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Are Rumination and Worry Two Sides of the Same Coin? A Structural Equation Modelling Approach

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Abstract

Worry and rumination are two types of Repetitive Negative Thinking (RNT) that have been shown to be related to the development and maintenance of emotional problems. Whereas these two forms of RNT have traditionally been regarded as distinct and differentially related to psychopathology, researchers have recently argued that worry and rumination share the same process and show a very similar relationship to different forms of psychopathology. In a series of three studies, we employed a structural equation modelling approach to compare these competing hypotheses. Results showed that a bi-factor model (representing RNT by one latent factor with two uncorrelated method factors) provided a better fit to the data than a two-factor model (with worry and rumination represented by separate factors). In addition, the shared variance within the bi-factor model fully accounted for changes in symptom levels of depression and anxiety in two prospective studies. These findings support a transdiagnostic account of RNT. Implications for theory, measurement and clinical practice are discussed.

Keywords: Repetitive Negative Thinking, Worry, Rumination, Transdiagnostic, Structural Equation Modelling

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Introduction

Repetitive Negative Thinking (RNT) is a perseverative cognitive activity, negative in valence and difficult to control (Ehring & Watkins, 2008). Evidence for elevated levels of RNT has been demonstrated for almost all anxiety and anxiety related disorders, mood disorders, insomnia, substance abuse, psychosis (Ehring & Watkins, 2008; Harvey, Watkins, Mansell, & Shafran, 2004), and there is emerging evidence that individuals with personality disorders also show increased levels of RNT (Baer, Peters, Eisenlohr-Moul, Geiger, & Sauer, 2012; Spinhoven, Bamelis, Molendijk, Haringsma, & Arntz, 2009). These findings suggest that RNT is a transdiagnostic process that cuts across the boundaries of psychological disorders. In addition, RNT is also present in individuals not suffering from psychopathology, and differences in RNT between non-clinical and clinical samples have been described as quantitative rather than qualitative (Watkins, 2008).

Despite the ubiquity of RNT in everyday life and psychopathology, RNT has traditionally not been studied as a unitary phenomenon. Instead, a diagnosis-specific approach distinguishing between different forms of RNT has mostly been taken to investigate this phenomenon. Various disorder-specific types of RNT have been defined, and measures have been designed to explore relationships with symptoms. The two most intensively studied types of RNT are worry and depressive rumination. Worry is the hallmark feature of generalized anxiety disorder and has been defined as a predominantly verbal thought activity, negatively affect-laden, relatively uncontrollable, and focused on uncertain events with the potential for future negative outcome (Borkovec, Robinson, Pruzinsky, & Depree, 1983; Borkovec, 1994; Borkovec, Ray, & Stöber, 1998). Rumination has mainly been studied in the context of depression and refers to a type of repetitive thinking in response to sad mood, whereby the individual dwells on the causes, meaning and implications of their mood, as well as problems and events from the past (Nolen-Hoeksema & Morrow, 1991). Although there is general consensus that worry and rumination are related, there is an ongoing debate about the extent to which both processes overlap. Whereas some researchers make the transdiagnostic claim that worry and rumination are essentially the same process that is simply applied to different content (e.g., Ehring & Watkins, 2008; Segerstrom, Tsao, Alden, & Craske, 2000; Watkins, 2008), other researchers favour a disorder-specific account and suggest that both processes are correlated, but distinguishable, and bear a different relation to psychopathological symptoms (e.g., Fresco, Frankel, Mennin, Turk, & Heimberg, 2002).

Several researchers have investigated the content of worry and rumination to study the differences between both processes. The only stable difference that has been consistently found pertains to the temporal orientation (Papageorgiou & Wells, 1999; Watkins, 2004; Watkins, Moulds, & Mackintosh, 2005); whereas worry is predominantly focused on the future, rumination is predominantly focused on the past. Past studies do however indicate that thoughts about the future correlate more highly with anxiety than depression, whereas thoughts about the past correlate more highly with depression than anxiety (Beck, Brown, Steer, Eidelson, & Riskind, 1987; Finlay-Jones & Brown, 1981; Kendall & Ingram, 1989). Yet, repetitive thought content is not stable over time (Roach, Salt, & Segerstrom, 2010), and worry and rumination appear to be generative of one another. For example, it has been found that the content of worry eventually also refers to negative aspects of a past or present situation, and thus seems to trigger rumination (Szabó & Lovibond, 2002).

Other researchers have investigated the similarities and differences between worry and rumination from a functional perspective. In line with a transdiagnostic account, it has been argued that worry and rumination serve the same purpose to an individual. For example, worry and rumination share an abstract, overgeneral thinking style (Stöber, Tepperwien, & Staak, 2000; Watkins & Teasdale, 2001) that people may engage in to avoid emotional processing and distressing somatic sensations (Borkovec & Hu, 1990; Dickson, Ciesla, & Reilly, 2012). In line with a disorder-specific account, others favour a position that ascribes different functions to worry and rumination. For example, it has been argued that the content of rumination focuses on the core negative affect and concerns whereas worry intends to avoid these topics (Nolen-Hoeksema, Wisco, Lyubomirsky, 2008). Rumination may therefore provide an individual with evidence that their situation is uncontrollable and that it is useless to take further action. This stance may help an individual to justify withdrawal and inactivity and signals to the social environment that support is needed. Although these different points of view explicate possible functions of worry and rumination, they have not been compared against each other within a single study which makes it difficult to clarify the extent of overlap in functions.

Researchers have also taken a factor-analytic approach to investigate the similarities and differences between worry and rumination. Typically, these types of studies have used the gold-standard measures of worry (Penn State Worry Questionnaire; Meyer, Miller, Metzger, & Borkovec, 1990) and depressive rumination (Ruminative Response Scale; Nolen-Hoeksema & Morrow, 1991) to compare different factor solutions. Results of a series of studies showed that the constructs of worry and rumination could be distinguished, with all RRS and PSWQ items almost exclusively loading on separate factors in a variety of populations (D'Hudson & Saling, 2010; Fresco et al., 2002; Goring & Papageorgiou, 2008; Muris, Roelofs, Meesters, & Boomsma, 2004; Rood, Roelofs, Bögels, & Alloy, 2010). Although these findings are often interpreted as evidence that measures of worry and rumination assess distinct processes, it cannot be ruled out that the results are simply due to methodological artefacts such as item confounds and criterion contamination (Ehring & Watkins, 2008). For example, the emergence of two separate factors could merely be a consequence of the fact that all items in the PSWQ include the word "worry", that several RRS items include a reference to depression symptoms, and that items of the RRS are preceded by the specific instruction to answer with respect to moments when the respondent felt sad, down or depressed. Recent studies have attempted to eliminate these artefacts; interestingly, results showed that the distinction between worry and rumination disappeared and items of the PSWQ and the RRS loaded on a general construct of repetitive thinking (McEvoy & Brans, 2013; McEvoy, Mahoney, & Moulds, 2010; however, note that D'Hudson & Saling, 2010, *reduced* method variance and obtained a factor structure that was more supportive of a distinction between worry and rumination).

A different approach to investigate similarities and differences between worry and rumination has been to compare the cross-sectional relationship of both constructs to symptoms of psychopathology. Results from this line of research are mixed. The majority of studies showed that worry and rumination are equally strongly related to symptoms of depression and anxiety (e.g., D'Hudson & Saling, 2010; Fresco et al., 2002; Goring & Papageorgiou, 2008; McEvoy & Brans, 2013; Muris et al., 2004; Rood et al., 2010; Segerstrom et al., 2000), and insomnia (Mitchell, Mogg, & Bradley, 2012). In contrast, other studies have found that worry is more strongly related to depression and anxiety (Hoyer, Gloster, & Herzberg, 2009) and alcohol abuse (Ciesla, Dickson, Anderson, & Neal, 2011) than rumination, whereas rumination is more strongly related to insomnia than worry (Carney, Harris, Moss, & Edinger, 2010). This inconsistent pattern has also been found in cross-sectional mediation studies. There is

some evidence that both worry and rumination partially mediate the relationship between neuroticism and anxiety, and fully mediate the relationship between neuroticism and depression (Muris, Roelofs, Rassin, Franken, & Mayer, 2005). Yet, other studies have found that worry plays a larger mediating role in the relationship between anxiety and self-compassion (Raes, 2011), exclusively mediates the relationship between anxiety and neuroticism (Verstraeten, Bijttebier, Vasey, & Raes, 2011), and between anxiety and intolerance of uncertainty (Yook, Kim, Suh, & Lee, 2010), whereas rumination exclusively mediates the relationship between these constructs and depression.

Longitudinal studies investigating the specificity of worry and rumination in the development of psychopathology are sparse. In one study, worry has been found to predict both anxious and depressive symptomatology one month later, whereas rumination only predicted depressive symptomatology (Hong, 2007). Moreover, the pathways through which worry and rumination predicted symptom levels of anxiety and depression differed; the relationship between worry and anxious and depressive symptomatology was mediated by low perceived coping effectiveness, whereas the relationship between rumination and depressive symptomatology was mediated through disengagement of problem solving. Yet, other studies pointed towards similarities between worry and rumination, and found that both thought processes predicted anxiety symptoms 6 to 8 weeks later, whereas neither thought process predicted depression symptoms (Calmes & Roberts, 2007). Similarly, a structural equation modelling approach demonstrated that both thought processes combined predicted anxiety (but not depression) one week after an exam, without any additional variance explained by worry and rumination separately (Segerstrom et al., 2000).

In sum, previous research on the difference between worry and rumination has been inconclusive. We hold that this may be due to several methodological weaknesses within this field that make it difficult to interpret a lot of the findings in a conclusive way. First, studies have typically relied on diagnoses-specific measures of RNT that may artificially emphasize distinctions rather than commonalities among worry and rumination (see also McEvoy & Brans, 2013). When these sources of method variance are diminished, studies tend to demonstrate an opposing pattern which indicates that worry and rumination share the same process (McEvoy & Brans, 2013; McEvoy et al., 2010). Yet, studies that do account for method variance are still sparse and therefore need to be replicated.

Second, when assessing potential differences between worry and rumination, researchers have typically relied on Classical Test Theory (CTT). In CTT, the items of a given scale are summed and used as a proxy for the underlying psychological construct in the statistical analyses. The limitations of this approach are increasingly being recognized in the literature (see e.g., Borsboom & Mellenbergh, 2002)). Importantly, summing item scores neglects the differences in the amount of information provided by the individual items about the individual difference on the underlying construct. In addition, person and item characteristics are not separated. Therefore, conclusions about the statistical analyses will depend on the sample characteristics and the item characteristics. Finally, no explicit statistical model is formulated nor tested, and it therefore remains unclear whether the CTT approach is an appropriate method for the data at hand. In addition, the CTT approach cannot test competing models. An alternative to CTT is Modern Test Theory (MTT). In MTT (Van der Linden & Hambleton, 1996), scores on the individual items are explicitly taken into account, person and item effects are separated and models can be falsified and/or compared to competing models.

Third, the literature to date is seriously limited by the scarcity of longitudinal studies testing whether worry and rumination are differentially related to the development of various disorders. Furthermore, in the few longitudinal studies that have been conducted the time between measurements was typically very short (less than 2 months). As a consequence, symptom measures at each measurement were highly correlated, leaving little room for residual variance that can be explained by additional variables such as worry and rumination (Segerstrom et al., 2000). Therefore, more time should be left between successive measurements. However, as time between measurements increases, it is essential to establish that differences in item scores over time reflect differences on the underlying constructs over time (e.g., Wicherts et al., 2004)) rather than a change in the measurement properties. This so-called assumption of measurement invariance (Meredith, 1993) is often ignored and should be tested to ascertain that changes across time can be reliably attributed to changes in the underlying construct (Horn & McArdle, 1992). In short, measurement invariance requires that on item level, model parameters are equal

across time (i.e., the factor loadings and the thresholds) while allowing for mean differences over time on the level of the construct.

Apart from longitudinal studies with longer intervals, research on the differences between worry and rumination could also benefit from longitudinal studies assessing the interaction between context and RNT. A key assumption of the transdiagnostic model is that the content of RNT varies as a function of contextual factors to produce a variety of psychopathological symptoms (Nolen-Hoeksema & Watkins, 2011). That is, the tendency to engage in RNT may result in different symptom presentations depending on the type of environmental conditions an individual is confronted with. For example, RNT in the context of an important interpersonal loss is likely to lead to symptoms of depression, whereas RNT in the context of a job interview is likely to lead to symptoms of anxiety. To our knowledge, this hypothesis has not directly been tested to date.

The series of studies described in this article used structural equation modelling to test whether worry and rumination are more appropriately conceptualized as distinct but correlated constructs versus as one unitary construct. Following the factor-analytic approach used in McEvoy and Brans (2013), we addressed the methodological limitations of earlier research by accounting for sources of method variance. In addition, we used MTT instead of CCT, we investigated the longitudinal relationship between RNT and symptom severities with longer time intervals between assessments and by investigating the impact of context, while testing the assumptions of method invariance.

In Study 1, a factor-analytic approach was employed over the RRS and the PSWQ and different models informed by disorder-specific and transdiagnostic accounts of RNT were compared using structural equation modelling. In Studies 2 and 3, longitudinal designs were employed to investigate the prospective relationship of a general RNT factor versus measurement-specific worry and rumination factors to symptoms of anxiety and depression. In both studies, measurement invariance was taken into account.

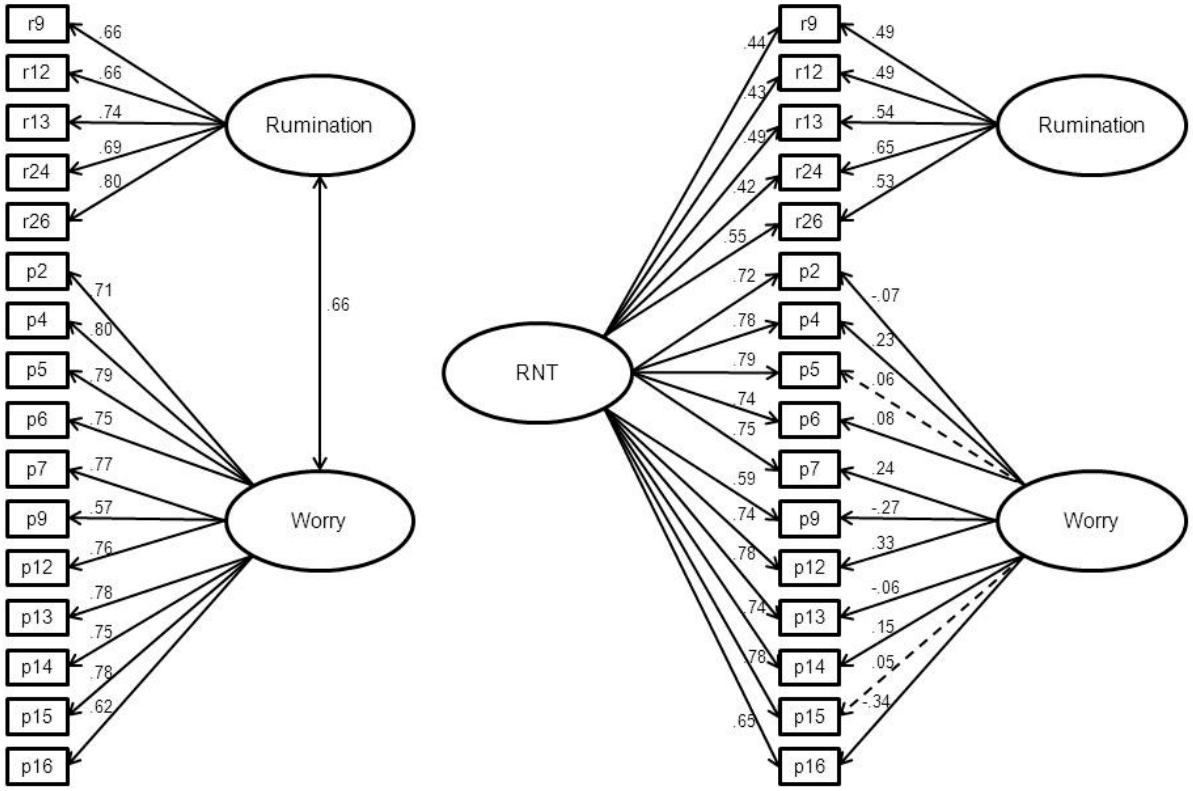
Study 1

In this study, two different models on the relationship of worry and rumination were compared in a large sample of adolescents. These models are identical to the ones used by McEvoy and Brans (2013). The first model was termed two-factor model and represents the traditional view that worry and rumination are distinct but correlated processes, see Figure 1 on the left. The second model, termed bi-factor model follows the transdiagnostic conceptualization of RNT. In the bi-factor model, the observed PSWQ items and the observed RRS items are all indicators of a common RNT factor. This RNT factor represents the construct of relevance for the association between RNT and psychopathology. The bi-factor model also includes an additional factor for the PSWQ items separately and an additional factor for the RRS items separately, see Figure 1 on the right (see also McEvoy & Brans, 2013). Importantly, however, these two measurement-specific factors were assumed to be uncorrelated and to reflect the method variance associated with each questionnaire. Adopting a transdiagnostic perspective, we hypothesized that the bi-factor model would show a better fit to the data than the two-factor model.

Methods

Participants and procedure.

The sample of this study consisted of 3,906 adolescents (53.2% female) from 13 secondary schools in The Netherlands. The mean age in this sample was 15.85 (*SD* = 0.88; range: 14-19). All adolescents filled out the PSWQ and the RRS between January 2010 and January 2011 as part of a recruitment procedure for a randomized controlled trial evaluating a selective prevention program.



Two-factor model **Bi-factor model**

Figure 1: Standardized regression weights and correlation coefficient for the two-factor model and the bi-factor model. Dashed lines indicate non-significant (p > 0.05) factor loadings. r = RRS-item, p = PSWQ-item.

Measures.

Penn State Worry Questionnaire (PSWQ).

The PSWQ (Meyer et al., 1990) was developed to measure aspects of clinically significant worry. It measures the tendency, intensity and uncontrollability of worry and consists of 16 items rated on a 5-point Likert scale, with values ranging from 1 (not at all typical of me) to 5 (very typical of me) (sample items: “I am always worrying about something”; “I worry about projects until they are all done”). The PSWQ has been shown to possess high internal consistency in clinical and non-clinical samples (α = .88 - .95), good test-retest reliability in various samples (r = .74 - .92), and good convergent and discriminant validity (Meyer et al., 1990). Research examining the factor structure of the PSWQ has indicated that a two-factor structure provides a better fit than the originally intended one-factor structure (Van Rijsoort, Emmelkamp, & Vervaeke, 1999). The second factor, however, exclusively consists of negatively worded items, and can be considered a statistical artefact rather than a meaningful construct (Brown, 2003; Hazlett-Stevens, Ullman, & Craske, 2004). We therefore used the 11-item version of the PSWQ which only consists of the positively worded items. The 11-item version has been found to be just as or even more reliable and valid than the original version (Hazlett-Stevens et al., 2004). Cronbach’s α in this study was .90.

Ruminative Response Scale (RRS).

The RRS (Nolen-Hoeksema & Morrow, 1991) is a subscale of the Response Styles Questionnaire and consists of 22 items on a 5-point Likert-type scale, with values ranging from 1 (almost never) to 4 (almost always). It assesses the tendency to respond to depressed mood (sample items: “Think why can’t I handle things better; “Think why do I

have problems that other people don't have?"). Only the five items of the brooding subscale (Treynor, Gonzalez, & Nolen-Hoeksema, 2003) were used for analyses as this scale is uncontaminated with depressive item content and possesses adequate reliability (Schoofs, Hermans, & Raes, 2010). Cronbach's α was .78 in this study.

Statistical analyses.

Using MTT, the two-factor model was compared against the bi-factor model. Within MTT, different approaches are available depending on the item structure. For example, for approximately continuously scored items, the method of linear factor analyses appears most appropriate (Mellenbergh, 1994). Items can be considered approximately continuous if the item scores are normally distributed and have at least seven answer categories (Dolan, 1994). In case of worry and rumination this is clearly not the case as 1) worry and rumination questionnaires like the PSWQ (Meyer et al., 1990) and the RRS (Nolen-Hoeksema & Morrow, 1991) employ a five point Likert scale; and 2) worry and rumination item scores commonly display floor effects in healthy populations (i.e., participants use the lower answer categories disproportionally more as compared to the higher answer categories). In this paper, we therefore used the method of item factor analysis (Wirth & Edwards, 2007) which is a MTT approach (see also Samejima, 1969). As the models within this approach are explicitly formulated for Likert scale scores, possible floor and ceiling effects are unproblematic.

The model to data fit was evaluated using the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI). For interpretation of these model fit indices we followed Hu and Bentler (1999). That is, RMSEA values less than .06 were taken as an indication of a good model fit whereas values between .06 and .10 were taken as an indication of an acceptable model fit. In addition, for the CFI and TLI, values of .90 or higher were taken as an indication of acceptable model fit, and values of .95 or higher were taken as an indication of good model fit. Finally, we compared the two-factor model to the bi-factor model using the χ^2 difference test as the bi-factor model is nested within the two-factor model (see Steiger, Shapiro, & Browne, 1985; Yung, Thissen, & McLeod, 1999)[1].

Analyses were conducted using *Mplus 5.0* (Muthén & Muthén, 2007) using weighted least squares estimation which allows for missing data and yields less biased parameter estimates as compared to listwise or pairwise deletion. The variance of the latent variables was set to 1.0 in order to identify the models. Throughout the analyses we used a significance level of 0.05.

Results

The mean total scores of the brooding scale of the RRS and the 11-item version of the PSWQ were 8.48 (*SD* = 2.99) and 25.47 (*SD* = 8.84) respectively. Table 1 provides fit statistics and specific details for the competing factor models of the PSWQ and RRS items.

In the two-factor model, the PSWQ-items loaded separately on a worry factor, and the brooding items loaded separately on a rumination factor. The covariance between worry and rumination was freely estimated. This model provided an acceptable fit. As shown in Figure 1, all standardized factor loadings were significant and larger than .55. The correlation between worry and rumination was *r* = .66.

In the bi-factor model, the PSWQ and RRS again loaded separately on a worry and a rumination factor. In contrast to the two-factor model, the covariance between worry and rumination was now set to zero. Importantly, all items additionally loaded on a third general RNT factor. Fit indices for this bi-factor model showed evidence of a good fit (see Table 1). As shown in Figure 1, all factor loadings on the RNT factor were significant, and larger than .40. A χ^2 difference test showed that the two-factor model and the bi-factor model were significantly different (see Table 1), indicating that the inclusion of a general RNT factor in the bi-factor model improved the fit to the data observed.

[1] In case of categorical observed item scores as is the case in the present study, the χ^2 value obtained from fitting the model cannot readily be used for the χ^2 difference test as it needs a correction first (that is, the raw difference in χ^2 between two models does not follow a χ^2 distribution). See Satorra and Bentler (2001). All χ^2 difference tests in this paper are appropriately corrected.

Table 1: Goodness-of-fit indices for the models fitted across studies.

Model	χ^2 (df)	Npar	χ^2_{diff}**	df	RMSEA	TLI	CFI
Study 1							
Two-factor model	1291.44 (72)	76			0.066	0.987	0.939
Bi-factor model	747.84 (67)	91	446.688	12	0.051	0.992	0.966
Study 2							
Bi-factor model	100.532 (65)	299			0.070	0.980	0.973
Bi-factor model MI	101.065 (66)	211	33.700	24	0.070	0.980	0.973
Study 3							
Bi-factor model	135.844 (75)	301			0.074	0.972	0.957
Bi-factor model MI*	135.496 (76)	207	42.241	27	0.073	0.973	0.958

Npar = number of free parameters, χ^2_{diff} = χ^2difference, RMSEA = root mean square error of approximation, TLI = Tucker Lewis Index, CFI = comparative fit index, MI = model subject to measurement invariance.

Note. * In this model the first threshold of item 7 and 9 from the anxiety subscale were freed over time

** The χ^2 difference tests, χ^2_{diff}, is subject to the correction derived by Satorra and Bentler (2001) which is necessary as the ordinary difference test is not appropriate here due to the categorical nature of the data. Therefore the χ^2 values and degrees of freedom for this test cannot be obtained from the values reported for the different models (e.g., the degrees of freedom does not equal the difference in degrees of freedom between the two models under consideration).

Discussion

In line with our hypothesis, findings of Study 1 indicate that worry and rumination are better conceived as belonging to the same latent construct labelled repetitive negative thinking (RNT) than as two separate, albeit related, constructs. A two-factor model, comprising worry and rumination as separate constructs, showed a worse fit than a bi-factor model. This bi-factor model consisted of one general RNT factor that contained all shared variance between worry and rumination along with two separate measurement-specific factors reflecting unique variance within the specific constructs of worry and rumination separate from the variance that is related to RNT. As these measurement-specific factors were uncorrelated with the general RNT factor in the bi-factor model, it is conceivable that these factors reflect pure method variance that can be ascribed to structural differences between the two questionnaires. Recent studies also accounting for sources of method variance within both questionnaires using different methods corroborate our findings (McEvoy & Brans, 2013; McEvoy et al., 2010), and support a transdiagnostic account of RNT by showing that part of the variance across measures of worry and rumination is shared.

However, based on the results from Study 1 we cannot rule out that the measurement-specific factors within the bi-factor model may not only reflect method variance, but unique variance that can be attributed to distinct features of worry and rumination. These features that are not shared by the two processes may well be relevant for RNT as a maintaining factor of psychopathology. In order to test these alternative explanations for the bi-factor model, Study 2 was conducted as a longitudinal study assessing the relationship between the different components of RNT and symptom levels of anxiety and depression.

Study 2

In this study, worry and rumination along with symptom measures of depression and anxiety were assessed at t1, and symptom levels were re-assessed at t2 taking place 6 months later. Based on the transdiagnostic model of RNT, we hypothesized that (1) the shared RNT variance within the bi-factor model predicts symptom levels at t2 over and above symptom severities at t1 and (2) the two measurement-specific factors of the bi-factor model do not further contribute to the prediction of symptom levels.

Method

Participants and procedure.

The sample consisted of 125 first year psychology students at a Dutch university who participated in mass testing for course credit. Each participant completed measures of worry, rumination and symptom levels of anxiety and depression in September 2012 (t1). The symptom measures of anxiety and depression were re-administered 6 months later (t2). Attrition was 13.6% over the course of the study period, which is not unexpected as some students were no longer enrolled at the university or no longer required additional course credit. There were no differences between dropouts and completers on any of the measures at t1 (all *p*'s > .05). The final sample included in the analyses consisted of 108 participants (71.4% female; age: *M* = 19.71 years, *SD* = 1.84; range: 17-30).

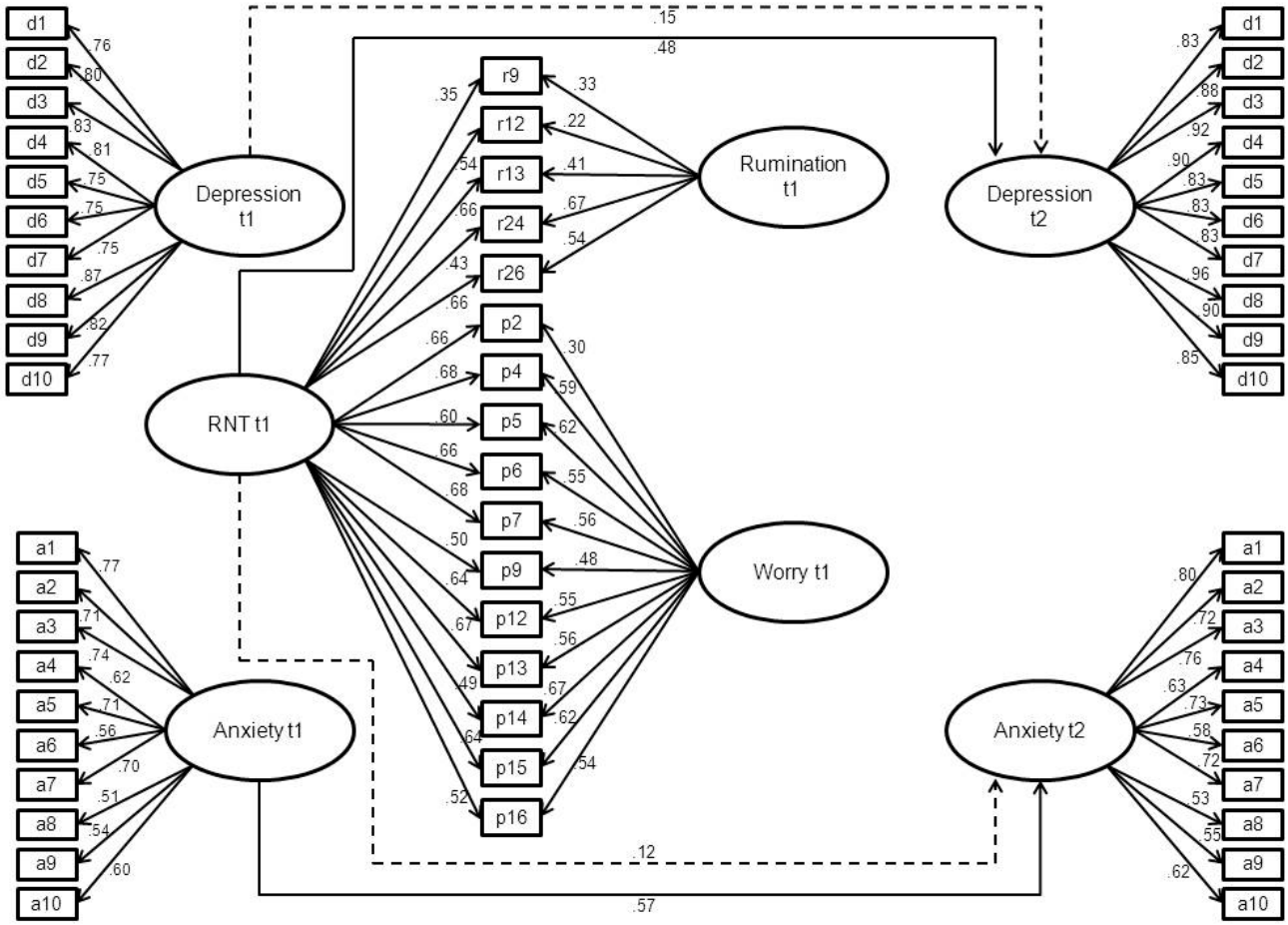


Figure 2: Standardized regression weights and correlation coefficient for the longitudinal bi-factor model of Study 2. χ^2 (65) = 99.00, p < .001, RMSEA = 0.068, TLI = 0.981, CFI = 0.974. Dashed lines indicate non-significant (p > 0.05) factor loadings. r = RRS-item, p = PSWQ-item, d = MASQ depression scale item, a = MASQ anxiety scale item.

Measures.

As in Study 1, the PSWQ and the RRS brooding scale were used to assess worry and rumination. Cronbach's α for the PSWQ and the RRS brooding scale were .92, and .75 respectively.

Mood and Anxiety Symptom Questionnaire-D30 (MASQ-D30).

The MASQ-D30 (Wardenaar, van Veen, Giltay, de Beurs, Penninx, & Zitman, 2010) was used to assess symptom levels of anxiety and depression. It is a short 30-item version of the original 90-item MASQ (Watson, Weber,

Assenheimer, Clark, Strauss, & McCormick, 1995) and was designed to measure depressive (e.g., “I felt optimistic.”), anxious (e.g., “My heart was racing or pounding.”), and non-specific (e.g., “I felt confused.”) symptomatology over the past week, and makes use of a 5-point scale, ranging from 1 (*not at all*) to 5 (*extremely*). Although the original MASQ has been developed to aid the measurement of and discrimination between anxiety and depression, factor-analytic studies have shown inconsistencies with respect to its proposed factor solution (Burns & Eidelson, 1998; De Beurs, den Hollander-Gijsman, Helmich, & Zitman, 2007). For the MASQ-D30, items with weak or complex loadings have been removed, resulting in a questionnaire that more clearly differentiates between depressive, and anxious symptomatology (Wardenaar et al., 2010).

Cronbach’s α for the depression subscale was .92 and .96 at t1 and t2. Cronbach’s α for the anxiety subscale was .80 and .78 at t1 and t2. The non-specific symptomatology subscale was not used in our analyses.

Statistical analyses.

As the bi-factor model was identified as the best fitting model in Study 1, this model formed the basis for the analyses in Study 2. Specifically, we tested whether the RNT factor in the bi-factor model could account for changes in depression and anxiety in time. To this end, we used structural equation modelling of the latent variables. In this way, measurement error is explicitly separated from the observed item scores (see Bollen & Long, 1993). At the first time point (t1), RNT, rumination, worry, depression, and anxiety were included as latent variables, whereas at the second time point (t2), the latent variables concern depression and anxiety. As depression and anxiety are in the analysis of both time points, measurement invariance needed to be established for these latent variables to ensure a meaningful comparison across time. When measurement invariance does not hold (i.e., item parameters are not equal over time) differences and relations on the level of the construct are most likely biased and cannot be substantively interpreted in terms of psychologically meaningful variables. In order to test measurement invariance for depression and anxiety, factor loadings and thresholds were constrained to be equal across time, while allowing for mean differences on t2 (as compared to t1) in the level of depression and anxiety. The tenability of this restriction (i.e., the tenability of measurement invariance) was evaluated using the model fit indices discussed previously. When measurement invariance was established, we proceeded by testing the model of interest. In this model, the paths between the latent variables at t1 (RNT and symptom levels) and the latent variables at t2 (symptom levels) were added and evaluated on significance. Within this final model, we tested whether additional paths exist between the measurement-specific worry and rumination factors and the depression and anxiety variables. To do so we used the modification indices of corresponding model parameters. The modification index of a given parameter quantifies the decrease of the χ^2 goodness of fit measure when the corresponding parameter is freed. We took a modification index of 10 or larger as an indication that the parameter should be freed (see Muthén & Muthén, 2007).

Results

The mean total scores of the brooding scale of the RRS, the PSWQ, and the symptom measures of anxiety and depression as measured by the MASQ-D30 are presented in Table 2. First, the restriction of measurement invariance was tested. To this end, we introduced equal factor loadings and threshold parameters across the measurement occasions for the anxiety and depression subscales of the MASQ, leaving open the possibility that there is a mean difference on the depression and anxiety latent variables across time. Introducing these restrictions did not significantly deteriorate the model fit as indicated by the χ^2 difference test, the RMSEA, CFI, and TLI (See Table 1). This indicates that measurement invariance is tenable and that the latent variables can be meaningfully compared across measurement occasions.

Next, the latent variables depression and anxiety at t2 were regressed on the general RNT factor, while controlling for depression and anxiety at t1. RNT was indicated by all items of the PSWQ and the brooding scale. Figure 3 shows that the general RNT factor predicted depression at t2, whereas this factor did not predict any additional variance in anxiety at t2.

In order to test whether the measurement-specific factors of worry and rumination would improve the prediction of anxiety and depression levels the modification indices were inspected. These did not suggest that additional

pathways should be freely estimated, which indicates that the separate factors of worry and rumination at t1 did not explain additional variance in depression and anxiety at t2 (modifications indices < 10). The amount of explained variance in symptom levels at t2 was similar; 40.0% of the variance in anxiety and 36.9% of the variance in depression was explained.

Table 2: Means and standard deviations across measures in Study 2.

	t1		t2	
	M	***SD***	***M***	***SD***
RRS-brooding	8.53	2.80		
PSWQ	28.86	10.92		
MASQ-AA	13.86	4.35	13.89	4.34
MASQ-AD	28.56	8.42	27.78	9.34

t1 = Time 1, t2 = Time 2, RRS-brooding = brooding scale of Ruminative Response Scale, PSWQ = Penn State Worry Questionnaire, MASQ-AD = Mood and Anxiety Symptom Questionnaire – Anhedonic Depression, MASQ-AA = Mood and Anxiety Symptom Questionnaire – Anxious Arousal.

Discussion

When looking at the prediction of depression over time, the findings of Study 2 confirmed our hypothesis of RNT as a transdiagnostic process because the common variance within the bi-factor model predicted symptom level change in this domain. On the other hand, RNT did not predict symptoms of anxiety at follow-up beyond initial anxiety levels. Importantly, the distinct factors of worry and rumination that potentially consisted of unique variance within each construct had no additional predictive value for any symptom levels. In sum, existing relationships between repetitive thinking and symptoms of psychopathology in the current sample were fully accounted for by the common variance component within RNT.

The finding that RNT did not predict anxiety beyond what could be predicted by initial anxiety symptoms is puzzling as it is at odds with earlier findings regarding a close association between RNT and anxiety (Ehring & Watkins, 2008). First, this finding may result from a lack of power to detect an effect due to the small sample size (Westland, 2010). Second, this finding may result from the relatively low amount of variance in anxiety symptoms. Compared to the depression scale of the MASQ-D30, the anxiety scale showed a lower mean value in our sample along with a smaller standard deviation. The same pattern of differences between these two MASQ-D30 scales has been found in other samples (e.g., Leventhal, Ameringer, Osborn, Zvolensky, & Langdon, in press). It is conceivable that the pure physiological symptoms of anxiety that this scale of the MASQ-D30 aims to tap into, are not very prevalent in non-clinical samples and do not vary as much between individuals and across time.

Study 3

This study aimed to replicate the longitudinal relationship between RNT and anxiety and depression in a larger sample with higher variance in symptom levels between individuals and across time. To this end, we introduced a stressor into our longitudinal design. As our sample consisted of university students and exams are experienced as the highest causes of stress in this population (Abouserie, 1994), we organized the administration of questionnaires around an exam. Transdiagnostic accounts posit that the type of symptoms experienced are a consequence of the current concerns that an individual is dealing with (Nolen-Hoeksema & Watkins, 2011). In Study 3, we tested this assumption. Symptom levels of anxiety and depression were measured before and after an exam. Using a transdiagnostic line of reasoning, we hypothesized that (1) the shared RNT variance within the bi-factor model predicts symptom levels of anxiety in the days before the exam, whereas it predicts symptom levels of depression in the days after the exam, (2) the two measurement-specific factors of the bi-factor model do not further contribute to the prediction of symptom levels.

Method

Participants and procedure.

The sample consisted of 169 first year psychology students at a Dutch university who received course credit for participation in this study. Participants filled out a set of questionnaires at three specific points in time; a 2-day period taking place 4 weeks before the exam (t1), a 2-day period immediately before the exam (t2), and a 2-day period immediately after completion of this exam (t3). Participants who did not take part in the exam (n = 14) and/or did not complete the questionnaires at all time points (n = 9) were excluded from analyses. There were no differences between dropouts and completers on any of the measures at t1 (all *p*'s > .05). The final sample included in the analyses consisted of 147 participants (81.6% female; age: *M* = 19.49 years, *SD* = 1.80; range: 17-27).

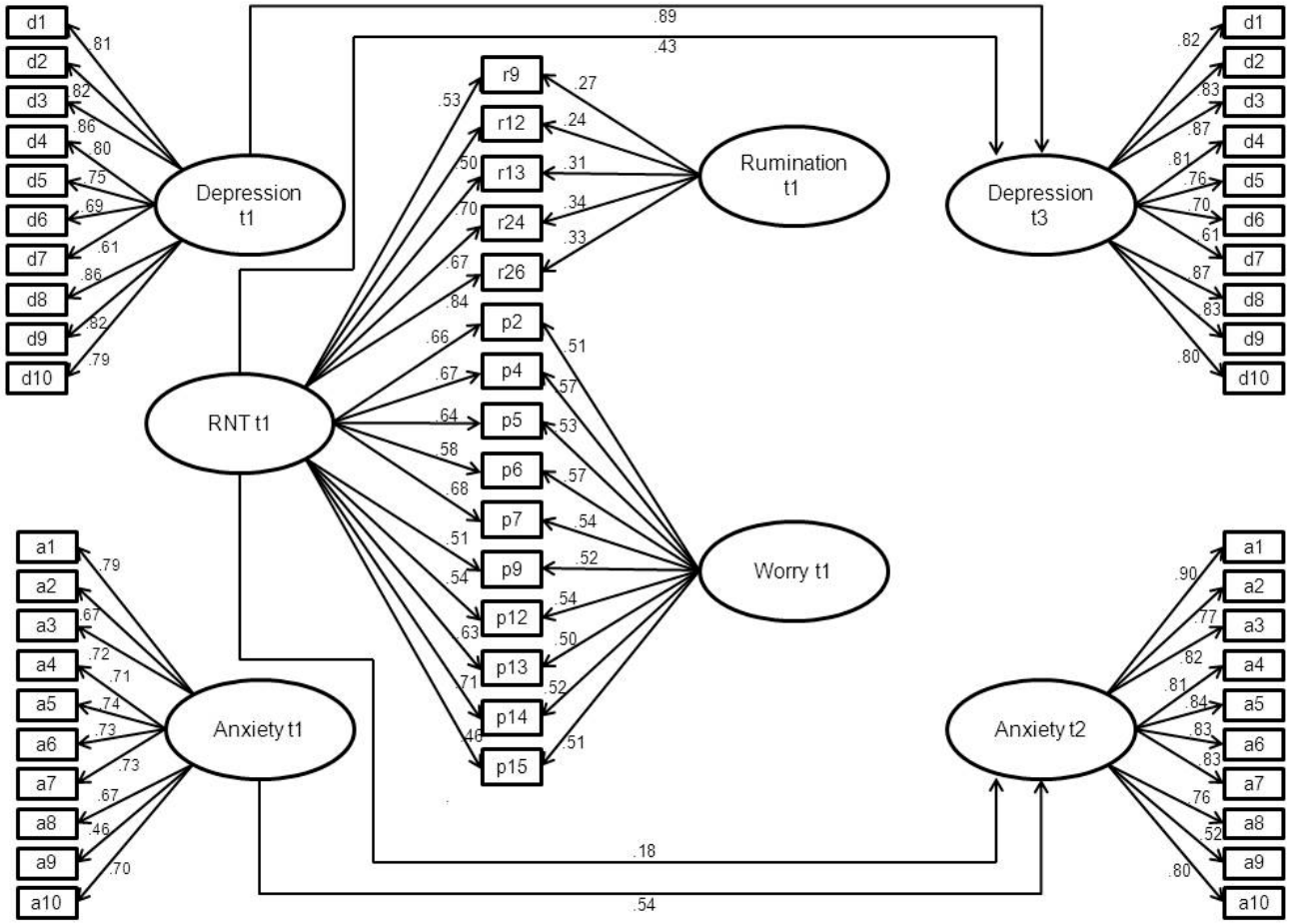


Figure 3: Standardized regression weights and correlation coefficient for the longitudinal bi-factor model of Study 3. χ^2 (75) = 135.28, p < .001, RMSEA = 0.074, TLI = 0.972, CFI = 0.958. r = RRS-item, p = PSWQ-item, d = MASQ depression scale item, a = MASQ anxiety scale item.

Measures.

The same instruments were used as in Study 2. However, instructions of the PSWQ, the RRS and the MASQ-D30 were adapted, and some items were reworded to obtain measures of worry, rumination and symptomatology that focus *on the past day only*. Item 12 of the PSWQ ("I have been a worrier all my life.") was omitted. Cronbach's α was .92 and .79 for the PSWQ and RRS respectively. Cronbach's α for the depression scale of the MASQ-D30 was .92 at t1 and t3. Cronbach's α for the anxiety scale of the MASQ-D30 was .81 and .87 at t1 and t2.

Statistical analyses.

The bi-factor model was evaluated in Study 3 to test whether the RNT factor could account for changes in anxiety from t1 to t2 and changes in depression from t1 to t3.

Results

The mean total scores of the brooding scale of the RRS, the PSWQ, and the symptom measures of anxiety and depression as measured by the MASQ-D30 are presented in Table 3. Following the same procedure as in Study 2, we fitted a baseline model and a model subject to measurement invariance. As indicated by the RMSEA, CFI, and TLI, this restriction was tenable, although we needed to relax the invariance constraint on the first threshold of item 7 and 9 of the anxiety subscale of the MASQ-D30 (See Table 1). This minor departure from strict measurement invariance is not considered problematic as it only concerns two of the 50 threshold parameters in the anxiety subscale. Given that only two parameters are not invariant, freeing these two parameters across time points ensures that the latent variables can still be meaningfully compared (see Byrne, Shavelson, & Muthén, 1989). The χ^2 difference test indicated that the invariance restrictions resulted in a deteriorated model fit, $\chi_{diff}^2(27) = 42.241$, $p = .03$. However, note that (1) all other fit indices indicate that the measurement invariance model should be favoured (2) none of the modification indices indicated additional misfit (i.e., additional to the two threshold parameters), and (3) the χ^2-difference test is well known to be sensitive to large samples sizes (see Schermelleh-Engel, Moosbrugger, & Müller, 2003). We therefore concluded that measurement invariance is tenable.

As a next step, the latent variables depression at t3 and anxiety at t2 were regressed on the general RNT factor, while controlling for depression and anxiety at t1. As shown in Figure 3, both depression at t3 and anxiety at t2 were predicted by the general factor of RNT even when controlling for initial symptom levels.

Inspection of the modification indices did not reveal that the additional pathways between rumination and depression or between worry and anxiety should be freed to improve model fit (both modification indices < 10). This indicates that the two measurement-specific factors of the bi-factor model did not further contribute to the prediction of symptom levels. The amount of explained variance in symptom levels of anxiety at t2 was 40.5%, the amount of explained variance in symptom levels of depression at t3 was 49.4%.

Table 3: Means and standard deviations across measures in Study 3.

	t1		t2		t3	
	M	***SD***	***M***	***SD***	***M***	***SD***
RRS-brooding	7.87	2.69				
PSWQ	25.55	8.77				
MASQ-AA	14.56	5.16	14.61	8.24		
MASQ-AD	27.27	7.84			29.28	9.43

t1 = Time 1, t2 = Time 2, t3 = Time 3, RRS-brooding = brooding scale of Ruminative Response Scale, PSWQ = Penn State Worry Questionnaire, MASQ-AD = Mood and Anxiety Symptom Questionnaire – Anhedonic Depression, MASQ-AA = Mood and Anxiety Symptom Questionnaire – Anxious Arousal.

Discussion

The results replicate and extend the findings from Study 2. As a whole, they support a transdiagnostic account of RNT, as the common variance between measures of worry and rumination predicted future anxiety and depression symptoms in the context of a stressor. Depressive symptoms in the days following an exam were predicted by levels of RNT during a period that was free of exams. In contrast to Study 2, a relationship between RNT and anxiety symptoms was now also established. Based on our methodological considerations of the findings in Study 2, it appears that the exam included in the current study generated sufficient fluctuations in anxiety symptoms in the non-clinical student sample that a relationship between levels of RNT emerged. In line with Study 2, the existing relationships between repetitive thinking and symptoms of psychopathology were fully accounted for by the

common variance component within RNT, and potentially unique aspects of worry and rumination were either non-existent or played no additional role in the development of future symptoms. Together, these results support the transdiagnostic account of Nolen-Hoeksema and Watkins (2011), which posits that the development of a disorder can result from the interplay between within-person risk factors such as RNT and environmentally induced stressors.

General Discussion

The aim of the series of studies reported in this article was to investigate the relationship between worry and rumination. Although it is generally agreed that both thought processes are involved in the development and maintenance of psychopathology, the exact nature of their relationship has been subject to some debate. Whereas the disorder-specific approach posits that worry and rumination are distinct and predispose for different disorders, the transdiagnostic account considers worry and rumination to be one unitary process that is related to multiple disorders. Using Modern Test Theory, we employed a structural equation modelling approach on questionnaire data to test both perspectives against each other.

Study 1 provided clear evidence that worry and rumination belong to the same construct of repetitive negative thinking. A bi-factor model that consisted of one general factor reflecting shared variance between worry and rumination, and two separate factors reflecting unique variance related to worry and rumination, was a better fit than a two-factor model comprised of worry and rumination as separate constructs. Our results stand in contrast to a large body of factor-analytic studies that point towards a distinction between worry and rumination (D'Hudson & Saling, 2010; Fresco et al., 2002; Goring & Papageorgiou, 2008; Muris et al., 2004; Rood et al., 2010). The distinction between worry and rumination may, however, be artificially inflated in these studies as they have typically ignored sources of method variance between measures of worry and rumination. In a bi-factor model, these sources of method variance can be distinguished from content-related sources of variance. Corroborating evidence for our results comes from a recent study by McEvoy and Brans (2013) who were the first testing a bi-factor model of RNT and found a similar pattern of results.

The bi-factor model was then used in Studies 2 and 3 to test the hypothesis that the common variance within RNT predicted future depressive and anxious symptomatology. A methodological strength of these studies was that we used a longer time interval (6 months) between measurements in Study 2 than previous studies (Calmes & Roberts, 2007; Hong, 2007; Segerstrom et al., 2000) and a stressor event in between measurements in Study 3, respectively. In addition, measurement invariance across the measures that were administered repeatedly was tested. Supporting a transdiagnostic perspective on the relationship between RNT and future symptomatology, the common variance between worry and rumination predicted future symptom levels, whereby the measurement-specific factors had no additional value in predicting symptom severities.

The findings of Study 2 and 3 suggest that it is the general tendency to engage in the process of RNT that evokes psychopathological symptoms over time. Yet, the findings also suggest that the type of symptoms an individual develops is determined by the context. In the absence of a contextual stressor (Study 2), RNT did not predict future symptoms of anxiety, whereas RNT did predict anxiety symptoms in the context of an upcoming exam, and depression symptoms in the context of a recently accomplished exam (Study 3). Transdiagnostic models clarify these (disorder-specific) effects by stating that the types of symptoms that are triggered vary as a function of current concerns (Nolen-Hoeksema & Watkins, 2011). In line with this view, it is possible that in Study 3 individuals mainly engaged in future-oriented thinking evoking anxiety before the exam took place, whereas they engaged in past-oriented thinking evoking depression after the exam. Although this explanation is tempting, the current study design and results are not entirely in line with this view. Importantly, content-related variance present in the measurement-specific factors of worry and rumination did not contribute to the prediction of anxiety and depression above what could be explained by general RNT in Studies 2 and 3. In addition, in order to test whether current concerns moderate the effect of RNT on anxiety vs. depression it would be necessary to directly assess the content of thinking (i.e. current concerns), which was not the case in the current study. Finally, the only other study that related worry and rumination to anxiety and depression symptoms in the context of an exam does not point to content-related effects of worry and rumination (Segerstrom et al., 2000). In this earlier study, anxiety and depression were measured one week after an exam. Worry and rumination did not predict depression, although it

should be noted that the time interval between measurements was only 1 week and very little variance in depression scores was left unexplained. Yet, worry and rumination together did predict anxiety. In order to directly investigate whether the content of RNT determines the type of symptoms that are developed, future studies will need to more accurately measure thought content and/or manipulate thought content using experimental procedures.

The findings of the current studies need to be interpreted in the light of some limitations. First, the non-clinical samples used in our studies limit generalization of results to clinical samples. Although it appears reasonable to assume that RNT is a continuous phenomenon with mostly quantitative differences between non-clinical and clinical samples (Ehring & Watkins, 2008; Watkins, 2008), it cannot be ruled out that different patterns of associations between facets of RNT and different types of psychopathology may emerge in clinical samples. Another critical issue regarding the generalizability of the findings concerns the fact that participants in the current study were relatively young and students of higher education. Again, replication in more diverse samples therefore appears necessary. Finally, the current studies exclusively used self-report measures and were purely correlational. Although the longitudinal design of Studies 2 and 3 can be regarded as more sound than frequently used cross-sectional studies, it appears necessary to cross-validate findings using experimental designs to establish causality (see McLaughlin, Borkovec, & Sibrava, 2007 for a recent example).

Notwithstanding these limitations, the current findings add to an emerging evidence base for repetitive negative thinking as a transdiagnostic process. Specifically, it appears that although different forms of RNT may differ regarding their exact content and the way in which they are assessed, it is the shared variance of these different forms of RNT that is relevant for their association with psychopathology. This view has a number of important implications. First, past research into the relationship between RNT and psychopathology has mainly used disorder-specific measures of worry or rumination, such as the PSWQ or the RRS. If RNT can meaningfully be conceptualized as a transdiagnostic process, it appears promising to develop and use purer instruments of RNT that can be applied across diagnostic categories. In recent years, a number of different transdiagnostic measures of RNT have been developed that could prove useful in this regarding, including the Repetitive Thinking Questionnaire (McEvoy et al., 2010), the Ruminative Thought Style Questionnaire (Brinker & Dozois, 2009), and the Perseverative Thinking Questionnaire (Ehring et al., 2011). Second, past research on the role of RNT in psychopathology has been heavily based on disorder-specific theoretical models. The emerging evidence of RNT as a transdiagnostic process calls for the development and empirical evaluation of theoretical models that can account for the processes involved in the relationship between RNT and emotional disorders. Promising candidates include the processing mode account of RNT (Watkins, 2008), the meta-cognitive model (Papageorgiou & Wells, 2003), and information processing models (Hirsch & Mathews, 2012; Joormann, 2010). Finally, the transdiagnostic view on RNT may also have important clinical implications. Interventions directly targeting RNT may prove effective for a wide range of disorders. In addition, as RNT appears to be related to a wide range of emotional problems it may be a particularly promising target for prevention (see Topper, Emmelkamp, & Ehring, 2010).

This special issue is published in the memory of Susan Nolen-Hoeksema. We would therefore like to conclude by acknowledging the enormous impact her seminal work on rumination has had on our own research, including the studies reported in this article. She has not only put the process of rumination on the research and clinical agenda, but has also provided the tools for researchers to further investigate it. This tool box includes the Response Style Questionnaire as the gold standard measure of rumination, her Response Styles Theory (Nolen-Hoeksema, 2004) as a major theoretical approach in the field, and a multitude of experimental paradigms that were first used in Susan's lab and have been adapted by many researchers since. In addition, she has also led the groundwork for many of the ideas we are focussing on in our own research, including the refinement of assessment tools (see e.g. Treynor et al., 2003), and the focus on transdiagnostic aspects of rumination (Nolen-Hoeksema & Watkins, 2011; Nolen-Hoeksema, Stice, Wade, & Bohon, 2007). Her influence on the field of rumination research cannot be overestimated, and the inspiration she gave to many researchers as well as her innovative theoretical and empirical contributions to the field will be greatly missed.

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