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Abstract
Two studies with data from 1671 students are presented describing the development and preliminary validation of the Positive and Negative Rumination Scale (PANRS), a brief measure with 2 s-order factors: Positive Rumination consisting of 2 first-order factors (i.e., Enjoy Happiness and Positive Coping) and Negative Rumination consisting of 3 first-order factors (i.e., Suppress Happiness, Self Deny and Negative Attribution). Results from exploratory and confirmatory factor analyses confirmed the measure's 5 first-order and 2 s-order factors structure. Moreover, correlation analyses provided first evidence for the subscales' differential validity: Positive Rumination showed positive correlations with positive indicators of psychological adjustment (e.g., life satisfaction) and negative correlations with negative indicators of psychological adjustment (e.g., depression), whereas Negative Rumination showed negative correlations with positive indicators of psychological adjustment (e.g., life satisfaction) and positive correlations with negative indicators of psychological adjustment (e.g., depression). In addition, all PANRS scores showed satisfactory reliability (Cronbach's alpha) and temporal stability (test-retest). Overall the findings suggest that the PANRS is a reliable and valid instrument to assess positive and negative aspects of Rumination.

Keywords Positive rumination · Negative rumination · Life satisfaction · Depression

Introduction

In the past two decades, a growing number of articles have addressed rumination related topics, and evidence has been consistently found for the important role of rumination in psychological adjustment such as depression, anxiety and psychological well-being, etc. (e.g., Chang et al. 2010; Maree and Abbott 2017; Nolen-Hoeksema et al. 1994, 2008; Topper et al. 2017). Though rumination simply means repetitive thought, pondering or meditating on information, essentially a cognitive "chewing the cud" (Cann et al. 2011), there is no unified definition of rumination and standard way of measuring it.

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Definitions and Measures of Rumination

In the response styles theory, Nolen-Hoeksema and Morrow (1991) defined rumination as repetitive and passive thinking about one's symptoms of depression and the possible causes and consequences of these symptoms. To measure rumination, Nolen-Hoeksema and her colleagues (Nolen-Hoeksema and Morrow 1991) developed the Rumination Response Scale (RRS) comprising three dimensions, i.e., Reflection (5 items, e.g., "Analyze recent events to try to understand why you are depressed"), Brooding (5 items, e.g., "Think 'What am I doing to deserve this?'") and Depression-Related Rumination (12 items, e.g., "Think about how alone you feel"). Because the Depression-Related Rumination was found to have overlap in item content with Beck Depression Scale, Treynor et al. (2003) removed this dimension in the revised version of RRS. However, the original RRS have been used to measure depressive rumination in many researches (e.g., Ferdek et al. 2015; Smith and Alloy 2009, a comprehensive review). Of note, some researchers found that reflection is adaptive while brooding is maladaptive (e.g., Joorman et al. 2006; Whiteman and Mangels 2016). Therefore the function of reflection is controversial.

Relatedly, Conway et al. (2000) argued that rumination is repetitive thinking about sadness and all events or circumstances related to sadness. They developed the Rumination on Sadness Scale (RSS) which is a one dimensional scale with 13 items (e.g., "I repeatedly analyze and keep thinking about the reasons for my sadness"). Similarly, Eisma et al. (2014) insisted that there are two different types of rumination, depressive rumination and grief rumination, which would negatively influence bereavement outcome. They defined grief rumination as recurrent, repetitive and self-focused thoughts about the causes and consequences of the loss and related negative feelings, and developed the Utrecht Grief Rumination Scale (UGRS) to measure grief-specific rumination. The UGRS consists of five dimensions of three items each, i.e., Reactions (e.g., "Did you try to analyze your feelings about this loss precisely?"), Injustice (e.g., "Did you wonder why this had to happen to you and not someone else?"), Counterfactuals (e.g., Did you analyze if you could have prevented the death?"), Meaning (e.g., "Did you analyze what the personal meaning of the loss is for you?"), and Relationships (e.g., Did you think about how you would like others to react to your loss?"). The RSS and UGRS measure maladaptive rumination on sadness and grief respectively.

However, multiple researchers have recognized that rumination can be beneficial. For example, Martin and Tesser (1996) developed the goal progress theory which views rumination, not as a reaction to a mood state per se, but as a response to failure to progress satisfactorily towards a goal. They proposed that rumination generally serves the function of discrepancy reduction which can help individuals find alternate solutions to their problems. They suggested that people engage in positive forms of rumination. According to this theory, Scott Jr. and McIntosh (1999) developed the Scott-McIntosh Rumination Inventory (SMRI) to measure three dimensions of rumination, i.e., Motivation (3 items, e.g., "There are some goals that are so important for me to attain that I am strongly motivated to reach them."), Distraction (3 items, e.g., "I often get distracted from what I'm doing by thoughts about something else.") and Emotionality (3 items, e.g., "When I think about an important goal that I have not yet reached, it makes me feel sad."). Motivation is an adaptive dimension whereas Distraction and Emotionality are maladaptive dimensions.

Another example is the Anger Rumination Scale (ARS; Sukhodolsky et al. 2001) which was developed to measure four dimensions of anger rumination, i.e., Angry Afterthoughts (6 items, e.g., "I re-enact the anger episode in my mind after it have happened."), Thoughts of Revenge (4 items, e.g., "I have long living fantasies of revenge after the conflict is over."), Angry Memories (4 items, e.g., "I ruminate about my past anger experience.") and Understanding of Causes (4 items, e.g., "I think the reasons that other people treat me badly."). The first three dimensions are maladaptive whereas the last one is adaptive.

With the similar rational, Cann et al. (2011) proposed that it is important to distinguish two major types of rumination: intrusive and deliberate. Intrusive rumination involves unsolicited invasions of thoughts about an event that are undesirable. In contrast, deliberate rumination, however, involves voluntary focus on understanding events and their implications. Consequently, they developed the Event-related Rumination Inventory (ERRI) to measure Intrusive Rumination (10 items, e.g., "I thought about the event when I did not mean to.") and Deliberate Rumination (10 items, e.g., "I thought about whether I could find meaning from my experience.").

Moreover, Watkins (2008) used the term "repetitive thought" to describe rumination and distinguished two types of rumination: abstract-analytic and concrete-experiential. The abstract analytic rumination is maladaptive, focusing on evaluating the higher-level causes, meanings and implications of self-experience. By contrast, the concrete-experiential rumination is adaptive, focusing on lower-level, specific, contextual and concrete moment-by-moment details of how does self experience unfold. The Cambridge Exeter Ruminative Thinking Scale (CERTs; Barnard et al. 2007) was developed to measure the abstract-analytic rumination (7 items, e.g., "I focus on why things happened the way they did") and the concrete-experiential rumination (8 items, e.g., "My thoughts move in new and interesting directions"). However, Pfeiler et al. (2017) found that abstract-distanced rumination may have adaptive effects on affective outcomes and anger-related coping-strategies.

Importantly, Feldman (Feldman et al. 2008) argued that response to positive affect (RPA) might be equally important in research on emotion regulation strategies. He then developed the Response to Positive Affect Scale (RPA) comprising three dimensions, i.e., Emotion-focused Positive Rumination (5 items, e.g., "Think about how happy you feel."), Dampening (8 items, e.g., "Think 'My streak of luck is going to end soon.'") and Self-focused Positive Rumination (4 items, e.g., "Think 'I am achieving everything.'"). Emotion-focus and Self-focus are adaptive factors whereas Dampening is a maladaptive one.

In sum, the conceptualizations and measures in previous studies capture either rumination on negative affect (e.g., Nolen-Hoeksema and Morrow 1991; Eisma et al. 2014) or rumination on positive affect (e.g., Feldman et al. 2008) but not both. However, previous studies have demonstrated the adaptive and maladaptive features of rumination on both positive and negative affect.

The Present Study

In the present study, we tried to integrate the positive and negative aspects of rumination on both positive and negative affect. For this, we defined rumination as repetitive thoughts

about both positive and negative affect and they function either positively or negatively regarding psychological adjustment. Accordingly, we proposed a 2 (positive and negative emotions) × 2 (positive and negative rumination) theoretical model for rumination. As showed in Table 1, there are four categories of rumination: positive rumination on positive affect (PROPA), negative rumination on positive affect (NROPA), positive rumination on negative affect (PRONA) and negative rumination on negative affect (NRONA).

The present study aims to develop a self-report measure taping these four categories of rumination: the Positive and Negative Rumination Scale (PANRS). Overall, Two studies are presented to describe the development and preliminary validation of the PANRS. In Study 1, college student samples were used. First, to develop a pool of items, we conducted an open-ended survey, a brain-storming study, and related scale items screening. We then constructed the first version of the PANRS and refined it. To investigate the structure of the measure, we conducted exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). To investigate the stability of PANRS, we retested some students after 4 weeks. To investigate the validity of the PANRS, we examined relations with optimism, anxiety, depression, emotion-focus, dampening, self-focus, brooding, and reflection, and conducted a cluster analysis.

Considering that those popular rumination measures such as RRS, RSS, ARS and ERRI have been adapted to study the rumination of children and adolescents (e.g., Peled and Moretti 2007; Stephanie et al. 2016; Stroud et al. 2018; Zhou and Wu 2016), it would benefit future research if we can validate the PANRS among them. We then conducted EFA and CFA with school student samples and examined relations with life satisfaction, optimism, depression, loneliness and learning stress. We also examined 4-week interval test-retest reliability and conducted a cluster analysis.

Studies 1: Development and Validation among College Students

Method

Participants and Procedure

For Sample 1, 91 students (40 male, 51 female) with an average age of 19.7 years (SD = 2.03; range = 15–27 years) were

recruited from the authors' university, one of the top universities in the eastern coastal region of the People's Republic of China. For Sample 2, 188 students (64 male, 124 female) with an average age of 20.3 years (SD = 1.6; range = 17–29 years) were recruited from the authors' university and another average university. For Sample 3, 953 students (428 males, 525 females) with an average age of 19.57 years (SD =1.6; range = 16–25 years) were recruited from the authors' university and another average university. In Sample 3, participants were randomly split into two samples (ns = 476 and 477) for EFA and CFA. All students were recruited after class, volunteered to participate in the study without compensation, and completed paper-and-pencil versions of all measures.

Measures

As a first step, we aimed to obtain a pool of items from which to construct a multidimensional scale measuring positive and negative rumination about positive and negative affect. To this aim, we distributed an open-ended questionnaire to the students of Study 1 with two questions: "When you are in a bad emotion, what kinds of thoughts would you have about the emotion? Please write as more as possible." and "When you are in a good emotion, what kinds of thoughts would you have about the emotion? Please write as more as possible." The order of two questions in the questionnaire was randomly arranged for participants. Overall, students generated 55 items (23 items about positive emotion and 32 items about negative emotion).

Next we held two discussion meetings in a study group (one teacher and four graduate students) to screen the students' responses to the open-ended questionnaire and other materials such as Ruminative Responses Scale (Nolen-Hoeksema and Morrow 1991; Chinese version, Han and Yang 2009) and Response to Positive Affect Questionaire (Feldman et al. 2008; Chinese version, Yang and Guo 2014) looking for items of different contents. We also generate further items by brain-storming with the aim to cover rumination about both positive and negative emotions. Moreover, we selected only items that would equally apply to men and women. This procedure resulted in a first, 80-item version of the PANRS with 17 and 18 items capturing positive and negative rumination about positive affect (Part I), and 24 and 21 items capturing positive and negative rumination about negative affect (Part II) respectively. Instructions for Part I stated "*(Please recall or imagine): When you have positive emotion such as happiness, excitement, or enthusiasm, how often do you think in the following way? Please circle the right number to indicate your answer*". Instructions for Part II stated "*(Please recall or imagine): When you have negative emotion such as sadness, angry, or shame, how often do you think in the following way? Please circle the right number to indicate your answer*". Participants were asked to rate their responses

Table 1 The 2 × 2 Theoretical model of rumination

	Positive Affect	Negative Affect
Positive Rumination	PROPA	PRONA
Negative Rumination	NROPA	NRONA

on a scale of 1 (*never*) to 4 (*always*). This version was administered to the students of Sample 2, after which 48 items were discarded (see the item analyses and EFA of the results section for details). A second, modified 32 item-version of the PANRS was then administered to the students of Sample 3.

In addition, the following variables for validity test were administered to Sample 3.

First, life satisfaction was measured by the Satisfaction with Life Scale (SWLS; Diener et al. 1985). The SWLS is a 5-item measure of global life satisfaction (e.g., "I am satisfied with my life"), or a person's satisfaction with life as a whole, rather than any specific domain. Respondents are asked to rate the extent of their agreement to these items across a 7-point Likert-type scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Higher scores on the SWLS indicate greater life satisfaction. In this study, the alpha was .84.

Second, optimism was measured by the Life Orientation Test-Revised (LOT-R; Scheier et al. 1994). The LOT-R is a 10-item measure, including 3 positively worded items (e.g., "In uncertain times, I usually expect the best"), 3 negatively worded items (e.g., "If something can go wrong for me, it will") and 4 filler items (e.g., "It is easy for me to relax"). Respondents are asked to rate the extent of their agreement to these items across a 5-point Likert-type scale, ranging from 0 (*strongly disagree*) to 4(*strongly agree*). The negatively worded items are reverse coded before scoring. The higher score indicates greater optimism. In this study, the alpha was .60[1].

Third, anxiety and depression were measured by the Anxiety and Depression subscales of Symptom Checklist −14 (SCL-14, See Prinz et al. 2013). The Anxiety subscale consists of 4 items (e.g., "Nervousness or shakiness inside"). The Depression subscale consists of 6 items (e.g., "Thoughts of death or dying"). Respondents are asked to rate the extent of their agreement to these items across a 5-point Likert-type scale, ranging from 1 (*none at all*) to 5(*very severe*) with higher scores indicating more severe anxiety and depression. In this study, the alphas were .87 and .84 respectively.

Fourth, response to positive affect was measured by the Response to Positive Affect questionnaire (RPA, Feldman et al. 2008; Chinese *v*ersion, Yang and Guo 2014). The RPA consists of 17 items measuring Emotion-focused Positive Rumination, Dampening and Self-focused Positive Rumination. Participants were asked to rate their responses on a scale of 1 (*almost never*) to 4 (*almost always*) with higher scores indicating stronger emotion-focused positive rumination, dampening and self-focused positive rumination. In this study, the alphas were .71, .77 and .82 respectively.

Finally, response to negative affect was measured by the Ruminative Response Scale—The RRS (Nolen-Hoeksema and Morrow 1991; Treynor et al. 2003). The RRS consists

of 22 items measuring Depression-related Rumination, Brooding and Reflection. Because of the item similarities between the Depression-related Rumination and Beck Depression Inventory (Treynor et al. 2003), we excluded the Depression-related Rumination in this study. Participants were asked to rate their responses on a scale of 1 (*almost never*) to 4 (*almost always*) with higher scores indicating stronger brooding and reflection. In this study, the alphas were .76 and .68 respectively.

Results

Item Analyses

To conduct item analyses, we calculated item discrimination according to the critical ratio "*t*" involving upper and lower groups of 27% for PANRS. Items were removed if their "*t*" values were not significant for confidence level of .05. We also calculated item-total correlation, which is corrected by removing every item one by one. Items were removed if the correlation failed to reach .40 and the difference in correlation with the positive and negative rumination dimensions was less than .30. This procedure discarded 5 items and resulted in a second, 75-item version of the PANRS with 17 and 18 items capturing positive and negative rumination about positive emotion and 22 and 18 items capturing positive and negative rumination about negative emotion, respectively.

EFAs

To investigate the factor structure of the 75-item version of the PANRS, the item responses obtained from the students of Sample 2 were subjected to an EFA in SPSS 20.0. Because of the significant deviations of all items from normality (Kolmogorov-Smirnov Z ranged from 1.50 to 3.13, all *p* < .001), we employed the principal components analysis, which is not relying on the multivariate normal distribution assumption. Following the EFA method used by Cann et al. (2011), Feldman et al. (2008), and Scott Jr. and McIntosh (1999) in developing their rumination measures each consists of positive and negative factors, we used varimax rotation to identify factors as they did. Items were removed if they met one or more of the following criteria: The factor loading failed to reach .50, the item demonstrated cross loadings on multiple factors greater than 0.32 (Tabachnick and Fidell 2001), the difference of cross loadings was less than .30, the item loaded primarily on factors that were either uninterpretable or contained three or fewer items. EFA was conducted after removing every item one by one from the item with the smallest loading to that with the largest loading.

This procedure discarded 43 items (e.g., "Think 'this is the result of my effort'" and "Think 'this negative emotion might be beneficial'") and resulted in a third, 32-item version of the

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[1] When the number of items of a scale is less than or equal to 6, alpha values from .50 to .60 are acceptable (Hair et al. 1998; Kavadia et al. 2013).

PANRS with six factors. The six factors were labeled Enjoy Happiness (10 items, e.g., "Think 'How wonderful life is'"), Suppress Happiness (7 items, e.g., "Think 'Happy days do not last long'"), Self Deny (5 items, e.g.,), Positive Coping (4items, e.g., "Think 'What I can do for it'"), Confidence (3 items, e.g., "Think 'If winter comes, can spring be far behind'"), and Negative Attribution (3 items, "Think 'Bad just turns to worse'"). The second-order EFA conducted for these six factors resulted in a 2-factor second order model with Enjoy Happiness and Positive Coping loading on one factor and Suppress Happiness, Self Deny, and Negative Attribution loading on another factor. The former was labeled Positive Rumination and the later was labeled Negative Rumination.

To develop the final version of PANRS, the 32-item version of PANRS was presented to the students of Sample 3. When the item responses were analyzed, they showed a KMO of 0.87 indicating suitability for factor analysis. Using the same procedure as before, nine items (e.g., "Think 'If winter comes, can spring be far behind'") were removed one by one and the fourth, 23-item version of the PANRS with five factors was reached: Enjoy Happiness (6 items), Suppress Happiness (5 items), Negative Attribution (5 items), Positive Coping (4 items) and Self Deny (3 items) (see Table 2). We also conducted a scree plot analyses. The result supported the five-factor model. The second-order EFA conducted for the five factors duplicated the 2-factor second order model with Enjoy Happiness and Positive Coping loading on Positive Rumination (loadings were .81 and .84 respectively), and Negative Attribution, Positive Coping and Self Deny leading on Negative Rumination (loadings were .75, .77 and .79 respectively).

CFA

To examine the factor structure of the PANRS, we conducted a CFA using LISREL 8.80 on the item responses testing for a 2-factor second-order confirmatory model in which Enjoy Happiness and Positive Coping were specified to load only on Positive Rumination, and Suppress Happiness, Self Deny and Negative Attribution only on Negative Rumination. And the 2 s-order factors were allowed to correlate whereas the five first-order factors were not. Because of the significant deviations of all items from normality, we employed robust maximum likelihood (RML) estimation to provide robust parameter and model fit estimates (Brown 2006)[2]. To evaluate model fit, it is necessary to use multiple measures that tap different aspects of fit (Hoyle and Panter 1995). Because the χ^2 statistic is extremely sensitive to sample size as a measure of model fit,

we used the following robust measures of fit: (1) the comparative fit index (CFI), for which values between .90 and .94 are indicators of adequate fit (McDonald and Ho 2002), whereas values of .95 and higher are indicators of good fit (Kline 2005) (2) the non-normed fit index (NNFI), for which values of above .90 are indicators of adequate model fit and values of .95 and higher are indicators of good fit (Hu and Bentler 1995); (3) the root mean square error of approximation (RMSEA) and the confidence interval (90% CI), for which values of .06–.80 are indicators of adequate fit and values of .05 and less are indicators of good fit (Hu and Bentler 1995); and a narrow CI is a indicator of good precision (MacCallum et al. 1996); (4) the standardized root mean square residual (SRMR), for which values of .08 or less are indicator of good fit (Kline 2005).

When the specified 2-factor second order model was estimated, results showed that the model provided a good fit to the data: CFI = .98, NNFI = .94, RMSEA = .038 (.031–.044), SRMR = .44.

Descriptive Statistics, Reliability, and Construct Validity

Correlations for the PANRS scales are presented in Table 3. As the table shows, scores for two positive rumination subscales (i.e., Enjoy Happiness and Positive Coping) were found to be positively associated with each other and so were the scores for three negative rumination subscales (i.e., Suppress Happiness, Self Deny and Negative attribution). The positive rumination subscales were found to be negatively and significantly or non-significantly associated with the negative rumination subscales. As the table also shows, the five first-order subscales and the 2 s-order subscales were found to have satisfactory internal consistency (Cronbach's α = .71 ∼ .85). We examined the test-retest stability of the PANRS by examining scores of 58 students across a 4-week time period. Results of this analysis indicated medium to high test-retest associations for all the subscales (r = .49 ∼ .84, all $p < 0.001$, see Table 3). Taken together, these results offer adequate support for the internal consistency and test-retest reliability of the PANRS scales.

To evaluate the convergent validity of the PANRS, we examined the associations between the PANRS subscales with psychological outcome variables (i.e., life satisfaction, optimism, anxiety, depression, dampening, emotion-focus and self-focus positive rumination). Results of computing correlations between these measures are presented in Table 4. As this table shows, we found evidence for convergent validity. That is, scores on the positive rumination subscales of the PANRS were found to be positively and significantly associated with scores on the positive outcome variables (i.e., life satisfaction, optimism, emotion-focused and self-focused positive rumination), and negatively and significantly or non-significantly associated with scores on the negative outcome variables

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[2] RML is not relying on the multivariate normal distribution assumption and provide sufficient power to detect misspecified models. It improves the chi-square statistic and standard errors of parameter estimates using the Satorra-Bentler procedure (Satorra and Bentler 1994).

Table 2 Results of exploratory factor analysis on the positive and negative rumination scale (PANRS) among college students

Items	Factor					
	1	2	3	4	5	h^2
Part I						
Enjoy Happiness						
1. Think "How wonderful life is"	**.65**	−.17	−.14	.16	−.01	.49
3. Think "I am proud of myself"	**.70**	.06	.02	.13	−.18	.54
4. Think "I am energetic"	**.70**	.01	−.10	.03	.01	.50
6. Think "How happy I am"	**.73**	−.16	.00	.13	.03	.58
7. Think "I am great"	**.77**	−.16	.09	.09	−.01	.63
10. Think "I have a bright future"	**.64**	−.09	−.06	.16	−.08	.45
Suppress Happiness						
2. Think "Happy days do not last long"	−.17	**.60**	.24	−.01	.18	.48
5. Think "Fall from the pinnacle of one's power"	−.08	**.82**	.07	.01	.02	.68
8. Think "I will not be always so lucky"	−.13	**.67**	.11	.06	.18	.52
9. Think "Extreme joy leads to sorrow"	−.16	**.78**	.23	.00	.10	.69
11. Think "It is not good to be so glad"	.05	**.73**	.17	.06	.02	.57
Part II						
Negative Attribution						
6. Think "Bad just turns to worse"	−.09	.11	**.65**	.04	.25	.51
8. Think "Misfortunes never come singly"	.02	.18	**.64**	−.07	.32	.56
10. Think "It just happened to me"	.03	.16	**.73**	−.04	.03	.56
11. Think "I knew it would go bad"	−.08	.15	**.67**	.08	−.02	.48
12. Think "It never rains it pours"	−.07	.17	**.74**	−.07	.18	.62
Positive Coping						
3. Think to calm down	.04	.06	.09	**.78**	−.06	.62
4. Think "What I can do for it"	.12	.04	−.01	**.74**	−.15	.58
7. Think "A fall into the pit, a gain in your wit"	.20	.01	−.07	**.62**	.17	.46
9. Think to cheer up	.32	.01	−.06	**.68**	−.01	.57
Self Deny						
1. Do not accept yourself	−.05	.13	.11	.10	**.76**	.62
2. Think "I am a useless person"	−.15	.18	.17	−.03	**.75**	.64
5. Think to hide yourself	.03	.08	.30	−.16	**.70**	.61
Eigenvalues	3.22	2.89	2.72	2.15	2.00	
%Variance	14.01	12.58	11.81	9.36	8.68	
Cumulative %	14.01	26.59	38.40	47.76	56.44	

$N = 476$

(The English translation was achieved with support from the English Language Department of the first author's university and followed established guidelines for cross-cultural translation of instruments (Brislin 1970): First, two graduate students translated the original measure from Chinese into English; then two other graduate students, independently from the first two, translated it back to Chinese; finally discrepancies were discussed in a conference (involving the four students, the first author, and an English lecturer) and the final translation was agreed)

(i.e., anxiety, depression and dampening). Furthermore, scores on the negative rumination subscales of the PANRS were found to be negatively and significantly or non-significantly associated with scores on the positive measures while they are positively and significantly associated with scores on the negative outcome variables.

Surprisingly, scores on positive and negative rumination subscales of the PANRS were found to be positively and significantly associated with scores on brooding and reflection of the RRS (see Table 4). Furthermore, scores on emotion-focus, dampening and self-focus were also found to be positively and significantly associated with scores on brooding ($r = .07, .30$ and .19; $p = .03$, .00 and .00) and reflection ($r = .07, .24$ and .23; $p = .03$, .00 and .00) of the RRS, which was similar to the association pattern found in the study of Feldman et al. (2008). To examine if all those factors belong to the same or different superordinate dimensions of rumination, we adopted the same method used by Frost et al. (1993) when they compared two

Table 3 Correlations and reliabilities for the positive and negative rumination scale (PANRS) in college students

	1	2	3	4	5	6	7	8
1. Enjoy Happiness	–							
2. Suppress Happiness	−.17***	–						
3. Negative Attribution	−.07*	.43***	–					
4. Positive Coping	.34***	.06	.01	–				
5. Self Denial	−.07*	.32***	.46***	−.01	–			
6. Positive Rumination	.83***	−.07*	−.04	.81***	−.02	–		
7. Negative Rumination	−.12***	.75***	.79***	.03	.78***	−.06	–	
8. Total	.44***	.62***	.66***	.47***	.56***	.52***	.79***	–
Cronbach's α	.83	.82	.77	.71	.72	.81	.85	.77
Test-retest correlation	.49***	.84***	.58***	.71***	.73***	.62***	.80***	.65***

$N = 953$ for correlations and Cronbach's α, 58 for test-retest correlation

measures of perfectionism, i.e., Frost Multidimensional Perfectionism Scale and Hewitt and Flett's Multidimensional Perfectionism Scale. They conducted a higher-order EFA on the 9 subscales of the two scales and identified two superordinate dimensions: Adaptive and maladaptive perfectionism. We then conducted a higher-order EFA on the 7 subscales of PRA, RRS and PANRS. The results showed a 2-factor higher-order structure, with one factor consisting of Emotion-focus, Self-focus and Positive Rumination, and the other factor consisting of Dampening, Brooding, Reflection and Negative Rumination. Factor loadings ranged from .69 to .85. The results indicated that the Positive and Negative Rumination belong to different superordinate dimensions, providing validity evidence for the 2-factor higher-order structure of PANRS.

Incremental Validity

To analyze the predictive utility of the PANRS subscales in accounting for psychological adjustment, we conducted a series of hierarchical regression analyses with life satisfaction, optimism, anxiety and depression as our outcome. For these analyses, however, we included response to positive affect in Step 1and response to negative affect in Step 2. We did this to provide a more rigorous test for the usefulness of the PANRS subscales in predicting psychological adjustment. If the PANRS subscales are getting at dimensions of rumination that are not redundant with RPA and RRS subscales, then we should find evidence for the utility of the PANRS. Accordingly, scores on two of the PANRS subscales were entered as a set in Step 3. To compare the effect sizes of the predictors that accounted for the variance in functioning, we used Cohen's (1988) suggestions of small ($f^2 \geq .02$), medium ($f^2 \geq .15$), and large effects ($f^2 \geq .35$) as a general guide. Results of conducting these regression analyses are presented in Table 5.

As the table shows, three key patterns emerged. First, the RPA set was consistently found to account for medium to large ($f^2 = .23 \sim .37$), significant 18.4 ~ 26.8% variances in the outcome measures examined. Second, the RRS set was consistently found to account for small or less ($f^2 = .00 \sim 0.04$), non-significant or significant additional 0.1 ~ 4.6% variances in the outcome measures examined, above and beyond what was accounted for by the RPA set. Third, the PANRS set was consistently found to account for small to medium ($f^2 = .06 \sim 0.17$), but significant additional 4.6 ~ 10.5% variances in the outcome measures examined, above and beyond what was accounted for by the RPA and RRS sets. Within the predictor sets, Dampening consistently showed stronger prediction to negative indicators of outcome (i.e., anxiety and depression) than Emotion-focus and Self-focus. Similarly, Negative Rumination consistently showed stronger prediction to negative indicators of outcome than Positive Rumination. Interestingly, those predictors did not show consistent differences in prediction of the positive indicators of outcome (i.e., life satisfaction and optimism) and the two RRS predictors, Brooding and Reflection, did not show consistent differences in predication of both positive and negative indicators of outcome.

Types of Ruminative Persons

In previous studies, persons with extremely high and low scores of RRS were identified as ruminators and nonruminators respectively (e.g., Davis and Nolen-Hoeksema 2000; Beckwé and Deroost 2016). With this methodology, only maladaptive rumination measured by RRS was used as a criterion, and therefore, the role of adaptive rumination was ignored in categorical study. Because the PANRS includes both adaptive and maladaptive dimensions, it is necessary to examine its ability to identify different types of ruminators as a validity test. Consequently, we conducted a two-step cluster analysis to identify different types of ruminative persons. The first step involved a hierarchical cluster analysis using Ward's linkage method with the squared Euclidian distance measure. Standardized positive and negative rumination

scores were used as variables. The first large agglomeration coefficient increase (41%) occurred when three clusters were combined into two, which indicated a three-cluster solution. We used this solution for the second step, which involved a nonhierarchical k-means cluster analysis. The standardized means of the positive and negative rumination scores for each cluster were used as starting values. The k-means analysis classified the participants into adaptive type (high positive rumination and low negative rumination; $n = 377$), maladaptive type (low positive rumination and high negative rumination; $n = 243$), and non-rumination type (low positive rumination and low negative rumination; $n = 333$; Fig. 1A for the z scores of each group). No significant sex distribution differences (χ^2 (2, $n = 953$) $= 1.00$, $p > .05$) were observed across these groups.

The psychological outcome variables were compared across these groups by using Tukey's HSD post hoc comparisons. The results are presented in Table 6. As the table shows, adaptive group reported higher levels of life satisfaction, optimism, emotion-focused and self-focused positive rumination, and lower levels of anxiety, depression and dampening as compared with the other groups. Overall, adaptive group have the highest level of psychological adjustment whereas maladaptive group have the lowest level of psychological adjustment.

Brief Discussion

After item collection, initial and secondary tests, we arrived at the final version of the PANRS that comprised 23 items and showed a clear 2-factor second-order structure differentiating positive and negative rumination. Positive rumination comprised of two first-order factors: Enjoy Happiness and Positive Coping, while negative rumination comprised of three first-order factors: Suppress Happiness, Self Deny and Negative Attribution. Whereas the PANRS total scores—combining all 23 items—would blur the distinction between positive and negative rumination, the PANRS subscales scores showed promise and first evidence of differential validity. This was demonstrated in the correlations with study measures. Whereas the PANRS total score showed positive correlations with all outcome variables except for life satisfaction, Positive rumination subscales showed positive correlations only with the positive outcome variables such as life satisfaction and optimism, and negative rumination subscales only with the negative outcome variables such as pessimism and anxiety. Finally, the cluster analysis provided further evidence for the differential validity of the PANRS.

However, further study was required to examine if the PANRS can be applied to people other than college students. Consequently, one further study was conducted to confirm the

factor structure of the PANRS by means of CFA and to further establish the PANRS subscales' differential validity by investigating their convergent and discriminant correlations with positive and negative psychological outcomes among school students.

Studies 2: Validating the PANRS among School Students

Method

Participants and Procedure

For Study 2, 718 school students (357 male, 359 female, 2 missing) with an average age of 14.3 years (SD = 2.4; range = 9–19 years) were recruited from elementary and high schools in mainland China. Participants were randomly split into two samples (ns = 361 and 357) for exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). All of them completed paper-and-pencil versions of all measures in Chinese. Among them, one class of 8th grade (42 students, 21 males, 21 females) and one class of 11th grade (41 students, 25 males, 16 females) completed a retest of the PANRS after 4 weeks. Classes represented in this study consisted of 5th grade 88(12.3%), 6th grade 96(13.4%), 7th grade 91(12.7%), 8th grade 93(13.0%), 9th grade 94(13.1%), 10th grade 77(10.7%), 11th grade 87(12.1%), and 12th grade 92(12.8%) students.

To recruit the participants, the third to seventh authors each contacted the principal of one school (i.e., 1 elementary school, 2 junior high schools and 2 senior high schools) and got approved for this study (parental permission is not required for this study in China). Finally, they went to the classes one by one with class tutors, asking students to finish the questionnaire.

Measures

To measure rumination, we used the PANRS. We used life satisfaction, optimism, depression, loneliness, and learning stress as outcome variables. Life satisfaction was measured by the Satisfaction with Life Scale (SWLS; Diener et al. 1985). In this study, the alpha was .81. Optimism was measured by the Life Orientation Test-Revised (LOT-R; Scheier et al. 1994). In this study, 4 fillers were excluded to shorten the measure. The alpha was .53. Depression was measured by the Depression subscales of Symptom Checklist −14 (SCL-14, See Prinz et al. 2013). It consists of 6 items. In this study, the alpha was .86.

Loneliness was measured by the Three-Item Loneliness Scale (Hughes et al. 2004): "I feel left out," "I feel isolated" and "I lack companionship". The items

Table 4 Correlations between positive and negative rumination scale (PANRS) subscales and study measures among college students

	Enjoy Happiness	Suppress Happiness	Negative Attribution	Positive Coping	Self Deny	Positive Rumination	Negative Rumination	Total
1. Life satisfaction	.40***	−.22***	−.22***	.18***	−.31***	.36***	−.32***	−.02
2. Optimism	.43***	−.38***	−.29***	.28***	−.31***	.43***	−.42***	.08**
3. Anxiety	−.08*	.36***	.42***	−.03	.43***	−.07*	.52***	.32***
4. Depression	−.23***	.37***	.46***	−.12***	.49***	−.22***	.57***	.38***
5. Emotion-focused	.62***	−.09**	−.03	.26***	−.12***	.54***	−.11***	.27***
6. Dampening	−.12***	.60***	.46***	.03	.44***	−.06	.64***	.50***
7. Self-focused	.52***	.02	.01	.38***	−.05	.55***	−.01	.34***
8. Brooding	.14***	.28***	.38***	.35***	.31***	.29***	.42***	.50***
9. Reflection	.13***	.23***	.30***	.36***	.21***	.29***	.32***	.42***

$N = 953$

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

were selected from the UCLA Loneliness Scale (Russell et al. 1980, Chinese version, Wang 1995). Participants were asked to rate their responses on a scale of 1 (never) to 4 (often) with higher scores indicating stronger loneliness. In this study, the the alphas were .87.

Learning stress was measured by the Perceived Learning Stress Scale (PLSS) modified from the 4-item version of the Perceived Stress Scale (PSS, Cohen et al. 1983; PLSS in Chinese, Yang et al. 2016). In the PLSS, the original phrasing was preserved as much as possible (e.g., "How often have you felt that you were unable to control the important things in your life" was changed to "How often have you felt that you were unable to control the important things in your learning?"). Besides, an item was added to evaluate overall learning stress: "How often have you felt strong learning stress?" Thus, the PLSS is a 5-item one-dimensional scale. Respondents are asked to rate items across a 5-point Likert-type scale ranging from1 (never) to 5 (very often). Higher scores on the PLSS reflect greater learning stress. In this study, the alphas were .72.

Results

EFA and CFA

First, an exploratory factor analysis was performed on the 23-item PANRS ($n = 361$) using principal components analysis with varimax rotation in SPSS 20.0. The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was 0.87, indicating that the data were suitable for factor analysis. Five factors had eigenvalues >1, explaining 55.12% of the total variance. All

the five factors were exactly the original factors. The factor loadings (standardized regression weights) for this model ranged as follows: Enjoy Happiness (.61–.80), Suppress Happiness (.55–.71), Negative Attribution (.46–.70), Positive Coping (.52–.77), and Self Deny (.64–.73). However, one of the Negative Attribution items (i.e., item 6 of Part II, "Think 'Bad just turns to worse'") demonstrated cross loadings of .33, .46 and .35 on Suppress Happiness, Negative Attribution and Self Deny respectively. Considering the meaning of item 6 is consistent with other items of Negative Attribution such as "Think 'Misfortunes never come singly'", we did not eliminate it. The second-order EFA conducted for the five factors resulted in the 2-factor second order model with Enjoy Happiness and Positive Coping loading on Positive Rumination (loadings were .75 and .86 respectively), and Suppress Happiness, Self Deny, Negative Attribution leading on Negative Rumination (loadings were .77, .74 and .83 respectively).
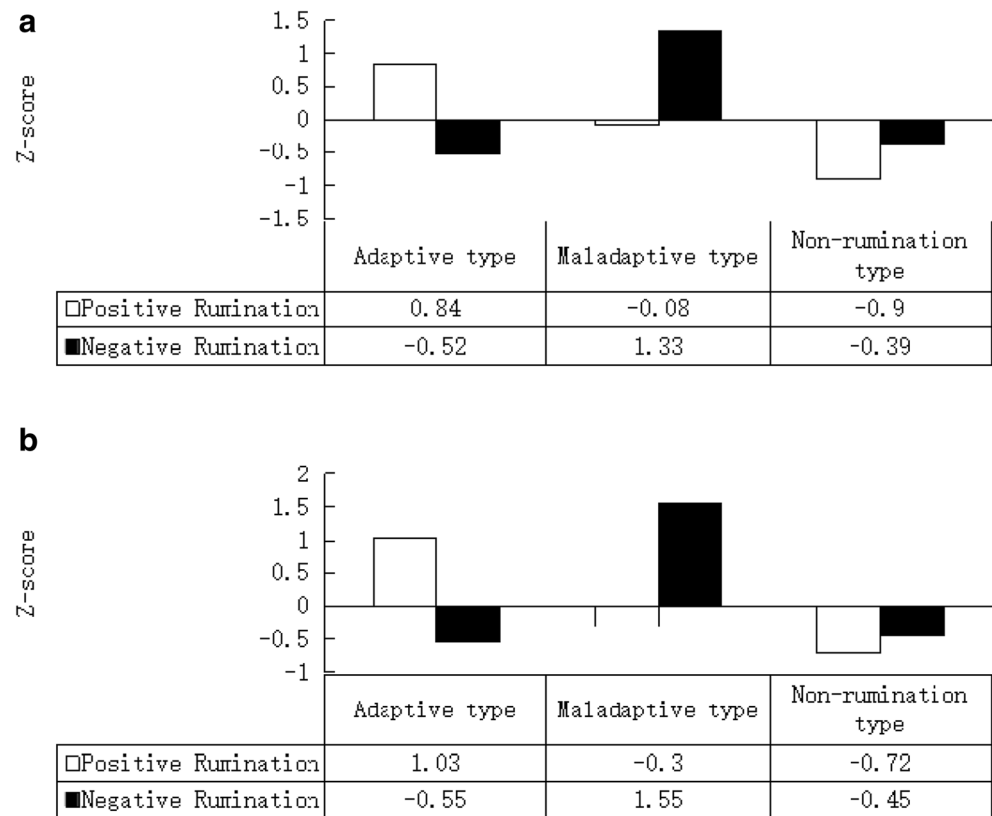
Therefore, a confirmatory factor analysis ($n = 357$) was conducted using LISREL 8.80 to examine whether the 2-factor second order model obtained for the original questionnaire would be validated among school students. Because all of the items displayed significant deviation from normality (Kolmogorov-Smirnov Z ranged from 1.79 to 2.89, all $ps < .001$), we used robust maximum likelihood (MLM) estimation which provides robust parameter and model fit estimates for data that deviate from normality (Brown 2006). The results showed that the model provided a good fit to the data: CFI = .96, NNFI = .96, RMSEA = .049 (.046–.051), SRMR = .49, indicating that the original 23-item version of PANRS was acceptable as a measure for school students.

Table 5 Results of hierarchical regression analyses showing amount of variance in psychological adjustment accounted for by response to positive affect, ruminative response scale and positive and negative rumination in college students

Outcome and Predictor	β	R^2	ΔR^2	F	p	f^2
Life satisfaction						
Step 1: RPA		.224	–	91.48	<.001	.29
Emotion-focus	.26***					
Dampening	−.22***					
Self-focus	.22***					
Step 2: RRS		.245	.021	61.52	< .001	.03
Brooding	−.17***					
Reflection	.04					
Step 3: PANRS		.291	.046	55.32	< .001	.06
Positive Rumination	.20***					
Negative Rumination	−.20***					
Optimism						
Step 1: RPA		.264	–	113.36	<.001	.36
Emotion-focus	.22***					
Dampening	−.36***					
Self-focus	.20***					
Step 2: RRS		.265	.001	68.35	<.001	.00
Brooding	−.02					
Reflection	−.03					
Step 3: PANRS		.370	.105	79.35	<.001	.17
Positive Rumination	.33***					
Negative Rumination	−.27***					
Anxiety						
Step 1: RPA		.184	–	71.37	<.001	.23
Emotion-focus	−.05					
Dampening	.42***					
Self-focus	.01					
Step 2: RRS		.230	.046	56.59	<.001	.06
Brooding	.13***					
Reflection	.13***					
Step 3: PANRS		.309	.079	60.46	< .001	.11
Positive Rumination	−.12**					
Negative Rumination	.36***					
Depression						
Step 1: RPA		.268	–	115.62	<.001	.37
Emotion-focus	−.07*					
Dampening	.48***					
Self-focus	−.16***					
Step 2: RRS		.296	.029	79.75	<.001	.04
Brooding	.07*					
Reflection	.13***					
Step 3: PANRS		.397	.100	88.72	< .001	.17
Positive Rumination	−.16***					
Negative Rumination	.40***					

$N = 927$. * $p < .05$. ** $p < .01$. *** $p < .001$

Fig. 1 Z scores of PANRS rumination types for college students (**a**) and school students (**b**)

a

	Adaptive type	Maladaptive type	Non-rumination type
□Positive Rumination	0.84	-0.08	-0.9
■Negative Rumination	-0.52	1.33	-0.39

b

	Adaptive type	Maladaptive type	Non-rumination type
□Positive Rumination	1.03	-0.3	-0.72
■Negative Rumination	-0.55	1.55	-0.45

Descriptive Statistics, Reliability, and Construct Validity

Correlations for the PANRS scales are presented in Table 7. As the table shows, scores for two positive rumination subscales (i.e., Enjoy Happiness and Positive Coping) were found to be positively associated with each other and so were the scores for three negative rumination subscales (i.e., Suppress Happiness, Self Deny and Negative attribution). The positive rumination subscales were found to be negatively and significantly associated with the negative rumination subscales. As the table also shows, the five first-order subscales and the 2 s-order subscales were found to have satisfactory internal consistency (Cronbach's α = .68 ∼ .84). We examined the test-retest stability of the PANRS by examining scores of 83 students across a 4-week time period. Results of this analysis indicated medium to high test-retest associations for all the subscales ($r = .68 \sim .88$, all $p < 0.001$, see Table 7). Taken together, these results offer adequate support for the internal consistency and test-retest reliability of the PANRS scales for school students.

To evaluate the construct validity of the PANRS, we examined the associations between the PANRS subscales with psychological outcome variables (i.e., life satisfaction, optimism, loneliness, depression, and learning stress). Results of computing correlations between these measures are presented in Table 8. As this table shows, we found evidence for convergent validity. That is, scores on the positive rumination subscales of the PANRS were found to be positively and significantly associated with scores on the positive outcome variables (i.e., life satisfaction and optimism), and negatively and significantly or non-significantly associated with scores on the negative outcome variables (i.e., loneliness, depression and learning stress). Furthermore, scores on the negative rumination subscales of the PANRS were found to be negatively and significantly associated with scores on the positive measures while they are positively and significantly associated with scores on the negative outcome variables.

Furthermore, we conducted a two-step cluster analysis to identify different types of ruminative persons using the same procedures in Study 1. The first large agglomeration coefficient increase (37%) occurred when three clusters were combined into two, and the k-means analysis classified the participants into adaptive type (high positive rumination and low negative rumination; $n = 242$), maladaptive type (low positive rumination and high negative rumination; $n = 217$), and non-rumination type (low positive rumination and low negative rumination; $n = 258$; Fig. 1B for the z scores of each group).

Table 6 Means and standards by rumination types

	Adaptive type (n = 377)		Maladaptive type (n = 243)		Non–rumination type (n = 333)		F	η^2
Positive rumination	3.26[a]	0.29	2.82[b]	0.38	2.42[c]	0.29	614.39	.56
Negative rumination	1.85[a]	0.33	2.80[b]	0.35	1.91[a]	0.28	740.53	.61
Life satisfaction	4.81[a]	1.08	3.85[b]	1.28	4.07[b]	1.11	64.23	.12
Optimism	2.80[a]	0.53	2.16[b]	0.55	2.34[c]	0.50	133.11	.22
Anxiety	2.09[a]	0.73	2.90[b]	0.94	2.12[c]	0.66	97.38	.17
Depression	1.58[a]	0.55	2.44[b]	0.90	1.81[c]	0.61	122.54	.21
Emotion-focus	2.80[a]	0.53	2.44[b]	0.59	2.23[c]	0.50	103.33	.18
Dampening	2.01[a]	0.52	2.77[b]	0.60	2.08[c]	0.48	168.90	.26
Self-focus	2.90[a]	0.61	2.56[b]	0.72	2.16[c]	0.60	119.01	.20
Brooding	2.78[a]	0.58	3.06[b]	0.58	2.44[b]	0.52	88.51	.15
Reflection	2.62[a]	0.51	2.81[b]	0.60	2.28[b]	0.53	64.12	.12

$N = 953$. All mulitivariate F tests were significant at $p < .001$. F tests for the variables were based on df = 2, 953. Values with different superscripts indicate significant within–row differences between the clusters using Tukey post–hoc comparisons, significant at $p < .017$ (.05/3, Bonferroni adjustment)

No significant sex distribution differences (χ^2 (2, $n = 718$) =1.13, $p > .05$) were observed across these groups.

The psychological outcome variables were compared across these groups by using Tukey's HSD post hoc comparisons. The results are presented in Table 9. As the table shows, adaptive group reported higher levels of life satisfaction and optimism, and lower levels of loneliness, depression and learning stress as compared with the other groups. Overall, adaptive group have the highest level of psychological adjustment whereas maladaptive group has the lowest level of psychological adjustment.

To examine the age trends for positive and negative rumination, we combined the school sample with the college sample ($n = 1671$) and conducted regression analyses using grade as a predictor. The results showed that grade had significant positive prediction on both positive rumination ($\beta = .09$, $t = 3.51$, $p = .000$) and negative rumination ($\beta = .16$, $t = 6.62$, $p = .000$).

Brief Discussion

The results of Study 2 confirmed the two-factorial second-order structure of the PANRS among school students by means of exploratory and confirmatory factor analysis. Furthermore they provided further support for the differential validity of the PANRS's subscales. Positive Rumination showed positive correlations with positive psychological outcomes (life satisfaction and optimism) and negative correlations with negative psychological outcomes (loneliness, depression and learning stress). In contrast, Negative Rumination showed negative correlations with positive psychological outcomes while showing positive correlations with negative psychological outcomes. The three types of rumination showed significant differences regarding psychological adjustment. The findings provide further evidence that Positive Rumination captures adaptive aspects of rumination whereas Negative Rumination captures negative aspects of rumination.

Table 7 Correlations and Reliabilities for the Positive and Negative Rumination Scale (PANRS) among School Students

	1	2	3	4	5	6	7	8
1. Enjoy Happiness	–							
2. Suppress Happiness	−.26[***]	–						
3. Self Deny	−.32[***]	.32[***]	–					
4. Positive Coping	.35[***]	.09[*]	.08	–				
5. Negative Attribution	−.23[***]	.51[***]	.50[***]	−.08[*]	–			
6. Positive Rumination	.83[***]	−.11[**]	−.20[***]	.82[***]	−.10[*]	–		
7. Negative Rumination	−.34[***]	.76[***]	.78[***]	.03	.83[***]	−.19[***]	–	
8. Total	.35[***]	.61[***]	.41[***]	.57[***]	.66[***]	.56[***]	.70[***]	–
Cronbach's α	.84	.75	.73	.68	.75	.81	.84	.72
Test-retest correlation	.88	.81	.72	.80	.68	.87	.78	.79

$N = 718$ for correlations and α, 83 for test-retest R

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

Table 8 Correlations between positive and negative rumination scale (PANRS) subscales and study measures among school students

	Enjoy Happiness	Suppress Happiness	Self Deny	Positive Coping	Negative Attribution	Positive Rumination	Negative Rumination	Total
1. Life satisfaction	.46***	−.22***	−.34***	.23***	−.27***	.42***	−.35***	.03
2. Optimism	.39***	−.36***	−.38***	.16***	−.35***	.34***	−.36***	−.14
3. Depression	−.36***	.31***	.58***	−.12**	.44***	−.30***	.56***	.19***
4. Lonliness	−.34***	.25***	.56***	−.11**	.38***	−.28***	.51***	.23***
5. Learning stress	−.41***	.27***	.48***	−.24***	.38***	−.39***	.48***	.10**

$N = 718$. EH =; SH =; SD =; PC =; NA =; PR =; NR =

** $p < .01$. *** $p < .001$

General Discussion

The present studies describe the development and preliminary validation of the Positive and Negative Rumination Scale (PANRS), a brief multidimensional measure of rumination based on the 2 (positive and negative rumination) × 2 (positive and negative emotion) model. Exploratory and confirmatory factor analyses indicated that the 23 items of PANRS form five factors, which form two distinct second-order subscales: Positive and Negative Rumination. When the subscales' relations with measures of response to positive affect, psychological outcomes were examined, results across studies showed a highly differential pattern of relations for the 2 s-order subscales. Positive Rumination showed positive correlations with emotion-focused and self-focused positive rumination, life satisfaction and optimism. In addition, it showed negative correlations with dampening, anxiety, depression, loneliness, and learning stress.

In contrast, Negative Rumination showed negative correlations with emotion-focused and self-focused positive rumination, life satisfaction and optimism. In addition, it showed positive correlations with dampening, anxiety, depression, loneliness, and learning stress.

Of note, cluster analyses showed that adaptive type has higher level of psychological adjustment than non-rumination type, whereas non-rumination type has higher level of psychological adjustment than maladaptive type. In addition, regression analyses showed that rumination, especially negative rumination, increases from childhood to adulthood. The overall pattern of correlations and three group differences regarding psychological adjustment suggest that the 2 s-order subscales have differential validity capturing different aspects of rumination: Whereas Positive Rumination captures only positive aspects; Negative Rumination captures mainly negative aspects.

Table 9 Means and standards by rumination types for school students

	Adaptive type (n = 242)		Maladaptive type (n = 217)		Non–rumination type (n = 258)		F	η^2
Positive rumination	3.27[a]	0.32	2.57[b]	0.40	2.35[c]	0.31	479.48	.57
Negative rumination	1.70[a]	0.36	2.56[b]	0.35	1.75[a]	0.27	492.76	.58
Life satisfaction	5.06[a]	1.14	3.84[b]	1.28	4.21[c]	1.16	65.02	.15
Optimism	2.71[a]	0.58	2.02[b]	0.62	2.38[c]	0.53	82.06	.19
Loneliness	1.52[a]	0.64	2.45[b]	0.89	1.84[c]	0.70	90.22	.20
Depression	1.41[a]	0.53	2.26[b]	0.86	1.66[c]	0.59	97.85	.22
Learning Stress	2.42[a]	0.67	3.28[b]	0.63	2.88[c]	0.65	100.16	.22

$N = 718$. All mulitivariate F tests were significant at $p < .001$. F tests for the variables were based on df = 2, 718. Values with different superscripts indicate significant within–row differences between the clusters using Tukey post–hoc comparisons, significant at $p < .017$ (.05/3, Bonferroni adjustment)

The PANRS provides for a multidimensional assessment of rumination in the tradition of previous theory and research on either positive or negative rumination that has shown that rumination is best understood when multidimensional measures of rumination are used and both positive and negative aspects are considered. With this the PANRS fills an important gap in the canon of rumination measures because it focuses on not only the positive and negative response to positive affect, but also the positive and negative response to negative affect. Moreover, because it is a measure capturing positive and negative aspects, it goes beyond the previously published studies using measures of rumination that did not differentiate positive and negative aspects and thus found rumination to be mainly maladaptive (e.g., Chang et al. 2010; Nolen-Hoeksema and Morrow 1991). The same, however, holds for the PANRS total score which also does not differentiate positive and negative aspects and showed high correlations indicative of psychological maladjustment, that is, positive correlations with negative characteristics (e.g., depression) and non-significant or very low positive correlations with positive characteristics (e.g., life satisfaction, optimism). Consequently, we advise against using the PANRS total score and urge researchers to examine only the subscale scores, especially Positive and Negative Rumination, when using the PANRS to investigate rumination.

Strengths, Limitations, Future Studies

The present studies have a number of strengths. First, when two studies are taken together, the development and preliminary validation of the PANRS is based on data from over 1671 participants. Therefore it can be expected that the present findings have a broad and robust empirical base. Second, when the PANRS was used among school students, the PANRS showed a comparable factor structure, the PANRS subscales a comparable pattern of differential relations and the three rumination types a comparable pattern of differential psychological adjustment. Moreover, the positive and negative rumination measured by the PANRS showed increase from childhood to adulthood. Consequently it can be assumed that the PANRS is an instrument that is not restricted to young adults, but may be useful across different age groups. Third, the present studies used a broad range of measures when investigating how the PANRS subscales were related to positive and negative psychological outcomes. Thus, it can be assumed that the evidence displayed in the present pattern of findings is not restricted to specific measures, but are generalizable across various measures of the constructs of interest.

The present studies also have a number of limitations. First, all studies used students as participants who were teenagers and young adults. Consequently, future studies need to demonstrate that the present findings generalize to different samples, for example, young adults who are not attending university, older adults, or clinical samples. Importantly, future studies need to find out if there are changes for positive and negative rumination from young adults to elders. Moreover, future studies should investigate the ability of the PANRS to successfully differentiate between mentally healthy and unhealthy individuals and between different forms of psychopathological problems in individuals who need treatment. Second, except for the test-retest study with Sample 3, all studies were cross-sectional. Therefore, the findings do not provide any indication of the effects that rumination may have on people's psychological adjustment. Therefore, longitudinal designs are required in future studies to examine if the PANRS has predicative power on changes in people's behavior and psychological adjustment over time. Moreover, future studies need to employ experimental manipulations of positive and negative life events or emotions to investigate if the PANRS is sensitive to detect *changes* in rumination.

Conclusions

Whereas the present findings need to be replicated and expanded in future studies, our studies provide substantial preliminary evidence for the usefulness of PANRS to capture positive and negative aspects of rumination about both positive and negative emotions, and we hope that much needed research on rumination will be conducted to further our understanding of its antecedents, concomitants, and consequences.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were approved by the Research Committee of Psychology and Behavioral Sciences at Zhejiang University.

Conflict of Interest   We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

Grant   Hongfei Yang has received a grant from Zhejiang Provincial Philosophy and Social Science Research Program of China (17NDJC198YB) and a grant from Humanities and Social Sciences of Ministry of Education Planning Fund (17YJA1900144).

Consent Form

Dear Participant,

This study—which is part of a research project funded by Zhejiang Provincial Philosophy and Social Science Research Program of China (17NDJC198YB) and Humanities and Social Sciences of Ministry of Education Planning Fund (17YJA1900144).—aims to develop a rumination scale and investigates the relationship between rumination and psychological adjustment. To participate in this study, you will be required to do one of the following sub-studies:

1. To have an interview with a researcher talking about your experience of rumination.

2. To complete an open questionnaire that contains questions regarding your rumination.

3. To complete an open questionnaire that contains questions regarding your rumination and psychological adjustment.

Important! All participants will help us to do the study without any compensation.

Your participation is completely voluntary and confidential and you have the right to withdraw at any time during the study.

This consent form will be separated from the questionnaire.

Please tick all 4 boxes if you would like to participate in the study.

1. I Confirm that I have read and understand the information sheet for the above study and have the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐

3. I am a student at _____ ☐

4. I agree to take part in the above study ☐

Your name: _____

Your signature: _____ Today's date: _____

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