipolar disorder or personality traits associated with the characteristics of mania) and future studies should aim to use these enhanced criteria to explore longitudinal risk factors. Additionally, more clearly defined risk criteria would allow for more meaningful comparisons with groups at risk for other psychological disorders to distinguish which (if any) emotion regulation strategies, or combinations of strategies, are specifically related to mania. As acknowledged by Duffy, Jones, Goodday and Bentall (2016), these mechanisms could be considered as additional early risk factors in combination with emerging criteria from staging models and are therefore a potential area for intervention.

Given that bipolar disorder is characterised by both high and low mood episodes, and both positive and negative emotion regulation strategies appear to be elevated within at risk groups, future research should investigate whether greater tendencies to engage in maladaptive regulation strategies in response to both positive and negative affect is important in this group. To the authors' knowledge, this has yet to be investigated within risk groups, however, investigation with individuals with bipolar disorder found that both extreme positive and negative appraisals of activated mood states discriminated this sample from those with depression and healthy controls (Kelly et al., 2011).

In addition to the methodological limitations discussed above, findings were also limited by a lack of consideration for key moderating or mediating

factors. Most notable was the consistent lack of consideration of the role of context. Given that emotions are dynamic and reactive in response to both external and internal triggers, the tendency to assess them in isolation of the contexts in which they occur significantly reduces the ecological validity of findings and limits insight into 'real life' emotion regulation processes (Aldao, 2013). Previous literature has identified several contexts that may be of particular relevance when investigating emotion control and mania risk. For example, Gruber and Johnson (2009) found that individuals high in hypomanic personality traits reported elevated levels of positive affect in response to goal attainment and reward, but displayed deficits in socially relevant positive emotions. Assessment of context also allows for insight into repertoires of emotion regulation (i.e. the range of strategies available to an individual; Dixon-Gordon, Aldao & De Los Reyes, 2015a) and willingness and ability to switch between these strategies (i.e. regulatory flexibility). One study that investigated these factors across a range of disorders identified detailed 'regulation profiles' based on self-reported use of strategies in response to high and moderate intensity emotions in a range of contexts (Dixon-Gordon, Aldao & De Los Reyes, 2015b). This approach offers the most holistic view of emotion regulation of those presented throughout the literature but, to date, has not been applied to the investigation of emotion regulation in people at heightened risk of mania.

It may also be beneficial to consider the desired outcome and perceived effectiveness of regulatory attempts. For example, an inability to recognise where emotion regulation has been successful in modifying affect in the intended way may lead to further exaggerated use of the same, or additional,

strategies, which may change mood in a way that is not in line with the original intention of the emotion regulation attempt. Consideration of intention is of particular relevance when attributing adaptive or maladaptive value to certain emotion regulation strategies. When the emotional response is appropriate and proportional to the stimuli, unnecessary attempts to alter the mood state may lead to feelings of incongruence and the development of maladaptive response patterns. Gross (1988, p.232) states that unrealistic appraisals may lead to the denial of important features of the environment. This is particularly apparent in bipolar disorder and mania risk. For example, the Integrative Cognitive Model (Mansell et al., 2007) suggests that extreme positive and negative appraisals of changes in mood states trigger disproportionate regulation attempts, leading to the development and maintenance of mood swings, which are characteristic of bipolar disorder. Ability to evaluate the appropriateness of emotional responses and regulate accordingly is therefore vital for maintenance of healthy mood patterns. Assessment of these belief systems and desired outcomes concurrently provides valuable insight into the motivations behind engagement, or lack thereof, in regulatory strategies in response to mood changes and may provide explanation of why some individuals report less use of emotion regulation strategies than others.

Clinical implications

Findings from this literature contribute to knowledge about processes underlying the development of bipolar disorder and provide evidence that strategies such as dampening and negative rumination may be related to mania risk. However, further work in needed, particularly well-controlled longitudinal studies predicting

transition to bipolar disorder in high risk groups, in order to disentangle which strategies are transdiagnostic (e.g. rumination) and which specifically relate to mania risk, such as positive rumination. This would allow for the development of targeted interventions for individuals displaying early indications of problematic mood regulation tailored to emotion regulation difficulties associated with development of bipolar disorder. Such interventions are vital for long-term outcomes, particularly within population of young adults. A prospective examination of bipolar disorder by Post et al. (2010) found that earlier onset was associated with delays in the first instance of treatment, which also predicted symptom severity and duration of future mood episodes, a trend which could be alleviated by development of appropriate interventions for initial mood control difficulties. This would also be advanced with the use of more clearly operationalised risk criteria, as has been done with risk for other disorders (e.g. psychosis).

Conclusion

Mania risk was typically associated with reported use of putatively maladaptive emotion regulation strategies such as dampening and rumination, with similar patterns of findings present across both behavioural and familial studies. However, the overall quality of findings is confounded by a number of key limitations apparent throughout the literature, most notably the lack of consideration of context and reliance of cross-sectional self-report designs and measures of trait-like emotion regulation strategies rather than real-world use of these strategies. Additionally, there remains a need for further assessment of positive emotion regulation across both behavioural and familial designs, given

their theoretical and clinical significance. Future research should aim to address these limitations with the inclusion of assessments of contextual factors (e.g. within ESM designs) and additional objective measures of both positive and negative affect regulation in order to provide the most holistic view of emotion regulation processes possible.

Declaration of Interests Statement

None.

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Supplementary Materials

Study Characteristics

Author(s)	Sample	Methodology	Mania Risk Measure	ER Measures	Summary of key findings.	Quality Score
Behavioural Mania Risk						
Carver & Johnson 2009	Students N = 235 USA	Cross-sectional *Pen-and-paper format*	HPS	*Self-report* RPA SBI	HPS significantly correlating with all subscale measures of RPA. *Dampening r =.20* *Emotion focused rumination r =.31* *Self-focused rumination r =.26*	Medium
Dempsey, Gooding & Jones 2011	University staff and students N = 353 Age M = 22.62 (SD = 6.38) UK	Cross-sectional *Online*	HPS	*Self-report* RPA RSS	Mania risk positively correlated with RPA and RSS rumination. *Dampening ρ =.178* *Emotion focused rumination ρ =.306* *Self-focused rumination ρ =.2.78* *Rumination ρ =.265* *Reflection ρ =.32* *Brooding ρ =.217*	Medium
Feldman, Joormann & Johnson 2008	Students N = 182 Age M = 19.37 USA	Cross-sectional *Pen-and-paper format*	HPS	*Self-report* RPA RSQ	HPS positive correlate with all RPA subscales. *Dampening r =.28* *Emotion focused rumination r =.3* *Self-focused rumination r =.16*	Medium
Fisk, Dodd & Collins 2015	Students N = 134 Age: 18 – 40+ UK	Cross-sectional *Online*	HPS	*Self-report* RPA RSQ	Mania risk positively correlated with all RPA subscales and RSQ dangerous activities subscale. *Dampening r =.27* *Emotion focused rumination r =.3* *Self-focused rumination r =.25* *Dangerous Activities r =.3* Rumination and active coping were not associated with risk.	Medium
Fulford, Johnson & Carver 2008	Students N = 233 Age >18 USA	Cross-sectional *Pen-and-paper format*	HPS	*Self-report* RPA	Mania risk positively correlated with RPA subscales. *Dampening r =.2* *Emotion focused rumination r =.32* *Self-focused rumination r =.27*	Medium
Giovanelli, Hoerger, Johnson & Gruber 2013	Students N = 482 Age M = 19.33 (SD = 4.33) USA	Cross-sectional *Online*	HPS	*Self-report* RPA	HPS significantly correlated with positive urgency *(r =.39)*	Medium
Heissler,	*Case-control*	Cross-sectional	HPS	fMRI Data	During reappraisal, HP groups displayed	High

Kanske, Schonfelder & Wessa 2013	HP N = 22 Age M = 20.95 (SD = 1.59) Non-HP (Controls) N = 24 Age M = 22.29 (SD = 2.93) *Groups matched for age, gender and handedness.* *All participants reported no history of mental illness, verified by diagnostic interviews.* Germany	Experimental Repeated measures High/Low risk groups Stimuli IAPS • 16 high arousal positive • 16 high arousal negative • 16 neutral Viewing conditions • Passive viewing (control) • Reappraisal • Distraction (maths task)		Amygdala activation *Self-report* ERQ Emotional States Rating Scale (9-point scale unpleasant to pleasant)	enhanced activation in the right amygdala compared to non-HP ($\eta^2 = .2$). This indicates less down-regulation of amygdala in HP group. During distraction, HP group displayed more activation in the left inferior parietal cortex than non-HP ($\eta^2 = .3$).	
Johnson & Jones 2009	Students N = 638 Age M = 30.34 (SD = 11.36) median = 27 UK, USA	Cross-sectional *Pen-and-paper format* *Online*	HPS	*Self-report* RPA	HPS was positively associated with dampening *(r =.13).*	Medium
Knowles, Tai, Christensen & Bentall 2005	Students N = 528 Age M = 19.27 (SD = 2.37)	Cross-sectional *Pen-and-paper format*	HPS	*Self-report* RSQ	Mania risk was associated with rumination *(r =.22)*, risk-taking *(r =.38)* and adaptive coping *(r =.13)*.	Medium
Raes, Daems, Feldman, Johnson & Gucht 2009	Sample 1 Students N = 170 Age: 18 - 58 M = 20.66 (SD = 6.34) Sample 2 N = 528 Age: 18 - 76 M = 29.38 (SD = 11.24)	Cross-sectional *Pen-and-paper format* *Online*	GBI	*Self-report* RPA RSS	Mania risk (GBI) was significantly associated with dampening *(r =.26)*. Positive rumination was not associated with mania risk.	Medium

Steel 2015	Students N = 187 Age: 18 – 64 M = 24.3 (SD = 9.1) UK	Cross-sectional *Online*	HPS	*Self-report* CERQ	HPS positively correlated with rumination *(r =.21)* and reappraisal *(r =.33)*. Risk was not associated with self-blame, acceptance, refocusing, planning, putting into perspective, catastrophizing or blaming others.	Medium
Thomas & Bentall 2002	Students N = 166 Age M = 22.85 (SD = 8.22) UK	Cross-sectional *Pen-and-paper format*	HPS	*Self-report* RSQ	All RSQ subscales were associated with HPS scores. *Rumination β =.23* *Distraction β =.37* *Dangerous activities β =.49*	Medium
Familial Mania Risk						
Green, Lino, Hwang, Sparks, James & Mitchell 2011	<u>BD-I Patients</u> N = 105 Age: 21 - 78 M = 52.39 (SD = 14.10) <u>Unaffected Biological Relatives</u> N = 124 Age: 18 - 85 M = 52.30 (SD = 15.65) <u>Healthy Controls</u> N = 63 Age: 20 - 82 M = 58.30 (SD = 16.83) Austria	Cross-sectional *Pen-and-paper format*	Self-reported first-degree relative with diagnosed BD-I	*Self-report* CERQ	<u>Rumination</u> BD > UR > HC *(η^2 =.2)* <u>Catastrophizing</u> BD > UR *(d=. 5)* BD > HC *(d = .8)* <u>Putting into perspective</u> BD < UR *(d =.4)* <u>Self-blame</u> BD > UR > HC *(η^2 =.11)* No between groups differences on other subscales.	High
Kanske, Schonfelder, Forneck & Wessa 2015	*Case-control* <u>Sample 1</u> Euthymic BD-I Patients N = 22 Age M = 39.4 (SD = 11.8) Healthy Controls N = 22 Age M = 40.5 (SD = 11.8) <u>Sample 2</u>	Cross-sectional Experimental Repeated Measures IAPS images -32 high arousal emotional (16 positive, 16 negative) -16 neutral low arousal Conditions • Reappraisal • Distraction • Viewing (control)	Diagnostic interview YMRS	fMRI data *Self-report* CERQ	UR indicated stronger downregulation of positive emotion during reappraisal compared with controls. <u>Habitual ER</u> BD group reported more frequent rumination *(d = 1.2)*, self-blame *(d =.1.1)* and catastrophizing *(d =.7)* than UR. No difference in positive reappraisal between BD and UR groups. UR also reported less frequent positive	High

	Unaffected Biological Relatives N = 17 Age: M = 36.7 (SD = 16.3) Healthy Controls N = 17 Age M = 35.94 (SD = 15.63) *Groups matched for gender, age and education.* Germany				reappraisal than controls *(d =.08)*.	
Pavlickova, Turnbull & Bentall 2014	*Case-control* <u>Children of Bipolar Parents (CBP)</u> N = 30 Age: 13 - 19 years M = 15.9 (SD = 1.92) *7 children met diagnostic criteria for mood disorder (Affected-CBP)* <u>Control Children</u> N = 30 Age: 13 – 19 M = 16.07 (SD = 1.7) *Groups matched for age and gender* UK	Cross-sectional *Pen-and-paper format*	Structured Clinical Diagnostic Interview for DSM-IV Axis I Disorders. Bech-Refaelson Mania Scale MAS	*Self-report* RSQ	No significant effect of risk status on rumination or risk-taking. CBP reported lower levels of active coping than control children *(d = .47)*.	High
Pavlickova, Turnbull, Myin-Germeys & Bentall 2015	*Case-control* <u>Children of Bipolar Parents (CBP)</u> N = 30 Age: 13 – 19 years M = 15.9 (SD = 1.92) <u>Control Children</u> N = 30 Age: 13 – 19 years M = 16.07 (SD = 1.7) UK	Prospective (6 days) ESM *Pen-and-paper format*	Diagnostic interviews Bech-Refaelson Mania Scale MAS	*Self-report* ESM entries Rumination Active coping Risk taking	CBP children reported significantly more risk taking *(d =.4)* CBP group reported less rumination *(d =.03)* and less active coping *(d =.03)*.	High

ASMR: Altman Self-Rating Mania Scale; CERQ: Cognitive Emotion Regulation Questionnaire; ERQ: Emotion Regulation Questionnaire; GBI: General Behaviour Inventory; HPS: Hypomanic Personality Scale; MASQ: Mood and Anxiety Symptom Questionnaire; MDQ: Mood Disorder Questionnaire; PANAS: Positive and Negative Affect Scale; PTQ: Perseverative Thinking Questionnaire; RPA: Response to Positive Affect; RPA-C: Response to Positive Affect Questionnaire for Children; RSQ: The Response Styles Questionnaire; RSS: Ruminative Response Scale; RTQ: Repetitive Thinking Questionnaire; SBI: Savouring Beliefs Inventory; YMRS: Young Mania Rating Scale.