Response Styles Theory and Internalizing Symptoms in Adolescence: A Network Approach

Running Title: RESPONSE STYLES AND INTERNALIZING SYMPTOMS

Daniel P. Moriarity¹, Mora M. Grehl¹, Lyn Y. Abramson², Lauren B. Alloy¹

¹Department of Psychology, Temple University

²Department of Psychology, University of Wisconsin-Madison

Correspondence concerning this article should be addressed to Lauren B. Alloy,
Department of Psychology, Temple University, Weiss Hall, 1701 N. 13th St., Philadelphia, PA
19122, United States of America. Fax: 1-215-204-5539. E-mail: lalloy@temple.edu.

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Abstract

Background: Response styles theory is a well-supported etiological theory of internalizing psychopathology. However, evidence indicates that the three response styles (rumination, problem-solving, and distraction) are not orthogonal, highlighting the importance of multivariate tests of this theory. Further, different types of symptoms within a disorder can have different risk factors, suggesting that refinement of theory and response style-focused interventions is possible with the help of analyses that go beyond symptom total scores or diagnoses. Methods: A sample of 567 participants ($M_{age}=12.6$ years, 54.1% female) completed measures of response styles, depression symptoms, and anxiety symptoms. A subset of 360 completed these measures a second time (mean/median months apart=18.2/12.4). Internalizing symptoms and response styles were modeled in cross-sectional and cross-lagged panel network models. Results: Rumination was the response style most comorbid with concurrent internalizing symptoms. Social anxiety, negative self-concept, and dysphoria were the symptom domains most comorbid with a classically-defined maladaptive response profile. Distraction was the response style most strongly predictive of future symptoms, whereas negative self-concept, somatic depression, and somatic anxiety were the strongest predictors of future response styles. Conversely, rumination was the response style most strongly predicted by past internalizing symptoms and dysphoria was the symptom subtype most strongly predicted by past response styles. Conclusions: Differential prospective relationships between response styles and symptom subtypes suggest that response style theory, and treatments informed by it, should be conceptualized transdiagnostically and at a more fine-grained level than diagnostic categories.

Keywords: Response style; depression; anxiety; rumination; internalizing symptoms

Introduction

An individual's cognitive response to negative events, thoughts, and emotions is a robust predictor of internalizing psychopathology (Roelofs et al., 2009). In fact, targeting maladaptive response styles, such as rumination, can improve treatment for clients with internalizing psychopathology (Hvenegaard et al., 2020). However, most research uses depression or anxiety symptom total scores. Given evidence that psychiatric symptoms within the same disorder can have different risk factors (Fried et al., 2014), analyses testing the associations between response styles and specific symptom subtypes have the potential to progress theory about cognitive mechanisms of risk and resilience for, as well as recovery from, internalizing psychopathology.

Response Styles Theory

Response styles theory (Nolen-Hoeksema, 1991) proposed that an individual's response to their psychiatric symptoms influences disease course. This theory focused on three specific response styles: rumination, distraction, and problem-solving. Although originally specific to depression, these concepts have been broadly applied to internalizing disorders (Nolen-Hoeksema et al., 2008), consistent with acknowledgement that depression and anxiety are highly comorbid (Clark & Watson, 1991).

Rumination is the passive, persistent focusing on negative affect, its causes and consequences. It is elevated in those with depression and anxiety compared to controls, a difference amplified by comorbidity (Olatunji et al., 2013) and is a transdiagnostic risk factor for internalizing symptoms (Abela et al., 2004; McLaughlin & Nolen-Hoeksema, 2011). Distraction and problem-solving typically are considered adaptive response styles that involve engaging in activities to turn one's attention away from negative affect and actively attempting to change unfavorable situations, respectively. Response style informed interventions focus on fostering a

more “adaptive” response style profile (i.e., less rumination, more distraction and/or problem-solving). Experimental and longitudinal designs have shown that distraction and problem-solving can protect against negative affect and internalizing symptoms (Abela et al., 2004, 2007; Hilt et al., 2010; Roelofs et al., 2009; Zelic et al., 2017). However, distraction and problem-solving sometimes predict worse symptoms (Nolen-Hoeksema et al., 2008). Additionally, different response styles may not be orthogonal (Abela et al., 2007), indicating the need for multivariate analyses simultaneously modeling all response styles.

Fine-grained Analysis

The association between response styles and internalizing psychopathology is well-established; however, the recent growth of symptom-level research highlights an opportunity to refine response styles theory. It is possible that rumination, distraction, and problem-solving are differentially related to components of depression and anxiety. If true, sampling variability in symptom profiles could explain some of the discrepancies between published studies. Importantly, these relationships could be moderated by temporal spacing (e.g., cross-sectional vs. prospective) and/or directionality (response styles → symptoms vs. symptoms → response styles) similar to the relationship between substance use-related impairment and mood symptoms (Moriarity et al., 2020). Thus, investigating the directionality between response styles and internalizing symptoms at several levels of measurement (i.e., total scores vs. subscales) can help refine theory, further understanding of potential treatment mechanisms, and provide insight into conflicting studies.

The Present Study

This study utilizes network analysis to investigate the contemporaneous and prospective associations between response styles and internalizing symptoms. First, models were estimated

with depression and anxiety total scores, and then, subscales, to investigate whether conclusions differed. Identification of central variables (variables with many and/or strong connections to the rest of the network, indexed by bridge expected influence (BEI) and in/out prediction, described below) might highlight potential treatment targets or constructs most likely to predict, or be predicted by, components of the other construct (Elliott et al., 2020).

To elucidate the interplay between response styles and internalizing symptoms, the current study asked: 1) Do different response styles have differential concurrent relationships with internalizing symptoms?; 2) Which response styles most strongly predict future symptoms, and vice-versa?; 3) Which response styles are most strongly predicted by past symptoms, and vice-versa? ; and 4) Are the answers to questions 1-3 equally applicable to all subtypes of depression and anxiety symptoms?

Methods

Participants

This study involved participants from the Adolescent Cognition and Emotion project at Temple University. Adolescents (N=640), aged 12-13 years, and their mothers were recruited from the greater Philadelphia area through a combination of mailings, newspaper advertisements, and calls to families with children attending local middle schools. Inclusion criteria included self-identification as Caucasian/White, African American/Black, or Biracial. Participants were excluded if either the child or mother did not have adequate proficiency in English to complete the assessments or had a severe psychiatric, developmental, or learning disorder (see Alloy et al., 2012). Informed consent was obtained from all participants. The Temple University Institutional Review Board approved the protocol (IRB protocol #6844).

Participants completed self-report measures of response styles and symptoms of depression and anxiety at Time 1 (T1) and Time 2 (T2; mean/median months apart=18.2/12.4, SD=15.1). Given the presence of outliers in time-to-follow-up, models were re-estimated after removing eight outliers with time-to-follow-up values > 3 SD from the mean. The pattern of results was identical to when these cases were included; thus, only results from the full sample are described below. The analytic sample included 567 participants ($M_{age}=12.6$ years at T1, $SD=0.9$ years, 54.1% female, 48.3% White, 48.1% Black, and 3.5% Biracial). At T1, 14.9 % and 21.5 % of participants had a history of depression and anxiety disorders, respectively; whereas 20.5% and 28.6 % of participants in the longitudinal subset had a history of depression or anxiety.

Procedure

At T1, adolescents completed questionnaires assessing depression symptoms, anxiety symptoms, and response styles. Participants were invited for follow-up sessions approximately every 6 months and recompleted the measures of internalizing symptoms; however, response styles only were completed every other visit. Thus, if a participant missed an annual visit in which response styles were scheduled to be measured, they may have had incomplete data for 2+ years. To attempt to reduce variability in time between assessments, the present analysis includes data from the two closest timepoints with complete data for each participant.

Measures

Depression Symptoms. Depression symptoms were measured using the Children's Depression Inventory (CDI; Kovacs, 1985). The CDI consists of 27 items reflecting affective, behavioral, and cognitive symptoms of depression ($\alpha=0.85$). Items are rated on a 0-2 scale. Additionally, five depression symptom subscales were used, in accordance with a meta-analytic

factor structure of the CDI in adolescents (Huang & Dong, 2014). The five subscales were somatic concerns (9 items; $\alpha=0.64$), externalizing (6 items; $\alpha=0.61$), negative self-concept (7 items; $\alpha=0.64$), anhedonia (5 items; $\alpha=0.65$), and dysphoria (4 items; $\alpha=0.65$).

Anxiety Symptoms. The Multidimensional Anxiety Scale for Children (MASC; March et al., 1997) is a self-report questionnaire consisting of 39 items endorsed on a 0-3 scale ($\alpha=.88$). The four subscales were somatic symptoms (12 items; $\alpha=0.84$), harm avoidance (9 items; $\alpha=0.70$), social anxiety (9 items; $\alpha=0.85$), and separation anxiety (9 items; $\alpha=0.68$).

Response Style. The Children's Response Styles Questionnaire (CRSQ; Abela, Vanderbilt, & Rochon, 2004) is a 25-item self-report instrument that measures how youth respond to sad moods and the frequency of such responses. It consists of 25-items rated on a 1-4 scale. The questionnaire contains three subscales: rumination (13 items; $\alpha=0.89$), distraction (7 items $\alpha=0.66$), and problem-solving (5 items; $\alpha=0.72$).

Statistical Analyses

Contemporaneous network estimation. In network models, variables are referred to as “nodes” and “edges” are pairwise associations between nodes controlling for all other associations in the network (Epskamp & Fried, 2016). First, to explore cross-sectional associations among response styles and internalizing symptoms, we estimated two Graphical Gaussian Models (GGMs), using the R package *bootnet* (Version 1.3; CRAN link: <http://cran.r-project.org/package=bootnet>). One GGM included the three response styles and total depression and anxiety scores. The second was identical, except that depression and anxiety subscales were modeled. Because all variables were continuous, models were estimated using Pearson correlations. No variables were significantly skewed (skewness>2) at either time point, so transformation was not necessary.

Recent work suggests that nonregularized models perform better than regularized models for psychopathology data (Williams et al., 2019). Consequently, all models (including temporal models) were nonregularized. Different nodes had different ranges, which could bias parameters. Thus, models were re-estimated with all nodes rescaled to match the node with the smallest potential range in the model. Centrality estimates (BEI and in/out-prediction, described below) were correlated with node variances to evaluate whether they might be driven by measurement characteristics. Large, positive correlations indicate measurement characteristics might be driving estimates and results should be interpreted with caution.

As the primary aim of this study was to explore how response styles influence internalizing symptoms and vice-versa, we estimated one-step BEI using the R package *networktools* (Version 1.2.3; Jones, 2018). One-step BEI quantifies the sum of the edge weights between a node (e.g., rumination) and all nodes from other constructs (e.g., all internalizing symptom subscales). Because the focus of this study was internalizing symptoms broadly, depression and anxiety were considered one construct for the calculation of BEI. In a scenario where edges represent causal connections, nodes with high BEI would be the most likely to influence other constructs or be activated by nodes from an associated construct, and consequently, spread activation within its own construct (Jones et al., 2019). Because problem-solving and distraction typically are considered “adaptive” response styles relative to rumination, they were reverse coded before calculating BEI (and in/out-prediction, described below) of internalizing symptoms, so that high centrality for internalizing symptoms can be interpreted as a strong, positive association with a maladaptive response style profile (i.e., more rumination, less problem-solving and distraction). Otherwise, the expected positive associations between

rumination and internalizing symptoms would be offset by expected negative associations between problem-solving/distraction and internalizing symptoms.

Before interpretation, it is necessary to test centrality parameter stability using a case dropping procedure. This involves identifying the proportion of the sample that can be dropped and result in a .7 correlation between centrality estimates (i.e., BEI) of the original and new samples, resulting in a correlation-stability coefficient. This bootstrapping procedure was executed in the R package *bootnet*. A correlation-stability coefficient of .25 (25% of the sample dropped) is considered adequately stable, and at least .50 is considered stable (Epskamp et al., 2017).

Temporal networks. We also examined cross-lagged panel networks (Rhemtulla et al., 2018) of response styles and internalizing symptoms at T1 and T2 in R package *glmnet* (Version 3.0-2; Friedman et al., 2010). This technique estimates the effects of nodes at T1 on all other nodes at T2, controlling for auto-regressive effects (i.e., regressing each node at T2 on itself at T1). Following Rhemtulla et al. (2018), we first computed within- and between-timepoint coefficients and auto-regressive coefficients with regularized regressions. Cross-lagged (i.e., T1 to T2) edges are directed, meaning it is possible to interpret directionality. The two focal estimates in these models are “in-prediction” (the proportion of variance for a given node at T2 that is accounted for by nodes at T1) and out-prediction (the effect a given node at T1 has on nodes at T2; computed as a sum of squared outgoing standardized regression coefficients). As the primary aim of the longitudinal models was to explore the effect of response styles at T1 predicting internalizing symptoms at T2, and vice-versa, cross-construct effects were calculated, which exclude paths connecting nodes within the same community (e.g., the effect of internalizing symptoms at T1 predicting internalizing symptoms at T2). Similar to BEI, out-

prediction and in-prediction estimates were correlated with node variances at T1 and T2, respectively. Additionally, one model was estimated including depression and anxiety total scores and another included the subscales. The *qgraph* package plotted all networks (contemporaneous and temporal) with identical maximum edge weight values and layouts.

Results

Preliminary Analyses

Sample characteristics and descriptive statistics for all nodes in the networks can be found in Tables 1 and 2, respectively. Correlations between rumination, problem-solving, distraction, total depression symptoms, and total anxiety symptoms are provided in Supplemental Table 1. The sample of 360 participants with complete follow-up measures at T2 did not differ from those without follow-up data based on age, race, sex, total depression symptoms, rumination, or distraction (all $ps > 0.05$). However, the participants with complete data at T2 were less anxious (mean difference = -2.7 points, $p = 0.03$) and engaged in problem-solving more frequently (mean difference = 0.80 points, $p = 0.01$). 27.8% met criteria for a depressive disorder, 4.3% met criteria for an anxiety disorder at one or both visits. Correlations between centrality estimates and node variances indicated variance might be a more serious confound of centrality estimates in the raw models, so only the rescaled models are described below.

Contemporaneous Networks

Bootstrapped correlation-stability analyses for both total score and subscale models found excellent stability for edge weights and BEI (75%). Figures 1 and 2 present the network models, which visualize the associations between the nodes. All associations are positive unless specified otherwise. See Supplemental Tables 2-3 for edge weights.

When symptom total scores were modeled, rumination was the response style with the highest BEI/concordance with internalizing symptoms (Table 2) and depression symptoms had higher concordance with a maladaptive response style profile (i.e., more rumination, less problem-solving and distraction) than anxiety. All BEI parameters were positive. When symptom subscales were modeled, rumination still had the highest BEI of the response styles. However, problem-solving's BEI was negative. Out of the internalizing symptom subscales, social anxiety, negative self-concept, and dysphoria had the highest concordance with a maladaptive response style profile. Additionally, two symptom subscales (harm avoidance and somatic anxiety) had negative BEIs, suggesting concordance with an adaptive response style profile. The correlation between node variance and BEI was large and negative for the model with symptom total scores ($r_s = -.50, p = .45$) and small and negative in the model with symptom subscales ($r_s = -.26, p = .42$), suggesting that BEI in these models was not an artifact of variability.

Temporal Networks

Cross-construct out-prediction. Figures 1 and 2 also show the cross-lagged panel networks. Figure 3 shows cross-construct (response style $\rightarrow$ internalizing symptoms, internalizing symptoms $\rightarrow$ response style) estimates of in-prediction and out-prediction. All associations are positive unless specified otherwise. See Supplemental Tables 4-5 for edge weights. In the model with symptom total scores, distraction had the greatest out-prediction of the response styles, followed by rumination and problem-solving (Table 2). Both distraction and problem-solving predicted fewer internalizing symptoms. Anxiety had a greater out-prediction than depression, but both were higher than any of the response styles. Out-prediction had a nonsignificant, negative correlation with node variance with a large effect size ($r_s = -.90, p = .08$).

When symptom subscales were modeled, the ordinal ranking of the out-prediction of the response styles stayed the same, but problem-solving predicted increased symptoms. Negative self-concept, somatic depression, somatic anxiety, and separation anxiety had the highest out-prediction of the internalizing symptom subscales. Both negative self-concept and separation anxiety predicted a more adaptive response style profile. Out-prediction had a nonsignificant, negative correlation with node variance with a moderate effect size ($r_s = -.44$, $p = .15$).

Cross-construct in-prediction. In the model with symptom total scores, rumination had the highest cross-construct in-prediction of the response styles, followed by distraction, then problem-solving. Both distraction and problem-solving were negatively associated with past internalizing symptoms. Anxiety and depression had comparable cross-construct in-prediction estimates. In-prediction had a non-significant, negative correlation with node variance with a moderate effect size ($r_s = -.30$, $p = .68$).

When symptom subscales were modeled, the ordinal ranking of response style in-prediction remained the same, but problem-solving was positively related to previous internalizing symptoms. Investigation of the edge weights found that this change was driven by positive associations between problem-solving and three out of the four anxiety subscales. Out of the internalizing symptom subscales, dysphoria had, by far, the greatest in-prediction, followed by social anxiety, somatic anxiety, and anhedonia. In-prediction had a significant, positive correlation with node variance with a large effect size ($r_s = .69$, $p = .02$), suggesting that variance might be driving the differences in these rankings.

Discussion

This study extends response styles theory (Nolen-Hoeksema, 1991) by investigating contemporaneous and longitudinal associations between i) rumination, distraction, and problem-

solving and ii) symptoms of anxiety and depression using network analysis. Models estimated using symptom subscales indicated that response styles did not have equal relationships with all symptoms within a diagnostic category (i.e., depression or anxiety). In both cross-sectional models, rumination was the response style most strongly associated with internalizing symptoms, and depression symptoms were more strongly associated with a maladaptive response style profile than anxiety symptoms. Modeling symptom total scores resulted in only positive BEIs among all constructs; however, the model with subscales found negative BEI between a maladaptive response style profile and both somatic anxiety and harm avoidance. This highlights that nuances of the contemporaneous relationship between response styles and anxiety might be missed when analyzing symptom total scores.

Temporal models consistently suggested positive feedback loops between rumination and internalizing symptoms (rumination predicted, and was predicted by, more symptoms), providing additional support for rumination as a risk and maintenance factor for internalizing psychopathology (McLaughlin & Nolen-Hoeksema, 2011). Distraction consistently had inverse relationships with internalizing symptoms, highlighting it as a potentially helpful response style to promote in therapy. Interestingly, problem-solving had the same pattern of associations as distraction in the total score model, but, consistent with the contemporaneous models, was associated with more of certain types of internalizing symptoms when subscales were modeled.

The total score model found larger out-prediction, and lower in-prediction, estimates for internalizing symptoms compared to response styles. This suggests that symptoms primarily function as drivers, rather than outputs, of response styles. However, this conclusion did not hold when modeling symptom subscales. Dysphoria had the highest in-prediction of the subscales, which fits with response styles theory in that an individual's response to negative emotions

influences their disorder course. Additionally, this finding may have been influenced by the fact that the CRSQ items specifically ask how someone responds to feeling sad. It is noteworthy that the symptom subscale with the highest out-prediction, negative self-concept, predicted an adaptive response style profile. The edge-weight matrices show that it positively predicted all three response styles. It had the strongest association with problem-solving, followed by rumination and then distraction. Given that negative self-concept measures cognitive symptoms, it may be associated with higher levels of cognitive responses more generally, additional insight into one's response styles, and/or greater likelihood of endorsing questions involving self-reflection.

These results implicate rumination as both highly comorbid and in a positive feedback loop with internalizing psychopathology. However, distraction was both predictive of, and predicted by, fewer internalizing symptoms, suggesting it might be a particularly effective response style to train in clients with internalizing symptoms and/or ruminative response styles. The relationship between problem-solving and internalizing symptoms was more complicated and differed in direction as a function of symptom subtype, potentially explaining some of the heterogeneity in results when problem-solving is used to predict symptom total scores (Nolen-Hoeksema et al., 2008). The discrepancies between models including total scores vs. symptom subscales highlight that refinement of response styles theory, and its implications for treatment (e.g., what symptoms should improve), is possible by testing it in the context of specific domains of symptoms.

Strengths, Limitations, and Future Directions

This study had several notable strengths. First, it featured longitudinal data, allowing for tests of bidirectional associations between response styles and internalizing symptoms. Second,

aggregate measures were modeled, avoiding concerns about the psychometric properties of single-item measures germane to many network analyses. Third, models were estimated with both symptom total scores and subscales, facilitating comparison to highlight nuance that might be lost in previous studies only assessing symptom total scores. Fourth, given concerns about whether anxiety and depression are orthogonal entities (Clark & Watson, 1991), both depression and anxiety symptoms were modeled transdiagnostically. Fifth, the inclusion of cross-sectional and longitudinal analyses facilitates comparison of results across different time-scales.

It is important to consider the limitations of the current study. Most notably is the large variability in time-to-follow-up. Given the power demands of network analyses, and that conclusions did not change when removing outliers, it was decided to not remove participants based on long time-to-follow-up. However, future research with different time lags (e.g., ecological momentary assessment), and more consistent spacing of visits is necessary. Second, although there are benefits to using aggregate measures, it would have been informative to also estimate models with individual symptoms. Unfortunately, this sample was not adequately powered for longitudinal modeling with individual symptoms. Third, investigating these questions in a community sample maximizes generalizability, but inclusion of a clinical sample would improve clinical relevance. Fourth, the CRSQ items specifically asked how participants responded to feeling sad; thus, it may have been a more relevant measure for depression (specifically dysphoria) symptoms than anxiety. Additionally, although not a limitation, it is important to note that the in-prediction of the model with symptom subscales had a large, positive correlation with node variance, suggesting that the measurement characteristics might be driving the associations.

Conclusion

Results identify rumination as the response style most strongly associated with concurrent internalizing symptoms and that it operates in a positive feedback loop with internalizing symptoms, highlighting rumination as an important target for intervention. On the other hand, distraction consistently showed an inverse relationship with internalizing symptoms, also supporting the utility of this response style as a treatment target. Importantly, the relationship between response styles and internalizing symptoms (particularly problem-solving) differed across symptom subscales, suggesting that potentially important nuances about what response styles might contribute to risk/resilience for internalizing psychopathology might be lost when analyzing symptom total scores.

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Table 1. Summary of Sample Characteristics

Variable	Time 1 (N = 567)	Time 2 (N = 360)
	M (SD) and range for continuous variables or % for categorical variables	
Age	12.6 (0.9)	14.1 (1.5)
Sex		
Female	54.1%	53.1%
Race		
Caucasian	48.3%	47.2%
African American	48.1%	49.2%
Biracial/Other	3.5%	3.6%

Note. M = Mean, SD = Standard deviation

Table 2. Node Descriptives and Estimates

Node	T1 Mean (Variance)	T2 Mean (Variance)	Stability [†]	BEI		CC In (Proportion Variance)		CC Out ($\sum\beta^2$)	
				Total Score	Sub- scales	Total Score	Sub- scales	Total Score	Sub- scales
1. Rumination	24.34 (63.37)	24.80 (66.52)	.58	.71	.76	.11	.06	<.01	.06
2. Distraction	15.80 (14.66)	15.76 (15.19)	.49	.07	.11	.01	.02	.02	.15
3. Problem- solving	11.41 (11.22)	11.73 (12.74)	.51	.11	-.11	.01	.02	<.01	.05
4. Dep. Total Score	7.22 (36.71)	7.24 (41.55)	.53	.73	n/a	.01	n/a	.04	n/a
5. Anxiety Total Score	38.77 (209.56)	36.64 (250.93)	.60	.15	n/a	.01	n/a	.06	n/a
6. Somatic Dep.	2.86 (6.00)	2.69 (5.91)	.51	n/a	.10	n/a	.01	n/a	.03
7. Externalizing Dep.	1.49 (2.89)	1.46 (2.87)	.52	n/a	.04	n/a	.02	n/a	<.01
8. Negative Self- concept	1.85 (3.81)	1.79 (3.58)	.43	n/a	.27	n/a	.02	n/a	.06
9. Anhedonia	1.27 (2.44)	1.48 (2.85)	.41	n/a	.09	n/a	.03	n/a	<.01
10. Dysphoria	.93 (1.75)	1.08 (2.34)	.40	n/a	.19	n/a	.10	n/a	<.01
11. Physical Anxiety	7.41 (34.59)	7.13 (43.30)	.60	n/a	-.05	n/a	.03	n/a	.02
12. Harm Avoidance	16.81 (20.27)	16.23 (20.87)	.53	n/a	-.23	n/a	.02	n/a	.01
13. Social Anxiety	8.86 (35.03)	8.59 (38.69)	.63	n/a	.27	n/a	.04	n/a	.01
14. Separation Anxiety	5.68 (17.12)	4.69 (15.38)	.59	n/a	.08	n/a	.02	n/a	.01

Note: [†] Temporal stability was estimated using Pearson correlations. Mean and variance describe raw values. Italicized numbers indicate in-prediction/out-prediction associations that were negative (in-prediction is proportion variance accounted for, out-prediction is a sum of squared standardized coefficients, neither of which indicate direction of association). Dep = Depression, T1 = Time 1 (Full Sample), T2 = Time 2, BEI = bridge expected influence, CC In = cross-construct in-prediction, CC Out = cross-construct out-prediction.

Figure 1. Nonregularized networks of response styles and internalizing total symptom scores

Note: CLPN = Cross-lagged panel network. Green edges in the networks depict positive associations, red edges represent negative associations, and thicker/more saturated edges depict stronger associations. Edges in the cross-lagged panel networks present cross-time effects and denote the direction of prediction with arrows. Circular paths are auto-regressive associations.

Figure 2. Nonregularized networks of response styles and internalizing symptom subscales

Note: CLPN = Cross-lagged panel network. Green edges in the networks depict positive associations, red edges represent negative associations, and thicker/more saturated edges depict stronger associations. Edges in the cross-lagged panel networks present cross-time effects and denote the direction of prediction with arrows. Circular paths are auto-regressive associations.

Figure 3. Cross-lagged panel network estimates of centrality for networks with symptom total scores (left) and subscales (right).

Note. Cross-Construct in-prediction estimates (top) for a given node at T2 by all nodes in the other construct at T1 (i.e., excludes any path connecting nodes from the same construct) and out-prediction estimates (bottom) for a given node at T1 to all nodes in the other construct at T2. Larger values indicate greater centrality.

Supplemental Table 1. Correlations between Response Styles and Internalizing Symptoms

	T1 Rumination	T1 Distraction	T1 Problem- Solving	T1 Depression	T1 Anxiety	T2 Rumination	T2 Distraction	T2 Problem- Solving	T2 Depression	T2 Anxiety
T1 Rumination	-									
T1 Distraction	-.103*	-								
T1 Problem- Solving	.024	.494**	-							
T1 Depression	.556**	-.206**	-.187**	-						
T1 Anxiety	.432**	-.042	.042	.426**	-					
T2 Rumination	.583**	-.138**	-.038	.413**	.389**	-				
T2 Distraction	-.167**	.490**	.257**	-.217**	-.028	-.206**	-			
T2 Problem- Solving	-.038	.284**	.506**	-.160**	.016	-.050	.499**	-		
T2 Depression	.336**	-.212**	-.155**	.532**	.296**	.616**	-.323**	-.217**	-	
T2 Anxiety	.260**	-.112*	.030	.211**	.604**	.526**	-.079	.033	.486**	-

Note: Sample size for correlations between measures at T1 = 567. Correlations involving T2 measures have a sample size of 360. T1 = Time 1 (Full Sample), T2 = Time 2, * = $p < .05$, ** = $p < .01$.

Supplemental Table 2. Total Symptom Score Contemporaneous Model Edge Weights

	Rumination	Distraction	Problem-Solving	Depression	Anxiety
Rumination	-				
Distraction	0.067	-			
Problem-Solving	0.143	0.475	-		
Depression	0.462	-0.069	-0.194	-	
Anxiety	0.244	0.002	0.088	0.263	-

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Supplemental Table 3. Symptom Subscale Contemporaneous Model Edge Weights

	Rum	Dist	Prob	SomD	ExtD	NSC	Anh	Dys	SomA	Harm	SocA	SepA
Rum	-											
Dist	-0.051	-										
Prob	0.119	0.448	-									
SomD	0.108	0.050	-0.040	-								
ExtD	0.029	-0.062	0.050	0.277	-							
NSC	0.119	-0.030	-0.119	0.443	0.090	-						
Anh	0.000	0.007	-0.101	-0.063	0.084	0.137	-					
Dys	0.232	-0.094	0.134	0.262	-0.036	0.048	0.367	-				
SomA	0.043	0.112	-0.017	0.161	0.066	0.080	-0.003	0.145	-			
Harm	0.055	0.050	0.239	-0.071	-0.176	0.040	-0.030	-0.044	0.008	-		
SocA	0.126	-0.084	-0.062	-0.043	0.042	0.175	0.151	-0.012	0.245	0.142	-	
SepA	0.043	-0.059	0.021	-0.002	-0.095	0.021	-0.017	-0.050	0.240	0.270	0.206	-

Note: Rum = Rumination, Dist = Distraction, Prob = Problem-solving, SomD = Somatic Depression, ExtD = Externalizing Depression, NSC = Negative Self-concept, Anh = Anhedonia, Dys = Dysphoria, SomaA = Somatic Anxiety, Harm = Harm Avoidance, SocA = Social Anxiety, SepA = Separation Anxiety.

Supplemental Table 4. Total Symptom Score Cross-lagged Panel Model Edge Weights

	T2 Rumination	T2 Distraction	T2 Problem- Solving	T2 Depression	T2 Anxiety
T1 Rumination	.478	-.068	-.045	.042	.035
T1 Distraction	-.042	.460	.046	-.085	-.117
T1 Problem-Solving	-.042	.015	.502	-.029	.019
T1 Depression	.127	-.127	-.076	.471	-.052
T1 Anxiety	.238	.047	.008	.120	.666

Note: T1 = Time 1, T2 = Time 2.

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Supplemental Table 5. Symptom Subscale Cross-lagged Panel Model Edge Weights

	T2 Rum	T2 Dist	T2 Prob	T2 SomD	T2 ExtD	T2 NSC	T2 Anh	T2 Dys	T2 SomaA	T2 Harm	T2 SocA	T2 SepA
T1 Rum	0.485	-0.081	-0.050	0.066	0.053	0.044	0.089	0.168	0.015	0.053	0.108	0.060
T1 Dist	-0.043	0.466	0.045	-0.065	-0.101	-0.073	-0.143	-0.201	-0.177	-0.063	-0.138	-0.101
T1 Prob	-0.047	0.015	0.502	-0.038	-0.021	-0.063	0.011	-0.067	-0.015	0.159	-0.004	0.121
T1 SomD	-0.095	-0.070	-0.119	0.335	0.126	0.115	0.183	0.176	0.029	-0.229	-0.119	-0.079
T1 ExtD	0.060	-0.008	-0.022	0.082	0.464	0.143	0.090	0.182	0.090	-0.152	0.054	-0.053
T1 NSC	0.124	0.109	0.168	-0.027	-0.065	0.153	-0.113	-0.068	0.087	0.021	-0.013	-0.005
T1 Anh	0.027	-0.056	-0.004	-0.056	-0.059	-0.021	0.367	0.049	-0.043	0.115	0.027	0.152
T1 Dys	0.012	-0.016	-0.025	-0.007	-0.014	-0.009	-0.071	0.179	-0.120	-0.088	-0.167	-0.064
T1 SomaA	0.116	-0.051	0.022	0.183	0.080	0.107	0.124	0.161	0.671	0.114	0.284	0.085
T1 Harm	0.077	0.007	0.007	0.033	-0.005	0.085	0.064	0.137	0.029	0.391	-0.004	-0.113
T1 SocA	0.042	-0.025	-0.078	0.035	-0.014	0.061	-0.027	-0.038	-0.025	0.037	0.577	0.017
T1 SepA	0.009	0.107	0.059	-0.023	-0.086	-0.051	-0.053	0.035	0.016	0.048	0.007	0.544

Note: T1 = Time 1, T2 = Time 2, Rum = Rumination, Dist = Distraction, Prob = Problem-solving, SomD = Somatic Depression, ExtD = Externalizing Depression, NSC = Negative Self-concept, Anh = Anhedonia, Dys = Dysphoria, SomaA = Somatic Anxiety, Harm = Harm Avoidance, SocA = Social Anxiety, SepA = Separation Anxiety.