Research paper

The association of changes in repetitive negative thinking with changes in depression and anxiety

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A B S T R A C T

Background: Repetitive negative thinking (RNT) is a common feature of different mental disorders in the affective spectrum. Most measures of RNT are disorder-specific and measure e.g. rumination in depression or worry in anxiety.
Methods: In the Netherlands Study of Depression and Anxiety (NESDA), 1820 adults completed the Perseverative Thinking Questionnaire to assess content-independent RNT over a 3-year follow-up period. We investigated the relative stability of content-independent RNT (Perseverative Thinking Questionnaire), over time as well as the association between changes in RNT and changes in affective disorder status (Composite International Diagnostic Interview) and depressive and anxiety severity (Inventory of Depressive Symptomatology, Beck Anxiety Inventory, Fear Questionnaire).
Results: In the total group, baseline RNT was strongly related to RNT three years later, while the difference between the scores at baseline and three years later was negligible. Increases and decreases in RNT were associated with the occurrence and recovery of affective disorders, respectively. Furthermore, changes in RNT between baseline and three years later were associated with corresponding changes in depression, anxiety, and avoidance symptom severity. These associations were small or negligible.
Limitations: Our findings may not be representative of all affective disorders as individuals with an obsessive-compulsive disorder or bipolar disorder were excluded from our sample.
Conclusions: The findings suggest that RNT is not primarily an index of disorder status or epiphenomenon of symptom severity and may constitute a relatively stable transdiagnostic person characteristic.

1. Introduction

Repetitive negative thinking (RNT) has been identified as a transdiagnostic cognitive construct as it is involved in different mental disorders, such as affective disorders (i.e., depressive, bipolar, and anxiety disorders; Ehring and Watkins, 2008; Harvey et al., 2004). It refers to a repetitive, passive and/or relatively uncontrollable, and negative thought process (Ehring and Watkins, 2008). RNT has been referred to as rumination in the literature on depression, while it is referred to as worry in the literature on anxiety. Most research has investigated RNT in such disorder-specific forms. Although there are differences between rumination and worry in features such as the thought content and time orientation (e.g., thoughts of past losses and future potential negative outcomes in rumination and worry, respectively), these constructs have been shown to involve similar processes, share substantial variance, and to be highly correlated (e.g., Arditte et al., 2016; Borkovec et al., 1983; Ehring and Watkins, 2008; Hur et al., 2017; Martin and Tesser, 1996; McEvoy and Brans, 2013; Nolen-Hoeksema et al., 2008; Spinhoven et al., 2015). Furthermore, experimentally manipulated

rumination and worry can both lead to increased levels of depression as well as anxiety (Ehring and Watkins, 2008; Harvey et al., 2004). Taken together, as previous research strongly relied on putative biased disorder- en content-dependent measures of rumination or worry, it may be worthwile that more research is performed to RNT in a content-independent form.

Cross-sectional studies in which RNT has been measured from a content-independent perspective, using either the Repetitive Thinking Questionnaire (RTQ; e.g., Arditte et al., 2016; Mahoney et al., 2012; McEvoy et al., 2014, 2010) or the Perseverative Thinking Questionnaire (PTQ; e.g., Ehring et al., 2012, 2011; Spinhoven et al., 2015), show that content-independent RNT is positively associated with clinical diagnoses of single depression and anxiety disorders and comorbidity among these disorders as well as with symptoms of depression, anxiety, and feelings of anger, shame, and general distress. Moreover, in line with the presupposition that repetitive negative thinking in the form of worry (Borkovec, 1994) and rumination (Moulds et al., 2007) constitute a form of cognitive avoidance, content-independent RNT has been shown to be associated with avoidance (Spinhoven et al., 2015).

Content-independent RNT has also been shown to negatively, but weakly, predict mania symptoms (McEvoy et al., 2018). Taken together, these results suggest that RNT may constitute a vulnerability trait for different forms of psychopathology. However, a limitation of these studies is that no relationships between changes in RNT and changes in psychopathology could be assessed over time because in these cross-sectional or longitudinal studies level of RNT was only assessed once.

Previous research suggests that RNT in the form of rumination is not only a symptom of depression but that it is a construct that is relatively stable over time even in people who experience significant change in their depression levels and that it can be observed beyond an acute depressive episode (e.g., Bagby et al., 2004; Kuehner and Weber, 1999; Merens et al., 2008; Nolen-Hoeksema, 2000; Nolen-Hoeksema et al., 1994, 1993). Bagby et al. (2004) distinguished between absolute (i.e., the degree to which a mean score for a group remains the same over time) and relative (i.e., predictability of individual differences on scores over time) stability. Similar with the findings of Kasch et al. (2001) and Kuehner and Weber (1999), they found that reductions in rumination are accompanied by reductions in depression, which suggests that rumination does not show absolute stability as rumination scores are typically elevated in the context of depressed mood and depressive symptoms. However, evidence of relative stability in the form of high retest correlations of rumination measurements was found. Carnevali et al. (2018) observed that ruminative thinking is a stable trait feature and is positively related to depressive symptoms. In line, research on worry has shown that although worry covaries with level of anxiety, overall worry is a construct that is relatively stable over time (e.g., Constans et al., 2002; Meyer et al., 1990; Muris et al., 2005; Stöber and Bittencourt, 1998).

Although research suggests that RNT is related to depression and anxiety outcomes, we are not aware of studies of the relationship between changes in RNT and the occurrence and recovery of depression and anxiety together with changes in the severity of depression and anxiety symptoms. By using measures of RNT that are disorder- and content-independent, it becomes possible to examine the hypothesis that RNT may primarily constitute an index of disorder status or symptom severity given the high covariation of changes of RNT with changes in psychopathology.

Previously, we published about the predictive value of PTQ scores for the 3-year course of depression and anxiety using data from a large longitudinal cohort study (Spinhoven et al., 2018b). In the present study using PTQ scores from two assessments three years apart, we investigated the association of 3-year changes in PTQ scores with the 3-year onset of and recovery from affective disorders, as well as 3-year changes in symptom severity of depression, anxiety, and avoidance. Based on the existing literature on rumination and worry, we hypothesized that although RNT will not show absolute stability as RNT scores will be somewhat higher in the context of depressive and anxiety symptoms, it will manifest itself as a rather stable characteristic of the person and consequently expected large stability coefficients for RNT (relative stability). Moreover, we hypothesized that content- and disorder-independent measurements of RNT are not an index of disorder status or epiphenomenon of psychopathology and consequently expected small to moderate associations of changes in RNT with changes in psychopathology (i.e., occurrence or recovery of affective disorders and changes in symptom severity).

2. Methods

2.1. Design

The Netherlands Study of Depression and Anxiety (NESDA) is a multi-site naturalistic ongoing cohort study developed to investigate antecedents, course, and consequences of depression and anxiety disorders. A total of 2981 persons aged 18 to 65 years were included,

recruited from the general population ($n = 564$), primary care ($n = 1610$), and mental health organizations ($n = 807$). The NESDA sample consists of healthy controls, persons with a prior history of depression and/or anxiety disorders, and persons with a current depression and/or anxiety disorder. General exclusion criteria were a primary diagnosis of severe psychiatric disorders such as a psychotic disorder, obsessive-compulsive disorder, bipolar disorder, or severe addiction disorder, and not being fluent in Dutch. More information about the framework of the NESDA study can be found somewhere else (see Penninx et al., 2008). The study protocol of NESDA was approved by the Ethical Committees of the participating universities and written informed consent was obtained from all respondents. The framework of this longitudinal cohort study with repeated measurements of core sociodemographic and clinical variables (psychiatric diagnoses and symptom severity) allows to introduce new study variables to assess their concurrent and prospective relationships with other data collected in the NESDA study.

The baseline assessment consisted of an assessment of demographic and personal characteristics, a standardized diagnostic psychiatric interview, and a medical assessment including blood sampling. After two (T2), four (T4), six (T6), and nine (T9) years, a face-to-face follow-up assessment was performed with a response rate of 87.1% ($n = 2596$) at T2, of 80.6% ($n = 2402$) at T4, of 75.7% ($n = 2256$) at T6, and of 69.4% ($n = 2069$) at T9. The PTQ was administered for the first time at T6 and was completed by 2143 of 2256 participants at T6 (95.0%). Of these 2143 participants, 1820 participants completed the PTQ also at T9 (attrition rate = 15.1%), constituting our present sample. We created four subgroups: (a) persons with no affective disorder at T6 and T9 (unaffected group); (b) persons with no affective disorder at T6 and an affective disorder at T9 (occurrence group); (c) persons with an affective disorder at T6 and no affective disorder at T9 (recovery group); (d) persons with an affective disorder at T6 and T9 (chronically affected group).

2.2. Measures

2.2.1. Affective disorder status

The 6-month prevalence of depressive (Major Depressive Disorder [MDD], Dysthymia [DYS]) or anxiety (Panic Disorder with or without Agoraphobia [PD], Social Anxiety Disorder [SAD], Generalized Anxiety Disorder [GAD], Agoraphobia without panic [AGO]) disorders according to DSM-IV criteria (APA, 1994) was established using the Composite Interview Diagnostic Instrument (CIDI-WHO lifetime, version 2.1). The CIDI is a comprehensive, fully standardized instrument for assessing mental disorders according to DSM-IV criteria (APA, 1994). The instrument has shown high interrater reliability, high test-retest reliability, and high validity for depression and anxiety disorders (Wittchen, 1994).

2.2.2. Symptom severity

Severity of depression symptoms was measured using the Inventory of Depressive Symptomatology (IDS; Rush et al., 1986). The IDS is a 30-item self-report measure, assessing depression symptom severity on a 4-point scale ranging from 0 to 3. The IDS has shown to be highly related to the Hamilton Depression Scale (Rush et al., 1996). In the present study, Cronbach's alpha was .89 for the IDS at T6 and .89 at T9. Severity of anxiety symptoms was assessed using the Beck Anxiety Inventory (BAI; Beck et al., 1988). The BAI is a 21-item self-report instrument, measuring anxiety symptom severity on a 4-point scale ranging from 0 to 3. The BAI have been found to have adequate reliability and validity (Osman et al., 2002). In the present study, Cronbach's alpha was .92 for the BAI at T6 and .92 at T9. Severity of avoidance symptoms was measured using the Fear Questionnaire (FQ; Marks and Mathews, 1979). The FQ is a 15-item self-report measure, assessing avoidance symptom severity on 9-point scales ranging from 0 to 8. The Dutch translation of the FQ has good psychometric properties

Table 1
Sociodemographic, clinical, and psychological characteristics of the total sample and the four groups at T6.

	Total sample (n = 1820)		Unaffected (n = 1128)		Occurrence (n = 203)		Recovery (n = 211)		Chronically affected (n = 278)	
	Values	Minimum–maximum values	Values	Minimum–maximum values	Values	Minimum–maximum values	Values	Minimum–maximum values	Values	Minimum–maximum values
Sociodemographic characteristics										
Age, M (SD)	48.3 (13.1)	23–72	48.4 (13.7)	23–72	47.2 (12.1)	23–69	48.9 (12.9)	23–70	48.1 (11.7)	25–71
Female gender, n (%)	1201 (66.0%)		726 (64.4%)		144 (70.9%)		145 (68.7%)		186 (66.9%)	
Years of education, M (SD)	13.0 (3.3)	5–18	13.3 (3.2)	5–18	13.2 (3.3)	5–18	12.3 (3.2)	5–18	12.4 (3.4)	5–18
Clinical characteristics										
IDS, M (SD)	14.8 (11.5)[a]	0–73	9.9 (7.8)	0–47	15.9 (9.8)	1–50	22.9 (10.7)	2–54	27.6 (12.3)[i]	1–73
BAI, M (SD)	8.1 (8.2)[b]	0–53	5.0 (5.4)[d]	0–37	8.7 (6.8)	0–33	12.9 (8.6)[g]	0–46	16.9 (9.9)[j]	0–53
FQ, M (SD)	16.9 (16.9)[c]	0–105	10.8 (11.5)[e]	0–69	18.5 (15.9)[f]	0–84	26.0 (18.1)[h]	0–105	33.6 (20.5)[i]	0–102
Current depression and/or anxiety (CIDI), n (%)	489 (26.9%)		0 (0.0%)		0.0 (0.0%)		211 (100%)		278 (100%)	
Current depression (CIDI), n (%)	297 (16.3%)		0 (0.0%)		0.0 (0.0%)		136 (64.5%)		161 (57.9%)	
Current anxiety (CIDI), n (%)	343 (18.8%)		0 (0.0%)		0.0 (0.0%)		130 (61.6%)		213 (76.6%)	
History of depression (CIDI), n (%)	1259 (69.2%)		626 (55.5%)		172 (84.7%)		200 (94.8%)		261 (93.9%)	
History of anxiety (CIDI), n (%)	1133 (62.3%)		509 (45.1%)		158 (77.8%)		196 (92.9%)		270 (97.1%)	
Psychological characteristic										
PTQ, M (SD)	35.6 (13.4)	15–75	30.6 (11.4)	15–69	37.7 (12.0)	15–75	44.8 (11.1)	18–75	47.0 (11.8)	15–75

Note: IDS = Inventory of Depressive Symptomatology; BAI = Beck Anxiety Inventory; FQ = Fear Questionnaire; CIDI = Composite Interview Diagnostic Instrument; PTQ = Perseverative Thinking Questionnaire;

[a] Two missing data points in the total sample;
[b] Four missing data points in the total sample;
[c] Twenty-three missing data points in the total sample;
[d] Two missing data points in the unaffected group;
[e] Fifteen missing data points in the unaffected group;
[f] Three missing data points in the occurrence group;
[g] One missing data point in the recovery group;
[h] Three missing data points in the recovery group;
[i] Two missing data points in the chronically affected group;
[j] One missing data point in the chronically affected group.

(Van Zuuren, 1988). In the present study, Cronbach's alpha was .89 for the FQ at T6 and .89 at T9.

2.2.3. Repetitive negative thinking

Content-independent RNT was assessed using the Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2012, 2011). The PTQ is a content-independent self-report measure of RNT consisting of 15 items. Participants are asked to rate on a scale ranging from 0 (never) to 4 (almost always) how often each of the items applies to their process of thinking. The instrument is trait-like in nature. Item examples of the key features of RNT include: "The same thoughts keep going through my mind again and again" (repetitive), "Thoughts come to my mind without me wanting them to" (intrusive), "I can't stop dwelling on them" (difficult to disengage from), "I keep asking myself questions without finding an answer" (unproductive), and "My thoughts prevent me from focusing on other things" (capturing mental capacity). Assessment of the psychometric properties of the PTQ, including the Dutch translation, has shown good internal consistency, acceptable test-retest reliability, and good convergent validity (Ehring et al., 2012, 2011). In the present study, Cronbach's alpha was .97 for the PTQ at T6 and .97 at T9.

2.3. Statistical analyses

Change scores were calculated by subtracting PTQ (subscale) scores and symptom severity scores at T9 from T6 scores. To examine whether changes in (dimensions of) RNT would be associated with the occurrence of affective disorders, a binomial logistic regression analysis was performed using the unaffected and occurrence groups as categories of the dependent variable (0 = unaffected group, 1 = occurrence group). To examine whether changes in (dimensions of) RNT would be associated with the recovery of affective disorders, a binomial logistic regression analysis was performed using the recovery and chronically affected groups as categories of the dependent variable (0 = recovery group, 1 = chronically affected group). The reason that we chose to provide the recovery group a value of 0 and the chronically affected group a value of 1 was that the other way resulted in ORs smaller than 1.00 which are not directly interpretable. For the binomial regression analyses, RNT change scores were T9 residualized PTQ change scores corrected for corresponding PTQ T6 (subscale) scores. In order to investigate whether RNT change scores would be associated with symptom severity change scores, multiple linear regression analyses were conducted using symptom change score as dependent variable. All analyses were controlled for age, gender, years of education, corresponding RNT measurements at T6, anxiety symptoms at T6, depression symptoms at T6, avoidance symptoms at T6, and a previous diagnosis of a depressive or an anxiety disorder before T6. Before the binomial logistic regression analyses were performed, the assumption of the linearity was tested by looking at whether the interaction term between continuous independent variables of the model and its log transformation were significant and the assumption of multicollinearity was tested by examination of a correlation matrix of all predictor variables

to assess whether these correlate very highly with each other and by inspecting tolerance and variance inflation factor statistics. Before the multiple linear regression analyses were performed, the assumptions of homoscedasticity and linearity were tested by visual examination of plots of standardized residuals against standardized predicted values, the assumption of independent errors was tested by using the Durbin-Watson test, the assumption of normally distributed errors was tested by visual examination of histograms and normal P-P plots of residuals, and the assumption of multicollinearity was tested similar as with the binomial logistic regression analyses. For both types of analyses, influential cases were detected by inspecting Cook's distance values. Pearson correlations were calculated for relationships between variables at T6 that are continuous, while Spearman's rho correlations were calculated for relationships between variables at T6 of which at least one of the variables in the relationship is dichotomous.

Odds ratios of the binomial logistic regression analyses were interpreted according to the findings of Chen et al. (2010), considering an OR of 1.68 a small effect, 3.47 a medium effect, and 6.71 a large effect. Cohen's f^2 was used to calculate the effect sizes for the multiple linear regression analyses (Cohen, 1988). A f^2 of .02, .15, and .35 was considered a small, medium, and large effect size, respectively. A correlation coefficient of .01, .30, and .50 was considered to have a small, medium, and large effect size, respectively. Cohen's d was used to calculate the effect sizes for the t-tests (Cohen, 1988). A d of .02, .05, and .08 was considered as a small, medium, and large effect size, respectively. No data imputation was applied in case of missing data. All statistical analyses were performed using SPSS version 25.0 (IBM Corp., 2017).

3. Results

3.1. Sample characteristics

Table 1 shows the sociodemographic, clinical, and psychological characteristics of the total sample and the unaffected, occurrence, recovery, and chronically affected group at T6. As can be derived from this table, most of the participants of the NESDA sample had a history of depression and/or anxiety. So, the great majority of the participants who developed a disorder between T6 and T9 (occurrence group) already suffered from depression and/or anxiety in the past. Even of the participants without a disorder at T6 and T9 about half of them had a history of such disorder.

3.2. Stability of repetitive negative thinking

RNT at T6 and T9 for the total sample and the four subgroups is shown in Table 2. In the total group, the rank-order consistency was high ($r = .72$, $p < .001$), while mean-level change between T6 and T9 scores was small ($d = .20$), although statistically significant ($p < .001$). Only the occurrence group showed a moderate and significant increase in PTQ scores ($d = .57$), while the other three subgroups showed negligible to small but significant changes in RNT ($-.18 < d < .27$, all

Table 2
Test of 3-year change in repetitive negative thinking and correlation between repetitive negative thinking at T6 and T9.

	PTQ at T6 M (SD)	Minimum–maximum values	PTQ at T9 M (SD)	Minimum–maximum values	t	p (t)	d	r	p (r)
Total sample (n = 1820)	35.6 (13.4)	15–75	38.2 (13.1)	15–75	11.3	< .001	.20	.72	< .001
Unaffected (n = 1128)	30.6 (11.4)	15–69	33.3 (11.4)	15–75	9.5	< .001	.23	.66	< .001
Occurrence (n = 203)	37.7 (12.0)	15–75	44.5 (11.8)	15–70	8.4	< .001	.57	.54	< .001
Recovery (n = 211)	44.8 (11.1)	18–75	42.9 (10.4)	19–75	-2.8	.006	-.18	.57	< .001
Chronically affected (n = 278)	47.0 (11.8)	15–75	50.1 (11.5)	15–75	5.3	< .001	.27	.66	< .001

Note: PTQ = Perseverative Thinking Questionnaire. The *t* values are results of the paired sample *t*-test on PTQ at T6 and T9, *p* (*t*) values are for the difference between the PTQ at T6 and T9 by the paired sample *t*-test, *d* indicates Cohen's *d*, *r* indicates the relationship between PTQ at T6 and T9, and *p* (*r*) values are for correlation between PTQ at T6 and T9.

Table 3

Correlations between variables of the study at T6 (n = 1820).

	Age	Gender (0 = male, 1 = female)	Years of education	IDS[a]	BAI[b]	FQ[c]	Current depression and/or anxiety (CIDI) (0 = no, 1 = yes)	Current depression (CIDI) (0 = no, 1 = yes)	Current anxiety (CIDI) (0 = no, 1 = yes)	History of depression (CIDI) (0 = no, 1 = yes)	History of anxiety (CIDI) (0 = no, 1 = yes)	PTQ
Age												
Gender (0 = male, 1 = female)	-.07**											
Years of education	-.21***	.03										
IDS[a]	.10***	.07**	-.21***									
BAI[b]	.07**	.11***	-.21***	.79***								
FQ[c]	.02	.09***	-.16***	.59***	.59***							
Current depression and/or anxiety (CIDI) (0 = no, 1 = yes)	.00	.02	-.11***	.54***	.50***	.46***						
Current depression (CIDI) (0 = no, 1 = yes)	.00	-.01	-.07**	.48***	.38***	.34***	.73***					
Current anxiety (CIDI) (0 = no, 1 = yes)	-.02	.02	-.13***	.42***	.44***	.42***	.80***	.36***				
History of depression (CIDI) (0 = no, 1 = yes)	.02	.07**	-.11***	.47***	.40***	.31***	.33***	.30***	.24***			
History of anxiety (CIDI) (0 = no, 1 = yes)	.01	.06**	-.12***	.47***	.45***	.41***	.41***	.27***	.38***	.44***		
PTQ	.00	.07**	-.03	.65***	.56***	.54***	.47***	.41***	.38***	.39***	.44***	

Note: $^*p \le .05$, $^{**}p \le .01$, $^{***}p \le .001$; IDS = Inventory of Depressive Symptomatology; BAI = Beck Anxiety Inventory; FQ = Fear Questionnaire; CIDI = Composite Interview Diagnostic Instrument; PTQ = Perseverative Thinking Questionnaire;

[a] Two missing data points in the total sample;

[b] Four missing data points in the total sample;

[c] Twenty-three missing data points in the total sample.

Table 4

Binomial logistic regression analysis with 3-year changes in (dimensions of) repetitive negative thinking as independent variable and the occurrence and recovery of an affective disorder as dependent variable.

		Crude OR	95% CI	Adjusted OR[a]	95% CI
Occurrence affective disorder (0 = unaffected group, 1 = occurrence group)	Total score	1.51	1.30, 1.76	2.04	.1.70, 2.45
	Core features	1.43	1.23, 1.67	1.94	1.61, 2.34
	Unproductiveness	1.39	1.20, 1.62	1.85	1.53, 2.22
	Mental capacity	1.56	1.34, 1.81	2.12	1.77, 2.54
Recovery affective disorder (0 = recovery group, 1 = chronically affected group)	Total score	1.70	1.39, 2.08	2.23	1.75, 2.86
	Core features	1.70	1.39, 2.08	2.26	1.76, 2.90
	Unproductiveness	1.53	1.27, 1.85	1.81	1.43, 2.28
	Mental capacity	1.48	1.23, 1.77	1.87	1.48, 2.36

Note: OR = Odds Ratio; 95% CI = 95% Confidence Interval;

[a] Adjusted for age, gender, years of education, corresponding RNT measurements at T6, anxiety symptoms at T6, depression symptoms at T6, avoidance symptoms at T6, and a previous diagnosis of a depressive disorder or an anxiety disorder before T6. p values are for the difference between the groups by analysis of variance.

$ps < .001$ except for change in the recovery group, $p < .01$). The association between T6 and T9 PTQ scores was also large and significant in each of the subgroups ($.54 < r < .66$). Table 3 shows the correlations between the variables at T6, which are provided for meta-analytic purposes.

3.3. Association between changes in repetitive negative thinking and changes in disorder status

Assumptions of the linear regression analyses were met and results of testing these assumptions can be found in the supplementary materials. Table 4 shows the result of binomial regression analyses of 3-year change in (dimensions of) RNT on 3-year occurrence and recovery of an affective disorder, adjusted for age, gender, years of education, corresponding RNT measurements at T6, anxiety symptoms at T6, depression symptoms at T6, avoidance symptoms at T6, and a previous diagnosis of a depressive or an anxiety disorder before T6. We found a small but significant association between 3-year increase in RNT and 3-year occurrence of an affective disorder (OR = 2.04, 95% CI = 1.70, 2.45). Similarly, we found a small but significant association between 3-year increase in RNT and 3-year maintenance of an affective disorder (OR = 2.23, 95% CI = 1.75, 2.86), meaning that a 3-year increase in RNT is 2.23 times more likely to result in the maintenance of an affective disorder than recovery of an affective disorder. Repeating these analyses using PTQ subscale scores yielded similar results (see Table 4).

3.4. Association between changes in repetitive negative thinking and changes in symptom severity

Assumptions of the linear regression analyses were sufficiently met

and results of testing these assumptions can be found in the supplementary materials. Table 5 shows the results of multiple linear regression analyses of 3-year change in RNT on 3-year changes in symptoms, adjusted for age, gender, years of education, RNT at T6, anxiety symptoms at T6, depression symptoms at T6, avoidance symptoms at T6, and a previous diagnosis of a depressive or an anxiety disorder before T6. We found a small but significant association between 3-year changes in RNT and corresponding 3-year changes in depressive symptoms ($\beta = .44$, $t = 19.9$, $p < .001$, $f^2 = .22$) with larger increases in RNT associated with larger increases in depression severity. Moreover, we found a negligible but significant association between 3-year changes in RNT and corresponding 3-year changes in symptoms of anxiety ($\beta = .31$, $t = 13.3$, $p < .001$, $f^2 = .10$) and avoidance ($\beta = .30$, $t = 12.4$, $p < .001$, $f^2 = .09$) with larger increases in RNT associated with larger increases in anxiety and avoidance symptoms. Repeating these analyses using PTQ subscale scores yielded similar results (see Table 5).

4. Discussion

The aim of the present study was to investigate the temporal stability of RNT and the association of changes in RNT with changes in psychopathology. We expected large stability coefficients for content- and disorder- independent PTQ scores and small to moderate associations of changes in RNT with changes in affective disorder status and symptom severity. In accordance with our hypotheses, in the total group we found that PTQ scores were relatively stable over time and showed negligible mean-level changes. Also, in the four subgroups (i.e., the unaffected group, occurrence group, recovery group, and chronically affected group) PTQ scores proved to be highly stable. Moreover,

Table 5

Multiple linear regression analysis with 3-year changes in (dimensions of) repetitive negative thinking as independent variable and 3-year changes in depression, anxiety, and avoidance severity as dependent variable.

		Unadjusted β	SE	p	Adjusted β [a]	SE	p
Depression symptoms	Total score	.39	.018	< .001	.44	.018	< .001
	Core features	.35	.251	< .001	.40	.255	< .001
	Unproductiveness	.34	.226	< .001	.40	.237	< .001
	Mental capacity	.36	.229	< .001	.43	.233	< .001
Anxiety symptoms	Total score	.28	.014	< .001	.31	.015	< .001
	Core features	.26	.204	< .001	.29	.208	< .001
	Unproductiveness	.22	.185	< .001	.26	.193	< .001
	Mental capacity	.25	.188	< .001	.28	.192	< .001
Avoidance symptoms	Total score	.25	.025	< .001	.30	.026	< .001
	Core features	.24	.352	< .001	.28	.369	< .001
	Unproductiveness	.21	.318	< .001	.27	.342	< .001
	Mental capacity	.21	.324	< .001	.28	.342	< .001

Note: β = standardized beta;

[a] Adjusted for age, gender, years of education, corresponding RNT measurements at T6, anxiety symptoms at T6, depression symptoms at T6, avoidance symptoms at T6, and a previous diagnosis of a depressive disorder or an anxiety disorder before T6. p values are for the difference between the groups by analysis of variance.

we found evidence that changes in affective disorder status and symptom severity were associated with corresponding changes in PTQ scores, but that the size of these associations was negligible to small.

This is the first study showing that RNT remains relatively stable over a 3-year time period and that this stability can be observed in unaffected and chronically affected participants as well as in participants with disorder occurrence or remittance. These results suggest that RNT is not only an epiphenomenon or severity index of psychopathology. However, as expected, reductions in content-independent RNT were associated with reductions in symptom severity, which is consistent with previous studies that found that rumination and worry scores tend to decrease when depression and anxiety scores decrease (Bagby et al., 2004; Kasch et al., 2001; Kuehner and Weber, 1999; Muris et al., 2005). In a cross-sectional study, RNT was shown to be related to avoidance symptoms (Spinhoven et al., 2015). Our study adds to this finding by showing that there is also an association between changes in RNT and changes in avoidance symptom severity. In analyzing dimensions of RNT [i.e., (a) key features of RNT (such as repetitiveness, intrusiveness and difficulty to disengage from), (b) perceived unproductiveness of RNT, and (c) capturing mental capacity] the association of changes in psychopathology with changes on dimensions of RNT was very similar. The structure of the PTQ is best presented by a second-order single-factor for RNT with three lower-order dimensional factors and our results suggest no differential effects on a particular dimension of RNT.

It is important to note that the size of associations of changes in RNT with changes in psychopathology was negligible or small. Notwithstanding a relatively high stability, level of RNT seems to be somewhat heightened with disorder occurrence. In the absence of a third assessment, it remains unknown to what extent this effect normalizes after remittance, although the relatively small reduction in PTQ scores in the remittance group suggests the possibility of scarring effects. Of note are further the negligible associations between changes in RNT and changes in avoidance and anxiety symptom levels, while a small effect size was found for the association between changes in RNT and changes in depression symptom levels. This finding is in line with multiple studies in which a stronger association was shown for the link between RNT and depressive symptoms than for the link between RNT and anxiety symptoms (e.g., Mahoney et al., 2012; McEvoy et al., 2014, 2010; Spinhoven et al., 2018, 2015). However, some studies found a stronger association between RNT and anxiety symptoms (e.g., Ehring et al., 2012, 2011). In the study of Arditte et al. (2016), it depended on the factors in the model whether depression or anxiety was stronger related to RNT. Based on these findings, we cannot conclude for which disorder RNT is more relevant.

As we found that content-independent RNT is a relatively stable construct and previous research suggests that RNT may constitute an important transdiagnostic factor responsible for the co-occurrence of anxiety and depressive disorders and their symptom severity (Spinhoven et al., 2018b), it may be useful to include "trait-oriented" interventions to optimize treatment effects (Bruce and Steiger, 2005). A recent meta-analysis of RCTs of the effect of any type of treatment for depression on RNT (Spinhoven et al., 2018a) showed that in particular cognitive behavioral therapy (CBT) may have a more pronounced effect on RNT than other types of interventions and that the effect on RNT is strongly associated with the effect depression. Interestingly, the association of reductions in RNT with reductions in depression seems mainly driven by RNT-focused CBT studies explicitly focusing on reducing RNT. These results are consistent with the habit model of rumination (Watkins and Nolen-Hoeksema, 2014), according to which the amount of rumination can be reduced either through changing the underlying habit by learning new responses to the triggers of the habit (such as depressed mood) or by temporarily reducing the expression of the habit by temporarily removing its triggers (i.e., by alleviating low mood). Possibly, CBT and in particular RNT-focused treatments thereby change the underlying habit fostering treatment gains and making

individuals less vulnerable to relapse or recurrence because RNT will be less likely reactivated once stress or low mood occurs again.

Strengths of the present study were the large sample size, the multisite, longitudinal, and naturalistic cohort design, and the structured diagnostic assessment procedures. However, some limitations of the study should also be mentioned. First, only two assessment points, T6 and T9, were used in this study because content-independent RNT was only measured at these points in the NESDA study. Advanced statistical modeling techniques such as latent state-trait models requiring preferably four or more time points covering short- as well as long-term follow-up are able to distinguish between "state variability (i.e., short-term and typically reversible changes in individual's true state scores that fluctuate around an invariant trait level) or trait change (i.e., long-term and typically irreversible modifications to individual's trait scores)" (Geiser et al., 2015, p. 191). Consequently, the present study based on two time points covering three years cannot determine whether the changes found constitute state variability or trait change. Second, notwithstanding the relatively large sample, the size of the occurrence, recovery, and chronically affected subgroups did not allow to differentiate between pure depression or anxiety disorder and comorbid depression and anxiety disorder with sufficient statistical power. Third, the findings may not be representative of all affective disorders as people with an obsessive-compulsive disorder or bipolar disorder were excluded from the sample. Fourth, the results may be subject to social desirability and response bias because of the use of self-report instruments in our study. Fifth, our study presupposes stable, between-person differences in RNT that are invariant over time and unaffected by situational influences such as presence or severity of psychopathology. This contrasts with recent integrative approaches to personality that combines within-person and between-person differences (e.g., Sosnowska et al., 2019) Future studies with more frequent repeated measurements are needed allowing more fine grained analysis to capture possible dynamic changes in personality states from such a more integrative perspective.

To conclude, we found that content-independent RNT remained relatively stable over a 3-year time period and that changes in RNT were only weakly associated with changes in affective disorder status and symptom severity. The findings suggest that RNT is not primarily an index of disorder status or epiphenomenon of symptom severity and may constitute a relatively stable transdiagnostic person characteristic.

Declarations of Competing Interest

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2020.07.002.

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