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Abstract

Repetitive negative thinking (RNT) is a transdiagnostic vulnerability factor, involved in the maintenance of a variety of emotional problems. Recently, the Perseverative Thinking Questionnaire – Child version (PTQ-C) was developed as a content-independent measure of RNT in children and adolescents. The current study investigated the reliability and predictive validity of the PTQ-C and examined temperament as a developmental predictor of RNT. For this end, 701 early adolescents completed measures of RNT, depressive symptoms, stressors, and temperament, both at baseline and after three months. First, the factor structure of the PTQ-C was investigated by comparing a one-factor model and a three-factor higher-order model using confirmatory factor analyses. Both models showed good fit to the data, but the more parsimonious one-factor model was retained. Internal consistency, as measured by cronbach's alpha and (hierarchical) omega, was found to be excellent for the total scale. Second, associations with depressive symptom levels were examined. RNT predicted both concurrent and prospective symptom levels, even when taking into account baseline depressive symptoms. RNT was further shown to act as a moderator strengthening the link between stress and levels of depressive symptoms, both concurrently and prospectively. Finally, associations with temperament were explored by investigating the mediating role of RNT in the association between temperament dimensions and depressive symptoms. One indirect effect was found, with low effortful control predicting increases in depressive symptoms through heightened levels of RNT. The current study supports the PTQ-C as a useful and psychometrically sound measure of dysfunctional RNT that may facilitate research on emotional problems in child and adolescent samples.

Keywords: temperament; repetitive negative thinking; depressive symptoms; adolescents; children

Temperament, Repetitive Negative Thinking, and Depressive Symptoms in Early Adolescence: A Prospective Study

The high degree of comorbidity between emotional disorders, such as anxiety disorders and depression, has motivated an increase in research examining so-called transdiagnostic mechanisms. According to Watkins (2008), unconstructive forms of repetitive thought represent a cognitive vulnerability factor implicated in a wide range of emotional disorders. Depressed individuals report passive, repetitive, and uncontrollable thinking about their depressive symptoms and the causes and consequences of these symptoms, that is, depressive rumination (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008). Anxious individuals typically report persistent and uncontrollable thoughts about the possible negative outcome of future events, that is, worry (Borkovec, Ray, & Stöber, 1998). Although depressive rumination and worry clearly differ in some respects (e.g., in the content of the thoughts), they also have important similarities (e.g., their unconstructive, repetitive, and uncontrollable nature; Harvey, Watkins, Mansell, & Shafran, 2004). Consistent with that view, self-report questionnaires measuring different types of repetitive negative thinking (RNT; e.g., rumination versus worry) have been found to be highly correlated and to have similar associations with anxiety and depression (e.g., Fresco, Frankel, Mennin, Turk, & Heimberg, 2002). Taking into account these findings, Ehrling and Watkins (2008) advocated the investigation of RNT across disorders rather than from a disorder-specific perspective.

To facilitate such transdiagnostic research, Ehrling et al. (2011) developed the Perseverative Thinking Questionnaire (PTQ) as a content-independent measure of RNT in adults. In contrast to existing measures of RNT that focus on the specific content of thoughts, this measure aims to capture the common characteristic process of all dysfunctional forms of RNT, independent of the specific content and time frame of the thoughts (Ehrling et al., 2011). The questionnaire is a 15-item self-report questionnaire that assesses core features of RNT, such as its intrusive and uncontrollable nature, and two additional features of individuals perceiving their thinking as unproductive and that it requires mental capacity. Research has shown the PTQ to have good internal consistency and construct validity (e.g., Cernis et al., 2016; Ehrling et al., 2011; Ehrling, Raes, Weidacker, & Emmelkamp, 2012;

Kornacka, Buczny & Layton, 2016). The original version of the PTQ includes three subscales: Core Characteristics, capturing the processes of the thinking as being repetitive (e.g., “The same thoughts keep going through my mind again and again”), intrusive (e.g., “Thoughts come to my mind without me wanting them to”), and difficult to disengage from (e.g., “I can’t stop dwelling on them”); Perceived Unproductiveness, (e.g., “I think about many problems without solving any of them”), and Mental Capacity (e.g., “My thoughts take up all my attention”). In the original study by Ehring et al. (2011), analyses were performed on both clinical and non-clinical samples, including a total of 1,832 participants. In this study, both a one-factor and a three-factor second-order model were examined and both models showed adequate fit to the data. Internal consistency, estimated with Cronbach’s alpha, was found to be high for the total sum score and the three subscales (Ehring et al., 2011). Moreover, studies including the three subscales generally showed high subscale intercorrelations (i.e., ranging from .77 to .96) and some studies failed to demonstrate differential associations of the subscales with relevant correlates (i.e., rumination and worry as well as depressive and anxiety symptoms; e.g., Ehring et al., 2011; Kornacka et al., 2016; Raes, 2012), suggesting that conceptually the one-factor model might be considered the most parsimonious.

Recently, Bijttebier, Raes, Vasey, Bastin, and Ehring (2015) constructed a child-appropriate version of the instrument, the PTQ-C, by rewording one third of the items to make them more comprehensible for children. The authors provided initial evidence for its reliability and validity in children and early adolescents from the fifth through eighth grade in Belgium. Both a one-factor model and a three-factor higher-order model were found to adequately fit the data, although the one-factor model was retained due to its greater parsimony. The unidimensional PTQ-C scale showed excellent internal consistency (Bijttebier et al., 2015). When exploring gender differences in their study, Bijttebier et al. (2015) found girls to report higher levels of RNT compared to boys. Next, convergent and divergent validity were supported by substantial correlations with measures of worry and ruminative thinking, and by the absence of associations with measures of distraction and problem-solving (Bijttebier et al., 2015). Criterion validity was supported by considerable associations with concurrent symptom levels of depression and anxiety (Bijttebier et al., 2015). Finally, the findings of Bijttebier et al. pointed toward good incremental validity of the PTQ-C, by showing that the total scale

explained additional variance in anxiety and depressive symptoms above and beyond the content-specific measures of brooding depressive rumination and worry. Although these results are promising, replication is necessary. Also, important additional questions remain unanswered. One such question relates to the predictive validity of the PTQ-C. To date, there are only a few studies that have examined prospective associations of PTQ scores with symptom levels. These studies were performed in older samples, including college students and adults. Raes (2012), for example, showed that, in a sample of undergraduates, PTQ subscale scores prospectively predicted levels of depressive symptoms over a three-year interval, even when taking into account baseline depressive symptoms. More recently, Kertz, Koran, Stevens, and Björgvinsson (2015) found that, in a clinical sample of adults with internalizing disorders, PTQ scores significantly predicted depression and anxiety symptom trajectories over the course of a relatively brief partial hospitalization treatment program.

Cognitive models of depression, like the diathesis-stress model, further conceptualize response styles as latent vulnerability factors (i.e., diathesis) that operate in interaction with stressors to predict psychopathology (e.g., Hankin & Abramson, 2001; Ingram & Price, 2001). These models postulate that the maladaptive outcomes of stress will be strongest for individuals who deploy maladaptive cognitive responses to such stressful life events (Hankin & Abramson, 2001). Consistent with this perspective, rumination has been found to moderate the association between the occurrence of negative events and the development of future depressive symptoms (e.g., Abela & Hankin, 2011; Abela, Hankin, Shesko, Fishman, & Stolow, 2012). In line with the diathesis-stress model and these findings, dysfunctional RNT can be expected to act as a vulnerability factor intensifying the harmful outcomes of stress on depressive symptoms. However, to our knowledge, no study has yet considered either the PTQ or the PTQ-C within a diathesis-stress framework.

Finally, given the abundant evidence linking RNT to reduced emotional well-being, it is important to examine the developmental origins of such thinking. Integrated cognitive-affective models of depression (e.g., Hyde, Mezulis, & Abramson, 2008) suggest that individual differences in trait negative affectivity (NA), a key component of temperament, may predispose individuals to develop maladaptive cognitive strategies that render them vulnerable to depression. Similarly, Nolen-Hoeksema (2004) posited that children and adolescents who are temperamentally prone to distress

(i.e., those high in NA or the closely related construct of neuroticism) are more likely to develop a ruminative response style. Consistent with this view, Roberts, Gilboa, and Gotlib (1998) found that neuroticism can lead to a ruminative focus on depressive symptoms. Moreover, Nolan, Roberts, and Gotlib (1998) showed that both neuroticism and a ruminative response style are vulnerability factors for increases in depressive symptoms over time. Finally, several studies provided evidence supporting mediation of NA by rumination and worry in the prediction of depressive and anxious symptoms, respectively (e.g., Mezulis, Simonson, McCauley, & Vanderstoep, 2011; Muris, Roelofs, Rassin, Franken, & Mayer, 2005; Nolan et al., 1998; Verstraeten, Bijttebier, Vasey & Raes, 2011). Apart from potential relationships with NA, it is interesting to investigate whether transdiagnostic RNT is also linked to individual differences in positive affectivity (PA), the second affective-motivational reactivity component of temperament (Rothbart & Bates, 1998). Insofar as PA is associated with active approach motivation (Lonigan & Phillips, 2001), the passive stance associated with rumination suggests that RNT may be less likely among those high in PA and a negative relationship between both can be expected. In addition to these two reactivity constellations of temperament, temperamental deficits in self-regulatory capacity (i.e., effortful control [EC]; more specifically deficits in executive functioning, such as inhibitory deficits and attentional inflexibility) have been related to RNT styles (see Joorman, 2005, for a review). However, despite the relevance of such dimensions of temperament, no such models have been tested for RNT as measured with PTQ or PTQ-C thus far.

Given these considerations, the present study has three main aims. First we sought to replicate past findings (see Bijttebier et al., 2015) regarding the factor structure of the PTQ-C, by comparing a three-factor higher-order model and a one-factor model. Our second aim was to examine the extent to which the PTQ-C predicts depressive symptoms, both concurrently and prospectively over a three-month interval. Consistent with a diathesis-stress framework, we further aimed to investigate the extent to which PTQ-C scores moderate the concurrent and prospective associations of stress with depressive symptoms. Third, we sought to test the extent to which dimensions of temperament (i.e., NA, PA, and EC) predict PTQ-C scores, as well as to investigate the mediational role of RNT in associations between these dimensions of temperament and depressive symptoms. This way, RNT was examined both as a *moderator* of the association between stress and depressive symptoms, and as a

mediator in the relationship between temperament and depressive symptoms. In these research questions, we focus on the developmental stage of childhood and early adolescence, as research evidence suggests negative cognitive styles to be formed and consolidated from late childhood on (Hankin & Abramson, 2001; Mezulis, Funasaki, & Hyde, 2011). For instance, using latent growth mixture modeling, Mezulis et al. (2011) found 71% of their sample to have rather stable reports of negative cognitive styles when they were followed-up from 11 to 15 years old. Furthermore, the interaction between cognitive vulnerabilities and stress has already been found to be predictive of elevations in rates of depression from the fifth grade on (Nolen-Hoeksema, Girgus, & Seligman, 1992).

Method

Participants

Consent forms were given to parents of 831 early adolescents from the fifth through seventh grades of 13 public Flemish schools¹. Consent rates were 84.36%, resulting in a final sample of 701 children (53.1% girls). Assent was obtained from all individual participants included in the study. The age of the youngsters ranged from 9 to 14 years ($M = 11.81$, $SD = 1.13$). Due to illness, 16 students were absent at the second assessment. Little's Missing Completely At Random test (1988) showed that these participants' data were missing completely at random. Furthermore, comparing both groups using *t*-tests (for continuous variables) and the Chi-square test (for gender), these students did not differ significantly from the remainder of the sample on any study variable. Data was collected in February and May (both in the second term of the school year), 2013.

Measures

Perseverative Thinking Questionnaire-Child version (PTQ-C). The PTQ-C (Bijttebier et al., 2015) is an adaptation of the Dutch version of the PTQ (Ehring et al., 2011, 2012) for use in children. This questionnaire comprises 15 items, to be rated on a 5-point scale (*never, almost never, sometimes, often, almost always*). Equivalent to the PTQ of Ehring and colleagues (2011), nine items tap Core Characteristics of RNT (e.g., "The same thoughts keep going through my mind again and again"), three items tap Perceived Unproductiveness (e.g., "I think about many problems without solving any of them"), and three items tap the extent to which RNT captures Mental Capacity (e.g., "I can't do

anything else while thinking about my problems”). Bijttebier et al. (2015) found adequate fit for both a one-factor and a three-factor higher-order model but chose the former for reasons of parsimony. Raw item scores sum up to one total score. In the current study, Cronbach's alpha coefficient for internal consistency is .92 [95% CI: .92, .93] for the total scale score.

Children's Depression Inventory (CDI). The CDI (Kovacs, 2003) is a self-report questionnaire that measures symptoms of depression during the past two weeks. The CDI consists of 27 three-choice statements which are coded from 0 to 2. The Dutch version by Timbremont, Braet, and Roelofs (2008) was used. The CDI has good reliability and validity and discriminates children with major depressive disorders from non-depressed children (Kovacs, 2003). In the current study, Cronbach's alpha coefficient for internal consistency was .86 [95% CI: .83, .87] for the total scale score.

Positive and Negative Affect Scales (PANAS). The PANAS (Watson, Clark, & Tellegen, 1988) is a self-report instrument comprising two 10-item subscales, which assess Negative Affectivity (NA) and Positive Affectivity (PA). It can be used as either a state or a trait measure. In the present study, it is used as a trait measure with a general time frame, tapping relative stable individual differences in temperamental reactivity. The Dutch version reported by Engelen, De Peuter, Victoir, Van Diest, and Van den Bergh (2006) was utilized. The PANAS was originally designed for adults, but adequate internal reliability and good convergent and discriminant validity have been demonstrated in children age 10-15 (e.g., Gijssbers van Wijk & Kolk, 1996). In the current study, Cronbach's alpha coefficient for internal consistency was .78 [95% CI: .75, .80] for the PA scale score and .79 [95% CI: .76, .81] for the NA scale score.

Effortful Control Scale (ECS). The ECS (Lonigan & Phillips, 2001) taps the self-regulatory aspect of temperament. It consists of 24 self-report items to be rated on a 5-point scale. Half of the items tap Persistence/Low Distractibility (e.g., “I do not finish my homework” and “Once I'm involved in a task, nothing can distract me from it”); the other half taps Impulsivity (e.g., “I have a hard time following instructions”). In our study, the Dutch version of the questionnaire was used (Verstraeten, Vasey, Raes, & Bijttebier, 2009). We included the ECS total scale (with the Impulsivity items reversed) as an index of temperament-based self-regulatory capacity (see Verstraeten, Vasey, Claes, & Bijttebier, 2010). In the current study, Cronbach's alpha coefficient for internal consistency

was .79 [95% CI: .76, .81] for the total scale score.

Adolescent Life Events Questionnaire (ALEQ). The ALEQ (Hankin & Abramson, 2002) assesses the occurrence of a broad range of negative events typically experienced by adolescents, including school problems, friendship difficulties, romantic difficulties, and family problems. For the present study, the Dutch version with a subset of 22 items representing daily life hassles was used (cf. Bijttebier, Raes, Vasey, & Feldman, 2012). For every item, participants had to indicate how often they had experienced the event over the past three months. Answers were rated on a 5-point rating scale ranging from ‘never’ to ‘always’.

Procedure

Children were sent home with a letter describing the aim of the study, which invited them to participate and asked for parental permission for them to do so. Children for whom parents did not decline participation and who gave assent to participate themselves, filled out the questionnaires collectively during regular school hours. Master’s level students in clinical psychology were present in each classroom to answer questions and to take care of children who would experience psychological distress as a consequence of their participation. Teachers were asked to leave the room to increase privacy and anonymity for participants. Most of the children were able to complete the questionnaires without help and none of the children reported or showed distress during or after completion of the questionnaires. Prior to data collection, children were ensured that they could withdraw from the study at any time without any consequence. There were no incentives for participation in the study. Ethical approval was obtained from the local research Ethics Committee.

Statistical Analyses

The concurrent and longitudinal associations with temperament and depressive symptoms were investigated using Pearson correlations and regression analyses in IBM SPSS Statistics 22. Both the confirmatory factor analysis to investigate the factor structure of the PTQ-C and the mediation analyses were investigated in Mplus 7.4 (Muthen & Muthen, 1998–2015). This program allows for accurate estimates of cross-time effects between the independent variables and the outcomes by accounting for both stability coefficients (i.e., the variable as predicted by its level at the previous time point) and all within-time associations (i.e., the correlations between the different variables at each

time point) (e.g., Neyer & Asendorpf, 2001). The program provides fit indices to evaluate model fit. For the analyses, model fit was assessed using the Chi-square test of model fit (χ^2), the Root Mean Square Error of Approximation (RMSEA; Browne & Cudeck, 1993), the Comparative Fit Index (CFI; Bentler, 1990; Hu & Bentler, 1999), and the Standardised Root Mean square Residual (SRMR). For an acceptable model fit, χ^2 is preferably as small as possible (and the ratio between χ^2 and the degrees of freedom preferably < 3). According to Kline (2006), RMSEA ≤ .08, SRMR ≤ .10, and CFI ≥ .90 indicate good fit. Comparison of model fit of the one-factor and the three-factor higher-order structure was examined using the Chi-square difference test, the Akaike's Information Criterion (AIC), and the Bayesian Information Criterion (BIC). Lower levels of AIC and BIC represent better fit (Nagin, 2005). Together with the comparison indices, parsimony of the model was also considered in our decision. Missing data were dealt with the method of full information maximum likelihood, resulting in an inclusion of all participants present at Time 1. All variables but gender were standardized. Internal consistencies were evaluated using Cronbach's alpha coefficient based on scale scores, omega (ω), i.e., a reliability index that is model-based, has less risk for inflation and attenuation of internal consistency compared to alpha, and outperforms alpha under violations of tau-equivalence; McDonald, 1999; Zinbarg, Revelle, Yovel, & Li, 2005) and omega h (ω_H , i.e., a model-based index of the proportion of the total variance that can be attributed to the general factor after removing the variance of the subscales; McDonald, 1999) using the statistical package semTools in the program R, version 3.3.1. Including all three estimates for internal consistency provides more complete and reliable information about the internal consistency of a scale (Cho, 2016; Cho & Kim, 2015).

Results

Confirmatory Factor Analysis and internal consistency

Confirmatory factor analysis (CFA) was used to examine the factor structure of the PTQ-C. Two models were compared: a one-factor model and the three-factor higher-order model of the original PTQ, comprising Core Characteristics, Perceived Unproductiveness and Mental Capacity as three lower-order factors that load onto a higher-order Perseverative Thinking factor. Both solutions reached an adequate fit: $\chi^2(90)=416.29$, $p<.001$, RMSEA=.07, SRMR = .04, CFI=.93, AIC = 26905.04, and BIC = 27109.90 for the one-factor model, and $\chi^2(88)=346.19$, $p<.001$, RMSEA=.07,

SRMR = .03, CFI=.95, AIC = 26838.95, and BIC = 27052.92 for the three-factor higher-order model. According to the χ^2 difference test and AIC and BIC, the three-factor higher-order model performed significantly better than the one-factor model, $\Delta\chi^2(2)=70.10$, $p<.001$. However, RMSEA, CFI, and SRMR indices indicated good fit for both models and values of the indices were comparable for both the one-factor and the higher-order model.

In a next step, measures of internal consistency were calculated. Alphas were highest for the total score and the subscale Core Characteristics. The obtained coefficient-alpha estimate was at .92, [95% CI: .92, .93] for the total scale score and at .91, [95% CI: .90, .92] for Core Characteristics, respectively. The obtained coefficient-alpha estimates for the subscales Perceived Unproductiveness and Mental Capacity were lower, with $\alpha = .62$, [95% CI: .55, .67] and $\alpha = .70$, [95% CI: .66, .74], respectively. Estimates of omega pointed towards the same conclusions on reliability for the total score and the three subscales Core Characteristics, Perceived Unproductiveness, and Mental Capacity with $\omega = .93$, 95% CI [.92, .93], $\omega = .91$, 95% CI [.90, .92], $\omega = .63$, 95% CI [.56, .68], and $\omega = .71$, 95% CI [.66, .75], respectively. Next, we calculated the hierarchical omega for the three-factor higher-order model. ω_H was .92, indicating a strong, general factor (McDonald, 1999). Finally, high correlations were observed between the three different subscales, with $r_s = .67$ to $.72$ at T1 and $.71$ to $.78$ at T2.

Additionally², a bifactor model was applied. This model separates covariance that can be accounted for by a single general factor (reflecting the common variance running among all scale items; i.e., RNT) from group factors (reflecting additional common variance among clusters of items with highly similar content; i.e., CC, MC, and PU) (Reise, 2012, p. 667). It thus allows researchers to retain the idea of a single common construct, while also recognising multidimensionality. It further increases insight into the predictive contribution of the total scale and the subscales separately. Applying a bifactor model allows for examining hierarchical omegas for both the total scale and the subscales, together with an Explained Common Variance (ECV; Reise, 2012) index. The fit of the bifactor model was $\chi^2(77)=241.64$, $p<.001$, RMSEA=.06, SRMR = .03, CFI=.96, AIC = 26790.85, and BIC = 27054.89. In the current model, the total reliable variance of the data was .93; 7% of the variance was due to random error. ω_H for the general factor was .90, indicating that 90% of the total

variance in the data was due to individual differences in the general factor. Only 3% of the reliable variance was due to individual differences in the separate subscales, indicating only very little variance to be explained by the separate subscales. Thus, most of the reliable variance was due to the general factor. In this model, Omega Hierarchical Subscale (ω_{HS}), was measured as well. This estimate reflects the reliability of a subscale score after controlling for the variance that is due to a general factor. ω_{HS} indicated that 7% of the variance in the subscale scores was due to the CC subscale, 8% to PU, and 8% to MC. These analyses provided further support for a general factor being derived, apart from group factors, as $\omega_H > .50$ (Revelle, 1979). Finally, to get more information on the utility of working with a multidimensional model, the ECV was estimated. This estimate provides insight into whether a unidimensional model fits the data better compared to a multidimensional model. The ECV for the PTQ-C was 0.86, which indicates a strong general (unidimensional) factor.

In sum, both models fitted the data well, two of the three subscales showed lower internal consistency, the hierarchical omega of the general factor was high, whereas the additional variance that could be explained by the three separate subscales was low. Furthermore, correlations among the three subscales were high and high support was found for a unidimensional factor as suggested by the high ECV. Taking into account all this information, the one-factor model was retained.

Descriptive Statistics

Table 1 presents the mean scores and standard deviations for all measures used, both for the total group and by gender, as well as Pearson correlations with age, and t-tests on gender differences. To be able to reliably examine age and gender differences, we tested whether the factor structure of the one-factor model held for boys and girls and across age. Measurement invariance was established both across age and gender³.

PANAS PA and ECS were found to be negatively associated with age, whereas CDI and ALEQ scores at both T1 and T2 showed positive associations with age. No significant associations were found with the PTQ-C. Gender differences emerged for PANAS PA and for T1 and T2 PTQ-C and CDI scores: Boys reported higher levels on PANAS PA and lower levels on the PTQ-C and the

CDI than girls. Given these associations with age and gender differences, age and gender were included as covariates in the subsequent analyses.

Correlations

Pearson correlations among all the measures are presented in Table 2. Bonferroni's correction was conducted to decrease the risk of a type I error, resulting in p-values being compared to a more strict alpha of .0014 (.05/36). Consistent with expectations, the PTQ-C score showed a significant positive association with depressive symptoms both at T1 and T2. Also, significant associations of PTQ-C scores with all three temperament measures and with ALEQ at T1 and T2 emerged: Higher PTQ-C scores were associated with lower PANAS PA, higher PANAS NA, lower ECS and higher levels on the ALEQ. Finally, high stability for the CDI, the PTQ-C, and the ALEQ was established, as correlations between baseline and follow-up values for these variables were high.

Regression analyses predicting depressive symptoms from repetitive thinking and stress

To examine the extent to which RNT predicts depressive symptoms, both concurrently and prospectively over a three-month interval, and to investigate its interaction with stress in these associations, two hierarchical regression analyses were conducted.

In the first analysis, the criterion variable was the CDI score at T1. Age and gender were included in the first step; PTQ-C at T1 was added in the second step; ALEQ at T1 and the PTQ-C T1 x ALEQ T1 interaction term were added in the third step. In the second analysis, the criterion variable was the CDI score at T2. Age, gender, and the CDI score at T1 were included in the first step; PTQ-C at T1 was added in the second step; ALEQ at T2 and the PTQ-C T1 x ALEQ T2 interaction term were added in the third step. The results are presented in Table 3.

The cross-sectional and the prospective analyses yielded similar results, showing that higher levels on the CDI were, on average, predicted by higher levels on the ALEQ as well as the PTQ-C. Also, in both analyses, a significant ALEQ x PTQ-C interaction emerged. Using PROCESS (Hayes, 2013) in SPSS, interactions were interpreted via the Johnson-Neyman technique to identify the regions of significance. Figures 1 and 2 depict the simple slopes using values of ± 1 SD for the predictor and moderator. ALEQ T1 scores significantly predicted CDI T1 scores at all levels of PTQ-C T1. However, as shown in Figure 1, its effect was stronger at higher (simple slope = 3.70, $p < .001$)

versus lower (simple slope = 2.74, $p < .001$) levels of the PTQ-C T1. ALEQ T2 scores also significantly predicted CDI T2 scores at all levels of PTQ-C T1. However, as shown in Figure 2, its effect was stronger at higher (simple slope = 1.86, $p < .001$) versus lower (simple slope = 1.09, $p < .001$) levels of the PTQ-C T1.

Regression analyses predicting repetitive thinking from temperament

To examine the extent to which RNT at T1 as well as the relative change in RNT from T1 to T2 are predicted by temperament, two hierarchical regression analyses were conducted.

In the first analysis, the criterion variable was the PTQ-C score at T1. Age and gender were included in the first step; PANAS NA, PANAS PA, and ECS were added in the second step; the two-way interactions between temperament dimensions were added in the third step; and the three-way interaction between the temperament dimensions was added in the fourth step. In the second analysis, the criterion variable was the PTQ-C score at T2. Age, gender and the PTQ-C score at T1 were included in the first step; the next three steps were identical to that of the cross-sectional analysis. The results are presented in Table 4. Given that the inclusion of the interaction terms did not account for additional variance in both models (R^2 change = ns) and that none of the interaction terms were significant (all p -values $> .23$), step 3 and step 4 are not represented in the table.

As shown in Table 4, cross-sectionally, higher PTQ-C scores were predicted by higher levels of PANAS NA and lower levels of ECS. PTQ-C scores were also significantly higher in girls than boys. Prospectively, baseline ECS and PTQ-C scores emerged as significant predictors of T2 PTQ-C scores, indicating that lower levels on the ECS and higher levels on the PTQ-C at T1 predict relative increases in PTQ-C levels over a three-month interval. Additionally, girls were significantly more likely than boys to exhibit relative increases on the PTQ-C. Finally, there was a trend for lower PANAS PA scores to predict relative increases on the PTQ-C.

Mediation analyses predicting depressive symptoms from temperamental factors

Next, we examined whether RNT would act as a mediator in the relationship between temperamental factors and depressive symptoms. First, the direct effects of all three temperamental dimensions at T1 on CDI scores at T2 were examined in a single path model. Therefore, CDI at T2 was regressed on all three temperamental dimensions, and on age, gender, and CDI scores at T1.

PANAS NA at T1 acted as a significant predictor of CDI scores at T2 ($\beta = .07, p = .02$), whereas ECS and PANAS PA at T1 did not ($\beta = -.04, p = .13$ and $\beta = -.03, p = .34$, respectively). However, as Holmbeck (1997) notes, two types of intervening effects can be distinguished, that is, mediated effects and indirect effects. Although mediated effects can only occur when an initial significant relationship between an independent variable (i.e., temperamental factors at T1) and a dependent variable (i.e., depressive symptoms at T2) exists, such a condition is not required for indirect effects. An indirect effect is evident when an independent variable is related to a dependent variable through an intervening variable (Cole & Maxwell, 2003; Hayes, 2013), without the requirement of a significant relationship between the independent and the dependent variable. Thus, a mediated effect could further be investigated for PANAS NA, and two indirect effects could further be examined for PANAS PA and ECS.

Given that both mediation and indirect processes are causal mechanisms, temporal separation is required (Cole & Maxwell, 2003; Sobel, 1990). Specifically, the independent variable must precede the mediator in time. The same goes for the temporal relationship between the mediator and the dependent variable. Given that there are two waves involved in the current study, we used a method comprising three longitudinal tests, while taking into account this requirement for temporal separation: (1) path a being estimated by regressing the mediator at Time 2 onto the independent variable at Time 1, controlling for the mediator at Time 1, (2) path b being estimated by regressing the dependent variable at Time 2 onto the mediator at Time 1, controlling for the dependent variable at Time 1, and (3) path ab, that is, the product of path a and path b, which provides an estimate of the indirect effect of the independent variable on the dependent variable through the mediator (Cole & Maxwell, 2003; Little, Preacher, Selig, & Card, 2007). Following this reasoning, the hypothesized model included stability coefficients for both our mediating variable (i.e., the PTQ-C) and the dependent variable (i.e., the CDI). All within-time associations at T1 and T2 were included in the model and, as a control, all variables at T1 and T2 were regressed on age and gender at T1. Paths were drawn from the independent variables (i.e., PANAS NA, PANAS PA, and ECS) at T1 to the mediator (i.e., PTQ-C) at T2, and from the mediator (i.e., PTQ-C) at T1 to the dependent variable (i.e., CDI) at T2. Direct paths from the independent variables at T1 to the dependent variable at T2 were included

as well. This model showed an excellent fit to the data ($\chi^2(1) = 5.00, p = .08; CFI = 1.00; RMSEA = .05$; see Figure 3).

Although PANAS NA was shown to have a direct effect on depressive symptoms over time in the single path model, we could not test for mediation, because the relationship between PANAS NA at T1 and the PTQ-C at T2 was not significant. Furthermore, this relationship between PANAS NA at T1 and CDI at T2 became marginally significant in the final mediational model (Figure 3). PANAS PA and ECS had a (marginally in the case of PANAS PA) significant effect on PTQ-C at T2. Further, the PTQ-C at T1 significantly predicted CDI scores at T2, indicating two potential indirect effects from PANAS PA and ECS to CDI scores through PTQ-C. To evaluate the statistical significance of the indirect effects, the non-parametric resampling method bootstrapping was used with 5000 resamples (Preacher & Hayes, 2008). Each indirect effect was calculated by multiplying the path from the temperamental factor at T1 to the PTQ-C at T2 by the path from the PTQ-C at T1 to the CDI at T2 (Cole & Maxwell, 2003; Hayes, 2013). The indirect effect of ECS on CDI through the PTQ-C appeared significant (bias-corrected 95% CI $[-.02, -.003]$, $p = .03$; $B = -.01$, $SE = .004$). No significant indirect effect was found for PANAS PA (bias-corrected 95% CI $[-.01, .000]$, $p = .17$; $B = -.005$, $SE = .003$)⁴.

Discussion

The first aim of the present study was to replicate previous findings on the factor structure of the PTQ-C (Bijttebier et al., 2015). Both the one-factor model and the three-factor higher-order model showed good fit to our data. However, correlations between the three factors were high and internal consistency estimates for two of the three subscales were poor. Consistent with Bijttebier et al. (2015), we therefore chose to use the one-factor model for further analyses. The unidimensional PTQ-C scale showed excellent internal consistency.

The second aim of the present study was to investigate associations of the PTQ-C with symptoms of depression, both concurrently and prospectively over a three-month interval, and to investigate its role in moderating the link between stress and increases in depressive symptoms. Consistent with the results of Bijttebier et al. (2015), the PTQ-C total score was positively associated with concurrent depressive symptoms. Furthermore, as predicted, it moderated the concurrent

association of stress with such symptoms. The prospective analyses yielded very similar results. Higher scores on the PTQ-C at T1 predicted relative increases in depressive symptoms over a three-month interval. Moreover, they again moderated the association of stress with change in such symptoms. These results clearly support the view that RNT acts as a vulnerability factor, which increases the risk for elevations in depressive symptoms under conditions of stress. Thus, taken together, these findings replicate and extend prior evidence for the validity of the PTQ-C as a measure of dysfunctional RNT.

To the best of our knowledge, this study is the first to demonstrate prospective associations of PTQ-C scores with depressive symptom levels. Our findings are consistent with those of Raes (2012), who showed that, in undergraduate students, PTQ scores predict relative increases of depressive symptoms over a three-year interval in undergraduate students. Findings further complement the study of Kertz et al. (2015), who found that more rapid decreases in RNT were associated with greater decreases in depression levels over the course of a brief partial hospitalization program in a clinical adult sample. Neither those two studies nor any other study, however, investigated the moderating role of RNT, as assessed by the PTQ(-C), on the link between stress and depressive symptoms.

The third aim of the present study was to investigate the extent to which dimensions of temperament predict RNT, as well as to investigate the mediational role of RNT in the associations between such dimensions of temperament and depressive symptoms. Only NA appeared to predict future levels of depressive symptoms (although it should be noted that regression coefficients were rather small and only marginally significant in the more complex path model). However, NA was not associated with increases in levels of RNT, ruling out mediational and indirect effects. One indirect effect was found for EC, however, in which lower levels of EC were predictive of relative increases in depressive symptom levels by augmenting levels of RNT. Thus, by working on strengthening the self-regulatory component of temperament, for instance via mixed attention training (Wass, Scerif, & Johnson, 2012), one might be able to diminish the cycle of repetitive negative thinking, implying a decrease in symptoms of depression. Furthermore, given that an indirect effect of EC on depressive symptoms through RNT was established, it might be useful for individuals with low levels of EC to take perseverative thinking as a target of treatment. Relevant to mention here is the recent finding by

Kertz et al. (2015) that changes in perseverative thinking predict changes in levels of internalizing symptoms over the course of treatment.

It is interesting that high levels of PA were predictive of relative decreases in RNT, although this association was only marginally significant. This finding suggests that the passivity associated with low PA might strengthen one's passive stance in cognitive processes as well. For PA, it was surprising to not find a relation with change in depressive symptoms. Low PA has consistently been related to depression and depressive symptomatology, cross-sectionally and prospectively, in children, adolescents, and adults (e.g., Clark, Watson, & Mineka, 1994; Klein, Kotov, & Bufferd, 2011). It is important to note, however, that we found a zero-order association, but that association did not persist in a more complex model including NA, EC, RNT, and baseline depressive symptoms. Similarly, at the zero-order level, high PA was associated with less RNT, but this association became marginally significant in the more complex analysis. This resembles the pattern of results found for PA and an RNT-related construct (i.e., rumination) in Hudson, Harding, and Mezulis (2015). PA was associated with rumination in a zero-order correlation, but not in a more complex model. PA possibly relates more robustly to thinking with a positive content (cf. Nelis, Bastin, Raes, Mezulis, & Bijttebier, 2016).

Several limitations should be taken into account when considering the implications of these findings. First, the current study relied exclusively on children's self-reports to assess temperament, RNT, and depressive symptoms, and we did not include a measure of social desirability. Social desirable answers might suppress or moderate relationships between study variables, and correlations might be spurious (Ganster, Hennessey, & Luthans, 1983). Thus, the validity of the results obtained may be compromised (Malhotra, 1988). It would be interesting for future studies to also incorporate reports of parents or teachers, to use observational tasks, or to include social desirability scale items. Second, the study focused on a non-clinical community sample. Mean symptom severities in the current study were rather low and no diagnoses of emotional disorders were established. In order to further test the relevance of the PTQ-C for clinical depression, the measure needs to be validated in diagnosed clinical groups. Third, research on the PTQ so far investigated its validity by considering associations with internalizing problems. Specifically, the PTQ-C was mostly studied using depressive rumination and worry as different types of RNT, and depressive and anxious symptomatology as

different outcome measures. However, given that the PTQ(-C) is a content-independent measure of RNT and given that there is evidence that RNT is relevant to a wider range of psychopathology (Harvey et al., 2004), it might be interesting for future research to investigate the role of the PTQ(-C) in the context of other psychopathology as well. We believe that it would be interesting to find out whether the PTQ is also relevant in the context of externalizing problems. In such research, it might be worthwhile to examine associations with hostile rumination and anger-related problems. Finally, this study included two measurement waves. It would be useful to investigate whether a full longitudinal mediation model would replicate our findings while testing prospective changes across three assessments. Given that this study was the first to investigate longitudinal associations using the PTQ-C and some effect sizes were found to be rather small, replication studies in independent samples is vital.

Despite these limitations, the current study further supports the PTQ-C as a useful and psychometrically sound measure of RNT in children and adolescents that may facilitate transdiagnostic research into this cognitive process in children and adolescents.

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Footnotes

¹ Unfortunately, we do not have any information on racial/ethnic background or SES.

However, the population of children in the participating schools is predominantly Caucasian and can be considered as representative of the Belgian population in terms of SES.

² We thank an anonymous reviewer for this suggestion.

³ To examine whether the one-factor structure of this model held across gender and age groups, sequential multi-group confirmatory factor analyses were conducted to test for configural invariance, metric invariance, and scalar invariance. Following the guidelines of Chen (2007), metric invariance was assessed if ΔCFI , $\Delta RMSEA$, and $\Delta SRMR$ were below .010, .015, and .030, respectively. Scalar invariance was regarded if these indexes were below .010, .015, and .010, respectively. For age, we compared a group of children aged 9 to 11 ([9.58-11.50]; $n = 327$) with a group of children aged 12 to 15 ([11.51-14.83]; $n = 371$). Results revealed both metric ($\chi^2_{diff}(14) = 16.44$, $p = .29$; $\Delta CFI < .001$, $\Delta RMSEA = .003$; $\Delta SRMR = .006$) and scalar invariance ($\chi^2_{diff}(14) = 18.27$, $p = .20$; $\Delta CFI = .001$, $\Delta RMSEA = .002$; $\Delta SRMR = .002$). For gender as well, results revealed both metric ($\chi^2_{diff}(14) = 13.26$, $p = .51$; $\Delta CFI < .001$, $\Delta RMSEA = .002$; $\Delta SRMR = .004$) and scalar invariance ($\chi^2_{diff}(14) = 20.30$, $p = .12$; $\Delta CFI = .002$, $\Delta RMSEA = .002$; $\Delta SRMR < .001$). Thus, we could conclude this one-factor structure to be invariant across age and gender.

⁴ After running this model, a second model was run in which we also included the temperamental factors at T2 (resulting in the addition of stability paths for temperament, as well as the within-time associations with temperamental factors at T2). Model fit decreased, with $\chi^2(14) = 165.95$, $p < .001$; $CFI = .96$; $RMSEA = .12$. The most apparent difference with the previous model was that the indirect effect from EC at T1 on CDI at T2 through PTQ-C disappeared (bias-corrected 95% CI [-.01, .00], $p = .22$; $B = -.00$, $SE = .003$). EC at T1 was still a significant predictor of the PTQ-C at T2, but the previously found association between PTQ-C at T1 and the CDI at T2 did not hold, $B = .05$, $p = .12$.

Table 1

Internal consistencies (α), means (M), and standard deviations (SD) for total group and by gender, Pearson correlations (r) with age and t tests on gender differences

	r age	$M(SD)$ tot	$M(SD)$ boys	$M(SD)$ girls	$ t $	df
PANAS PA	-.14***	34.62 (5.71)	35.58 (6.03)	33.78 (5.28)	4.23***	699
PANAS NA	.05	19.59 (5.73)	19.57 (5.38)	19.60 (6.02)	0.08	699
ECS	-.16***	85.97 (10.16)	85.78 (10.80)	86.13 (9.58)	0.46°	660.53
PTQ-C T1	.04	27.28 (11.33)	26.01 (11.03)	28.39 (11.49)	2.79**	699
T2	.06	26.76 (12.26)	24.38 (11.72)	28.83 (12.36)	4.81***	683
CDI T1	.08*	8.91 (6.31)	8.18 (6.00)	9.56 (6.51)	2.92*** °	697.79
T2	.11**	8.08 (6.32)	7.43 (6.14)	8.64 (6.42)	2.53*	683
ALEQ T1	.11**	18.70 (10.09)	18.69 (10.33)	18.71 (9.89)	0.02	699
T2	.15***	18.01 (9.71)	17.48 (9.54)	18.47 (9.84)	1.33	683

* $p < .05$, ** $p < .01$, *** $p < .001$

°equality of variances not assumed

Table 2

Pearson correlations among all the measures used

	PANAS NA	ECS	PTQ-C T1	PTQ-C T2	CDI T1	CDI T2	ALEQ T1	ALEQ T2
PANAS PA	-.16	.44	-.17	-.23	-.45	-.38	-.22	-.22
PANAS NA		-.28	.40	.33	.58	.51	.47	.36
ECS			-.28	-.31	-.53	-.46	-.50	-.47
PTQ-C T1				.68	.49	.46	.40	.39
PTQ-C T2					.45	.54	.33	.43
CDI T1						.80	.64	.55
CDI T2							.58	.62
ALEQ T1								.75

Note. All of the correlations were significant beyond the adjusted alpha level of .001 (.05/36), two tailed test.

Table 3

Summary of hierarchical regression analyses predicting depressive symptoms from demographics, repetitive negative thinking and stress

	Prediction of T1 CDI				Prediction of T2 CDI			
	R^2	R^2 change	B (SE)	β	R^2	R^2 change	B (SE)	β
Step1	.02**	—			.64***	—		
Intercept			8.21*** (.35)				8.06*** (.21)	
Age			.53* (.24)	.08*			.27 [†] (.15)	.04 [†]
Gender			1.33** (.47)	.11**			.06 (.29)	.01
CDI T1			-	-			5.02*** (.15)	.80***
Step 2	.25***	.25***			.65***	.01**		
Intercept			8.54*** (.30)				8.09*** (.21)	
Age			.38 [†] (.21)	.06 [†]			.27 [†] (.15)	.04 [†]
Gender			.70 [†] (.42)	.06 [†]			-.003 (.29)	.00
CDI T1			-	-			4.76*** (.17)	.75***
PTQ-C T1			3.03*** (.21)	.48***			.54** (.17)	.09**
Step 3	.49***	.24***			.69***	.04***		
Intercept			8.22*** (.26)				7.91*** (.20)	
Age			.07 (.17)	.01			.11 (.14)	.02
Gender			.95** (.35)	.08**			.05 (.27)	.00
CDI T1			-	-			4.01*** (.17)	.64***
PTQ-C T1			1.76*** (.19)	.28***			.36* (.16)	.06*
ALEQ T1			3.22*** (.19)	.51***			-	-
ALEQ T2			-	-			1.48*** (.17)	.23***
PTQ-C T1x ALEQ T1			.48** (.17)	.08**			-	-
PTQ-C T1x ALEQ T2			-	-			.38** (.13)	.07**

[†] $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Note. Gender: boys coded as 0 and girls coded as 1. All independent variables but gender were standardized prior to analyses.

Table 4

Summary of hierarchical regression analyses predicting repetitive negative thinking from demographics and temperament

Prediction of PTQ-C T1					Prediction of PTQ-C T2			
Step1	R^2 .02**	R^2 change -	B (SE)	β	R^2 .48***	R^2 change -	B (SE)	β
Intercept			26.04*** (.62)				25.40*** (.50)	
Age			.55 (.43)	.05			.32 (.34)	.03
Gender			2.33** (.85)	.10*			2.54*** (.68)	.10***
PTQ-C T1			-	-			8.23*** (.34)	.67***
Step 2	.21***	.20***			.50***	.02***		
Intercept			26.01*** (.56)				25.43*** (.49)	
Age			-.08 (.39)	-.01			.00 (.34)	.00
Gender			2.38** (.78)	.11**			2.51*** (.68)	.10***
PTQ-C T1			-	-			7.61*** (.38)	.62***
PANAS PA			-.17 (.43)	-.02			-.68 [†] (.38)	-.06 [†]
PANAS NA			3.97*** (.40)	.35***			.37 (.37)	.03
ECS			-2.04*** (.44)	-.18***			-1.33** (.39)	-.11**

[†] $p < .08$, * $p < .05$, *** $p < .001$

Note. Gender: boys coded as 0 and girls coded as 1. All independent variables but gender were standardized prior to analyses.

Fig.1

ALEQ x PTQ-C interaction predicting concurrent depressive symptoms

Fig.2

ALEQ x PTQ-C interaction predicting future depressive symptoms

Fig.3

Mediation model with significant standardized path coefficients. Dashed lines represent the non-significant paths. Within-time correlations at T1 and T2, and relations with age and gender are not presented for reasons of clarity

T = Time; $^{\dagger} p \leq .09$, $* p < .05$, $** p < .01$, $*** p < .001$