Journal of Affective Disorders Reports 14 (2023) 100625

Contents lists available at ScienceDirect

Journal of Affective Disorders Reports

journal homepage: www.sciencedirect.com/journal/journal-of-affective-disorders-reports

Research Paper

Hypomanic Defence: Investigating the relationship between depression, response styles and vulnerability to mania

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ARTICLE INFO

Keywords:
Bipolar Spectrum Disorder
Hypomanic Personality
Depression
Response Styles
Rumination
Mediation

ABSTRACT

Background: The purpose of this study was to investigate the role of response styles to negative affect in mediating the relationship between depression and vulnerability to experiencing mania.

Methods: A cross-sectional correlational design was utilized to examine 217 participants' responses to an online survey comprising the Hypomanic Personality Scale (HPS), Response Styles Questionnaire (RSQ), and Personal Health Questionaire (PHQ-8).

Results: After controlling for covariates (age, gender, ethnicity & depression), rumination, risk-taking and adaptive-coping were all positive predictors of hypomanic personality. Parallel mediation analysis demonstrated that rumination and risk-taking positively mediated the relationship between depression and hypomanic personality, whilst adaptive-coping negatively mediated this relationship. Serial mediation analysis revealed evidence for a sequence of causal mediators, demonstrating that rumination independently predicted risk-taking, which subsequently predicted hypomanic personality. Adaptive-coping continued to supress the relationship between depression and hypomanic personality after including risk-taking in the mediation analysis.

Limitations: An unstratified volunteer sampling technique was utilised, introducing potential bias regarding the tendency to adopt maladaptive response styles. Utilising a three-factor response styles solution may lack face validity due to the wide variety of behaviours that encompass adaptive-coping strategies such as pleasant distraction and problem solving.

Conclusions: Our findings support the maladaptive role of rumination and risk-taking in mediating the relationship between depression and vulnerability to experience mania, and further substantiates the protective function of adaptive-coping. Clinical interventions may endeavour to diminish the use of rumination and risk-taking, whilst promoting adaptive-coping strategies such as pleasant distraction and problem-solving.

The emergent concept of a bipolar spectrum suggests that affective disorders such as depression and mania exist on a continuum, rather than as distinct experiences (Angst, 2007). Though estimates indicate lifetime prevalence of bipolar disorder ranges from 1-1.7% (Humpston et al., 2021; McManus et al., 2016; Moreira et al., 2017), there is growing evidence to support that a significant proportion of the population exhibit subclinical bipolar symptoms (Akiskal et al., 2000). Hypomania is a prevalent sub-group of the bipolar spectrum (Angst, 2007), distinguished by a less severe form of mania that typically presents in shorter duration, and without typical psychotic features (American Psychiatric Association [APA], 2013). Hypomanic episodes are characterised by frequent periods of elevated, expansive, and irritable mood, inflated self-esteem, decreased need for sleep, mood disturbance, and increased psychomotor agitation and distractibility (APA, 2013).

In a prospective longitudinal cohort study, it was estimated 5.5% of the general population meet the diagnostic classification of hypomania, with an additional 2.8% experiencing brief occurrences (Angst, 1998). Furthermore, 11.3% of the population exhibited sub-diagnostic symptoms associated with hypomania, supporting the existence of a broad spectrum of hypomanic syndromes (Angst, 1998). However, hypomania can be difficult to identify within the general population (Angst, 2007). Individuals experiencing hypomania tend to be unaware of their fluctuations in mood and behaviour, often viewing such changes positively, for instance, with perceptions of increased productivity and creativity (Akiskal, 2002; Angst et al., 2003; Goodwin and Jamison, 1990). Hence, as hypomanic symptoms are underrecognized and underreported, these figures may reflect minimum rates of occurrence (Angst, 2007, 1998).

Hypomanic personality is characterised by an overactive, gregarious,

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https://doi.org/10.1016/j.jadr.2023.100625
Received 4 February 2023; Received in revised form 19 June 2023; Accepted 10 July 2023
Available online 12 July 2023

and energetic disposition, but also irritability, impulsivity and irresponsibility (Akhtar, 1988; Eckblad and Chapman, 1986). In contrast to hypomania, hypomanic personality is displayed habitually rather than within isolated episodes (Klein et al., 1996). The Hypomanic Personality Scale (HPS) was developed to identify and measure predispositional personality characteristics consistent with the bipolar spectrum (Eckblad & Chapman, 1986). In the preliminary investigation, individuals who scored high on the HPS exhibited increased prevalence of hypomanic episodes, substance abuse, mood disorders and psychotic-like symptoms compared to controls (Eckblad and Chapman, 1986). In a longitudinal 13-year follow-up, high scores were associated with the development of a variety of adverse outcomes, such as increased incidence of substance-use, severe psychotic-like experiences, and higher rates of arrest (Kwapil et al., 2000). Of particular significance, the HPS has been shown to predict the onset of bipolar spectrum disorders (Klein et al., 1996; Kwapil et al., 2000).

According to the Response Styles Theory of Depression (Nolen--Hoeksema, 1991), the behavioural strategies an individual employs in response to negative affect can influence the duration and intensity of depressive symptoms. Rumination refers to contemplation of the symptoms, causes, and consequences associated with depression, and is linked to behaviours such as isolation, retrospection on past events, and reflection on personal shortcomings and failures (Nolen-Hoeksema, 1991). Distraction refers to active attempts to ignore negative affect, alternatively opting to focus on pleasant or neutral activities, such as participating in sports, helping other people, or becoming engrossed in work (Just and Alloy, 1997; Nolen-Hoeksema, 1991). Risk-taking is considered to represent an extreme approach to distraction, comprised of behaviours that are pleasurable but inherently maladaptive or dangerous, such as recreational drug use, risky sexual encounters, and reckless driving (Knowles et al., 2005). Finally, constructive problem-solving refers to active attempts to relieve symptoms of depression, such as talking to someone you trust about your wellbeing, or making a plan to overcome challenges (Knowles et al., 2005; Nolen-Hoeksema, 1987).

Evidence suggests that unipolar depression is associated with rumination and risk-taking responses, but negatively linked to distraction and problem-solving (Knowles et al., 2005). Conversely, hypomanic personality is associated with rumination, risk-taking, distraction, and problem-solving (Knowles et al., 2005; Thomas and Bentall, 2002). Intriguingly, rumination and risk-taking are associated with lower levels of positive affect and increased depression, whilst distraction and problem-solving are associated with increased positive affect and reduced severity of depression (Knowles et al., 2005; Thomas et al., 2007; Thomas and Bentall, 2002). Consequently, it has been suggested that rumination and risk-taking may be considered maladaptive response styles that exacerbate and maintain symptoms of depression, whereas problem-solving and distraction elevate mood and provide resistance against depression (Knowles et al., 2005). Subsequent factor analysis conducted by Knowles et al. (2005) provides evidence that a three-factor solution is even more appropriate, combining pleasant distraction and problem-solving to create an adaptive-coping factor.

Knowles et al. (2005) suggest that hypomanic traits may represent an adaptive attempt to deal with depression, by increasing confidence, extraversion, and motivation to deal with upcoming challenges. Moreover, hypomania may occur in response to maladaptive coping styles (Knowles et al., 2005; Thomas & Bentall, 2002). Knowles et al. (2005) propose that hypomania may emerge from a cyclical pattern that incorporates rumination and risk-taking whereby rumination is detrimental to wellbeing and exacerbates symptoms of depression, prompting an impulsive attempt to restore positive affect by engaging in pleasant activities. However, this cannot be sustained, resulting in pleasure-seeking through spontaneous risk-taking behaviours that may subsequently develop into hypomanic or manic behaviour (Knowles et al., 2005). Similarly, Lam and Wong (1997) suggest that rumination regarding prodromal symptoms may deteriorate into depression, but may also precipitate spontaneous attempts to avoid negative emotions through pleasure-seeking. This evidence implies that whilst ineffective response styles may mediate the relationship between depression and hypomanic personality, it is also plausible that response styles may interact in sequence to determine this relationship. The current study is the first of its kind to investigate the possible mediating role of response styles in determining the relationship between depression and vulnerability to experience mania.

The primary aim of this study is to investigate the role of response styles to negative affect in predicting vulnerability to experiencing mania within a nonclinical population. It is hypothesised that rumination, risk-taking and adaptive-coping will be positive predictors of hypomanic personality. The secondary aim is to explore the mediating role of response styles to negative affect in determining the relationship between depression and vulnerability to experiencing mania. It is hypothesised that ineffective response styles such as rumination and risk-taking will mediate the relationship between depression and hypomanic personality. Furthermore, rumination and risk-taking may interact in sequence to further influence the relationship between depression and hypomanic personality.

1. Method

1.1. Participants

A volunteer sampling technique was used to recruit 217 individuals to participate in an online survey distributed via Qualtrics (Provo, UT) (complete responses, n=198). Participants were required to be aged over 18, speak fluent English, and have no current or previous mental health diagnosis. The sample were predominantly White/White British (86.6%, n=188), female (77.9%, n=169), and originating from the UK (75.1%, n=163) with a mean age of 21.38 (±7.01).

1.2. Materials

1.2.1. Hypomanic Personality Scale (HPS; Eckblad & Chapman, 1986)

The HPS is a 48-item questionnaire used to assess predispositional personality characteristics associated with the bipolar spectrum. The instrument is comprised of a series of true/false questions, e.g. "I have often felt happy and irritable at the same time." The HPS displayed excellent internal consistency in the present sample (α=.90).

1.2.2. Response Styles Questionnaire (RSQ; Knowles et al., 2005; Nolen-Hoeksema, 1991; Thomas & Bentall, 2002)

The RSQ is a 48-item self-report inventory of behavioural responses to depression. Items are answered using a 4-point Likert scale, ranging from "Almost Never" to "Almost Always". This study employed an adapted version of the RSQ, based on the factor analysis conducted by Knowles et al. (2005) with additional items adapted from Thomas and Bentall (2002). This measure, consistsof three subscales: Rumination (25 items, α=.93), Risk-taking (8 items, α=.78), and Adaptive-coping (15 items, α=.87). Due to ethical considerations, the item on self-injury was excluded, resulting in a total of 47 items.

1.2.3. Personal Health Questionnaire 8 (PHQ-8; Kroenke et al., 2009)

The PHQ-8 is used to measure depression within the general population against the DSM-IV diagnostic criteria of depressive disorder, using a 4-point Likert scale ranging from "Not at all" to "Nearly every day". Internal consistency for the PHQ-8 in this sample was good (α=.86).

1.2.4. Procedure

A volunteer sampling technique was used to recruit individuals to participate in an online survey distributed via Qualtrics (Provo, UT). An advertisement containing an anonymous URL link was distributed via social media platforms, online forums, and the University of Liverpool

Experiment Participation Requirement (EPR) system. The link directed the prospective participant to the information sheet and consent form. A screening questionnaire was then utilized to identify individuals with a current or previous diagnosis of depression, mania, bipolar disorder, or any other mental health diagnosis; affirmation of which would terminate the study. Subsequently, participants recorded their demographic data and completed a battery of questionnaires, in a randomised order with no forced response initiated. Following completion of the survey, participants were presented with a debrief sheet thanking them for their time and directing them to appropriate support resources. Ethical approval for the current study was granted by the University of Liverpool Health and Life Sciences Research Ethics Committee.

1.3. Statistical Analyses

Analysis was conducted using SPSS (Version 28). To investigate our first hypothesis, a hierarchical linear regression was conducted to investigate the role of response styles in predicting hypomanic personality. HPS score was input as the dependent variable, whilst covariates (Age, Gender, Ethnicity and Depression) were entered into step one of the model, and predictors (rumination, risk-taking and adaptive-coping) were entered into step two. A Bayesian Multiple Linear Regression (BMLR) was also conducted using JASP (Version, 0.14.1) with HSP as the dependent variable and depression, rumination, risk-taking, and adaptive-coping as predictors. The BMLR allowed us to examine the relative strength of various models, allow for additional inferences regarding the probability distributions of model parameters, and evaluate the strength of any evidence in favour of the null.

To investigate our second hypothesis, a series of exploratory atemporal mediation analyses were conducted using the PROCESS Macro (Version 4.1) (Hayes, 2013) for SPSS. Direct effects between the independent and dependent variables were first established (X→Y); then, direct effects between the independent variable and mediators (X→M) and between the mediators and dependent variable (M→Y) were established. PROCESS Model 4 allows the examination of simple or parallel indirect effects (X→M→Y), whilst Model 6 permits the examination of a serial/sequential indirect effects, accounting for the influence of one mediator on another. ($X \rightarrow M^1 \rightarrow M^2 \rightarrow Y$). Age, Gender and Ethnicity were incorporated into the model as covariates. The 95% confidence intervals for the indirect effect were generated on the basis of 5,000 bootstrapped samples. Evidence of a significant mediating effect was considered in cases where zero did not fall within the 95% confidence intervals for the bootstrapped samples (MacKinnon et al., 2007; Preacher and Hayes, 2008).

2. Results

2.1. Hierarchical Linear Regression Analysis

A hierarchical linear regression was conducted to investigate the role of response styles in predicting hypomanic personality. Variance inflation factors (VIF) indicated multicollinearity was not a concern. The final regression model was statistically significant and predicted 37% of variance, $R^2 = .37$, $F(7, 182) = 15.18$, $p<.001$. Model 1 was statistically significant and accounted for 12% of variance, $R2 = .12$, $F(4, 185) = 6.19$, $p<.001$, revealing that gender (male > female; $p=.049$) and depression ($p<.001$) were positive predictors of hypomanic personality, while age ($p=.271$) and ethnicity ($p=.773$) were not. Model 2 was statistically significant and accounted for an additional 25% of variance, $R2 = .25$, $F(3, 182) = 24.07$, $p<.001$. When including response styles into the regression model, depression was no longer a statistically significant predictor of hypomanic personality ($p=.274$); however, gender remained a positive predictor (female > male; $p=.02$). The analysis revealed that rumination ($p=.001$), risk-taking ($p<.001$) and adaptive-coping ($p=.003$) were all positive predictors of hypomanic personality (see Table 1). In the final model, being male increased HPS score by 3.24 points, while each one-point increase on the Likert scale for rumination, risk-taking, and adaptive-coping increased HPS scores by 0.17, 0.89, and 0.22 points, respectively.

Table 1
Multiple Linear regression for response styles in predicting hypomanic personality

	B	*Std. Error*	*β*	Lower 95% CI	Upper 95% CI	VIF
Model 1						
Age	-.10	.09	-.08	-.28	.08	1.06
Gender	3.15*	1.59	.14	.01	6.29	1.02
Ethnicity	-.57	1.98	-.02	-4.48	3.34	1.01
Depression	.51**	.12	.31	.28	.75	1.08
Model 2						
Age	.01	.08	.00	-.15	.16	1.11
Gender	3.24*	1.38	.14	.52	5.96	1.05
Ethnicity	-.38	1.69	-.01	-3.72	2.95	1.01
Depression	.15	.14	.09	-.12	.42	1.91
Rumination	.17*	.05	.26	.07	.27	1.72
Risk-Taking	.89**	.16	.37	.57	1.20	1.24
Adaptive-coping	.22*	.07	.19	.07	.37	1.19

Notes: Gender (Male =1, Female =0); Ethnicity (Any White Background =1, Black, Asian and Minority Ethnicity [BAME]= 0); Depression = PHQ-8; Response Styles = RSQ (Rumination, Risk-Taking, Adaptive-coping);
* $p \leq .05$
** $p \leq .001$.

2.2. Bayesian Multiple Linear Regression

A BMLR was conducted using a uniform *JZS* (*r* scale .350) prior to gain insight into the relative strength of each model (Table 2) and the coefficients contained within (Table 2). First, Models 4 and 5 show decreased support after data observation compared to their prior distributions, so will not be considered further. Compared to the prior distribution, observation of the data increased the odds (BF_M) in favour of Model 1 (Rumination, Risk-taking and Adaptive Coping) by a factor of 21.92, and it explained 34% of variance in Hypomanic Personality Scale responses. Similarly, odds in favour of Model 2 (Rumination & Risk-taking) and Model 3 (PHQ-8, Rumination, Risk-taking & Adaptive-coping) increased by a factor of 4.07 and 2.63, respectively. Further, BF_{10} shows the relative predictive adequacy of each model compared to the best model (Model 1): the data are 2.78 × more likely under M1 compared to M2 (1/0.36) and 4 × more likely compared to M3 (1/0.25). (See Table 2).

$BF_{inclusion}$ for risk-taking is 2.319e+6, suggesting the data have increased our prior odds (Pincl) for including Risk-taking as a predictor

Table 2
Model comparison displaying model odds and relative predictive adequacy.

Models	P(M)	P(M|data)	BF_M	BF_{10}	R^2
Model 1	0.063	0.59	21.92	1.00	0.34
Model 2	0.063	0.21	4.07	0.36	0.32
Model 3	0.063	0.15	2.625	0.25	0.35
Model 4	0.063	0.03	0.51	0.06	0.32
Model 5	0.063	0.01	0.12	0.01	0.31

Note. Response Styles (Rumination, Risk-taking, Adaptive-coping); HPS: Hypomanic personality scale; PHQ-8: Depression. **Model 1:** Rumination + Risk-Taking + Adaptive-coping; **Model 2**:Rumination + Risk-taking; **Model 3**: PHQ-8 + Rumination + Risk-taking + Adaptive-coping; **Model 4**: PHQ-8 + Rumination + Risk-taking; **Model 5**: PHQ-8 + Risk-taking + Adaptive-coping **P(M)**: Prior model probabilities; **P(M | data)**: Posterior probabilities of the models considered.**BFM**: The updating factor by which the prior model odds change into the posterior model odds; **BF10**: Bayes factor comparing a model to the best model (Model 1); **R2**: Explained variance.

in the model by a factor of 2.3 million, offering extreme evidence in favour of its inclusion. The marginal posterior distribution is 0.94 (95% CrI 0.64 to 1.26), suggesting that each additional point scored on Risk-taking predicts a 0.94 increase in HPS score. Very strong evidence is also found in favour of rumination ($BF_{inclusion}$ = 88.78), with moderate evidence in favour of adaptive coping ($BF_{inclusion}$ = 3.02). For each additional point scored on Rumination and Active-Coping, HPS score increases by 0.17 (95%CrI 0.07 to 0.26) and 0.13 (95%CrI 0.00 to 0.28), respectively. In contrast, the posterior probability of including depression is reduced – the probability of excluding depression from the model is 0.81. (See Fig. 1 and Table 3). Fig. 2 demonstrates a significant spike at 0, reflecting a large probability (0.81) of excluding depression from the model. The BMLR offers evidence to support the inclusion of rumination, risk-taking and adaptive coping into a model predicting HPS scores, and excluding depression as a predictor.

2.3. Atemporal Mediation Analysis

2.3.1. The role of response styles to negative affect in mediating the relationship between depression and vulnerability to experiencing mania

Depression was a significant positive predictor of rumination and risk-taking, and a significant negative predictor of adaptive-coping. There was no significant direct effect between depression and hypomanic personality. Rumination and adaptive-coping were significant predictors of risk-taking, however rumination and adaptive-coping were not associated. Rumination, risk-taking and adaptive-coping were positive predictors of hypomanic personality. The 95% confidence intervals for the indirect effect were calculated using the PROCESS macro model 6 (Hayes, 2013).

The analysis revealed a significant positive indirect effect between depression and hypomanic personality via rumination (*B*=.27, *SE* =.08, *95% CI* .12 to .43 *p*<.05) and risk-taking (*B*=.19, *SE*=.05, *95% CI* .09 to .29 *p*<.05), and a negative indirect effect via adaptive-coping (*B*=−.09, *SE*=.04, *95% CI* −.18 to −.02, *p*<.05) (See Fig. 3 and Table 4). Findings suggest that the tendency to engage in rumination and risk-taking in response to depression may increase susceptibility to mania; however, engaging in adaptive-coping styles such as pleasant distraction and problem-solving may reduce vulnerability.

Analysis was further conducted to examine any potential sequential effect of response styles in mediating the relationship between depression and vulnerability to experiencing mania. Results suggested a sequential indirect effect via rumination and risk-taking (*B*=.09, *SE*=.05, *95% CI* .01 to .20, *p*<.05), indicating that individuals who engage in rumination in response to depression are more likely to engage in risk-taking, subsequently increasing vulnerability to experiencing mania (See Fig. 4 and Table 5). Furthermore, a significant negative indirect effect was discovered between adaptive-coping and risk-taking (*B*=−.05, *SE*=.02, *95% CI* −.10 to −.01), suggesting that engaging in adaptive-coping in response to depression may precipitate risk-taking, however the likelihood of demonstrating elevated vulnerability to depression is reduced (See Fig. 5 and Table 6). No significant indirect effect was discovered via a sequence of rumination and adaptive-coping (*B*=.02, *SE*=.03, *95% CI* −.04 to .08).

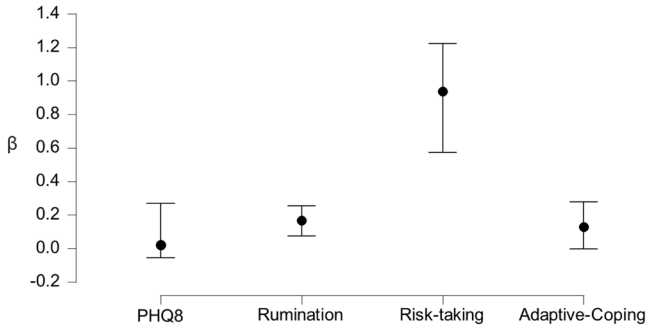

Fig. 1. Posterior Summary Table (Model Averaged) displayed graphically
Notes: Variables: PHQ-8: Depression; Response Styles (Rumination, Risk-taking, Adaptive-coping). Figure demonstrating the model averaged marginal posterior summary of the variables . β = Beta Coefficient. Model Averaged Credible interval offers 95% probability that the true coefficient estmate lies between the interval.

3. Discussion

The primary aim of this study was to investigate the role of response styles to negative affect in predicting vulnerability to experiencing mania. As predicted, evidence from hierarchical linear regressions demonstrated that after controlling for covariates and depression, rumination, risk-taking and adaptive-coping were all positive predictors of hypomanic personality. Furthermore, Bayesian multiple linear regression provided further evidence to support the inclusion of rumination, risk-taking and adaptive-coping into the regression model as predictors of hypomanic personality and to reject the inclusion of depression as a predictor. The secondary aim of the study was to assess the mediating role of response styles to negative affect in determining the relationship between depression and hypomanic personality. Parallel atemporal mediation analysis demonstrated a positive indirect effect via rumination and risk-taking, with a negative indirect effect via adaptive-coping. Evidence derived from serial atemporal mediation analysis also offered evidence of a positive indirect effect via a sequential series of rumination and risk-taking, and a negative indirect effect via a sequence of adaptive-coping and risk-taking.

Consistent with prior literature, individuals who reported greater depression demonstrated elevated scores on the hypomanic personality scale. Furthermore, individuals who exhibited elevated measures of depression were more inclined to engage in rumination and risk-taking. To this extent, the evidence supports the classification of rumination and risk-taking as representing maladaptive response styles that may exacerbate and prolong depression (Knowles et al., 2005).

It has been proposed that the relationship between depression and hypomanic personality is linked via maladaptive response styles (Knowles et al., 2005; Thomas and Bentall, 2002). Our findings support this proposal, indicating that rumination and risk-taking increase the likelihood of exhibiting hypomanic personality in response to depression. Our findings also demonstrate that individuals who adopt rumination in response to depression are likely to endorse risk-taking, which subsequently predicts elevated vulnerability to experience mania. It has been suggested that individuals engage in impulsive risk-taking behaviours in response to rumination as alternative methods of pleasant distraction are not sufficiently efficacious to disrupt the escalating cascade of negative affect (Selby et al., 2016). Such findings are consistent with the model proposed by Knowles et al. (2005), whereby rumination may precipitate an impulsive attempt to alleviate symptoms of depression through impulsive pleasure-seeking. Resultantly, in accordance with a manic-defence framework, our findings offer evidence to support the supposition that hypomanic behaviour may occur in response to attempts to alleviate depression viaa sequence of maladaptive response styles.

Our study further illustrates that adaptive-coping is negatively associated with depression, but positively associated with hypomanic personality. This evidence supports the assumption that distraction and problem-solving represent adaptive-coping strategies, which help to maintain an individual's emotional health and resilience to depression (Knowles et al., 2005). Furthermore, hypomanic behaviour may encourage an individual to be more confident and extraverted in order to combat impending challenges (Knowles et al. 2005). To this extent, hypomanic behaviour may also be somewhat adaptive as it may facilitate and improve the efficacy of adaptive-coping strategies such as problem-solving.

The current study also establishes that adaptive-coping strategies

Table 3
Posterior Summary Table (Model Averaged)

Coefficient	P(incl)	P(excl)	P(incl|data)	P(excl|data)	$BF_{inclusion}$	Mean	SD	95% Credible Interval Lower	95% Credible Interval Upper
Intercept	1.00	0.00	1.00	0.00	1.00	16.5	0.54	15.36	17.55
Depression	0.50	0.50	0.19	0.81	0.24	0.02	0.08	-0.02	0.30
Rumination	0.50	0.50	0.99	0.01	88.78	0.17	0.05	-0.07	0.03
Risk-taking	0.50	0.50	1.00	4.313e-7	2.319e+6	0.94	0.16	0.64	1.26
Adaptive-coping	0.50	0.50	0.75	0.25	3.02	0.13	0.10	-1.242e-4	0.28

Note. Response Styles (Rumination, Risk-taking, Adaptive-coping); HPS: Hypomanic personality scale; PHQ-8: Depression
Coefficient: Name of the predictors; **P(incl)**: Prior inclusion probability; **P(excl)**: Prior exclusion probability; **P(incl|data)**: Posterior Inclusion probability; **P(excl|data)**: Posterior Exclusion probability; **BFinclusion**: Inclusion Bayes Factor, change from prior to posterior inclusion odds;
Mean: Mean of the model averaged posterior. **SD**: Standard Deviation of the model averaged posterior.

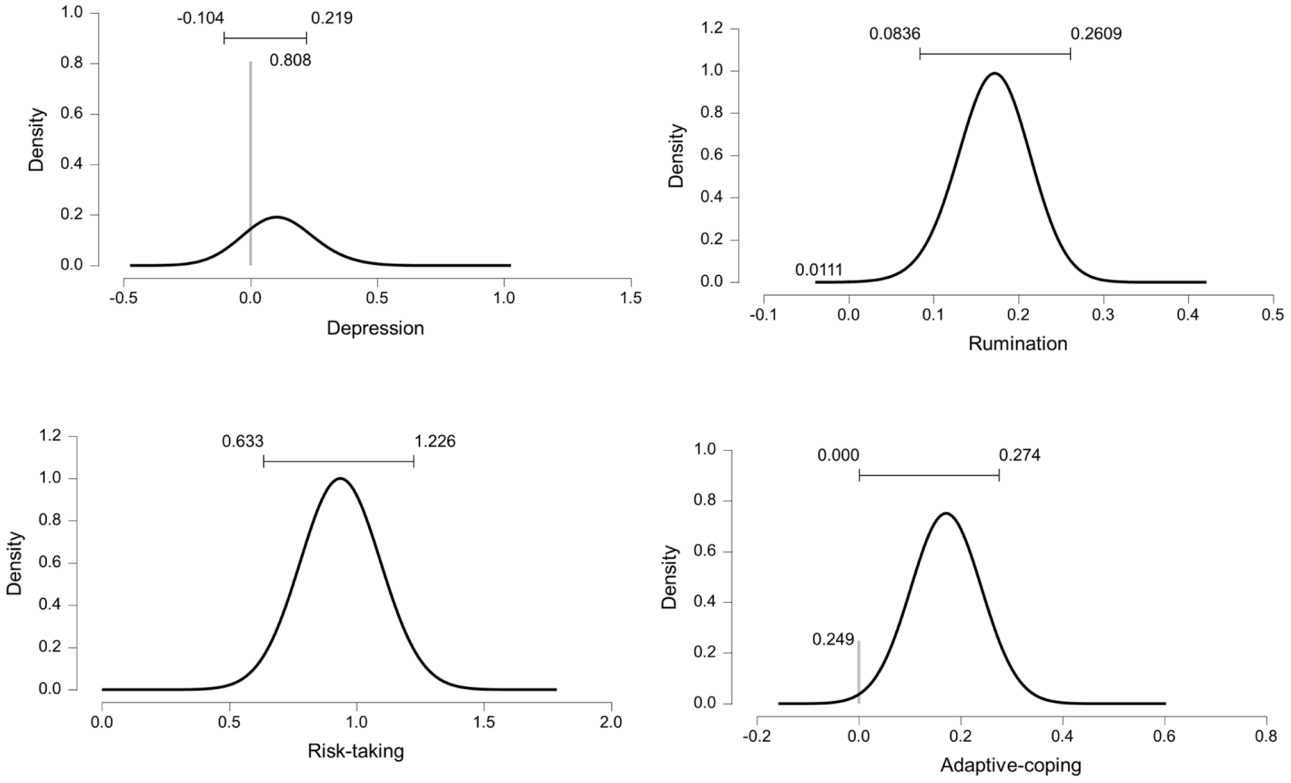

Fig. 2. Coefficient plots: Marginal Posterior Distribution for all variables
Notes: Variables: PHQ-8: Depression; Response Styles (Rumination, Risk-taking, Adaptive-coping). Figure demonstrating the marginal posterior distribution of the variables. Credible interval offers 95% probability that the true coefficient estmate lies between the interval. Spikes on the marginal posterior distribution plot, represented by a vertical line, demonstrate the probability of excluding the variable from the model.

supress the relationship between depression and hypomanic personality. Due to the correlational nature of the present study, it is difficult to determine directionality of the relationship between depression and adaptive-coping, however, it is feasible that adaptive-coping may alleviate initial symptoms of depression, which subsequently reduces vulnerability to experiencing mania. However, it is also conceivable that more depressed individuals are predisposed to reject adaptive-coping strategies due to their reliance on maladaptive response styles. Evidence suggests that rumination may impair problem-solving capabilities (Donaldson & Lam, 2004; Lyubomirsky & Nolen-Hoeksema, 1995; Watkins & Baracaia, 2002) and can negatively bias information processing (Bower, 1981). Furthermore, problem-solving may also be more efficacious following pleasant distraction due to alleviation of negative affect, which may subsequently suspend ruminative behaviours (Lyubomirsky and Nolen-Hoeksema, 1995; Nolen-Hoeksema, 1991). Therefore, whilst excessive rumination in response to depression may exacerbate and maintain depressive symptoms, it may also adversely impact the adoption of adaptive-coping strategies.

Intriguingly, despite the evidently strong link between risk-taking and hypomanic personality, evidence from the serial atemporal mediation analysis revealed that adaptive-coping continued to supress the relationship between depression and hypomanic personality when both adaptive-coping and risk-taking were considered as serial mediators. Knowles et al. (2005) suggest that although engaging in pleasant activities can help to alleviate negative affect, distraction can be adverse if taken to the extremes. If we are to consider that adaptive-coping is a combination of distraction and problem-solving, it is plausible to suggest that adaptive-coping and risk-taking are linked via the distraction elements of the construct. In consequence, it may be more adequate to adopt a more direct classification when attempting to investigate the particular strategies individuals employ in response to depression.

3.1. Limitations

Although the results of this study offer novel and intriguing evidence to support the role of response styles in mediating the relationship

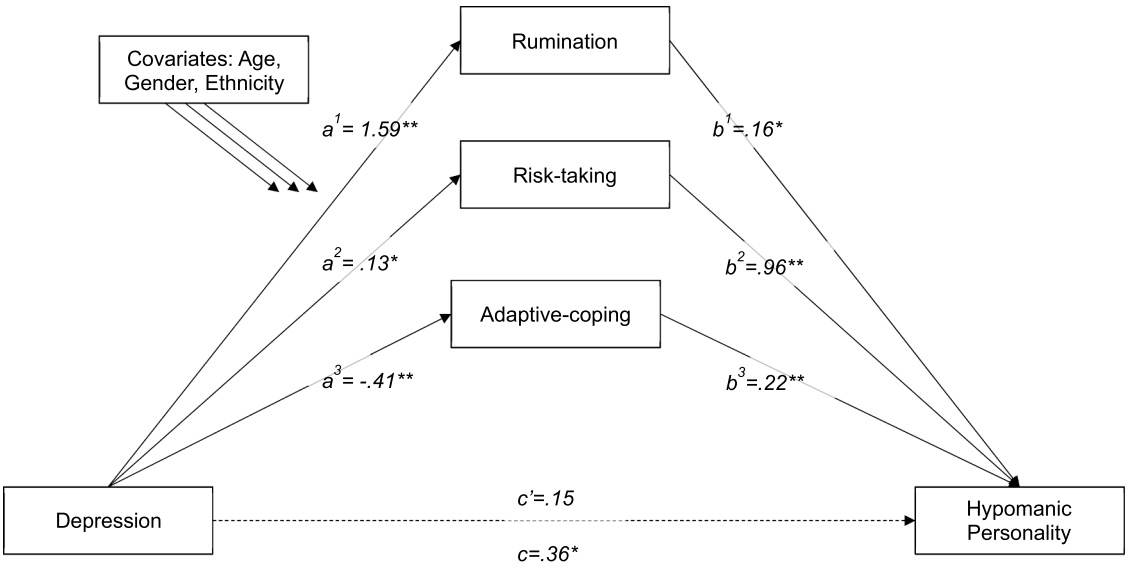

Fig. 3. Parallel mediation model incorporating rumination, risk-taking and adaptive-coping
Notes: PHQ-8=Depression, RSQ=Response Styles (Rumination, Risk-Taking, Adaptive-coping), HPS=Hypomanic Personality *p≤.05 **p≤.001. Paths (a^1= *Depression → Rumination;* a^2= *Depression → Risk-taking;* a^3= *Depression → Adaptive-coping;* b^1= *Rumination → Hypomanic Personality;* b^2= *Risk-taking → Hypomanic Personality;* b^3= *Adaptive-coping → Hypomanic Personality; c'= Depression → Hypomanic Personality [direct path]; c= Depression → Hypomanic Personality [indirect path])*

Table 4
Parallel Mediation model investgating the role of response styles in mediating the relationship between depression and hypomanic personality

Effect	95% Confidence Intervals			
	B	*Std. Error*	Lower Bound	Upper Bound
Direct Paths (a^1, a^2, a^3)				
Depression→Rumination	1.60**	.15	1.30	1.90
Depression→Risk-taking	.21**	.05	.11	.31
Depression→Adaptive	-.41**	.10	-.62	-.21
Direct Paths (b^1,b^2,b^3)				
Rumination→HPS	.17**	.05	.07	.27
Risk-taking→HPS	.89**	.16	.57	1.20
Adaptive→HPS	.22**	.07	.07	.37
Direct Path (path c')				
Depression→HPS	.15	.14	-.12	.42
Total Indirect Effects (path c)				
Depression→ HPS	.36*	.11	.15	.56
Specific Indirect Paths				
PHQ-8→Rumination→ HPS	.27*	.08	.11	.42
PHQ-8→Risk-taking→HPS	.19*	.05	.09	.29
PHQ-8→Adaptive-coping→HPS	-.09*	.04	-.18	-.02

Notes: PHQ-8=Depression, RSQ=Response Styles (Rumination, Risk-Taking, Adaptive-coping), HPS=Hypomanic Personality
* p≤.05
** p≤.001.

between depression and vulnerability to experience mania, there is concern that these findings may not exhibit sufficient external validity to establish generalisability. As a result of an unstratified volunteer sampling methology, the sample was primarily young, white, and female. Although efforts were made to include gender, age and ethncity as covariates in the analysis, there remains a possibility that results of this study are not representative. It has been consistently documented that depression is more prevalent among women (Angst et al., 2002; Nolen-Hoeksema and Hilt, 2009; Parker and Brotchie, 2010). This observed disparity in depression may be partially explained by differences in the response styles men and women adopt to help cope with depression (Nolen-Hoeksema et al., 1999). Women are more likely to engage in rumination, whilst men are more likely to endorse distraction and risk-taking such as alcohol and substance abuse (Johnson and Whisman, 2013; Nolen-Hoeksema and Jackson, 2001). To this extent, the sample employed in this research may have been predisposed to experience depression and the adoption of maladaptive response styles.

The present study also opted to utilize a three-factor response styles solution, derived from factor analysis conducted by Knowles et al. (2005), incorporating distraction and problem-solving response styles into a singular adaptive-coping factor. It has been noted that the shorter subscales of the RSQ (Nolen-Hoeksema, 1991) relating to dangerous activities and problem-solving have experienced poor reliability, prompting some researchers to attempt to generate new items to improve psychometric properties (Thomas & Bentall, 2002). Similarly, Knowles et al. (2005) acknowledge that due to the small number of items relating to problem-solving and distraction, this may have introduced difficulty to distinguish independent dimensions utilizing factor analysis. To this extent, although adaptive-coping may be considered a valid construct relating to the propensity to reduce depressive symptomology, it may be considered that this factor may not possess face validity due to the wide variety of behaviours that encompass problem-solving and pleasant distraction. Furthermore, although pleasant distraction may be considered adaptive to an extent, there is evidence to suggest that particular forms of distraction may represent attempts to avoid negative thoughts or feelings (Dempsey et al., 2000), and may be ultimately detrimental to an individual's wellbeing (Woodward et al., 2020). To this extent, further research may be required to delineate the distinction between distraction-acceptance and distraction-avoidance (Wolgast & Lundh, 2017) in determining the relationship between depression and vulnerability to mania.

3.2. Future Directions

According to Depue and Iacono (1989), dysregulation of the Behavioural Activation System (BAS) may be accountable for producing behaviours associated with the bipolar spectrum. The BAS is responsible for mediating an individual's response to reward and initiating approach behaviour, underlying goal motivation and attainment (Gray, 1982). Excessive activation of the BAS is associated with manic and hypomanic behaviours, such as increased energy, goal-orientated activity, optimism and euphoria; whilst excessive deactivation of the BAS is associated with

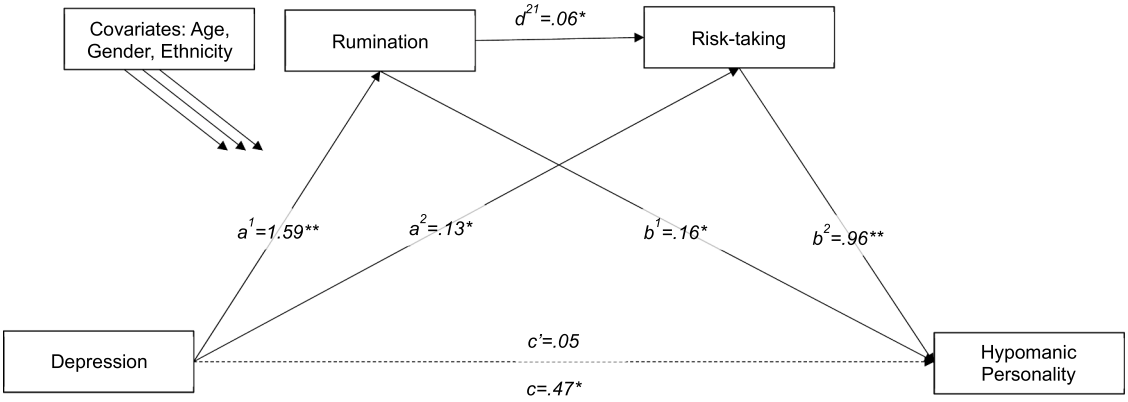

Fig. 4. Serial mediation model incorporating rumination and risk-taking
Notes: PHQ-8=Depression, RSQ=Response Styles (Rumination, Risk-Taking, Adaptive-coping), HPS=Hypomanic Personality *p≤.05 **p≤.001. Paths (a^1= *Depression → Rumination;* a^2= *Depression → Risk-taking;* b^1= *Rumination → Hypomanic Personality;* b^2= *Risk-taking → Hypomanic Personality;* d^{21}= *Rumination → Risk-taking; c'= Depression → Hypomanic Personality [direct path]; c= Depression → Hypomanic Personality [indirect path])*

Table 5
Serial mediation model incorporating rumination and risk-taking.

Effect	95% Confidence Intervals			
	B	*Std. Error*	Lower Bound	Upper Bound
Direct Paths (a^1, a^2)				
PHQ-8→Rumination	1.59**	.15	1.29	1.89
PHQ-8→Risk-taking	.13*	.06	.01	..25
Direct Paths (b^1,b^2)				
Rumination→HPS	.16*	.05	.06	.26
Risk-taking→HPS	.96**	.15	.66	1.26
Direct Paths (d^{21})				
Rumination→Risk-taking	.06*	.02	.01	.11
Direct Path (path c')				
PHQ-8→HPS	.05	.13	-.21	.31
Total Indirect Paths (path c)				
PHQ-8→ HPS	.47*	.09	.29	.64
Specific Indirect Paths				
PHQ-8→Rumination→ HPS	.25*	.08	.10	.40
PHQ-8→Risk-taking→ HPS	.13	.07	-.03	.26
PHQ-8→Rumination→Risk-taking →HPS	.09	.05	.01	.20

Note. Response Styles (Rumination, Risk-taking, Adaptive-coping); HPS: Hypomanic Personality Scale; PHQ-8: Depression
* significant at the p<0.05 level.
** significant at the p<0.001 level.

Table 6
Serial mediation model incorporating adaptive-coping and risk-taking.

Effect	95% Confidence Intervals			
	B	*Std. Error*	Lower Bound	Upper Bound
Direct Paths (a^1, a^2)				
PHQ-8→Adaptive-coping	-.41**	.10	-.62	-.21
PHQ-8→Risk-Taking	.26**	.05	.16	.36
Direct Paths (b^1,b^2)				
Adaptive-coping→HPS	.22*	.09	.07	.37
Risk-Taking→HPS	.97**	.16	.65	1.29
Direct Paths (d^{21})				
Adaptive-coping→Risk-taking	.12**	.03	.05	.19
Direct Path (path c')				
PHQ-8→HPS	.40**	.12	.17	.63
Total Indirect Paths (path c)				
PHQ-8→ HPS	.11	.09	-.04	.25
Specific Indirect Paths				
PHQ-8→Adaptive-coping→ HPS	-.09*	.04	-.18	-.02
PHQ-8→Risk-Taking→ HPS	.25*	.06	.14	.37
PHQ-8→Adaptive-coping→Risk-Taking →HPS	-.05*	.02	-.10	-.01

Note. Response Styles (Rumination, Risk-taking, Adaptive-coping); HPS: Hypomanic Personality Scale; PHQ-8: Depression;
* significant at the p<0.05 level.
** significant at the p<0.001 level.

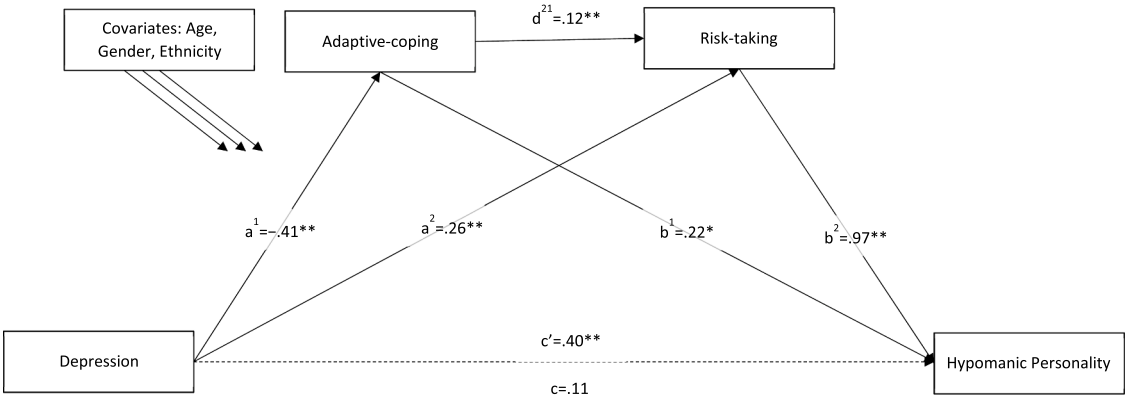

Fig. 5. Serial mediation model incorporating adaptive-coping and risk-taking
Notes: PHQ-8=Depression, RSQ=Response Styles (Rumination, Risk-Taking, Adaptive-coping), HPS=Hypomanic Personality *p≤.05 **p≤.001. Paths (a^1= *Depression →Adaptive-coping;* a^2= *Depression → Risk-taking;* b^1= *Adaptive-coping → Hypomanic Personality;* b^2= *Risk-taking → Hypomanic Personality;* d^{21}= *Adaptive-coping → Risk-taking; c'= Depression → Hypomanic Personality [direct path]; c= Depression → Hypomanic Personality [indirect path])*

depressive symptoms such as decreased energy, hopelessness, loss of interest and decreased goal-directed activity (Alloy and Abramson, 2010).

It has been suggested that engaging in distraction and risk-taking may result in overstimulation of the BAS, which may possibly explain the appearance of manic and hypomanic behaviour (Thomas et al., 2007). It is therefore plausible that mechanisms of depression avoidance such as pleasant distraction and impulsive risk-taking behaviours may result in the overstimulation of the BAS, which may subsequently lead to demonstration of hypomanic behaviour. As such, the BAS provides another avenue for future research to investigate the potential underlying mechanisms that dictate the appearance of hypomanic behaviour in response to maladaptive response styles.

3.3. Clinical Implications

Hypomanic traits are associated with a variety of adverse consequences (Klein et al., 1996; Kwapil et al., 2000; Meyer, 2002) and are particularly difficult to detect within the general population (Angst, 2007). Hence, it may be more efficacious for clinical interventions to target antecedental factors that foster the development of hypomanic traits.

A variety of clinical interventions aimed to tackle depression have identified the significance of fostering the adoption of adaptive-coping strategies, whilst attempting to reduce reliance on maladaptive-coping strategies. Problem-Solving Therapy (PST) is a cognitive-behavioural intervention that aims to foster adaptive problem-solving skills to enhance wellbeing, and has been employed as an effective treatment for depression (Bell and D'Zurilla, 2009; Cuijpers et al., 2018; Nezu and Perri, 1989). Problem-solving appraisal has also been identified as a focus for cognitive-behavioural therapies, as individuals who perceive themselves to be ineffective at problem-solving tend to experience greater depression (Blankstein et al., 1992; Chen et al., 2006). Additionally, the importance of pleasant distraction has also been highlighted. For instance, pleasant activity scheduling is a behavioural intervention for depression that requires individuals to monitor their mood and behaviour, and encourage participation in activities that they deem to be pleasurable (Cuijpers et al., 2007; Lewinsohn and Libet, 1972). Furthermore, the significance of rumination in maintaining and worsening depression has also been identified. Rumination-focused CBT aims to tackle maladaptive cognitive biases by promoting constructive rumination and facilitation of beneficial approach behaviour (Watkins, 2015, 2018; Watkins et al., 2011). Although evidence remains limited, rumination-focused CBT has demonstrated promising clinical properties, and has been shown to be superior to CBT for major depression (Hvenegaard et al., 2020; Watkins, 2018).

Accordingly, the results of this study also offer evidence to suggest that similar clinical interventions may be utilised to reduce vulnerability to experience mania, such as seeking to diminish endorsement of maladaptive-coping strategies that precipitate hypomanic personality and facilitating the adoption of adaptive-coping strategies that reduce depression.

4. Conclusion

The current study aimed to explore the relationship between vulnerability to experience mania and response styles to depression. Consistent with the manic defence hypothesis, the current study offers evidence to support the function of hypomanic traits as a mechanism that occurs in response to depression. Importantly, the current study builds upon existing literature to further substantiate the titular role of maladaptive response styles, namely rumination and risk-taking, as factors that mediate the relationship between depression and hypomanic personality. In constrast, this study establishes the role of adaptive-coping strategies in reducing vulnerability to experience mania in response to depression. Despite the stated limitations, the current study offers a greater comprehension of the dynamic interaction of factors responsible for increasing vulnerability to mania in response to depression. Clinical interventions may aim to facilitate the use of adaptive-coping styles and minimise the use of maladaptive-coping strategies such as rumination and risk-taking.

Data availability statement

The data that support the findings of this study are openly available on the Open Science Framework at https://osf.io/fcgzj/

Funding Sources

No funding sources to note.

CRediT authorship contribution statement

Connor Bryan O'Reilly: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Project administration, Visualization. **Dr Jay J. Duckworth:** Formal analysis, Writing – review & editing, Visualization, Supervision. **Dr Victoria Vass:** Writing – review & editing, Supervision.

Declaration of Competing Interest

No conflicts of interest to report.

Acknowledgements

No Acknowledgements to note.

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