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Rumination and Worry: Factor Structure and Predictive Utility

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by

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Abstract

Criticism of discrete classification systems for mental disorders has led to a focus on identification of mechanisms that cut across symptom clusters, known as transdiagnostic factors. One such proposed factor is negative repetitive thought (NRT), or a perseverative, often uncontrollable, focus on negative information, experiences, or expectations. Worry and rumination are two major constructs thought to compose NRT. No confirmatory factor analyses have investigated whether worry and rumination might compose a general NRT factor, discrete factors, or some combination of the two. The first purpose of the current study was to use confirmatory factor analyses to uncover whether worry and rumination are best characterized as separate or common constructs. In addition to this purpose, the study investigated NRT as a transdiagnostic factor for psychopathology. Finally, it examined incremental associations of NRT with mental illness symptoms, after controlling for negative emotionality, the most well established transdiagnostic risk factor. A bi-factor conceptualization of worry and rumination, in which there was a common NRT factor and specific worry and rumination factors, yielded the best fit to the data across three separate samples. The NRT factor was associated with both internalizing and externalizing psychopathology; however, it demonstrated significant overlap with negative emotionality. Further exploration of this overlap using bi-factor modeling demonstrated that NRT and negative emotionality are likely best thought of as a unidimensional general negative affect construct, and this structure was replicated across samples. Importantly, evidence was found that this tendency to experience negative affect was also a common liability for mental illness symptoms.

Rumination and Worry: Factor Structure and Predictive Utility

There has been much recent criticism of the Diagnostic and Statistical Manual of Mental Disorders (APA, 2014). This criticism has focused on a lack of evidence for clear diagnostic cutoffs, an inability to explain high rates of comorbidity, and a poor understanding of the underlying factors contributing to symptom development (Flaskerud, 2010; Morris & Cuthbert, 2012; Sanislow et al., 2010; Tully & Iacono, 2014b). In recognition of these problems with the current classification system, many have advocated against studying discrete diagnoses, and instead focusing on identification of mechanisms that cut across symptom clusters (Morris & Cuthbert, 2012; Sanislow et al., 2010; Seligman, 2014; Tully & Iacono, 2014b). These mechanisms are sometimes referred to as transdiagnostic factors or common liabilities for mental illness.

One proposed unifying risk factor for psychopathology is negative repetitive thinking (NRT; Mansell, Harvey, Watkins, & Shafran, 2008; Tully & Iacono, 2014b; Watkins, 2008). NRT is defined as perseveratively, and often uncontrollably, focusing on negative information, experiences, or expectations (Mansell et al., 2008; Tully & Iacono, 2014b; Watkins, 2008). It is thought to be composed of two main repetitive thought processes: worry (repetitive focus on future negative events, consequences, and possibilities, thought to be characteristic of anxiety; Starcevic & Berle, 2006), and rumination (repetitively and passively focusing on symptoms of distress, thought to be characteristic of depression; McEvoy, Mahoney, & Moulds, 2010; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). In line with this thinking, there have been a number of recent attempts to assess the interrelatedness of these constructs and establish a unitary measure of NRT.

Evidence for combining across different measures of NRT has been mixed. Theorists have proposed that worry and rumination compose the broader construct of NRT, given that they are both frequent, intrusive, difficult to control cognitive processes (Mathews & MacLeod, 2005; Watkins, Moulds, & Mackintosh, 2005). They cite research indicating that worry and rumination correlate similarly with related constructs, including intolerance of uncertainty, avoidance, metacognitive beliefs, and cognitive control strategies (McEvoy et al., 2010). In line with this notion, moderate to strong intercorrelations have been reported between rumination and worry in several studies

(Calmes & Roberts, 2007; D'Hudson & Saling, 2010; Fergus, 2013; Flett, Coulter, Hewitt, & Nepon, 2011; Hong, 2007; Hoyer, Gloster, & Herzberg, 2009; Hughes, Alloy, & Cogswell, 2008; Merino, Ferreiro, & Senra, 2014; Muris, Roelofs, Rassin, Franken, & Mayer, 2005; Raes, 2010; Verstraeten, Bijttebier, Vasey, & Raes, 2011; Yook, Kim, Suh, & Lee, 2010; Zalta & Chambless, 2008). However, five different studies using exploratory factor analyses have indicated that items assessing worry and rumination load onto different factors (D'Hudson & Saling, 2010; Fresco, Frankel, Mennin, Turk, & Heimberg, 2002; Goring & Papageorgiou, 2008; Muris, Roelofs, Meesters, & Boomsma, 2004; Yang et al., 2014). Thus, rumination and worry may be best characterized as distinct constructs, rather than related elements of NRT.

However, a number of methodological factors temper any definitive conclusions that can be made about the above studies. First, some of these earlier reports did not use optimal analytic methods. Specifically, three of the five factor analytic studies used principal components analyses to explore the underlying factor structure of rumination and worry (D'Hudson & Saling, 2010; Goring & Papageorgiou, 2008; Muris et al., 2004). Principle components analysis, as opposed to principal axis factoring, uses all the variance in the observed items to assess for commonality across items and does not truly assess for underlying factor structure (Costello & Osborne, 2011). In contrast, principal axis factoring assumes that an underlying factor gives rise to item responding, only uses shared variance of observed items to generate factors, and would have been more appropriate for assessing whether worry and rumination items load onto the same underlying NRT factor (Costello & Osborne, 2011). Second, evidence from confirmatory factor analyses is necessary to confirm the findings from these exploratory studies. Third, the possibility remains that a common NRT factor exists, alongside the specific rumination and worry factors. This possibility has not been tested in empirical research. Such a goal is important to test whether an NRT construct actually exists.

In addition to these issues with the factor structure of NRT, questions remain about the ability of NRT to transdiagnostically predict psychopathology. Individually, worry and rumination have been linked with depression, anxiety and substance use (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Mor & Winquist, 2002; Olatunji, Naragon‐Gainey, & Wolitzky‐Taylor, 2013; Rood, Roelofs, Bögels, Nolen-Hoeksema, & Schouten, 2009). However, no published studies have comprehensively tested NRT's relationships with both internalizing and externalizing disorders, following the establishment of a clear factor structure of worry and rumination. Thus, the ways in which NRT and related constructs are associated with psychopathology remain unclear. Uncovering this

information is important to validate the transdiagnostic nature of NRT, identify pathways to psychological symptoms, and inform treatment efforts aimed at reducing NRT.

If NRT does indeed transdiagnostically predict psychopathology, as some have proposed, it may still lack incremental utility over other established common liabilities for mental illness. For instance, negative emotionality is the transdiagnostic factor with the most support in the research literature (Grant, 2011; Tully & Iacono, 2014a). The tendency to experience a greater frequency and intensity of negative emotions predisposes an individual to experience the depression and anxiety associated with internalizing disorders (Tully & Iacono, 2014a). Furthermore, it enhances the likelihood of rejection by peers and use of ineffective coping strategies (Dougherty, 2006). These factors precipitate further distress and increase the likelihood of engaging in externalizing behaviors (Grant, 2011). For NRT to be considered useful, it should predict psychopathology above and beyond the more established common liability of negative emotionality. One study found that NRT does indeed predict anxiety and depression above and beyond neuroticism, an analog of negative emotionality (McEvoy et al., 2010). Another preliminary study indicated that NRT is important in predicting the internalizing, but not the externalizing dimension after accounting for negative affect (Sibiga, Echevarria, Kiselica, & Bornovalova, 2015). These studies were important first steps; however, they require replication, following the establishment of a definitive factor structure for NRT.

The current manuscript reports on three studies using confirmatory factor analyses and structural equation modeling to answer three main research questions. First, they investigated the factor structure of worry and rumination. It was hypothesized that variance in worry and rumination measures would be primarily accounted for by a common NRT factor, in line with the theory that rumination and worry represent a unitary cognitive process. Second, these studies tested the association of NRT with psychological outcomes. It was hypothesized that NRT would account for a moderate to large portion of the variance in internalizing and externalizing symptoms on the basis of previous meta-analyses. Finally, incremental utility of NRT over negative emotionality was examined to establish the validity of NRT as a risk factor for psychopathology. It was predicted that NRT would exhibit an independent association with internalizing, but not externalizing symptoms, after controlling for negative emotionality (Sibiga et al., 2015).

Data analyses proceeded in 3 stages. In study 1, data from a sample of participants was used to test the factor structure of worry and rumination. In study 2, data from a second, larger sample was used to validate this

factor structure and test the incremental association of NRT with psychopathology over and above negative emotionality. In study 3, a third sample was used to replicate the procedures from studies 1 and 2.

Study 1

Method

Participants and procedures. Participants included English-speaking adults. They completed study procedures via the Amazon Mechanical Turk System (MTurk). MTurk allows posting of online surveys and tasks, to which participants respond in exchange for monetary compensation. It has been shown to be a reliable, cost-effective means of collecting samples with greater diversity than traditional undergraduate samples, even when collecting data on clinical symptoms (Behrend, Sharek, Meade, & Wiebe, 2011; Berinsky, Huber, & Lenz, 2012; Buhrmester, Kwang, & Gosling, 2011; Ross, Zaldivar, Irani, & Tomlinson, 2009; Shapiro, Chandler, & Mueller, 2013). Filters were placed on MTurk, such that only the most qualified and reliable workers were allowed to take our survey. Only those with a work approval rate greater than 90 percent and with a history of completing work on MTurk (at least 100 jobs) were eligible to participate.

Participants in sample 1 were paid $0.15 for completing a 5 minute online survey, which amounts to $1.75/hour, $0.50 above the average pay of $1.25 per hour (Ross et al., 2009). In total, 303 participants completed the survey. However, 26 participants' data were removed due to random responding (identification of random responders discussed below in the measures section).

The final sample included data from 277 individuals. Participants were an average of 32.70 (*SD* = 10.15) years of age. The sample consisted of 51.50% males, 41.20% females, and 0.30% transgender individuals. The respondents self-reported their races/ethnicities as Asian/Southeast Asian (65.0%), Caucasian (21.30%), African American (6.10%), Hispanic (2.90%), and other/mixed (1.10%). With regard to education, 50.50% had a Bachelor's Degree, 23.80% had a Master's Degree, 17.00% had a high school degree or equivalent, and 5.40% had a graduate or professional degree. Participants described their annual household incomes as $0-50,000 (60.30%), $50,000-100,000 (23.10%), $100,000-$150,000 (7.6%), and $150,000 or greater (4.80%).

Measures. NRT was assessed via several measures of rumination and worry. Three commonly used measures of each construct were used to ensure the widest possible coverage of each construct. The measures of

rumination included the 12-item Rumination subscale of the Rumination and Reflection Questionnaire (Trapnell & Campbell, 1999), the 5-item Brooding subscale of the Ruminative Response Scale (Treynor, Gonzalez, & Nolen-Hoeksema, 2003), and a 10-item measure of post event rumination, known as the Post Event Processing Questionnaire (Rachman, Grüter-Andrew, & Shafran, 2000). The measures of worry included the 8-item Penn State Worry Questionnaire-Abbreviated version (Kertz, Lee, & Björgvinsson, 2014; Meyer, Miller, Metzger, & Borkovec, 1990), the 10-item Worry Domains Questionnaire-Short Form (Stöber & Joormann, 2001; Tallis, Eysenck, & Mathews, 1992), and the 8-item Brief Measure of Worry Severity (Gladstone et al., 2005). These measures were chosen because they are the most commonly used assessments of worry and rumination in the literature, with the most evidence for good psychometrics properties (reliabilities reported in Table 1).

In addition to these NRT measures, four attention items were inserted in the questionnaires (e.g., "If you are reading this item, select 'strongly agree'"). Participants were required to respond correctly on at least 3 of these 4 items for their responses to be considered reliable. Data for participants containing unreliable responding were removed. Participants also completed a demographic questionnaire.

Analyses

Several confirmatory factor analysis (CFA) models of the structure of rumination and worry were examined. Model fit was investigated using both statistical and approximate model-fit indices. The statistics included the chi-square, *RMSEA*, *CFI*, and *AIC*. Fits were interpreted based on traditional rules of thumb (Hu & Bentler, 1999; Kline, 2011; MacCallum, Browne, & Sugawara, 1996; Raftery, 1995). Excellent model fit is given by a non-significant chi-square value, *CFI* close to one (> than .95), *RMSEA* close to 0 (< .06), and a lower *AIC* value (only used for model comparisons; cannot be used for a model in isolation). Acceptable model fit is evidenced by a *CFI* greater than .90 and an *RMSEA* less than .08. Comparisons across models were accomplished by examining the change in fit indices. Significant reductions in chi-square, numerical increase in the *CFI*, and numerical decrease in *RMSEA* indicated improved model fit (Kline, 2011). When comparing models using the *AIC*, a difference of 2-6 in *AIC* is considered weak evidence, a difference of 6-10 is positive evidence, a difference of 6-10 is strong evidence, and any difference over 10 is very strong evidence (Raftery, 1995).

The three measures of worry and the three measures of rumination served as indicators in all models. The first model was a single-factor model, in which all rumination and worry measures loaded onto a general NRT factor. This model was expected to fit poorly, given that worry and rumination items typically load onto separate

factors in exploratory factor analyses. The next model was a correlated two-factor model with worry and rumination measures loading onto separate, correlated factors. We also examined the fit of a bi-factor model involving a Schmid-Leiman transformation (hereafter referred to as a Schmid-Leiman model; Canivez, in press; Schmid & Leiman, 1957). Herein, the rumination measures served as indicators of a specific rumination factor, the worry measures served as indicators of a worry factor, and all measures loaded additionally onto a general NRT factor (Canivez, in press; Gibbons & Hedeker, 1992). The Schmid-Leiman method apportions the variance among a set of measures to a general factor (in this case, NRT) and uncorrelated specific factors (rumination and worry) using proportionality constraints, which allow a researcher to examine each factor's relative importance (see McDonald, 2013, p. 190). Thus, the Schmid-Leiman method indicates the degree to which variance among rumination and worry items can be explained by a general (NRT) and construct-specific (rumination and worry) factors. To determine the most appropriate model for the data, each model's overall goodness of fit was examined, as well as the change in goodness of fit from the simple to more complex representations.

Results and Discussion

Descriptive statistics for study 1 variables are presented in Table 1. Model fit results are displayed in Table 2. All figures for study 1 are represented in the Appendix A, while the most relevant figures to the manuscript are presented along with the manuscript itself. Fits for the one and two-factor models were adequate, but not excellent, as indicated by the significant chi-square test and large *RMSEA* values (i.e., greater than .06). In contrast, the Schmid-Leiman model provided an excellent fit to the data. It yielded a non-significant chi-square, low *RMSEA* (.033), and high CFI (.995). Importantly, there was very strong evidence (a 12 point decrease in *AIC*) for the superiority of this model over the one and two-factor models.

Table 3 shows the proportion of variance in each indicator accounted for by the common and specific factors. The NRT factor accounted for a majority of the variance in the worry and rumination measures (M = 54.89%). In contrast, the specific worry and rumination factors accounted for a comparably negligible amount of variance (M = 3.00%).

Findings from study 1 indicate that there is merit to retaining the Schmid-Leiman structure for rumination and worry. Specifically, most of the shared variance in these items is accounted for by a general NRT factor, though a small amount of unique, construct specific variance remains. These findings support the notion that a unitary NRT construct exists and that worry and rumination may have limited independent value. Study 2 replicated the

modeling procedures from study 1 in a larger sample and extended them by testing the independent value of the NRT factor in explaining variance in psychopathology after accounting for the influence of negative emotionality.

Study 2

Method

Participants and procedures. Participants in study two were collected via Amazon Mechanical Turk, as in study 1. These participants were paid $1.75 for completing a 45-60 minute online survey. A total of 972 people completed the survey. Of those 972, 61 were excluded for incorrectly answering 2 or more of 4 attention check items (replication of study 1 procedures). The remaining participants (N = 911) ranged in age from 19 to 56 (M = 35.55, SD = 11.15). They included 53.3% males, 43.1% females and 0.20% transgendered individuals. Participants self-identified their races/ethnicities as Asian/South Asian (48.60%), Caucasian (38.00%), African American/Black (4.9%), and other/mixed (1.30%). With regard to education, participants reported that they had less than a high school degree (0.10%), a high school degree or equivalent (20.00%), a Bachelor's degree (53.10%), a master's degree (18.40%), or a graduate or professional degree (0.20%). Additionally, participants came from a range of economic backgrounds: Their household incomes were reported as $0-50,000 (56.50%), $50,000-100,000 (27.30%), or $100,000 or more (12.60%).

Measures. Study 2 utilized the worry, rumination, and demographic measures described in study 1 (see Table 1 for reliabilities). Additionally, it included assessments of psychopathology and negative emotionality. Measurement of psychopathology followed the well-validated structure put forth by Kreuger and colleagues (1998). It characterizes mental disorders as either internalizing, in which distress is expressed inwardly (e.g., in depression), or externalizing, in which distress is expressed outwardly (e.g., in antisocial personality disorder). Internalizing was modeled from standard measures of depression, generalized anxiety, social phobia, panic disorder/agoraphobia, specific phobia, and obsessive-compulsive disorder. These included the Beck Depression Inventory-II (Beck, Steer, & Brown, 1996), which captures symptoms of major depression, the Beck Anxiety Inventory (Steer & Beck, 1997), which captures symptoms of generalized anxiety, the Liebowitz Social Anxiety Scale (Liebowitz, 1987), which assesses symptoms of social phobia, the Panic and Agoraphobia Scale (Bandelow, 1995), which measures symptoms of panic and agoraphobia, the Phobic Stimuli Response Scales (Cutshall & Watson, 2004), which assess fear of

specific stimuli, including animals, bodily harm, confinement, and blood/injections (Note that this scale also contains items assessing social anxiety; these were not used due to redundancy with Liebowitz's scale), and the Obsessive-Compulsive Inventory (Foa et al., 2002), which captures obsessive-compulsive symptoms. These measures of internalizing were used to form an internalizing factor.

Externalizing psychopathology was assessed via the Externalizing Spectrum Inventory-Brief Form (Patrick, Kramer, Krueger, & Markon, 2013), a 160-item Likert-type scale. The brief Externalizing Inventory maps well onto the structure of the original measures, exhibits criterion validity, and adequate reliability (Patrick et al., 2013). It assesses three broad domains of externalizing personality traits and behavior: Callous Aggression, Substance Abuse, and Disinhibition. These domains were used to form an externalizing factor.

Trait negative emotionality was measured with the Multidimensional Personality Questionnaire—Brief Form (Patrick, Curtin, & Tellegen, 2002), a 155-item True-False assessment of personality traits. It has higher order Negative Emotionality, Positive Emotionality, and Constraint factors. The Negative Emotionality factor was formed from the subfactors Stress Reaction (Note that 4 items were removed from this scale due to clear overlap with worry or rumination; e.g., "I often find myself worrying about something"), Alienation, and Aggression. Negative Emotionality was used as a control in final tests of the incremental predictive utility of worry and rumination. The Multidimensional Personality Questionnaire has strong evidence of reliability and validity as a measure of personality (Patrick et al., 2002; Tellegen, 1982).

Analyses

Analyses from study 1 were replicated in study 2 (i.e., one-factor, two-factor, and Schmid-Leiman models were compared for fit). Next, the best fitting model was used in predicting internalizing and externalizing psychopathology in an SEM framework. Finally, negative emotionality was entered as a covariate in models predicting mental health outcomes to test incremental utility.

Results and Discussion

Factor structure of worry and rumination. Descriptive statistics for study 2 variables are presented in Table 1. All figures for study 2 are presented in Appendix B, with the most pertinent models included with the manuscript and referred to in-text. CFA model fit results for worry and rumination are presented in Table 2. Study 2 replicated the overall factor structure findings from study 1, in that the Schmid-Leiman model once again represented the best fit to the data. Specifically, it demonstrated very strong evidence of improved fit on the basis of

the *RMSEA* (.077 for the two-factor vs. .054 for the Schmid-Leiman) and *AIC* values (11.99 point decrease from the two-factor to the Schmid-Leiman model). The NRT factor again accounted for the majority of the variance in the rumination and worry items. Consequently, the Schmid-Leiman model was used to test the predictive utility of NRT.

Predictive utility of NRT. An SEM model was used to test the incremental utility of NRT in explaining variance in internalizing and externalizing psychopathology. This model included three components. The first component was the Schmid-Leiman Model including the general NRT factor, along with specific worry and rumination factors. Within the same model, psychopathology was modeled via correlated internalizing (composed of depression, generalized anxiety, phobia, panic/agoraphobia, and OCD indicators) and externalizing (composed of callous aggression, substance abuse, and disinhibition indicators) factors. The final component of the model consisted of predictive paths from NRT to both internalizing and externalizing psychopathology.[1] Fit of this model was only fair: $\chi^2(92) = 687.33$, $p < .0001$, $CFI = .937$, $RMSEA = .084$, $AIC = 29488.17$. However, NRT significantly predicted both internalizing ($\beta = .92$, $p < .001$, $R^2 = .85$) and externalizing symptoms ($\beta = .52$, $p < .001$, $R^2 = .27$). Consequently, the subsequent model tested the incremental association of NRT with psychopathology when controlling for negative emotionality (Figure 2 provides a visual example of this model).

In this model, a negative emotionality factor was created from measures of stress reaction, alienation, and aggression. This factor was added to the existing model, which included NRT, internalizing, and externalizing. Paths were created from NEM and NRT to both externalizing and internalizing. These changes resulted in poorer fit than the model only including NRT as a predictor, $\chi^2(134) = 1265.17$, $p < .0001$, $CFI = .903$, $RMSEA = .096$, $AIC = 37689.00$, $\Delta\chi^2(42) = 577.84$, $p. < .0001$. In addition to obtaining worse fit, a strange pattern of prediction emerged. Though NRT significantly predicted internalizing psychopathology ($\beta = .68$, $p < .001$), it negatively predicted externalizing psychopathology ($\beta = -.53$, $p < .001$).

Closer examination of local fit of the model revealed a collinearity problem ($r = .90$, $p < .001$) between NRT and negative emotionality (Bollen, 2014; Dormann et al., 2013; Grewal, Cote, & Baumgartner, 2004). In regression and SEM frameworks collinearity of predictors results in biased parameter estimation, weights that are difficult or impossible to interpret, and increased Type II error rates (Cohen, Cohen, West, & Aiken, 2013; Dormann

[1] Models examining prediction of psychopathology by the specific factors were not examined due to the low percentage of variance ($M = 5.66\%$) in the items explained by these factors and the difficulty in interpreting their meanings. This same procedure was applied in all further analyses.

et al., 2013; Grewal et al., 2004; Kraha, Turner, Nimon, Zientek, & Henson, 2012; Maruyama, 1997). One solution to the collinearity problem in SEM is to combine highly correlated predictors into one latent variable. Consequently, models in which negative emotionality, rumination, and worry indicators loaded onto the same latent factor were examined (note that these CFA investigations differed from previous models in that previous models only included worry and rumination indicators loading onto the same factor). Table 4 includes CFA model fitting results for these analyses.

Factor structure of worry, rumination, and negative emotionality. First, a one-factor model with all indicators (worry, rumination, and negative emotionality variables) loading onto the same factor was examined. This model provided an inadequate fit to the data. Next, a Schmid-Leiman model was tested. Herein, the worry, rumination, and negative emotionality indicators all loaded onto a general negative affect factor. Additionally, they each had a respective specific factor. The fit of this model was better than that of the one-factor model. Fit for this model was excellent on the basis of the *CFI* (.950); however, the *RMSEA* value was slightly above the generally accepted cut-off (.093).

Consequently, standardized residual covariances were examined for areas in which model fit could be improved (Byrne, 2013; Gefen, Straub, & Boudreau, 2000). There were several standardized residual covariances above the acceptable +/-2.58 value for the MPQ Aggression scale. Consequently, the model was reexamined, removing this scale. This decision was made on the basis of several factors. First, some empirical research suggests that aggression may be best conceptualized as a separate from negative affect (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). Second, aggression may be better associated with externalizing behaviors, rather than negative emotions, as it is in the Externalizing Inventory (Patrick et al., 2013). Finally, because aggression was used as an indicator for our externalizing outcome, it was not sensible to also use it as a predictor (i.e., it does not make sense to predict aggression with aggression).

As can be seen in Table 4, removing aggression from the model resulted in a substantial improvement in model fit. The final model is shown in Figure 3. This Schmid-Leiman conceptualization implied that negative emotionality and NRT constructs shared a large amount of common variance, while allowing for a small amount of construct specific variance. In fact, the majority of the variance in all measures was accounted for by the general negative affect factor (see Table 3; $M = 59.43\%$).

Concurrent validity of the general negative affect factor. Next, tests of the concurrent validity of the general negative affect factor were undertaken. The updated Schmid-Leiman conceptualization containing general negative affect, negative emotionality, rumination, and worry factors was entered along with internalizing and externalizing factors. Paths were created from general negative affect to internalizing and externalizing symptoms. Importantly, general negative affect predicted internalizing ($\beta = .92$, $p < .001$, $R^2 = .85$) and externalizing symptoms ($\beta = .54$, $p < .001$, $R^2 = .30$) and the model yielded a generally acceptable fit, $\chi^2(121) = 887.77$, $p < .0001$, *CFI* = .93, *RMSEA* = .083, *AIC* = 33325.84. This result implied that psychopathology symptoms across the spectrum are predicted by the general tendency to experience negative affect and not perseverative thought processes per se. Notably, the effect size for this association was quite large, especially for internalizing disorders. Study 3 replicated the modeling procedures from study 2 in a student sample to ensure that findings could be extended to varied populations.

Study 3

Method

Participants and procedures. Participants included 545 university undergraduate students, who completed the same series of surveys from study 2 (descriptive statistics and reliabilities provided in Table 1). These participants were compensated with course credit or extra credit towards a course grade. Twenty-two participants' data were eliminated on the basis of incorrect responding on 2 or more of 4 attention check items. Remaining participants included 523 individuals with a mean age of 21.03 (*SD* = 5.15). Respondents self-reported their genders as female (79.90%), male (18.5%), and transgender female (0.20%). They identified their races/ethnicities as Caucasian (58.50%), Hispanic (16.30%), Asian/South Asian (9.60%), African American/Black (8.00%), and other/mixed (5.70%). Since participants were recruited from a university, the majority of them had only completed high school (89.30%); however, small percentages of the sample had bachelor's degrees (8.0%), Master's degrees (0.60%), or graduate/professional degrees (0.40%). Finally, participants came from a range of economic backgrounds: Their household incomes were reported as $0-50,000 (48.90%), $50,000-100,000 (26.20%), or $100,000 or more (23.40%).

Analyses

Analyses from study 2 were replicated in study 3 (i.e., one-factor, two-factor, and bi-factor models including rumination and worry indicators were compared for fit). Next, the best fitting model was used to assess associations with internalizing and externalizing psychopathology with negative emotionality entered as a control. Again, all figures for study 3 are provided in Appendix, with the most relevant figures included with the manuscript and referred to in-text.

Results and Discussion

Factor structure of worry and rumination. The global structure of rumination and worry was replicated in study 3 (See Table 2). Specifically, one-factor, two-factor, and Schmid-Leiman CFA models were compared for fit. Once again, the Schmid-Leiman conceptualization of rumination and worry provided the best fit to the data.

Predictive utility of NRT. Next, the incremental utility of NRT was investigated. As in study two, an SEM model was constructed with NRT, worry, and rumination factors (i.e., the Schmid-Leiman model), in addition to internalizing and externalizing factors. Paths were drawn from NRT to internalizing and externalizing. This model yielded an acceptable fit $\chi^2(92) = 445.79$, $p < .0001$, $CFI = .909$, $RMSEA = .086$, $AIC = 18515.35$. NRT significantly predicted both internalizing ($\beta = .95$, $p < .001$, $R^2 = .90$) and externalizing symptoms ($\beta = .27$, $p < .001$, $R^2 = .07$).

Next, a negative emotionality factor was added to the model and paths were created from negative emotionality to internalizing and externalizing. As in study 2, fit for this model was inadequate: $\chi^2(134) = 657.40$, $p < .0001$, $CFI = .888$, $RMSEA = .087$, $AIC = 22324.95$, $\Delta\chi^2(42) = 211.61$, $p. < .0001$. In addition to obtaining worse fit, a strange pattern of prediction again emerged. Specifically, though NRT positively predicted internalizing ($\beta = .72$, $p < .001$), it negatively predicted externalizing psychopathology ($\beta = -.65$, $p < .001$). Again the cause was a collinearity problem, as the correlation between NRT and negative emotionality was excessively high, $r = .89$, $p < .001$.

Factor structure of negative emotionality, rumination, and worry. Consequently, models combining NRT and negative emotionality were examined. A one-factor model with worry, rumination, and negative emotionality provided an inadequate fit to the data. However,
fit of a Schmid-Leiman model including a general negative affect factor and specific worry, rumination, and negative emotionality factors provided a good fit (see Table 4). To replicate study 2 procedures, fit of this model after removing the Aggression scale was examined. This change resulted in a significant improvement in fit on the basis of the change in chi-square, *RMSEA*, and *AIC* values. Table 3 demonstrates that the majority of the variance in negative emotionality, rumination, and worry measures was accounted for by the general negative affect factor ($M = 53.48\%$). The specific factors contributed to the explanation of a comparably minuscule amount of variance in the indicators ($M = 4.46\%$). Figure 4 illustrates this final model.

Concurrent validity of general negative affect. Next, a test of the concurrent validity of the general negative affect factor was completed. This Schmid-Leiman conceptualization including general negative affect, negative emotionality, rumination, and worry, factors was entered along with internalizing and externalizing factors. Paths were created from general negative affect to internalizing and externalizing symptoms. General negative affect predicted internalizing ($\beta = .96$, $p < .001$, $R^2 = .92$) and externalizing symptoms ($\beta = .30$, $p < .001$, $R^2 = .09$)

and the model yielded an acceptable fit, $\chi^2(121) = 524.43$, $p < .0001$, *CFI* = .91, *RMSEA* = .073, *AIC* = 20898.73. In general, results showed good generalization for overall structure of models combining NRT and negative emotionality. These results provide further evidence that a tendency toward negative affect and negative thinking are largely one and the same. Importantly, this general negative affect factor explained a large percentage of variance in internalizing symptoms and a moderate percentage of variance in externalizing symptoms.

General Discussion

The above investigation examined the factor structure and incremental utility of NRT constructs. It had several strengths. First, it had a broad focus on several measures of rumination and worry. Second, it used the most appropriate statistical models. Third, it included replication of glaboal model structure with 3 large, diverse samples to ensure statistical and external validity. Several interesting findings emerged.

Across three samples, models produced evidence that worry and rumination are best conceptualized under the broader umbrella of NRT. These results imply that there may be a general underlying tendency toward perseverative thought processes, which may be manifested differently, depending on the content of the thoughts. Importantly, evidence from two separate samples suggests this general tendency towards NRT cannot be distinguished from a tendency to experience negative emotions. This finding was surprising, given the conceptual delineation I between thoughts and emotions. Two possible explanations for this finding are apparent: one substantive and another methodological.

Substantively, it may be that negative thoughts and negative emotions are inextricably intertwined (i.e., the experience of negative affect goes hand in hand with perseveration, and vice versa, such that the moment individuals attend to their negative emotions, they have already begun the process of perseveration). Importantly, studies 2 and 3 provided evidence that this general tendency to experience negative affect is associated with both internalizing and externalizing psychopathology. Thus, this work added further evidence to the growing body of literature, which suggests that a tendency to experience negative affect is a broad-based risk factor for mental illness (Tully & Iacono, 2014b). Taken together, findings from the three studies suggest that targeting negative emotions in treatment and prevention paradigms may reduce both negative thinking and psychopathology.

A methodological explanation for the overlap of worry, rumination, and negative emotionality concerns the emotional valance of the questionnaires. Data from the literature on the structure of personality questionnaires can help illustrate this point (Biderman, 2013; Biderman, Nguyen, Cunningham, Chen, & Watson, 2013). Multiple studies have shown that a bi-factor conceptualization of the Big-5 personality traits (conscientiousness,

agreeableness, neuroticism, openness, and extraversion) provides the best fit to the data. In this conceptualization, there is a general factor and 5 specific factors (one for each trait). The general factor is positively correlated with positive affect and self-esteem and negatively correlated with negative affect and depression. These results were interpreted to mean that common variance in the personality items as indexed by the general factor represent the affective or emotional state of the respondent. Similarly, the common variance across worry, rumination, and negative emotionality items may reflect the respondents' emotional state at the time of questionnaire completion.

Studies could be designed to test this possibility. For example, future studies might examine the general factor's correlation with state mood. Obtaining high correlations between the general factor and current mood would give credence to the interpretation that common variance across worry, rumination, and negative emotionality factors is accounted for by the respondents' mood state. Alternatively, one could examine the correlation between the general and factor created from scores on negative emotionality, rumination, and worry items, which have had current affect "regressed out". Herein, one would expect to observe low or non-significant correlations.

Despite the revealing findings in this series of studies, the current investigation was limited in a few important respects. First, it was cross-sectional in nature. Consequently, the issue of whether psychopathology precedes negative emotions or vice versa could not be resolved. Though multiple studies have found that negative emotionality is a predictor mental health symptoms over time (Barbot, Hunter, Grigorenko, & Luthar, 2013; Bradley et al., 2011; Hallquist & Lenzenweger, 2013; Hankin, 2010), the developmental associations of personality and psychopathology remain unclear. It may be that the overlap of NRT with negative emotionality occurs over time. For example, the relationship of rumination with depression and anxiety emerges more strongly in adolescence as self-awareness and verbal abilities are developed (Broderick & Korteland, 2004; Du, Chen, & Li, 2014; Wilkinson, Croudace, & Goodyer, 2013). Thus, negative emotions and negative thoughts may become coupled from childhood into adolescence. This possibility could be examined in future research.

Second, the study relied solely on self-report methodology, leading to the possibility that methodological overlap across negative emotionality and NRT questionnaires caused issues with collinearity. Unfortunately, this question may be difficult to resolve, as there is currently no other way of measuring emotion or cognition directly. Alternative, indirect measures of negative repetitive thinking may enable researchers to extend current findings using a multi-method approach. For example, a recent method indexes rumination by assessing attentional biases to emotional stimuli, following a rumination induction procedure (Folsom, 2014).

Another means of assessing the relationship between NRT and negative emotionality may come in the form of behavior genetic studies. Previous work using samples of twins with biometric modeling has established that the phenotypic correlation between rumination and depression is accounted for largely by shared genetic vulnerability (Chen & Li, 2013). Such studies could reveal a general underlying risk factor (environmental or genetic) for both NRT and negative emotionality. Alternatively, they may yield results demonstrating non-shared influences on NRT and negative emotionality, which could suggest that they are unique constructs with different developmental etiologies.

A final limitation of this study concerns external validity. Though efforts were made (e.g., collecting multiple samples from different populations, using different methods) to ensure external validity in these studies, the models may not extend to clinical populations. Therefore, replication of these findings in samples with mental health issues represents an important next step.

In conclusion, this series of studies provided clear evidence that rumination and worry are best conceptualized as one underlying tendency towards NRT. Additionally, they demonstrated that NRT is likely indistinguishable from negative emotionality—at least when assessed in a questionnaire format. Finally, they provided further evidence for the importance of negative affect as a risk factor for mental illness symptoms. Future research using developmental, multi-method, and behavioral genetic research is important to confirm and extend these findings.

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Appendix A: Main Figures and Tables

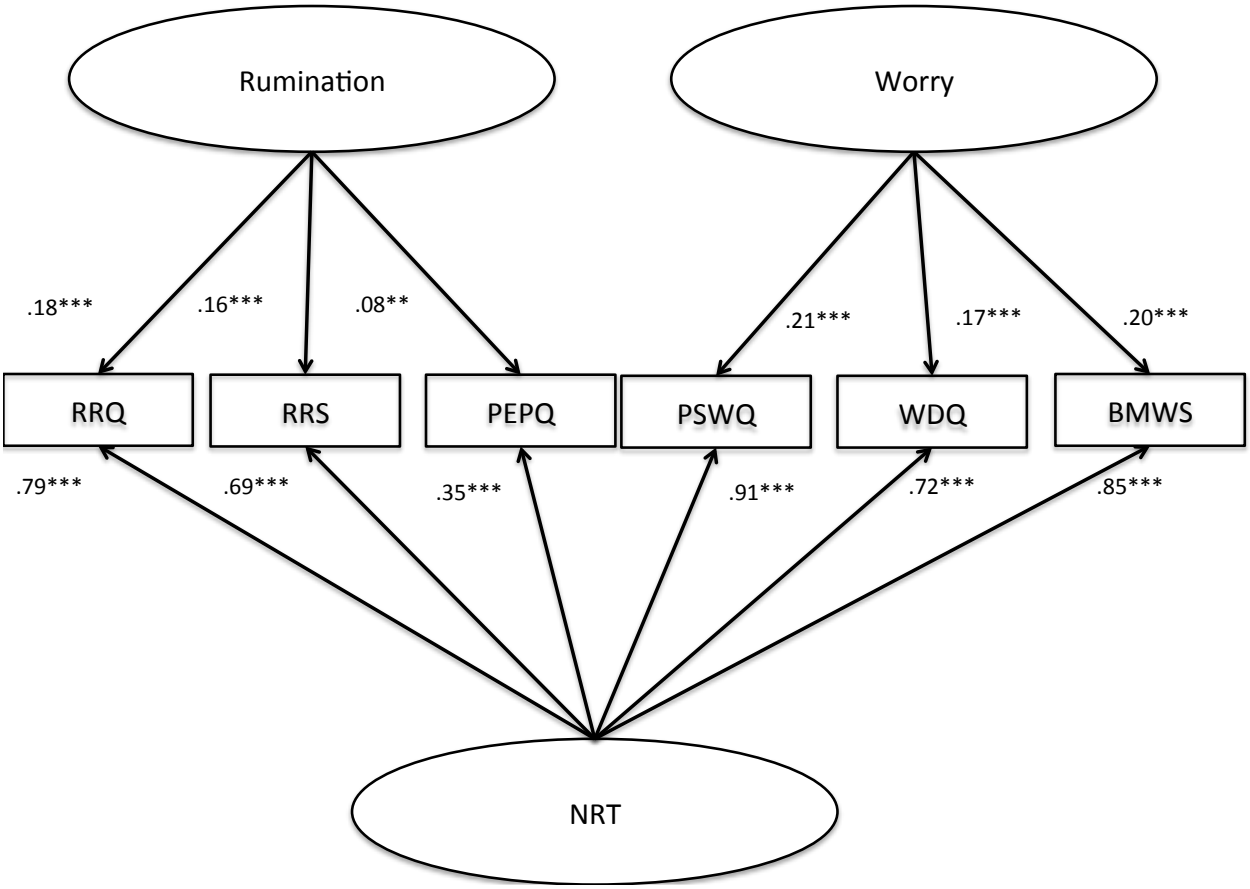

Figure 1. Best fitting bi-factor model from study 1—standardized factor loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

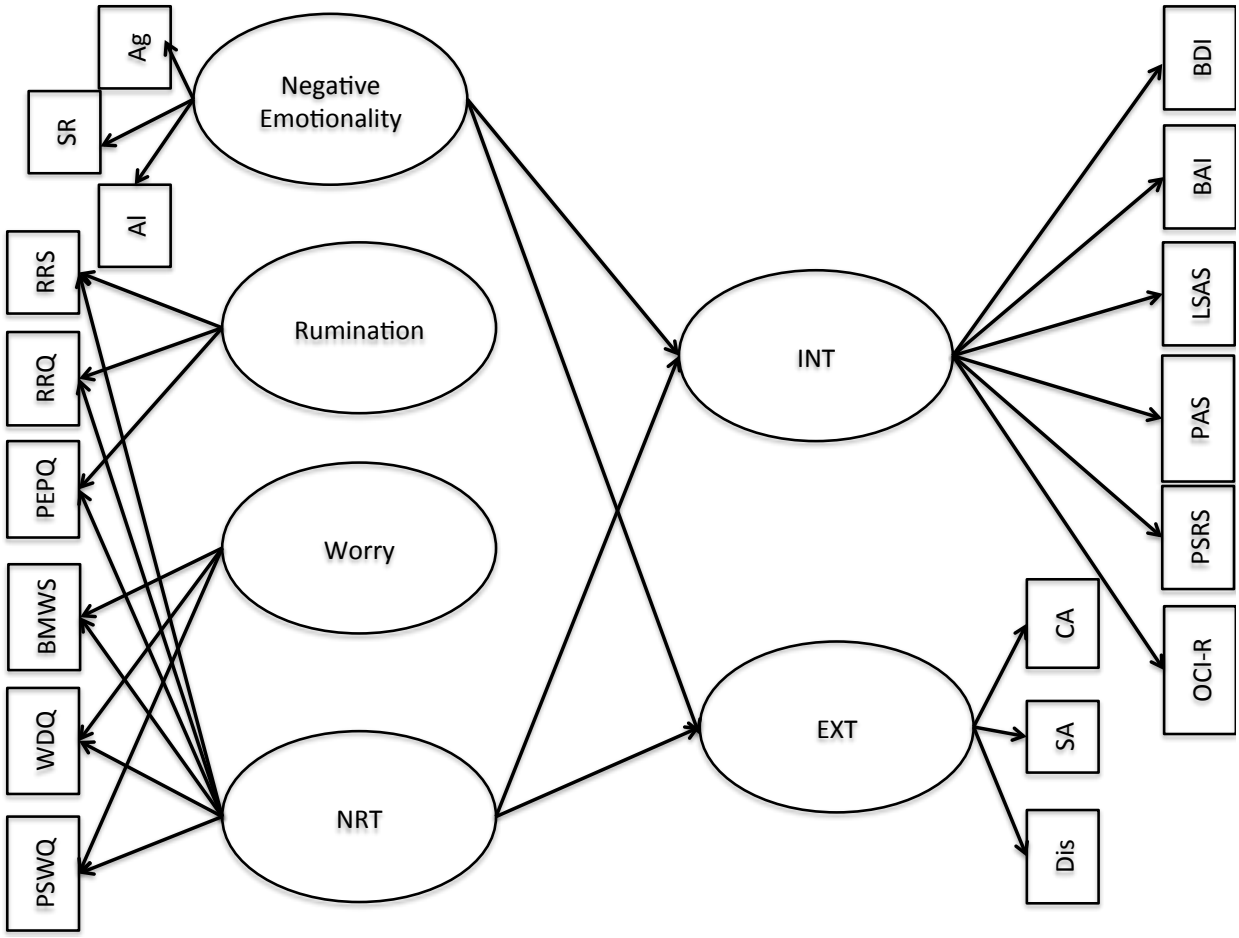

Figure 2. Example predictive utility model for studies 2 and 3. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; Al=Alienation; SR=Stress Reaction; Ag=Aggression; INT=Internalizing; EXT=Externalizing; BDI=Beck Depression Inventory; BAI=Beck Anxiety Inventory; LSAS=Liebowitz Social Anxiety Scale; PAS=Panic and Agoraphobia Scale; PSRS=Phobic Stimulus Response Scale; OCI-R=Obsessive-Compulsive Inventory-Revised; Dis=Disinhibition; SA=Substance Abuse; CA=Callous Aggression.

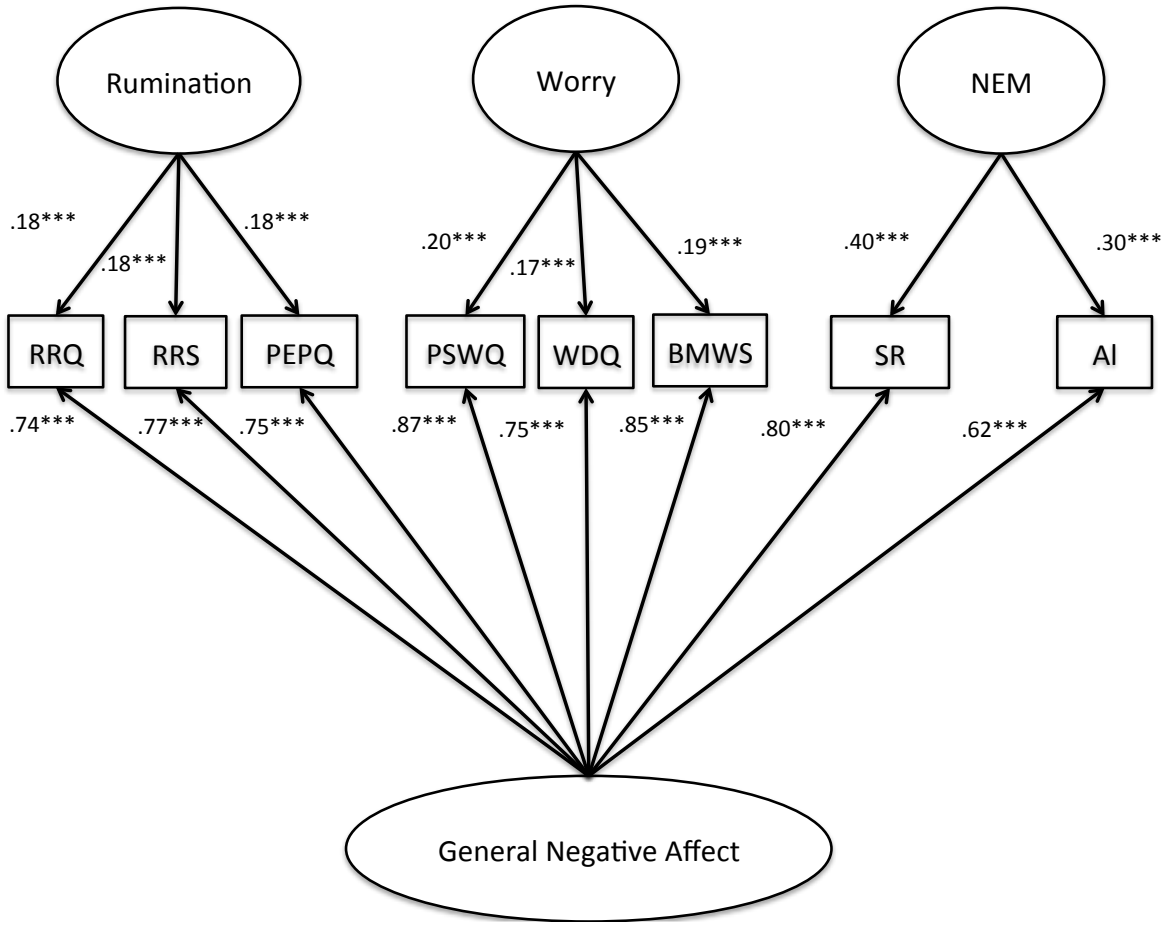

Figure 3. Study 2 bi-factor model including negative emotionality, rumination, and worry—standardized loadings, residuals, and errors. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; SR=Stress Reaction; AI=Alienation; Rum=Rumination; NEM=Negative Emotionality; GNA=General Negative Affect. *p < .05, **p < .01, ***p <.001

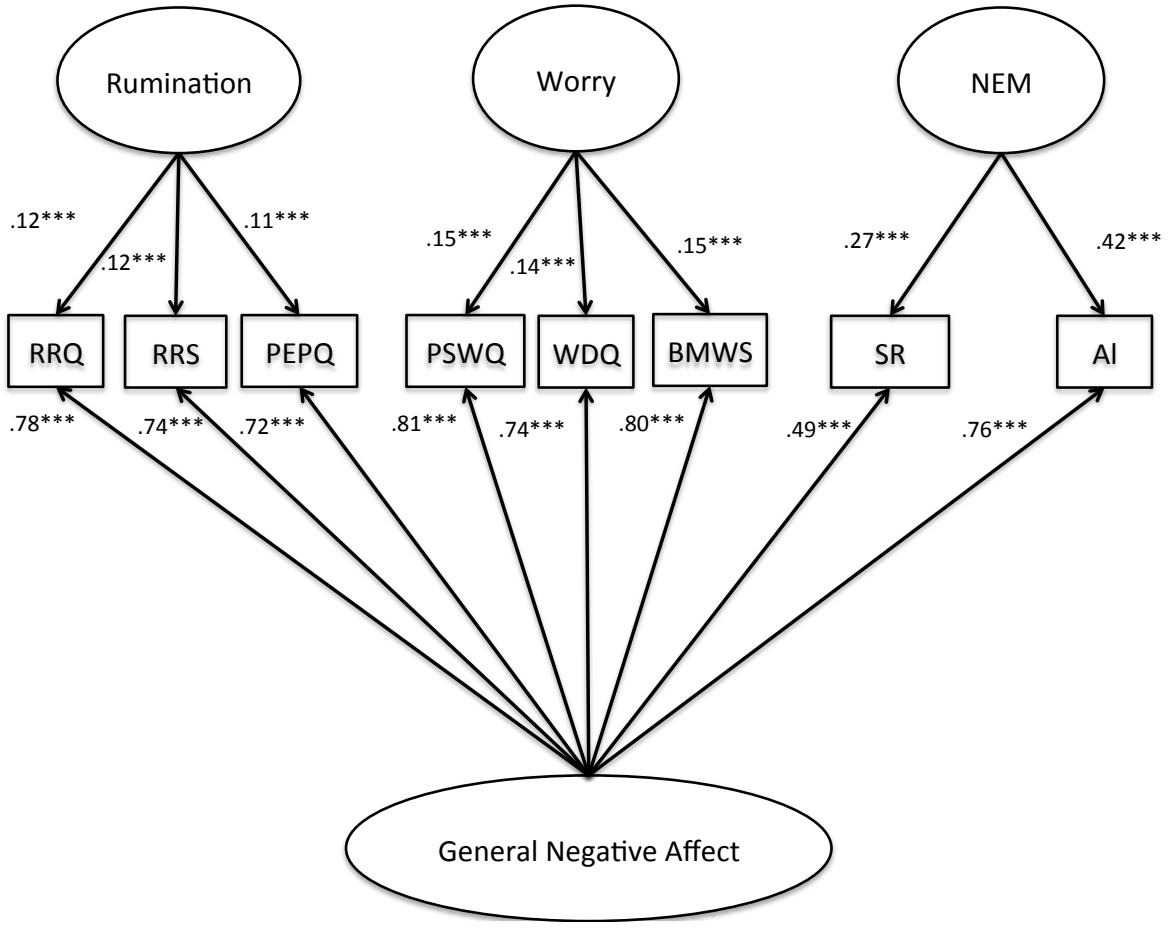

Figure 4. Study 3 bi-factor model including negative emotionality, rumination, and worry—standardized loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; SR=Stress Reaction; Al=Alienation; Rum=Rumination; NEM=Negative Emotionality; GNA=General Negative Affect. *$p < .05$, **$p < .01$, ***$p < .001$

Table 1

Means, Standard Deviations, and Reliabilities for Study 1 Variables

	Study 1			**Study 2**			**Study 3**		
Scale	*Mean*	*SD [Range]*	*α*	*Mean*	*SD [Range]*	*α*	*Mean*	*SD [Range]*	*α*
RRQ	39.27	8.99 [12,60]	.81	37.30	10.39 [12,60]	.81	38.54	10.57 [12,60]	0.85
RRS	12.54	3.59 [5,20]	.84	11.49	3.77 [5,20]	.84	10.56	3.77 [5,20]	0.86
PEPQ	636.15	209.61 [115,1218]	.93	575.72	219.79 [50,1238]	.93	552.63	238.57 [103,1201]	0.93
PSWQ	23.44	8.67 [8,40]	.94	21.32	9.27 [8,40]	.94	22.28	9.78 [8,40]	0.96
WDQ	15.59	9.94 [0,40]	.93	14.64	10.27 [0,40]	.93	15.55	10.05 [0,40]	0.93
BMWS	11.62	5.93 [0,24]	.92	9.71	6.35 [0,24]	.92	8.35	6.56 [0,24]	0.94
Depression	--	--	--	14.51	13.46 [0.63]	.96	11.14	10.34 [0,53]	0.94
Anxiety	--	--	--	17.32	15.83 [0,63]	.97	13.62	13.65 [0,63]	0.96
Social Anxiety	--	--	--	53.55	34.05 [0,144]	.97	45.19	30.46 [0,144]	0.97
Panic and Agoraphobia	--	--	--	6.16	10.37 [0.46]	.98	2.9	6.46 [0,36]	0.94
Specific Phobia	--	--	--	86.48	19.36 [34,140]	.94	79.09	19.11 [35,135]	0.93
Obsessive-Compulsive Disorder	--	--	--	52.35	41.75 [0,168]	.95	24.46	24.91 [0,119]	0.96
Callous Aggression	--	--	--	24.99	7.33 [11,49]	.74	21.61	4.56 [11,43]	0.49
Substance Abuse	--	--	--	22.90	6.94 [12,45]	.74	19.88	4.71 [8,42]	0.50
Disinhibition	--	--	--	20.35	9.80 [4,56]	.86	15.65	6.54 [4,56]	0.73
Stress Reaction	--	--	--	6.76	4.44 [0,15]	.87	7.16	4.44 [0,15]	0.88
Alienation	--	--	--	5.09	3.98 [0,13]	.87	3.92	3.76 [0,13]	0.88
Aggression	--	--	--	3.81	3.21 [0,12]	.83	1.95	2.29 [0,12]	0.79

RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity.

Table 2

Model Fitting Results for Rumination and Worry

Study 1							
Model	χ^2	*df*	*p*	*CFI*	*RMSEA*	*AIC*	$\Delta\chi^2$
One-Factor	21.77	9	.0096	.986	.072	3835.182	--
Two-Factor	18.09	8	.0206	.989	.067	3833.5	3.68
Schmid-Leiman	18.13	14	.2011	.995	.033	3821.54	0.04
Study 2							
Model	χ^2	*df*	*p*	*CFI*	*RMSEA*	*AIC*	$\Delta\chi^2$
One-Factor	74.39	9	<.0001	.981	.089	12026.32	--
Two-Factor	51.17	8	<.0001	.987	.077	12005.09	23.22***
Schmid-Leiman	51.17	14	<.0001	.989	.054	11993.10	0.00
Study 3							
Model	χ^2	*df*	*p*	*CFI*	*RMSEA*	*AIC*	$\Delta\chi^2$
One-Factor	36.52	9	<.0001	.983	.077	7127.84	--
Two-Factor	31.17	8	.0001	.986	.074	7124.49	5.35*
Schmid-Leiman	33.52	14	.0024	.988	.052	7114.85	2.35

Note. Chi-square difference values are reported for the difference in fit from the preceding model in the table. *p < .05, **p < .01, ***p < .001.

Table 3

Percentage of Variance Explained in Each Measure by the Final Models

Study 1				
	NRT Factor	Rumination Factor	Worry Factor	
RRQ	61.62%	3.39%	--	
RRS	48.02%	2.62%	--	
PEPQ	12.53%	0.69%	--	
PSWQ	82.99%	--	4.53%	
WDQ	52.42%	--	2.86%	
BMWS	71.74%	--	3.92%	
Study 2				
	General Negative Affect Factor	Rumination Factor	Worry Factor	Negative Emotionality Factor
RRQ	54.91%	3.46%	--	--
RRS	58.52%	3.31%	--	--
PEPQ	56.25%	3.17%	--	--
PSWQ	75.00%	--	3.84%	--
WDQ	55.80%	--	2.86%	--
BMWS	72.25%	--	3.73%	--
Stress Reaction	64.64%	--	--	15.69%
Alienation	38.06%	--	--	9.24%
Study 3				
	General Negative Affect Factor	Rumination Factor	Worry Factor	Negative Emotionality Factor
RRQ	55.80%	1.51%	--	--
RRS	51.27%	1.39%	--	--
PEPQ	65.61%	1.28%	--	--
PSWQ	55.20%	--	2.19%	--
WDQ	64.64%	--	1.85%	--
BMWS	23.62%	--	2.16%	--
Stress Reaction	58.22%	--	--	7.29%
Alienation	51.27%	--	--	17.98%

NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity.

Table 4

Model Fitting Results for Combining Negative Emotionality and Negative Repetitive Thought Indicators

Study 2						
Model	χ^2	*df*	*p*	*CFI*	*RMSEA*	*AIC*	$\Delta\chi^2$
One-factor	453.14	27	< .0001	.918	.132	18284.08	--
Schmid-Leiman	294.05	33	< .0001	.950	.093	18112.99	159.09***
Schmid-Leiman—Aggression scale removed	106.57	25	<.0001	.983	.06	15858.36	187.48***
Study 3							
	χ^2	*df*	*p*	*CFI*	*RMSEA*	*AIC*	$\Delta\chi^2$
One Factor	123.19	27	< .0001	.957	.083	11032.63	--
Schmid-Leiman	89.54	33	< .0001	.975	.057	10986.98	33.65***
Schmid-Leiman—Aggression scale removed	53.63	28	< .0001	.987	.047	9555.18	35.91***

Note. Chi-square difference values are reported for the difference in fit from the preceding model in the table. *p < .05, **p < .01, ***p < .001.

Appendix B: Study 1 Models

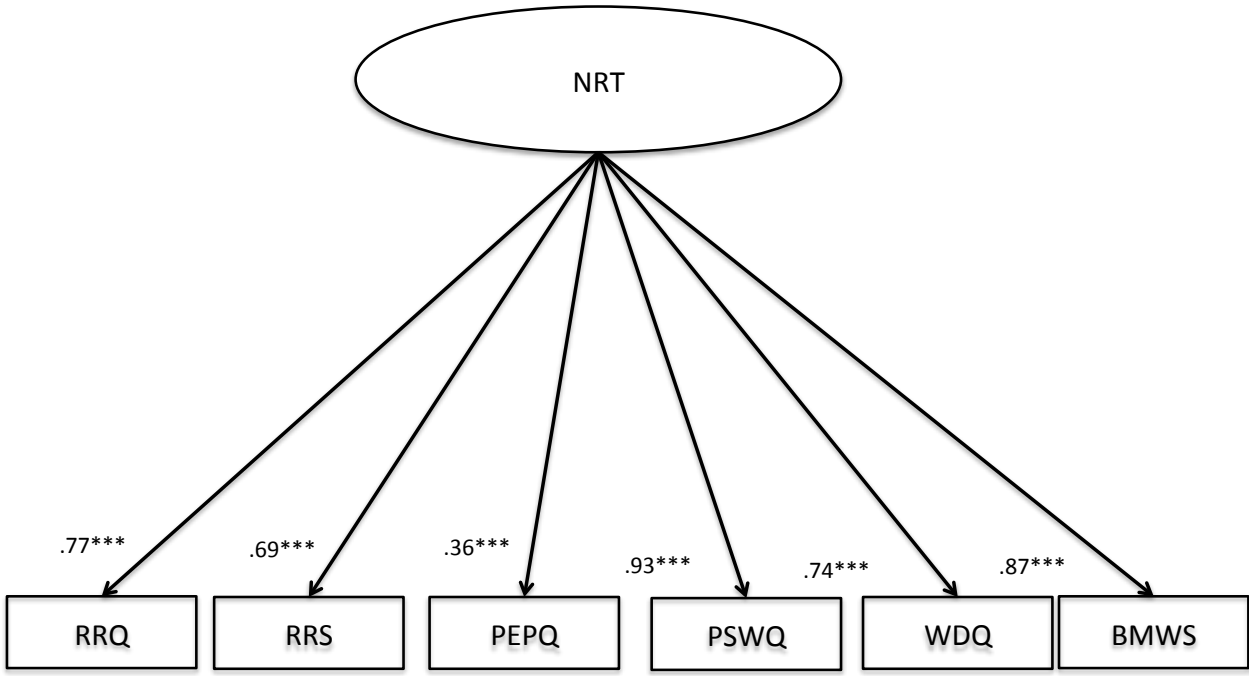

Figure 1A. One-factor model, including worry and rumination indicators—standardized loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

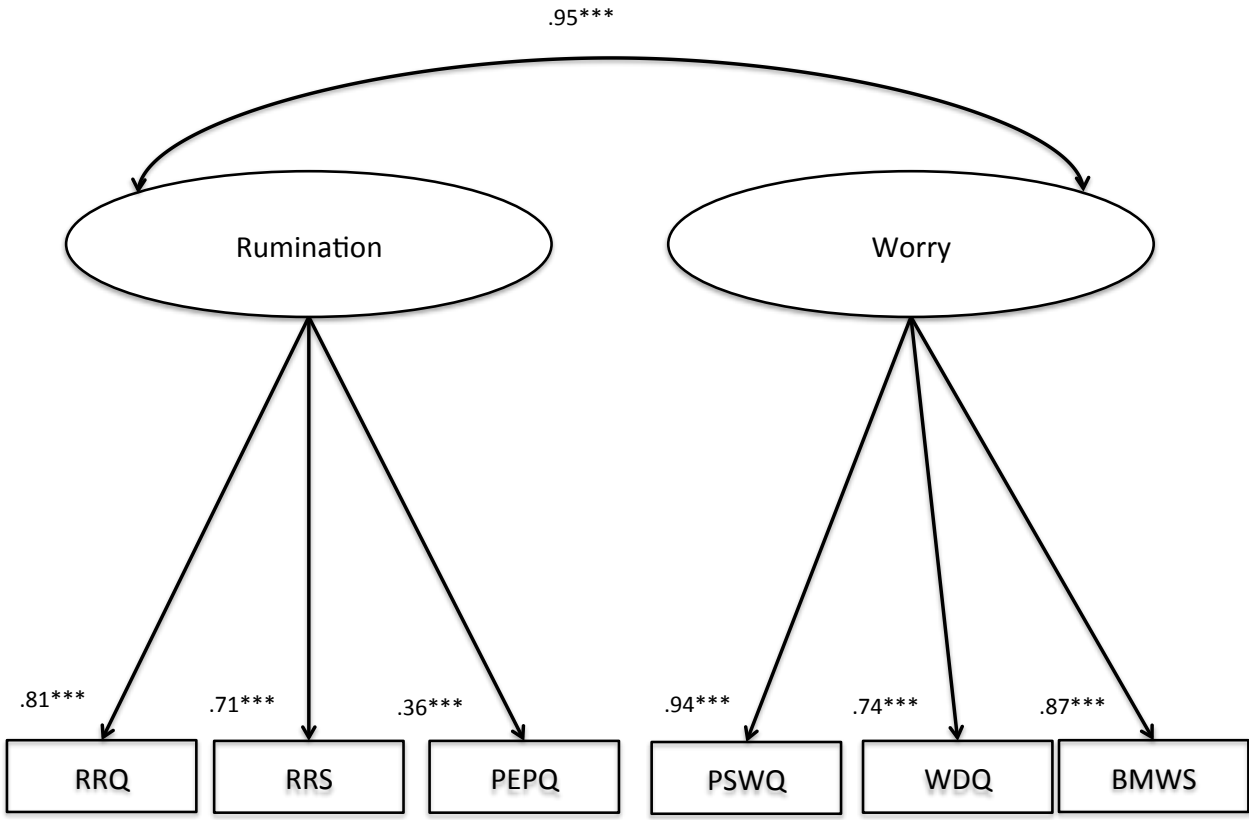

Figure 2A. Two-factor correlated model of worry and rumination—standardized loadings. RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

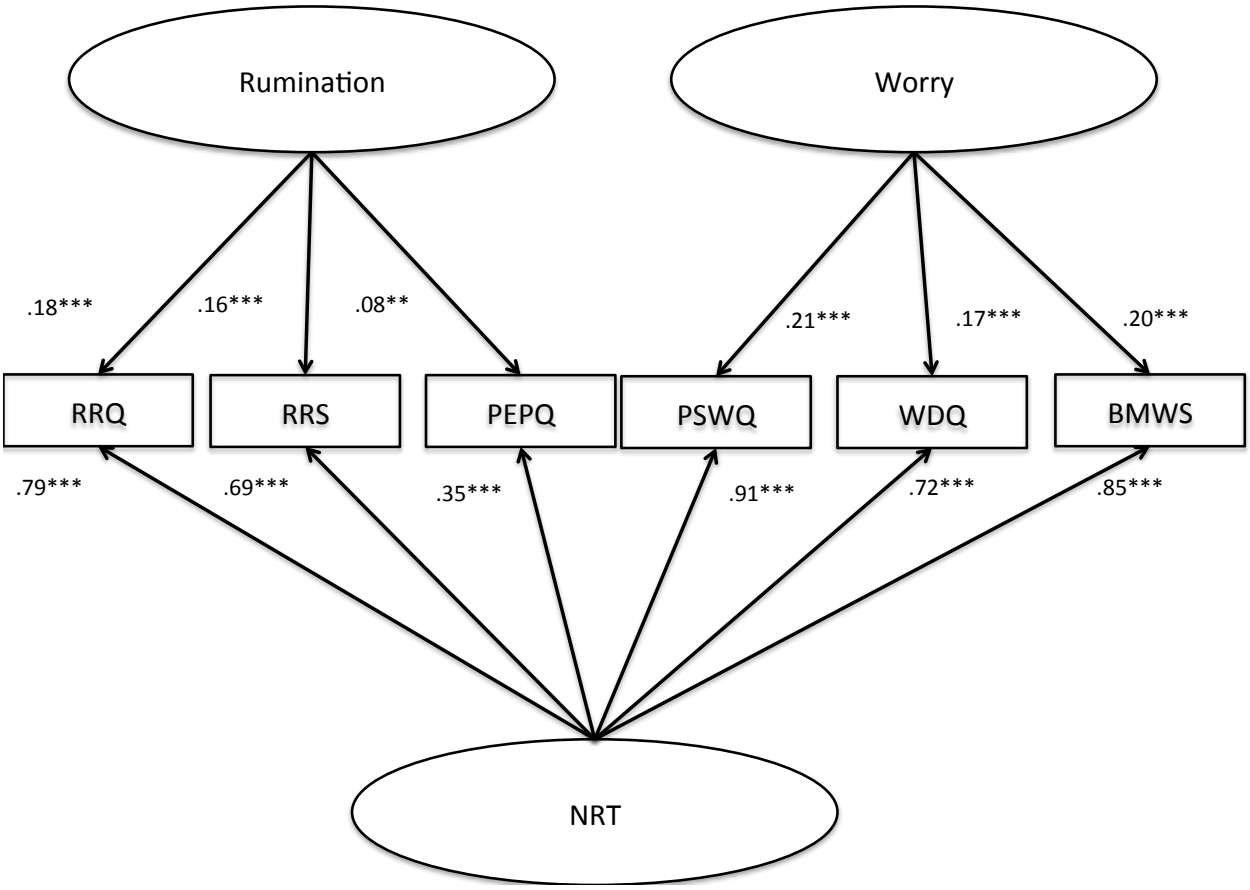

Figure 3A. Schmid-Leiman model, including a general negative repetitive thinking factor and specific worry and rumination factors—standardized loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

Appendix C: Study 2 Models

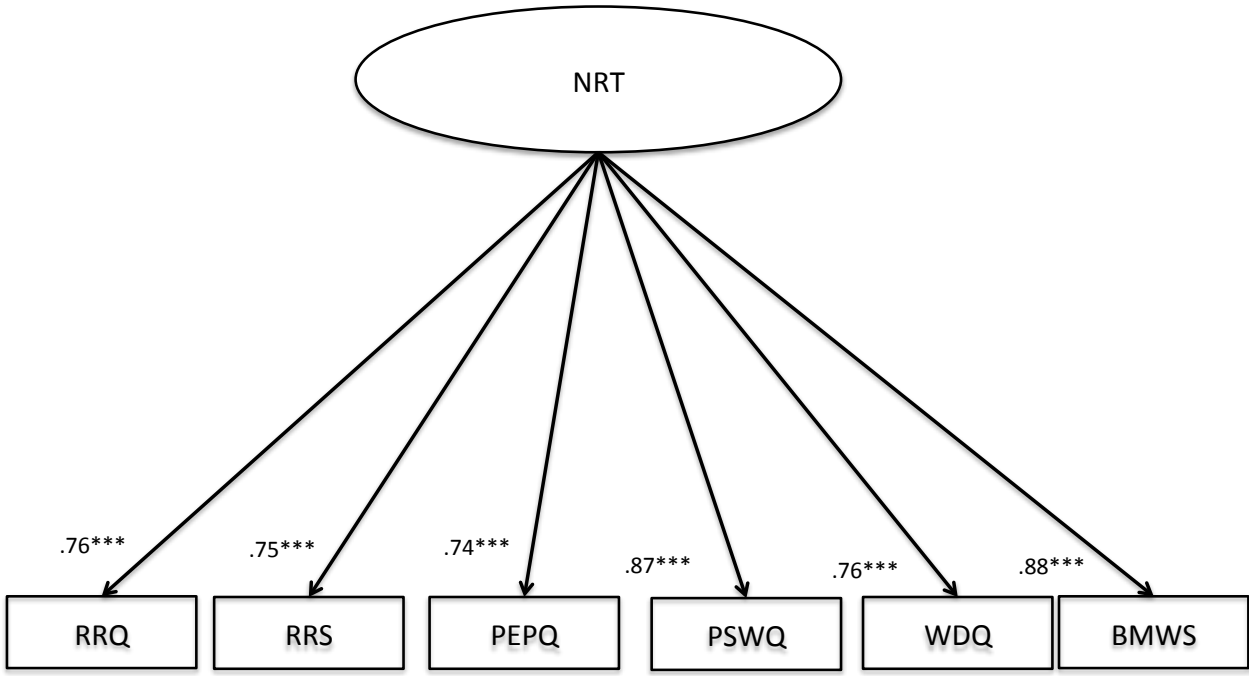

Figure 1B. One-factor model, including worry and rumination indicators—standardized loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

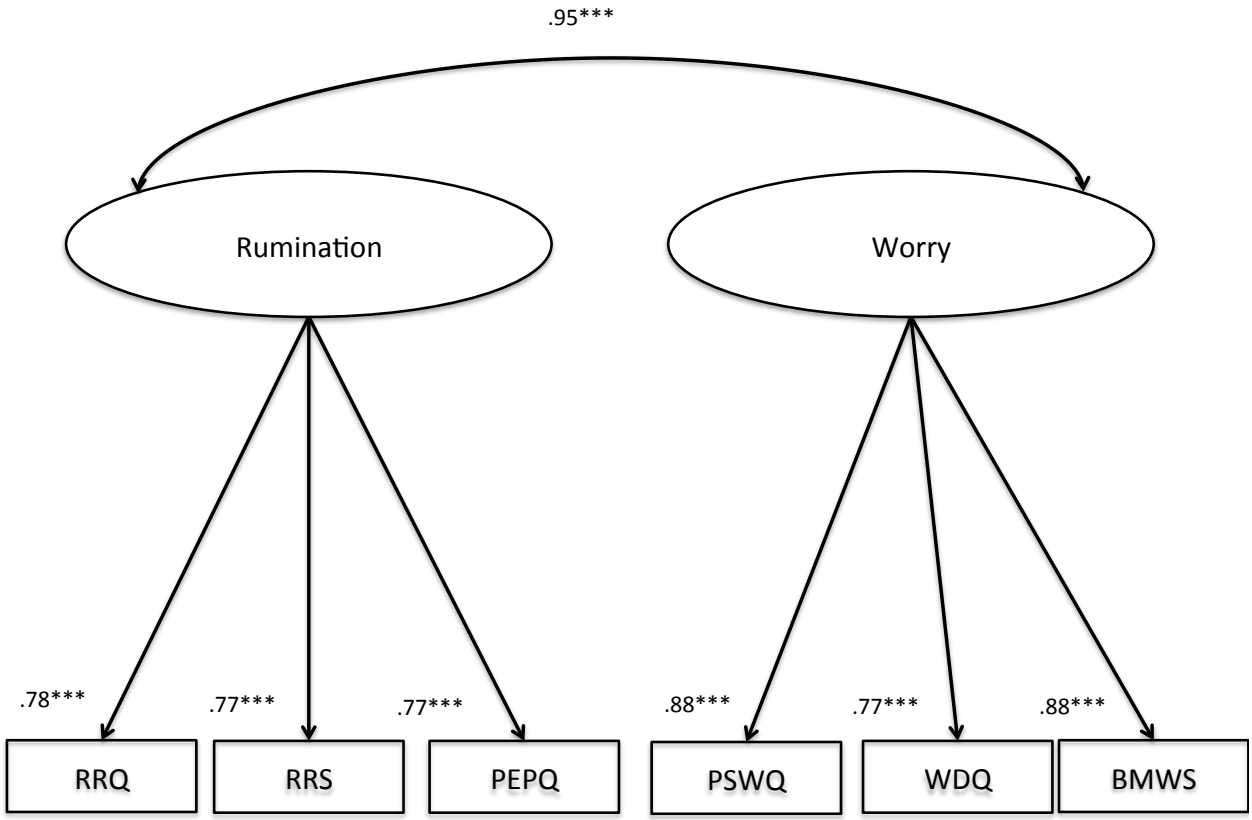

Figure 2B. Two-factor correlated model of worry and rumination—standardized loadings. RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

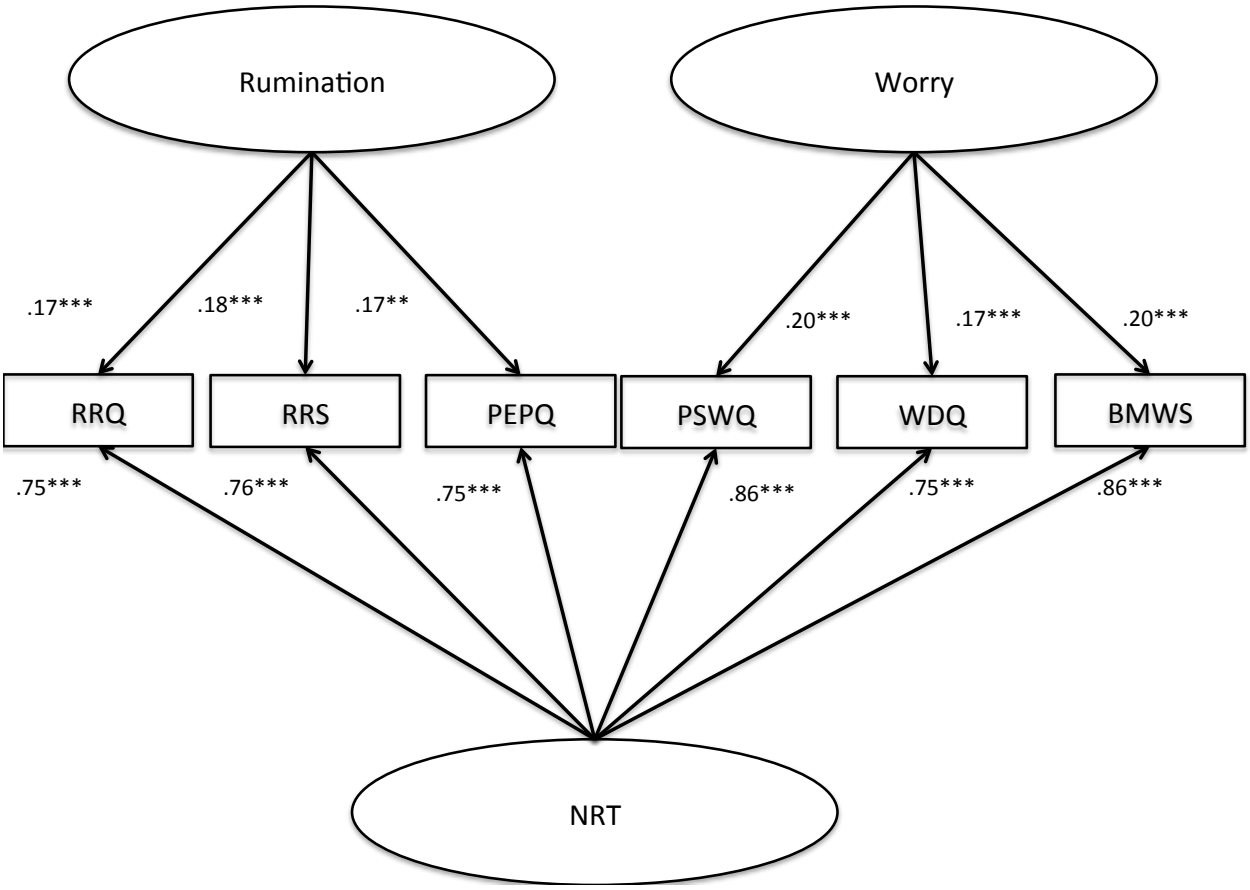

Figure 3B. Schmid-Leiman model, including a general negative repetitive thinking factor and specific worry and rumination factors—standardized loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

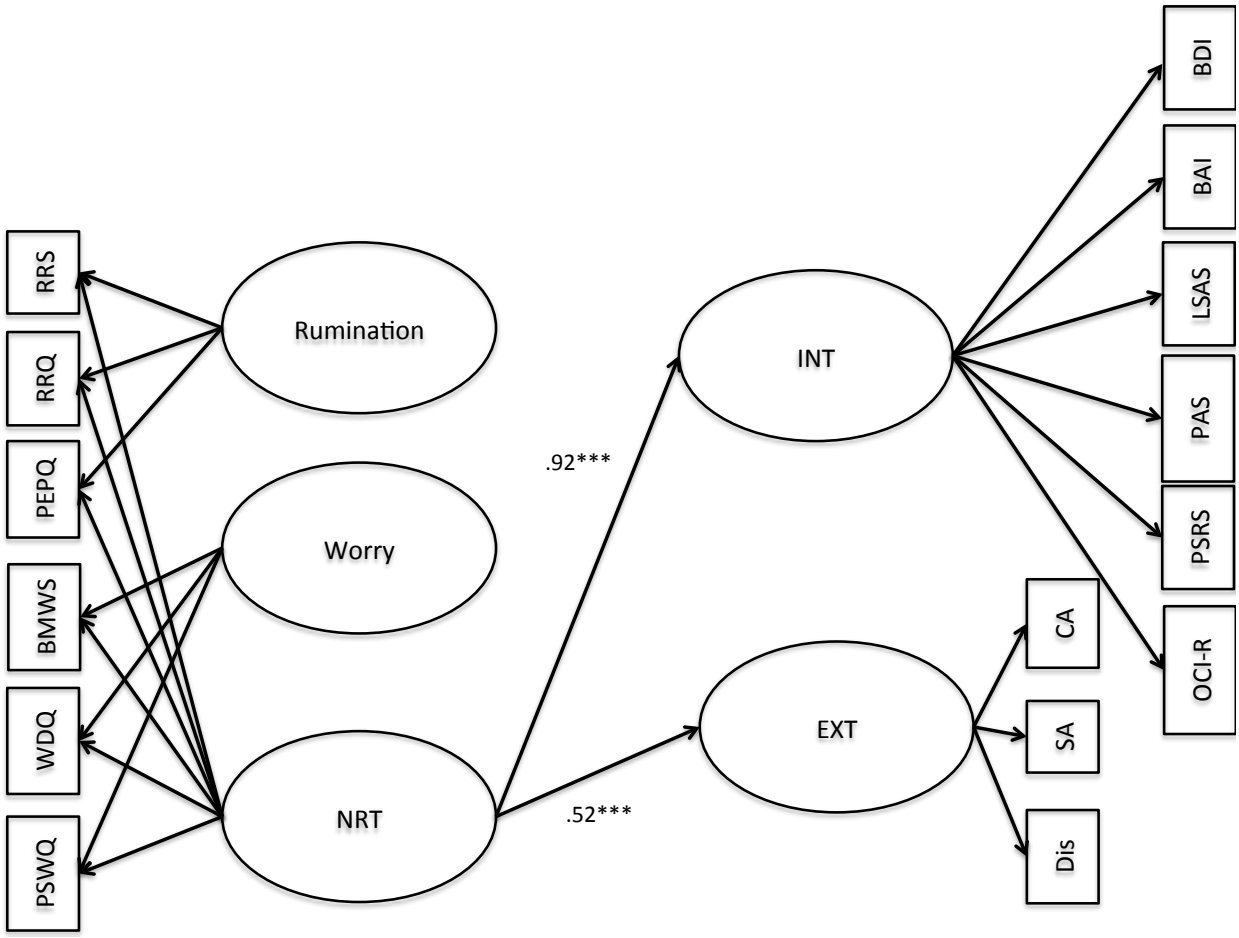

Figure 4B. Test of concurrent validity with a general negative repetitive thinking factor predicting internalizing and externalizing factors—standardized beta weights. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; INT=Internalizing; EXT=Externalizing; BDI=Beck Depression Inventory; BAI=Beck Anxiety Inventory; LSAS=Liebowitz Social Anxiety Scale; PAS=Panic and Agoraphobia Scale; PSRS=Phobic Stimulus Response Scale; OCI-R=Obsessive-Compulsive Inventory-Revised; Dis=Disinhibition; SA=Substance Abuse; CA=Callous Aggression. Note that due to the complexity of the model, only the weights for the paths from NRT to INT and EXT are included. The rest of the model is included without the weights to demonstrate the overall structure. *p < .05, **p < .01, ***p <.001

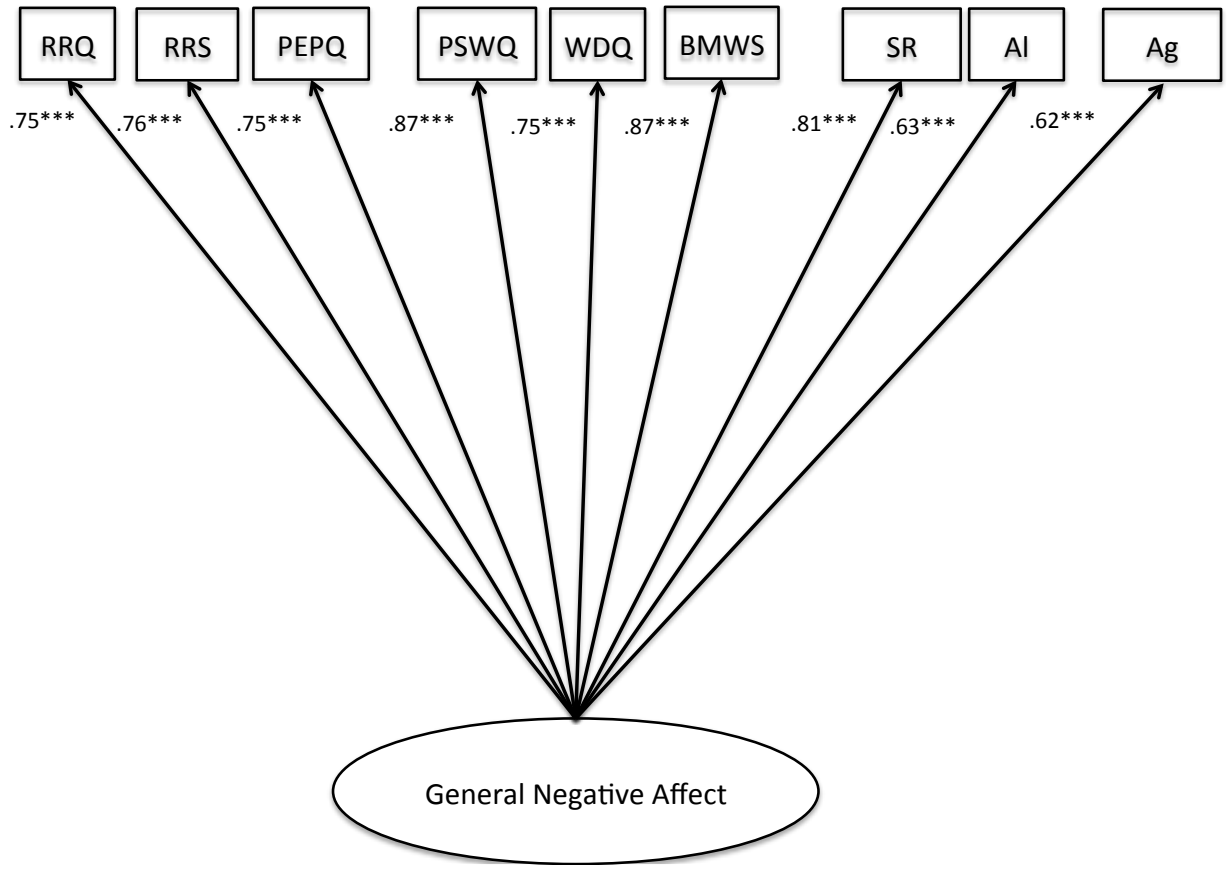

Figure 5B. One-factor model, including worry, rumination, and negative emotionality indicators—standardized factor loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; SR=Stress Reaction; Al=Alienation; Ag=Aggression. *$p < .05$, **$p < .01$, ***$p < .001$

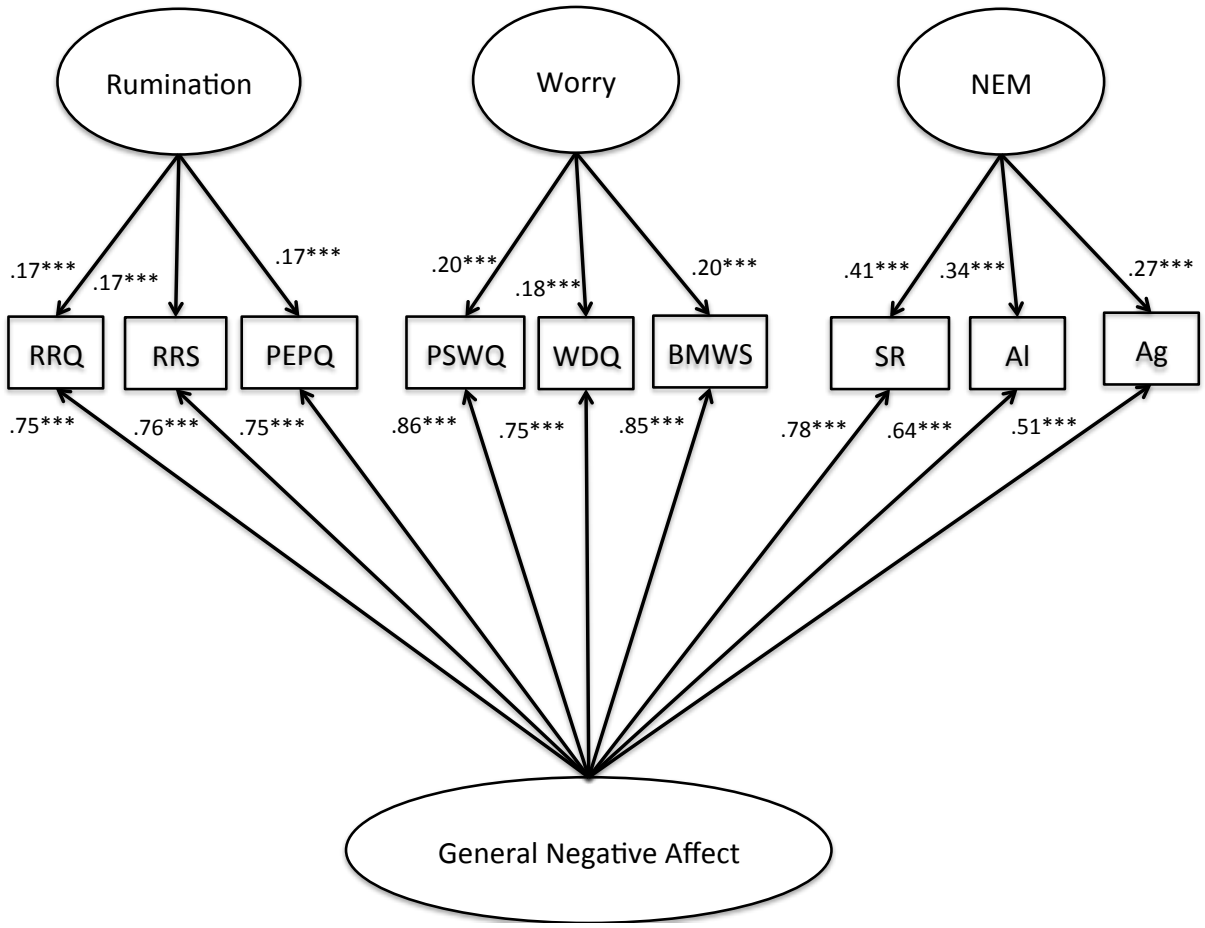

Figure 6B. Schmid-Leiman model, including a general negative affect factor and specific worry, rumination, and negative emotionality factors—standardized factor loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; Al=Alienation; SR=Stress Reaction; Ag=Aggression. *$p < .05$, **$p < .01$, ***$p < .001$

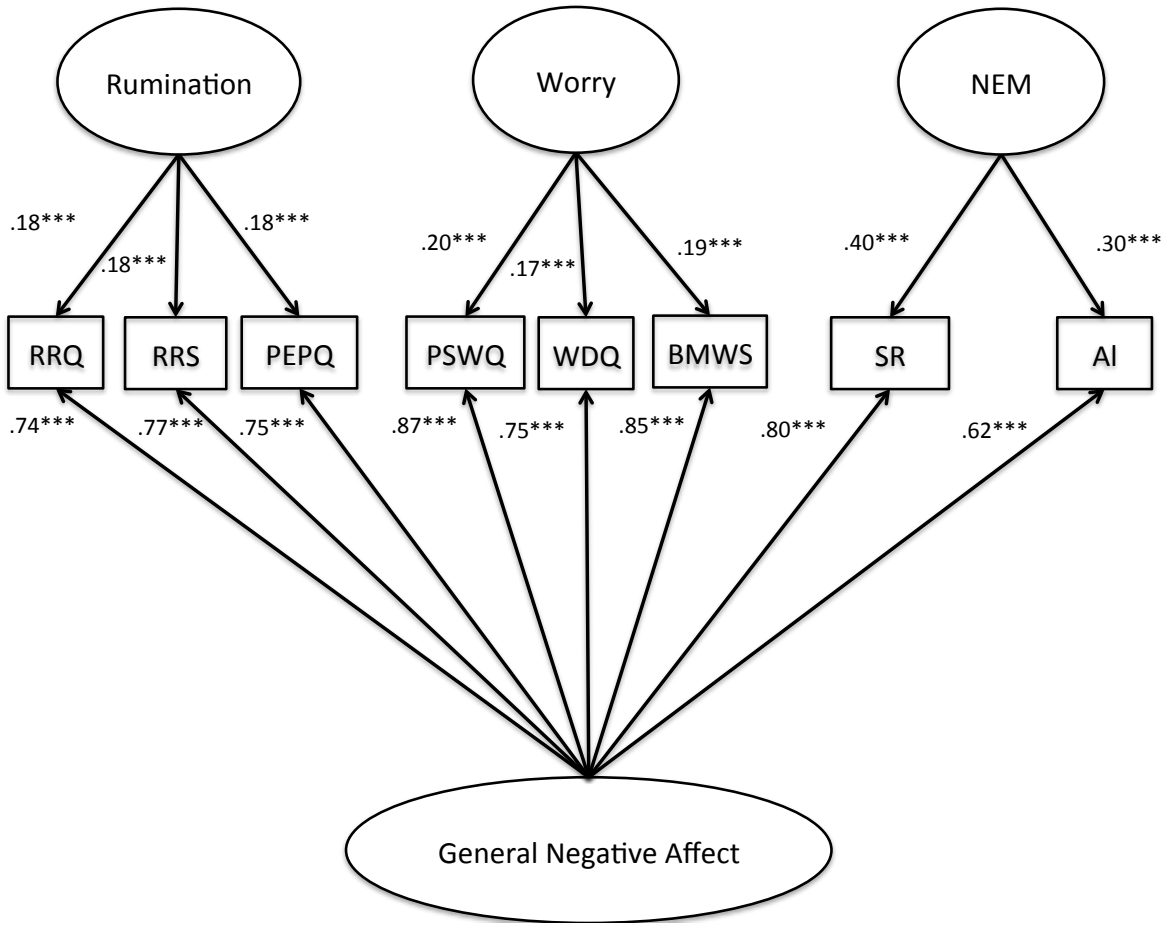

Figure 7B. Schmid-Leiman model, including a general negative affect factor and specific worry, rumination, and negative emotionality factors, excluding the aggression scale—standardized factor loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; Al=Alienation; SR=Stress Reaction. *$p < .05$, **$p < .01$, ***$p < .001$

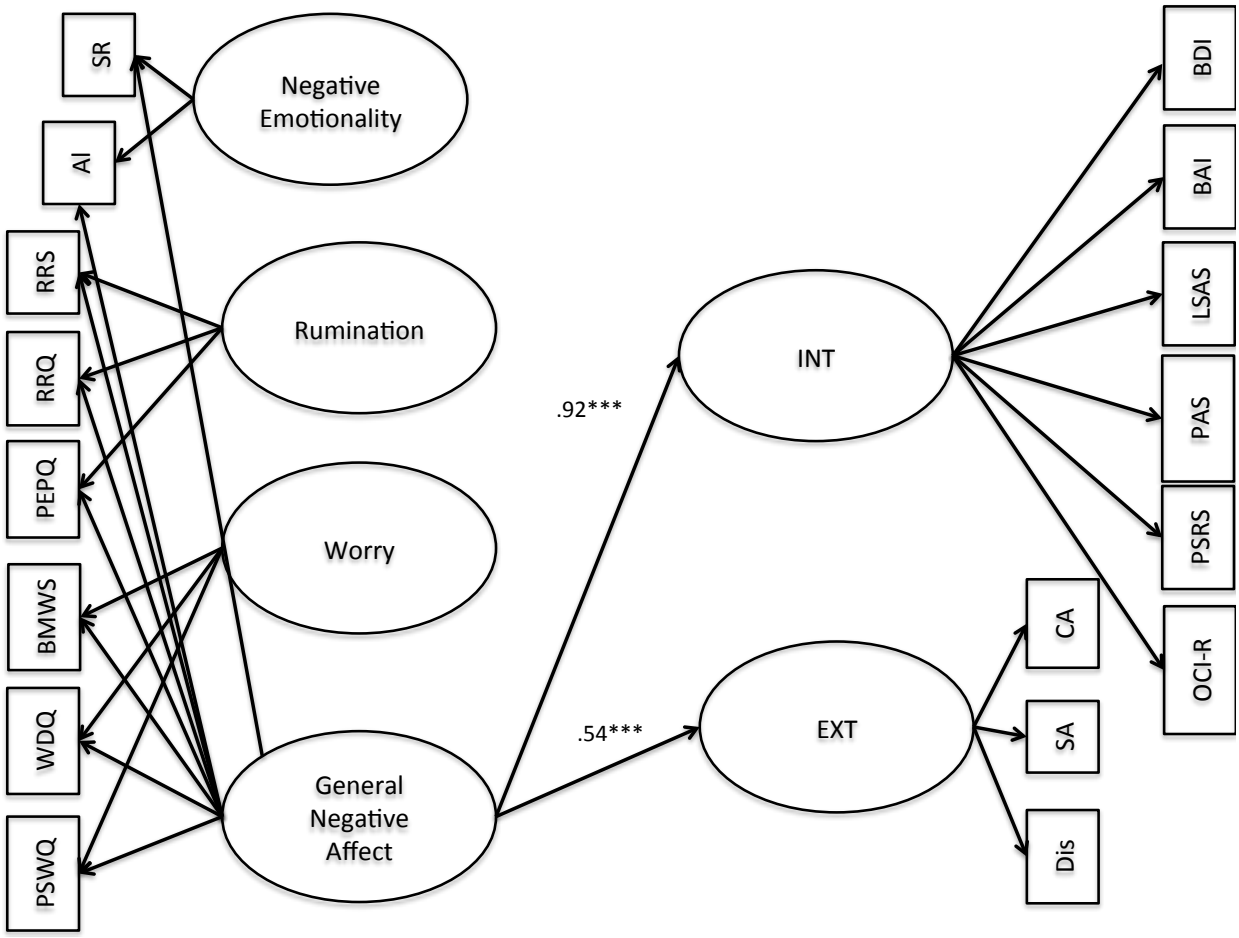

Figure 8B. Test of concurrent validity with a general negative affect factor predicting internalizing and externalizing factors—standardized beta weights. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; Al=Alienation; SR=Stress Reaction; INT=Internalizing; EXT=Externalizing; BDI=Beck Depression Inventory; BAI=Beck Anxiety Inventory; LSAS=Liebowitz Social Anxiety Scale; PAS=Panic and Agoraphobia Scale; PSRS=Phobic Stimulus Response Scale; OCI-R=Obsessive-Compulsive Inventory-Revised; Dis=Disinhibition; SA=Substance Abuse; CA=Callous Aggression. Note that due to the complexity of the model, only the weights for the paths from NRT to INT and EXT are included. The rest of the model is included without the weights to demonstrate the overall structure. Note that due to the complexity of the model, only the weights for the paths from general negative affect to INT and EXT are included. The rest of the model is included without the weights to demonstrate the overall structure. $*p < .05$, $**p < .01$, $***p < .001$

Appendix D: Study 3 Models

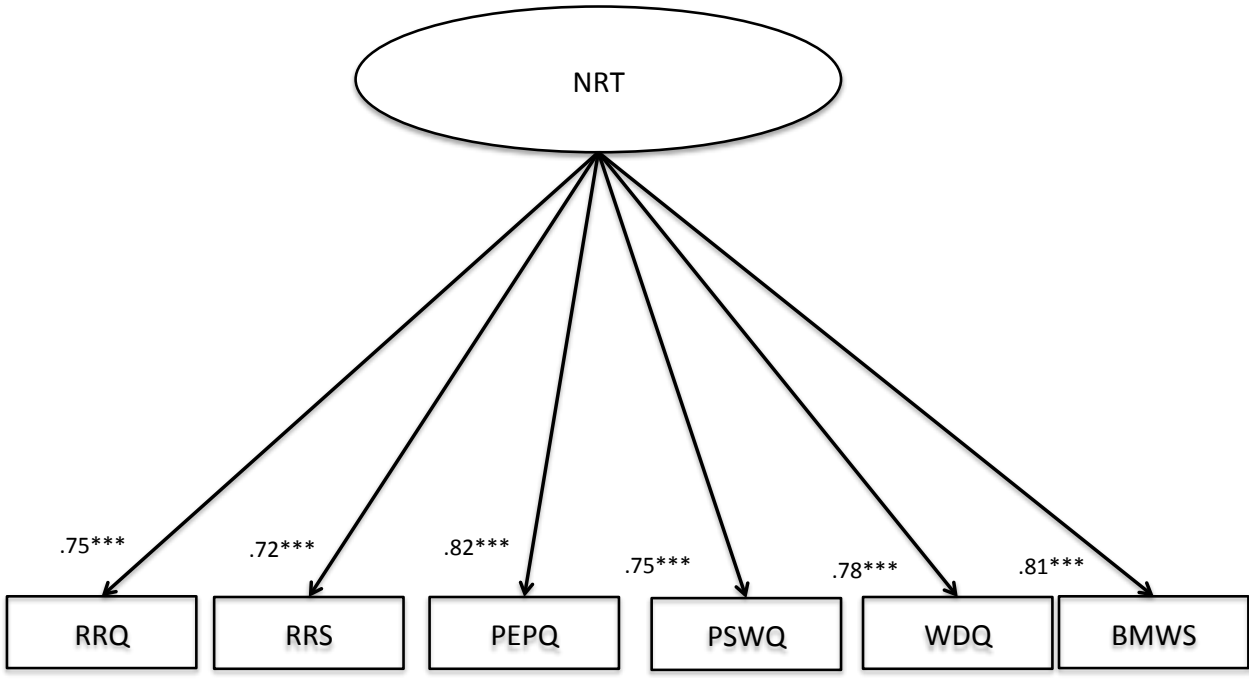

Figure 1C. One-factor model, including worry and rumination indicators—standardized factor loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

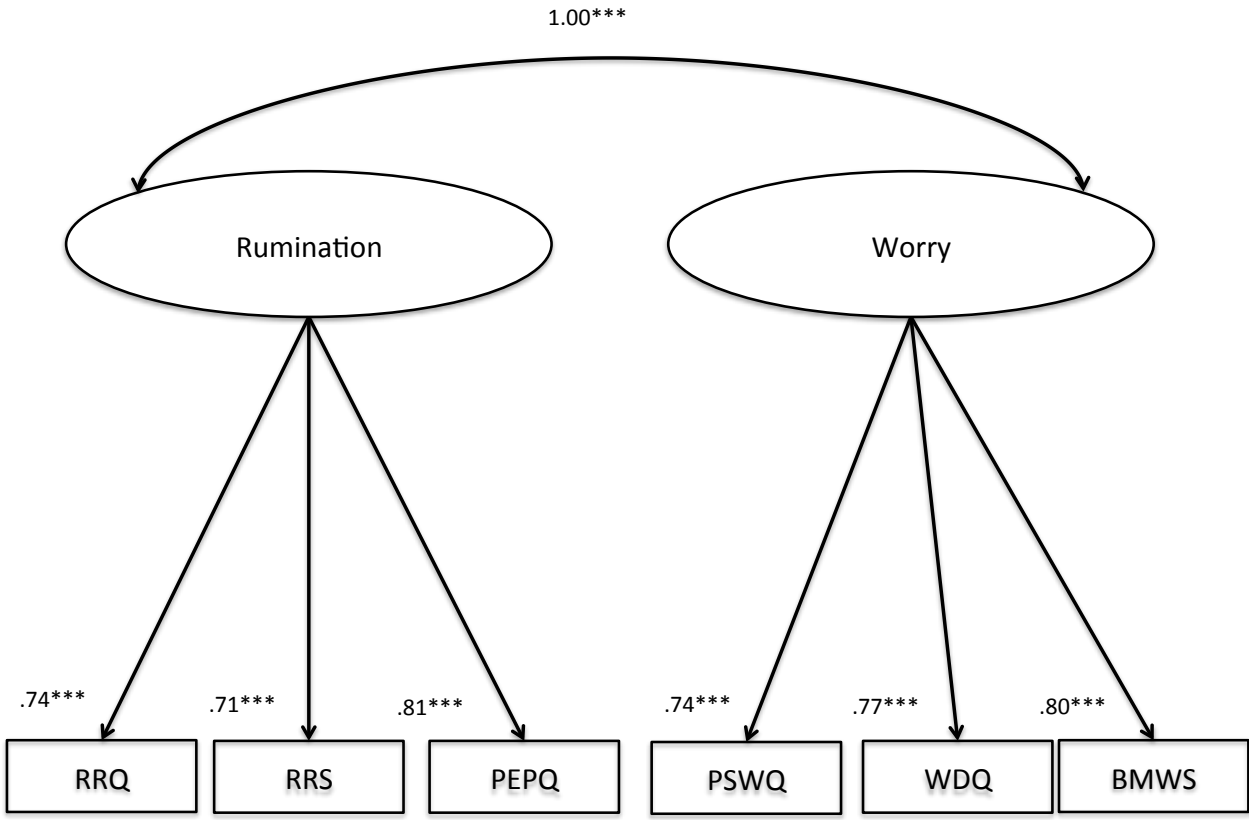

Figure 2C. Two-factor correlated model of worry and rumination—standardized factor loadings. RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

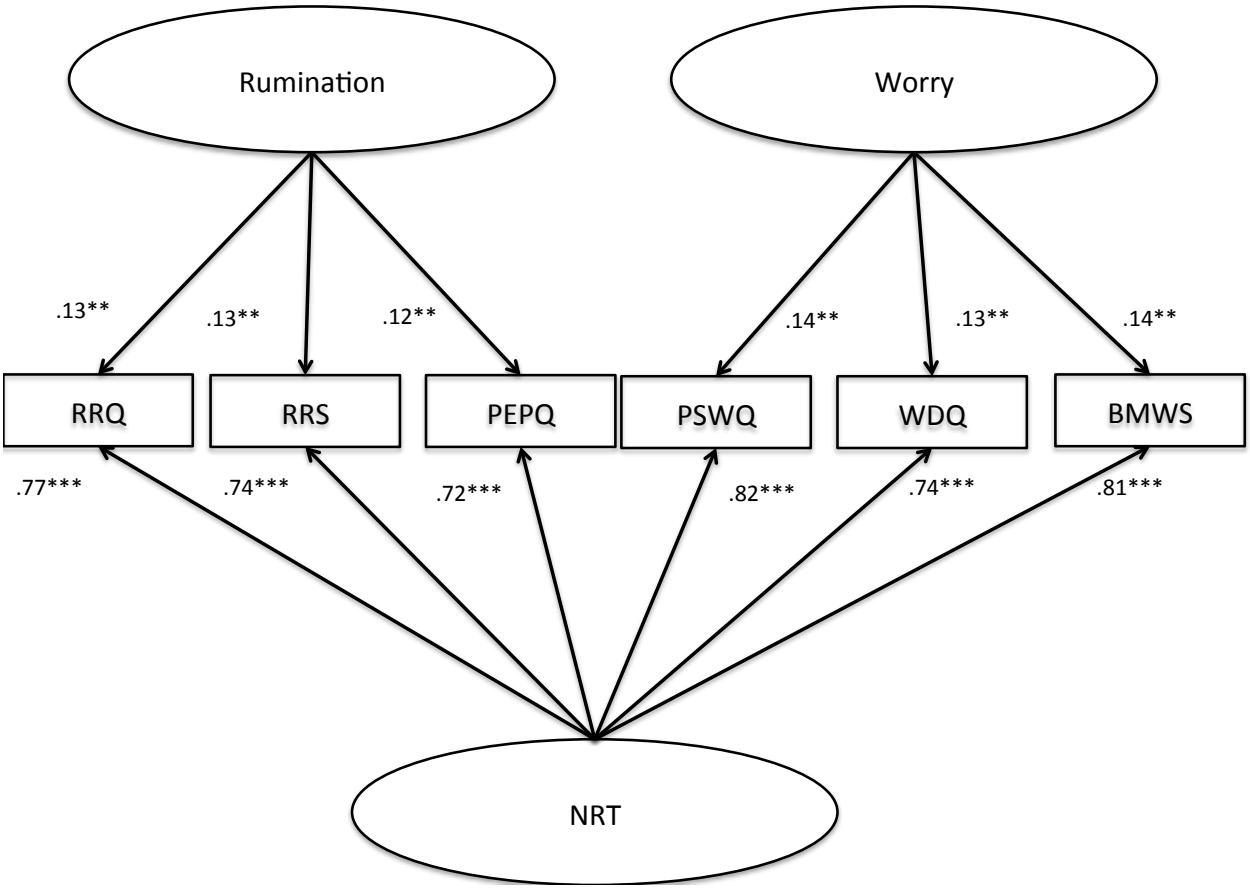

Figure 3C. Schmid-Leiman model, including a general negative repetitive thinking factor and specific worry and rumination factors—standardized factor loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity. *$p < .05$, **$p < .01$, ***$p < .001$

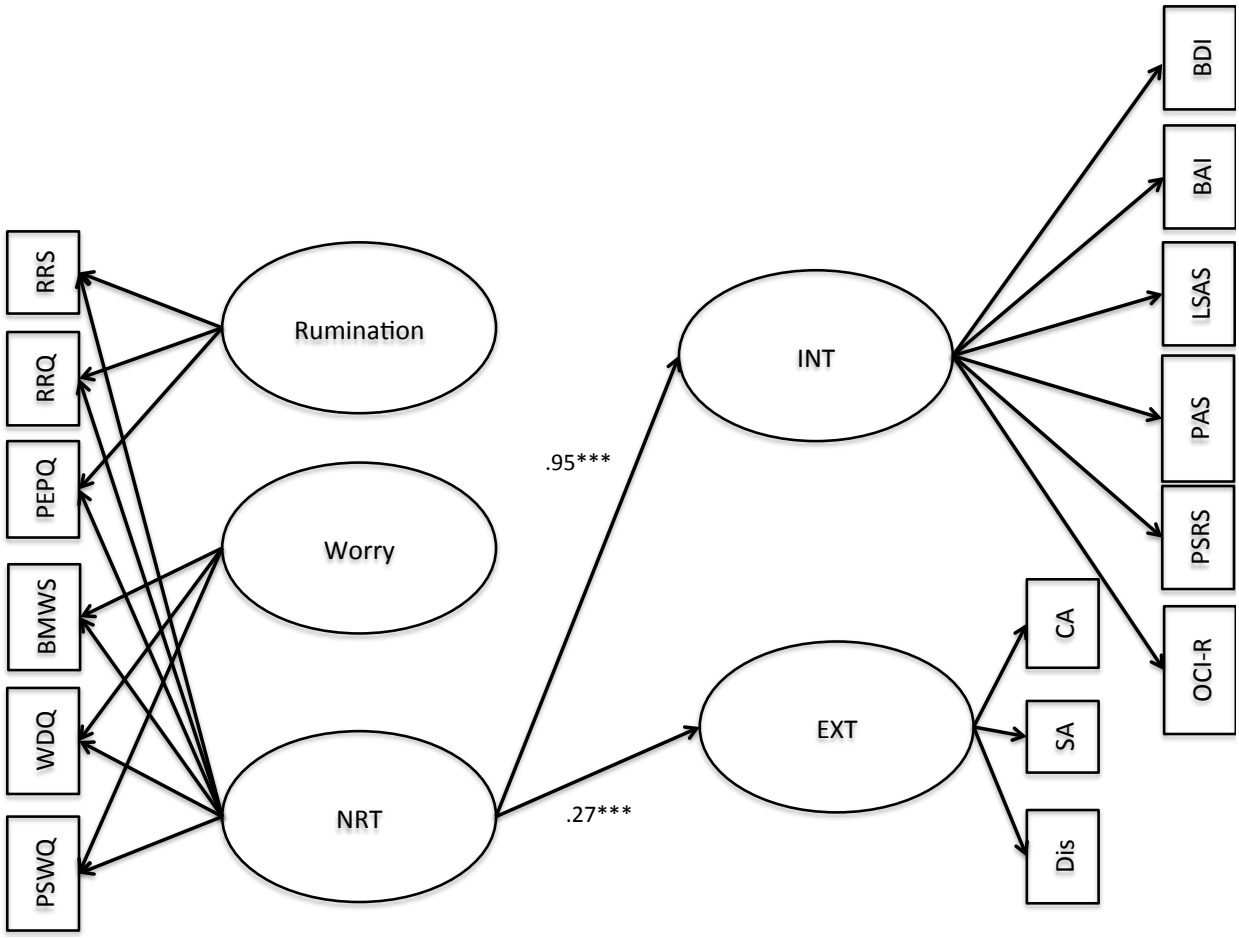

Figure 4C. Test of concurrent validity with a general negative repetitive thinking factor predicting internalizing and externalizing factors—standardized beta weights. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; INT=Internalizing; EXT=Externalizing; BDI=Beck Depression Inventory; BAI=Beck Anxiety Inventory; LSAS=Liebowitz Social Anxiety Scale; PAS=Panic and Agoraphobia Scale; PSRS=Phobic Stimulus Response Scale; OCI-R=Obsessive-Compulsive Inventory-Revised; Dis=Disinhibition; SA=Substance Abuse; CA=Callous Aggression. Note that due to the complexity of the model, only the weights for the paths from NRT to INT and EXT are included. The rest of the model is included without the weights to demonstrate the overall structure. Note that due to the complexity of the model, only the weights for the paths from general negative affect to INT and EXT are included. The rest of the model is included without the weights to demonstrate the overall structure. Note that due to the complexity of the model, only the weights for the paths from NRT to INT and EXT are included. The rest of the model is included without the weights to demonstrate the overall structure. $*p < .05$, $**p < .01$, $***p < .001$

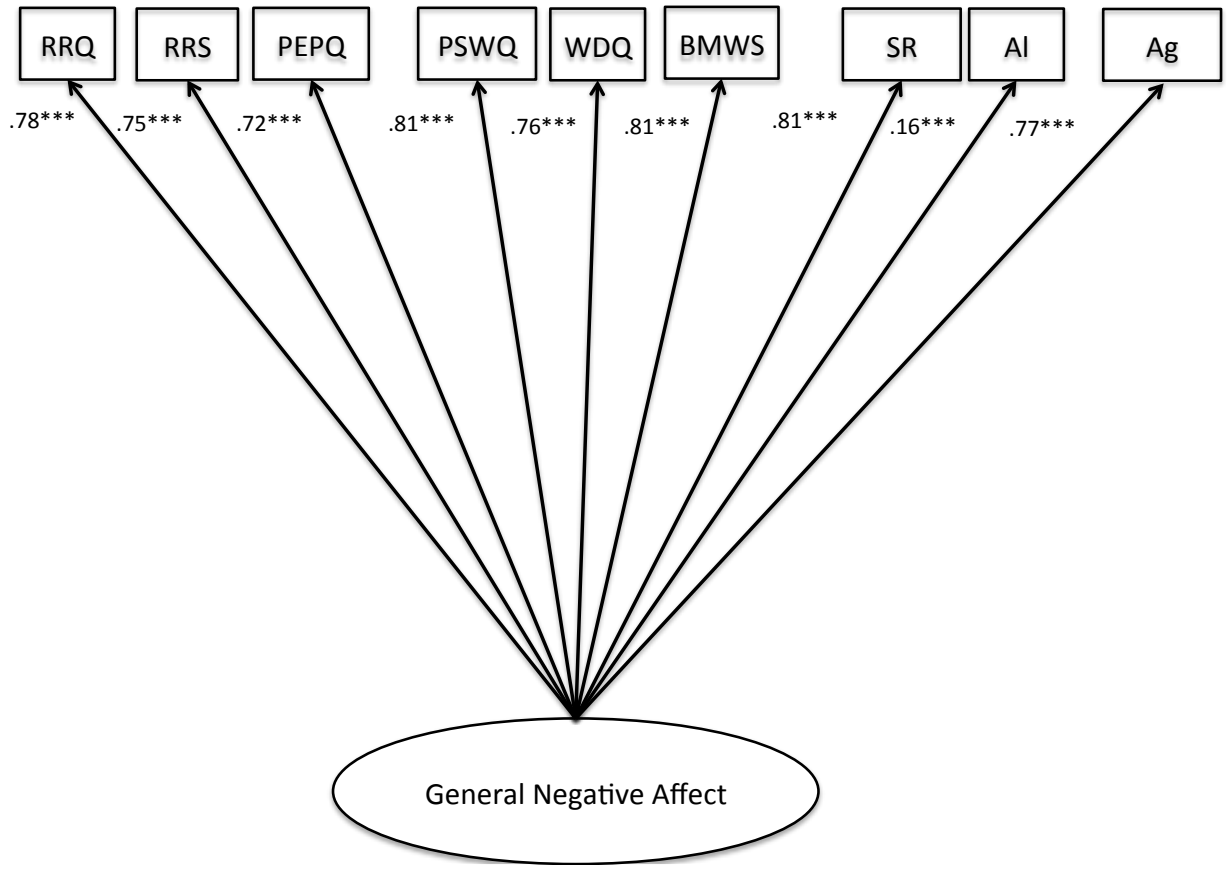

Figure 5C. One-factor model, including worry, rumination, and negative emotionality indicators. —standardized loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; SR=Stress Reaction; Al=Alienation; Ag=Aggression. *$p < .05$, **$p < .01$, ***$p < .001$

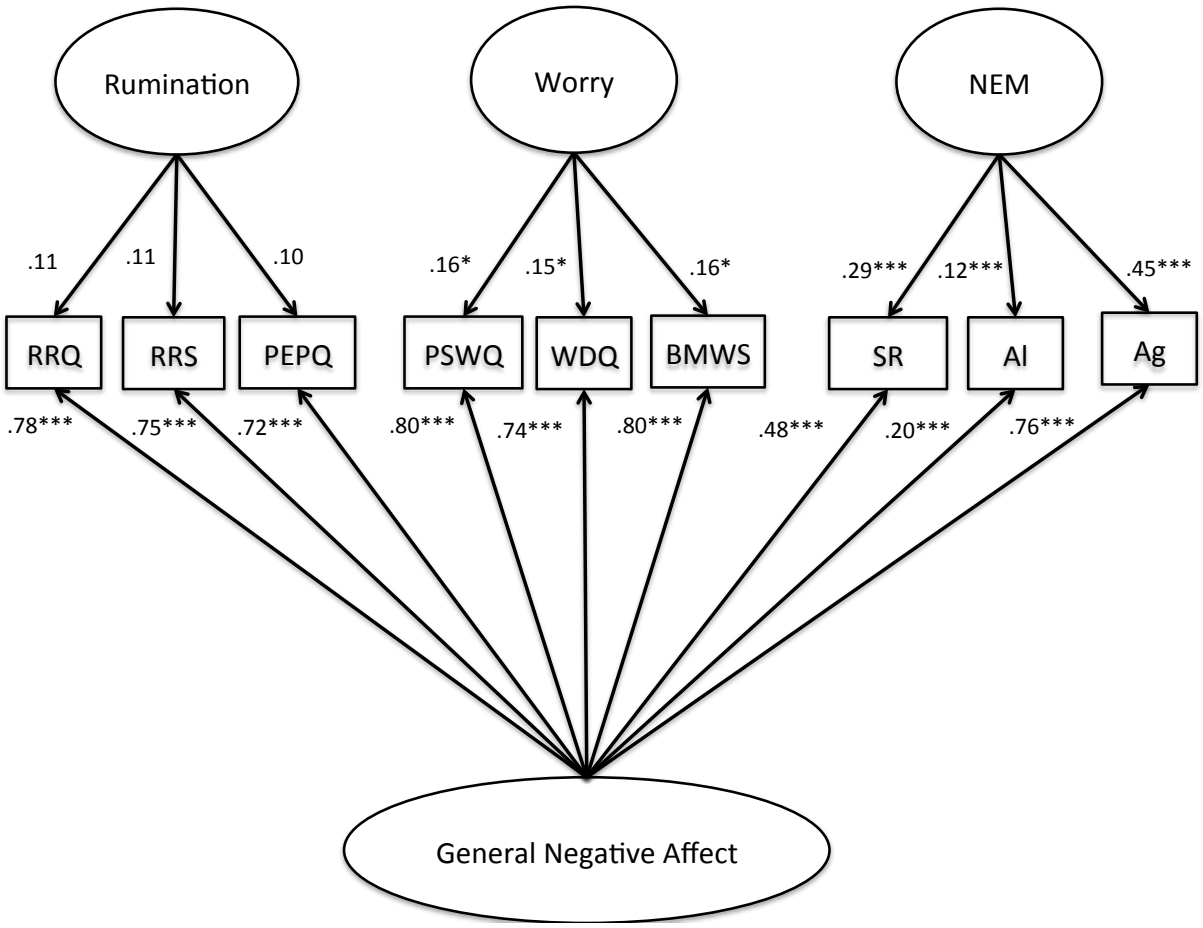

Figure 6C. Schmid-Leiman model, including a general negative affect factor and specific worry, rumination, and negative emotionality factors—standardized loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; SR=Stress Reaction; AI=Alienation; Ag=Aggression. *$p < .05$, **$p < .01$, ***$p < .001$

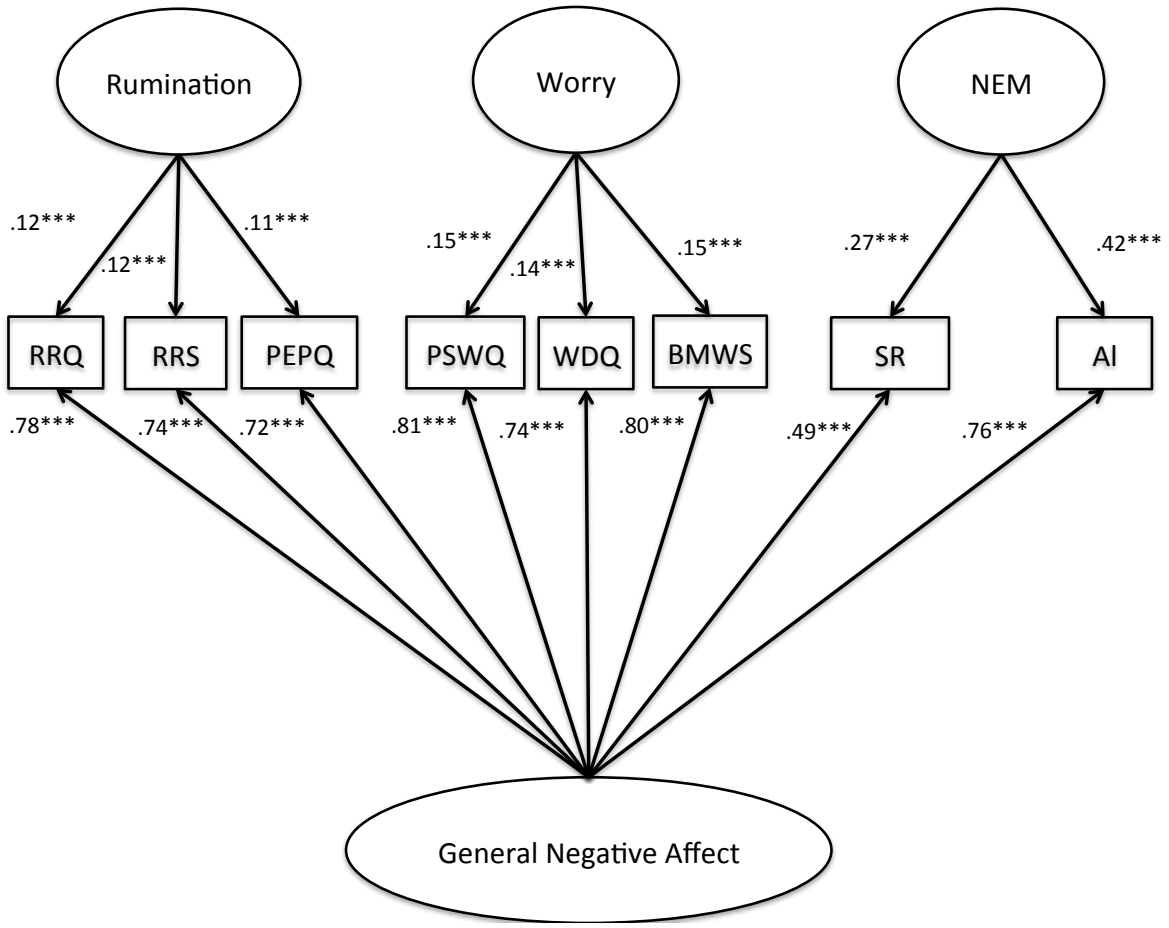

Figure 7C. Schmid-Leiman model, including a general negative affect factor and specific worry, rumination, and negative emotionality factors, excluding aggression—standardized loadings. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; SR=Stress Reaction; Al=Alienation. *p < .05, **p < .01, ***p <.001

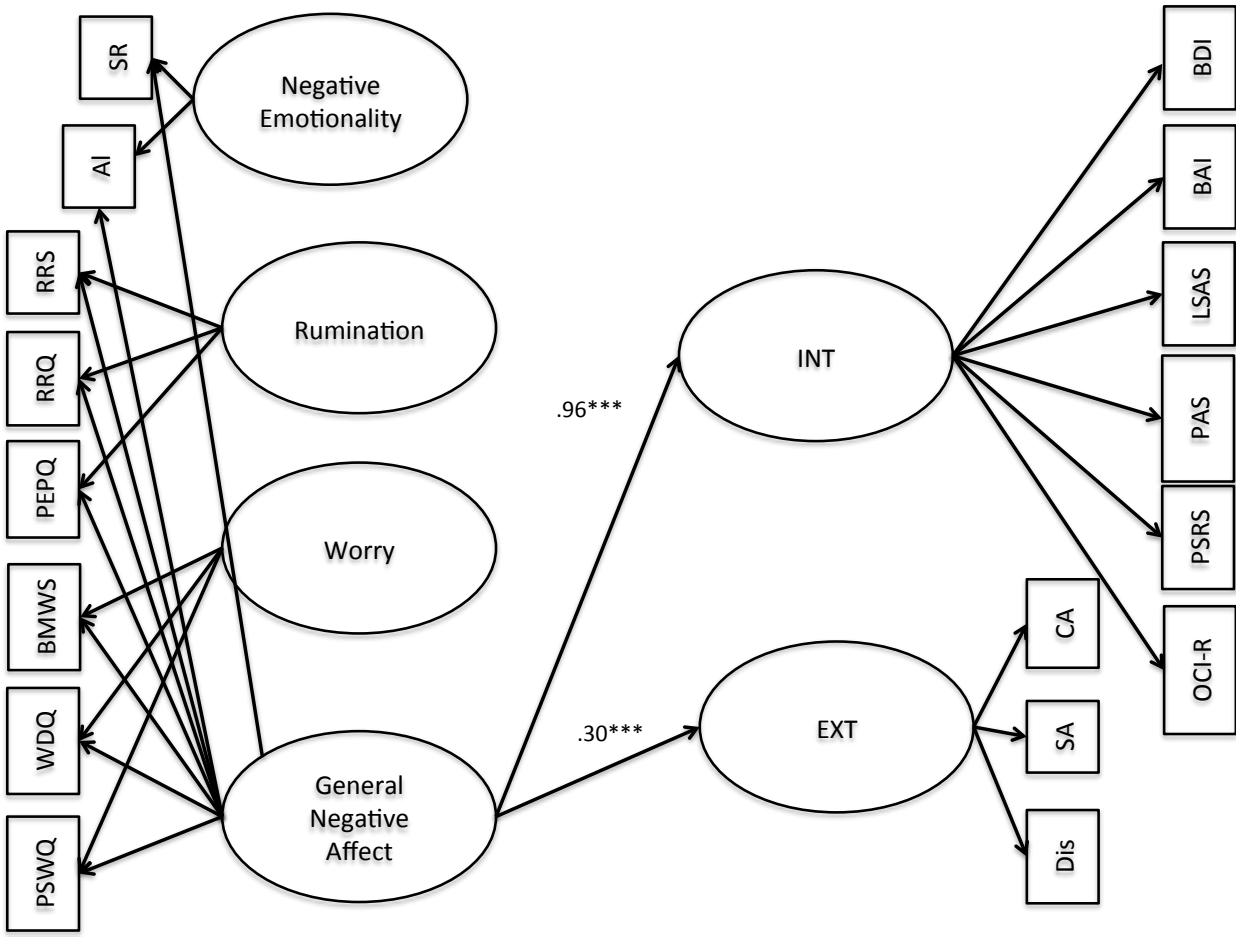

Figure 8C. Test of concurrent validity with a general negative affect factor predicting internalizing and externalizing factors—standardized beta weights. NRT=Negative Repetitive Thought; RRQ=Rumination-Reflection Questionnaire; RRS=Ruminative Response Styles; PEPQ=Post Event Processing Questionnaire; PSWQ=Penn State Worry Questionnaire; WDQ=Worry Domains Questionnaire; BMWS=Brief Measure of Worry Severity; INT=Internalizing; EXT=Externalizing; BDI=Beck Depression Inventory; BAI=Beck Anxiety Inventory; LSAS=Liebowitz Social Anxiety Scale; PAS=Panic and Agoraphobia Scale; PSRS=Phobic Stimulus Response Scale; OCI-R=Obsessive-Compulsive Inventory-Revised; Dis=Disinhibition; SA=Substance Abuse; CA=Callous Aggression. Note that due to the complexity of the model, only the weights for the paths from general negative affect to INT and EXT are included. The rest of the model is included without the weights to demonstrate the overall structure.

Appendix E: IRB Approval Letters

3/13/2015

Andrew Kiselica, B.A. USF Department of Psychology 4202 East Fowler Ave, PCD4118G

Tampa, FL

RE: IRB#: Title:

33613

Dear Mr. Kiselica:

Exempt Certification

Pro00021551 The Thinking Validation

On 3/13/2015, the Institutional Review Board (IRB) determined that your research meets criteria for exemption from the federal regulations as outlined by 45CFR46.101(b):

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Approved Item(s): Protocol Document(s):

IRB Protocol Dissertation Part 2.docx

Consent/Assent Document(s):

Informed Consent Dissertation Part 2 Waiver Version.docx

As the principal investigator for this study, it is your responsibility to ensure that this research is conducted as outlined in your application and consistent with the ethical principles outlined in the Belmont Report and with USF

IRB policies and procedures.

Please note, as per USF IRB Policy 303, "Once the Exempt determination is made, the application is closed in eIRB. Any proposed or anticipated changes to the study design that was previously declared exempt from IRB review must be submitted to the IRB as a new study prior to initiation of the change."

If alterations are made to the study design that change the review category from Exempt (i.e., adding a focus group, access to identifying information, adding a vulnerable population, or an intervention), these changes require a new application. However, administrative changes, including changes in research personnel, do not warrant an amendment or new application.

Given the determination of exemption, this application is being closed in ARC. This does not limit your ability to conduct your research project. Again, your research may continue as planned; only a change in the study design that would affect the exempt determination requires a new submission to the IRB.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Kristen Salomon, Ph.D., Vice Chairperson USF Institutional Review Board

March 24, 2015

Andrew Kiselica , B.A. Psychology 4202 East Fowler Ave, PCD4118G

Tampa , FL

RE: IRB#: Title:

33613

Dear Mr. Kiselica:

Exempt Certification

Pro00021547 The Thinking Study

On 3/23/2015 , the Institutional Review Board (IRB) determined that your research meets criteria for exemption from the federal regulations as outlined by 45CFR46.101(b):

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Approved Items:

IRB Protocol Dissertation Part 1.docx Informed Consent Dissertation Part 1 Waiver Version.docx

As the principal investigator for this study, it is your responsibility to ensure that this research is conducted as outlined in your application and consistent with the ethical principles outlined in the Belmont Report and with USF IRB policies and procedures.

Please note, as per USF IRB Policy 303, "Once the Exempt determination is made, the application is closed in eIRB. Any proposed or anticipated changes to the study design that was previously declared exempt from IRB review must be submitted to the IRB as a new study prior to initiation of the change."

If alterations are made to the study design that change the review category from Exempt (i.e., adding a focus group, access to identifying information, adding a vulnerable population, or an intervention), these changes require a new

application. However, administrative changes, including changes in research personnel, do not warrant an amendment or new application.

Given the determination of exemption, this application is being closed in ARC. This does not limit your ability to conduct your research project. Again, your research may continue as planned; only a change in the study design that would affect the exempt determination requires a new submission to the IRB.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka , Ph.D. , Chairperson USF Institutional Review Board

April 20, 2015

Andrew Kiselica, B.A. Psychology 4202 East Fowler Ave, PCD4118G

Tampa, FL

RE: IRB#: Title:

33613

Exempt Certification

Pro00021876 Thinking Validation Replication

Dear Mr. Kiselica:

On 4/19/2015, the Institutional Review Board (IRB) determined that your research meets criteria for exemption from the federal regulations as outlined by 45CFR46.101(b):

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Approved Items:

IRB Protocol Dissertation Part 3.docx Informed Consent Dissertation Part 3 Waiver Version.docx

As the principal investigator for this study, it is your responsibility to ensure that this research is conducted as outlined in your application and consistent with the ethical principles outlined in the Belmont Report and with USF IRB policies and procedures.

Please note, as per USF IRB Policy 303, "Once the Exempt determination is made, the

application is closed in eIRB. Any proposed or anticipated changes to the study design that was previously declared exempt from IRB review must be submitted to the IRB as a new study prior to initiation of the change."

If alterations are made to the study design that change the review category from Exempt (i.e., adding a focus group, access to identifying information, adding a vulnerable population, or an intervention), these changes require a new

application. However, administrative changes, including changes in research personnel, do not warrant an amendment or new application.

Given the determination of exemption, this application is being closed in ARC. This does not limit your ability to conduct your research project. Again, your research may continue as planned; only a change in the study design that would affect the exempt determination requires a new submission to the IRB.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka, Ph.D., Chairperson USF Institutional Review Board