Cognitive reactivity: Structure and validity of the LEIDS-R

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Abstract

Background:

The Leiden Index of Depression Sensitivity (LEIDS) was developed to measure cognitive reactivity (CR). CR is the ease with which maladaptive cognitions become reactivated during a low mood. The scale can distinguish between previously depressed and never-depressed individuals. The LEIDS was later revised (LEIDS-R, containing 34 items and 6 subscales) and has been used extensively in depression literature.

Aim:

The current study aimed (1) to examine and validate the six-factor structure of the LEIDS-R, (2) to investigate and compare alternative factor structures for the items and (3) to test the predictive validity and internal consistency of the scale.

Methods:

Data from the Netherlands Study of Depression and Anxiety (NESDA; N = 1696; M_{age} = 42.86, SD = 13.61) were used in exploratory factor analysis (EFA) and models were verified in an independent student sample (N = 811; M_{age} = 20.95, SD = 3.62) using confirmatory factor analysis (CFA).

Results:

Results from the CFA showed that the model fit and factor loadings of the LEIDS-R six-factor structure were satisfactory (RMSEA = .063, TLI = .923, and CFI = .930). Removal of 4 poor items (30-items; LEIDS-30-R) in an EFA yielded a five-factor structure showing the best model fit, which was found to be slightly superior to the original LEIDS-R factor structure. Higher scores in both the LEIDS-R and the LEIDS-30-R were associated with a history of depression.

Conclusion:

The LEIDS-R showed good psychometric properties. As an improvement to the scale, a slightly modified version (LEIDS-30-R, comprised of five subscales) is now recommended for future research when measuring cognitive reactivity.

Cognitive reactivity: structure and validity of the LEIDS-R

Major depressive disorder (MDD) is considered a chronic, lifelong psychiatric mood disorder (Richards, 2011) due to the high risk of relapse (Hardeveld, Spijker, De Graaf, Nolen, & Beekman, 2013; Jarret et al., 2000; Mueller & Leon, 1999). For this reason, it is essential to identify the risk factors that contribute to the development and maintenance of MDD. Cognitive models of depression show how dysfunctional cognitions (i.e. beliefs, attitudes, or schemas), such as “I made a mistake, therefore I am a failure,” can act as a risk factor of MDD (Beck, 1967; Clark & Beck, 1999).

Early research showed that psychologically-focused and biologically-based treatment can “freeze” negative beliefs (Simons, Garfield, & Murphy, 1984). Building upon this research, Teasdale (1988), in his *differential activation* hypothesis, and Miranda and Persons (1988), in their *mood state hypothesis*, amended cognitive models to state that negative cognitions remain latently present in individuals even when depressive symptoms are in remission. Research shows support for the latent presence of these negative cognitions, even in a remitted state, as they are more likely to be re-activated during naturally-occurring or experimentally-induced sad moods (Hollon, DeRubeis, & Evans, 1987). The ease with which these latent negative cognitive attitudes can be reactivated by mild dysphoria is called cognitive reactivity (Teasdale, 1988; Segal, Gemar, & Williams; 1999). Recovered-depressed individuals tend to show higher cognitive reactivity than never-depressed individuals (Hedlund & Rude, 1995; Miranda, Persons, & Byers, 1990; Miranda & Persons, 1988; Miranda, Gross, Persons, & Hahn, 1998; Scher et al., 2005). Differences in information processing (e.g. overgeneralized thinking, selective abstraction, absolutistic thinking) between recovered-depressed and never-depressed individuals during sad moods may be at the root for the maintenance of these negative beliefs (Teasdale & Dent, 1987; Ingram, Bernet, & McLaughlin, 1994).

Cognitive reactivity has been traditionally measured using two parallel forms of the Dysfunctional Attitudes Scale (DAS; Weissman, 1979), which are administered before and after a sad mood induction (Segal et al., 1999; Miranda et al., 1998). Segal et al., (1999) showed strong support for the causal impact of cognitive reactivity on the recurrence of depression. Recovered-depressed individuals experienced an increase in dysfunctional cognitions after an experimental sad mood induction, and this cognitive reactivity was predictive of depressive relapses at one-year follow-up. In another prospective study, a sample of remitted outpatients were followed over an 18-month period and Segal et al., (2006) showed that higher levels of cognitive reactivity were associated with a higher risk of relapse, especially in those individuals receiving antidepressants. Several studies have shown that individuals with many dysfunctional beliefs are at an increased risk of depression relapse (Bockting et al., 2006; Jarret et al., 2012; Lewinsohn, Allen, Seeley, Gotlib, 1999; Otto, Teachman, Cohen, Soares, Vitonis, & Harlow, 2007; Ten Doesschate, Bockting, Koeter, & Schene, 2010).

The Leiden Index of Depression Sensitivity (LEIDS; Van der Does, 2002) was a scale developed to measure cognitive reactivity by circumventing the mood induction procedure. The LEIDS can be used without a mood induction and without the necessity to statistically control for possible artifacts of using two parallel forms of a scale which is necessary when using the DAS. This is an advantage since the parallel DAS forms may not be interchangeable, necessitating statistical correction for order of administration (Segal et al., 1999). Furthermore, mood changes tend to be difficult to induce and those induced in the laboratory tend to be brief (Martin, 1990). Instead, prior to answering items, participants filling out the LEIDS-R are instructed to recall a situation when they felt sad (or imagine a future occasion) and then rate how well they were able to imagine this situation (i.e. well, somewhat, or not at all). Similar to the Anxiety Sensitivity Index (ASI; Peterson & Reiss, 1992), each subsequent item on the questionnaire is conditionally phrased with “When in a sad mood…” or “When I feel down…” to remind the participant to continue to recall the sad mood. The LEIDS was later revised and expanded (LEIDS-R; Van der Does & Williams, 2003, unpublished). Since then, the scale has been in use with six subscales, based on a factor analysis of a 49-item version in a sample of N = 500, which in unpublished.

The LEIDS-R has been used extensively in cognitive reactivity literature. The scale can distinguish recovered-depressed individuals from those with no history of depression (Van der Does, 2005; Booij & van der Does, 2007; Kruijt et al, 2013; Moulds et al., 2008; Antypa et al., 2009) and high scores on the total LEIDS-R have been shown to predict depression onset in healthy individuals, in a prospective study (Kruijt et al, 2013). The subscales of the LEIDS-R are also informative, as for instance, recovered depressed individuals score higher than never-depressed individuals on the rumination subscale (Moulds, et al., 2008) and irritable and non-irritable depressed patients can be distinguished using the aggression subscale of the LEIDS-R (Verhoeven et al., 2011). Furthermore, higher scores of hopelessness and aggression reactivity were found in recovered depressed individuals with history of suicide attempts, in comparison to a non-suicidal recovered depressed group (Antypa et al., 2009). In another study, the relationship between neuroticism traits and current symptoms of depression was mediated by hopelessness reactivity in participants with a history of depression, indicating that neuroticism may increase the chance of relapse through the reactivation of cognitions related to hopelessness (Barnhofer & Chittka, 2010). Moreover, cognitive reactivity using the LEIDS-R has been shown to be associated with genetic vulnerability factors of depression, such as variations in the serotonin transporter gene (Antypa & van der Does, 2010), and in the monoamine oxidase A (MAOA) gene (Verhoeven et al, 2012). The LEIDS-R also predicted the depressive response to a serotonergic manipulation (tryptophan depletion) in remitted depressed individuals (Booij & van der Does, 2007). These studies underscore the use of cognitive reactivity using the LEIDS-R as a psychological vulnerability marker of depression, which also correlates with known biological factors.

Although several studies have shown support for the validity of the LEIDS-R, the precise psychometric properties of the LEIDS-R remain to be assessed. Therefore, the aim of the current study was three-fold: (1) to examine and validate the six-factor structure of the LEIDS-R developed and revised by Van der Does & Williams (2003), (2) to investigate and compare alternative factor structures using exploratory factor analysis (EFA), and (3) to test the predictive validity and internal consistency of the original and alternative factor structures. We aimed to verify the results using confirmatory factor analysis (CFA) in an independent student sample. Concerning predictive validity, we expected higher scores on the scale to be associated with a history of depression, in line with the differential activation hypothesis.

Method

Participants

The present report includes a large cohort study sample (Sample 1) and one university sample (Sample 2). In sample 1, participants were selected from the Netherlands Epidemiological Study of Depression and Anxiety (NESDA), a large, longitudinal cohort study with the aim of determining the factors involved in the development and maintenance of depression and anxiety disorders (Penninx et al., 2008). The NESDA sample included a cohort of 2,981 individuals (18 – 65 years of age) who were recruited from three locations in the Netherlands: 564 from the community, 1610 from primary care clinics, and 807 from mental health care organizations. At baseline, participants had either (1) a current or lifetime diagnosis of depression or anxiety or (2) no history of a depressive or anxious episode. During the study, participants completed a four-hour test battery at one of the research sites and additional questionnaires at home (Penninx et al., 2008). The cohort was then followed for eight years. Further detailed information regarding the rationale, methods, and procedure is described by Penninx et al. (2008).

The following participants in sample 1 were excluded: those with a current diagnosis of MDD (*n* = 1115); those who did not return the questionnaire (*n* = 164); those who returned the LEIDS-R questionnaire but did not complete any items (*n* = 4); and those who completed few items (*n* = 2). Those with a current MDD were excluded since it is uncertain how the questionnaire functions in an acutely depressed sample. We therefore only included individuals recovered from depression (not fulfilling criteria for MDD in the last 6 months) and individuals with no history of psychiatric disorders (i.e. healthy controls). This group would ensure a broad range of cognitive reactivity levels in the sample. The final sample included 1696 participants (male = 557, female = 1139; M_{age} = 42.86, *SD* = 13.61).

Sample 2 consisted of students of European ancestry who were recruited at various sites at Leiden University by means of advertisements (sample 2). The sample included 899 students (17 - 45 years of age). In the current report, the sample was used to cross-validate the factor structure of the LEIDS-R. Participants who had not completed any items on the LEIDS-R (*n* = 14) and those likely to have had an acute depressive disorder during the study period (score ≥ 8 on the Hospital Anxiety and Depression Scale; *n* = 74) were excluded from the sample. The final sample contained 811 participants (male = 185, female = 626; M_{age} = 20.95, *SD* = 3.62).

Measures

Cognitive Reactivity. Cognitive reactivity was measured with the Leiden Index of Depression Sensitivity Revised (LEIDS-R, Dutch language; Van der Does, 2002; Van der Does & Williams, 2003; Williams et al., 2008). The LEIDS-R is a 34-item self-report measure with six subscales: Hopelessness / Suicidality (HOP; “*When I feel sad, I feel as if I care less if I lived or died*.”), Acceptance / Coping (ACC; “*When I am in a sad mood, I am more creative than usual*.”), Aggression / Hostility (AGG; “*When I feel bad, I feel more like breaking things*.”), Control / Perfectionism (CON; “*When I feel somewhat depressed, I think I can permit myself fewer mistakes*.”), Risk Aversion (RAV; “*When I feel sad, I feel less inclined to express disagreement with someone else*.”), and Rumination (RUM; “*When I feel sad, I have more problems concentrating*.”). Participants rate the extent to which each statement applies to them on a five-point Likert scale (0 = not at all; 1 = a bit; 2 = moderately; 3 = strongly; and 4 = very strongly). Assuming an equivalent metric interval between scores, the total score is obtained by summing item responses. A higher total score indicates stronger cognitive reactivity. The highest possible total score on the LEIDS-R is 136.

Depression. Two instruments were used to measure depression in the two samples. In sample 1, trained clinical research staff used the lifetime Composite International Diagnostic Interview (CIDI-WHO, version 2.1; Wittchen et al., 1988) to diagnose the depressive (i.e. MDD and dysthymia) and anxiety (i.e. panic disorder, social phobia, generalized anxiety disorder, agoraphobia) disorders. The CIDI has shown acceptable interrater (Wittchen et al., 1991) and test-retest reliability (Romera, et al., 2002), and high validity for depressive and anxiety disorders (Andrews & Peters, 1998; Kessler, Wittchen, Abelson, Kendler, Knauper, & Zhao, 1998; Romera et al, 2002; Wittchen, 1994).

In sample 2, the Hospital Anxiety and Depression Scale (HADS) was administered to assess depressive and anxiety disorders. A cut-off score (≥ 8) was used to indentify participants with a current depressive disorder. Using this criterion, the mean specificity is 0.79 and the mean sensitivity for case detection is 0.83, as reported by Bjelland et al. (2002).

Statistical Analyses

STEP 1: To examine the model fit of the original six-factor structure of the LEIDS-R, CFA for ordered categorical data was conducted in MPLUS version 7.2 using sample 1 (Muthen & Muthen, 2012). The estimation of the parameters in the factor models was performed using Weight Least Squares Means and Variance adjusted (WLSMV), the default estimator available in MPLUS for ordinal data (Muthen, Toit, & Spisic, 1997).

STEP 2: To investigate alternative models, the descriptive data and Oblimin-rotated principal component analysis (PCA) using 6 factors on IBM SPSS Statistics version 20 (IBM Corp., Armonk, NY) were investigated as a preliminary step. EFA was conducted in MPLUS 7.2 using the default oblique Geomin rotation. To determine the number of factors to be retained, eigenvalues (Guttman, 1954), scree plots (Cattell, 1996), parallel analysis results (PA; Horn, 1965; Glorfeld, 1995), and lowest minimum average partial correlations by means of Velicer's Minimum Average Partial test (MAP; Velicer, 1976) were examined. On the basis hereof, several EFA models were selected to be estimated and inspected in more detail. PA for categorical data was conducted using the polychoric correlations matrix package in *R* version 3.1.1 (The R Foundation for Statistical Computing Platform, 2014). This analysis also provided the MAP data. MAP is considered to be the most accurate method for choosing how many factors to retain, although it can underfactor in some conditions, such as in the case of poor factor loadings (<.30), larger number of factors in the population, and stronger correlation among factors (Warne & Larsen, 2014). PA is sensitive to sample sizes and large number of observed variables (>30), which can lead to overfactoring (Warne & Larsen, 2014).

CFA was subsequently conducted in sample 2 to confirm the model fit of the selected structures (from the EFA) for their similarity in observed and expected covariance matrices. The variance of the factors was set to 1 to set the metric of the latent variables.

EFA models were evaluated by examining the model fit statistics, residual correlations (i.e. > .10 and > .20 in absolute value), number of factor loadings per factor, pattern of strong and weak factor loadings, underlying conceptual meaning of the factors, and inter-factor correlations. CFA models were evaluated by investigating residual correlations (i.e. > .10 and > .20 in absolute value, presented as a percentage out of 561 unique correlations), model fit indices, modification indices, factor loadings, and factor correlations. The model fit indices used to evaluate all models were the root-mean-square error of approximation (RMSEA; Steiger, 1990), the standardized root-mean-square residual (SRMR; Bentler, 1995), Comparative Fit Index (CFI; Bentler, 1990), and the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973). For the RMSEA and SRMR, a score of ≤ .08 and ≤ .05, respectively, were considered indicative of an acceptable and good model fit (Hu & Bentler, 1999; McCallum, Browne, & Sugawara, 1996). Values ≥ .95 on the CFI and TLI were considered to be representative of good model of fit. Values between .90 and .95 were considered acceptable (Hu & Bentler, 1999). Poor factor loadings were also inspected. Although a criterion of <.50 was used, factor loadings of at least .21 can be statistically meaningful for samples of at least 600 (Field, 2009; Guadagnoli & Velicer, 1988).

Whereas previous analysis (Van der Does, 2002) has used PCA, the current report focuses on EFA and CFA. While both techniques are used to reduce the number of variables and are based on a linear model, there are differences between PCA and factor analysis. PCA aims to optimize the total variance by directly investigating the best fit in linear low-level dimensional subspace and ranking factors by importance using their corresponding eigenvalues. EFA and CFA, on the other hand, are linear-model techniques that are used to model the relationships among observed variables by finding the smallest number of interpretable factors (i.e. latent variables) needed to explain the correlations or covariances among these observed variables (Flora, LaBrish, & Chalmers, 2012). EFA and CFA therefore groups items that measure similar constructs (Klinke, Mihoci, & Härdle, 2010). The difference between EFA and CFA is that in EFA, the researcher does not know beforehand exactly how the observed variables will fit into the factors, and in CFA, the researcher hypothesizes the model *a priori* (Flora, LaBrish, & Chalmers, 2012). In MPLUS, EFA is based on the correlation matrix (Klinke, Mihoci, & Härdle, 2010).

STEP 3: On the basis of a) item descriptive statistics, b) item loadings per factor of each model, and c) theoretical interpretability of the items with their respective factors, items were selected for removal from the questionnaire. To test the fit of the abbreviated and alternative-structure of the LEIDS-R, a second CFA using sample 2 was conducted to cross-validate the findings. The variance of the factors was set to 1 to set the metric of the latent variables.

STEP 4: The predictive validity of the alternative model to discriminate between individuals with and without a history of depression was explored using correlations in sample 1 (34- and 30-item total LEIDS-R scores and subscales X lifetime depression diagnosis, where 1 = no depression history, 2 = history of lifetime depressive disorder). A two-tailed independent samples *t*-test, $p < .05$, was also conducted to check mean test scores for participants with and without a history of depression. We then examined the predictive value of each subscale by comparing the correlations of the corrected total scores of the LEIDS-R by depression history to the correlation using the uncorrected total score by depression history. Spearman's rho was used for all correlations. Internal consistency of the subscales was tested using reliability analysis. The aforementioned analyses were conducted in IBM SPSS Statistics version 20 (IBM Corp., Armonk, NY).

Results

Missing Data

In sample 1, 68 participants had missing item scores on one to four items. Most participants had one missing item score (n = 55) and a few had two or four missing items on the questionnaire (n = 13). No participants completed fewer than 30 items. Items 7 ("*In a sad mood, I do more things that I will later regret*"), 12 ("*When I feel somewhat depressed, I think I can permit myself fewer mistakes*"), and 15 ("*When I feel down, I have a better intuitive feeling for what people really mean*") had between 7 or 8 missing values for all participants. Missing values were not replaced. No data were missing in sample 2.

Statistical Assumptions

Most of the assumptions to conduct EFA and CFA were met (Field, 2009; Suhr, 2006; Wirth & Edwards, 2007). First, the datasets were randomly sampled, did not contain too many missing data, and the two samples were sufficiently large. According to Field (2009), there should be at least 10-15 participants per item in the questionnaire. This indicates that there should be at least 340 participants in the sample.

Moreover, the analyses use ordered polytomous data. When conducting factor analyses using ordered-categorical data, one typically assumes that the item responses are discrete representations of continuous latent constructs with severity parameters denoting the point where each response category is separated from one another (Withers & Edwards, 2007). This means that most researchers treat ordinal variables (with 5 or more categories) as continuous, without any significant impact on the results (Newsom, 2012). Additional statistical assumptions is that the indicators are multivariate normally distributed. MPLUS does not have multivariate normality tests (Newsom, 2012) so the univariate distributions were inspected. Using the criteria that skewness is > 2 (in absolute value) or kurtosis is > 7 in absolute value (Kim, 2013), 10 of the 34 items were positively skewed, including items 4, 10, 18, 19, 24, 26, 28, 30, and 34. This indicates that these items were endorsed infrequently and most respondents responded with 0 = “Not at all” or 1 = “A bit”. These items were not transformed. Field (2009) discusses the two most important aspects for a reliable factor analysis are the absolute sample size and the magnitude of the factor loadings (as based on Guadagnoli & Velicer, 1988), where, for samples of at least 600, factor loadings of at least .21 can be statistically meaningful.

Psychometric Properties and Validation of the Original LEIDS-R

Confirmatory factor analysis. CFA was conducted to test the model fit of the original six-factor structure of the LEIDS-R (van der Does, 2002; van der Does & Williams, 2003). Examination of the residual correlations indicated that 13.90% were > .1, in absolute value. A small percentage, 2.14%, of item residuals was > .2, in absolute value, increasing our confidence in the results.

The model-fit indices of the six-factor structure indicated an acceptable fit for the data (RMSEA = .063, TLI = .923, and CFI = .930). Inspection of the modification indices revealed several problematic items, however, specifically items 5, 17, 19, 8, and 32, which cross-loaded on two or more factors. Allowing these items to load freely on multiple factors in a step-wise approach substantially improved the model fit to good levels (RMSEA = .050, TLI = .953, and CFI = .957).

Table 1 shows the inter-factor correlations of the six-factor structure in CFA. Notably, the six-factor structure had two strongly correlated factors (> 0.9), RAV and RUM, $r = .92$, suggesting these items most likely measure similar concepts. Similarly, the factor CON also correlated strongly with RAV, $r = .83$, and RUM, $r = .82$, respectively. The remaining inter-factor correlations ranged from .36 to .79, which were acceptable. As shown in **Table 2**, the analysis showed few poor item loadings (< 0.5) in the original six-factor model of the LEIDS-R with the exception of items 8 ("*go out and do more pleasurable activities*") and 19 ("*work harder*"), which loaded weakly, .02 and .34, respectively, on the factor CON.

To further examine the model fit of the original six-factor structure, two simplified models were formed on the basis of the inter-factor correlations. Factors RAV and RUM were combined to form one factor (i.e. RAVRUM) and factors RAV, RUM, and CON were combined into form one factor (i.e. RRC), resulting in five- and four-factor nested models. These CFA-derived models were used as competing models for comparison. All model fit indices showed an acceptable fit for the data. Compared to the four-factor (RMSEA = .067, CFI = .921, TLI = .915) and five-factor (RMSEA = .064, CFI = .927, TLI = .921) CFA-derived models, however, the model fit of original six-factor model was slightly better (RMSEA = .063, CFI = .930, TLI = .923). **Table 3** shows the results of the chi-square difference tests between the three nested models. The chi-square difference test checks whether the model fit of the less-restrictive is less optimal than the model fit of the more-restrictive model. Because the chi-square tests are significant for both comparisons, $p < .001$, the six-factor model fits the data better than the four- and five-factor nested models.

Internal consistency. The original six-factor structure of the LEIDS-R as a whole was strongly internally consistent, $\alpha = .92$. The subscales showed moderate to high internal consistency: ACC, $\alpha = .63$, CON, $\alpha = .65$, AGG, $\alpha = .79$, RAV, $\alpha = .81$, RUM, $\alpha = .82$, and HOP, $\alpha = .83$. For each subscale, the range of corrected item-total correlations indicated generally moderate correlations: ACC (.34 - .43), CON (.09 - .55), AGG (.44 – 65), RAV (.45 – 64), and RUM (.41 - .67). However, the lower item-total correlations in the CON subscale (e.g. .09) suggested poor items in this subscale. Item 8 was suspected as the poor item because the internal reliability of the subscale increased considerably when it was removed, $\alpha = .71$.

Predictive validity. The total LEIDS-R score also correlated moderately with depression status, r = .37, suggesting good predictive validity. The subscales, AGG, CON, RAV, HOP, and RUM, in order of increasing correlation, were moderately correlated with a history of depression, ranging from .24 to .36. The ACC subscale, however, correlated weakly with history of depression, r = .14. Alternating the removal of the subscales from the total test score (i.e. corrected subscales correlations) did not improve the test's ability to predict which individuals had a higher risk of being depressed (rs ranged from .36 to .38). This included removal of the ACC subscale, r = .37. All correlations were statistically significant, $p < .05$.

The average total LEIDS-R scores between previously-depressed participants (n = 772, M = 33.93, SD = 16.87) and never-depressed participants (n = 924, M = 21.19, SD = 15.29) were significantly different and in the expected direction, $t(1573) = -16.03$, $p < .05$, showing higher levels of cognitive reactivity in participants with a history of depression. Further post-hoc inspection of the mean total LEIDS-R scores by gender suggested no differences between men (M_{with} = 33.87, SD = 17.71, $M_{without}$ = 19.89, SD = 16.00) and women (M_{with} = 33.81, SD = 16.53, $M_{without}$ = 21.92, SD = 14.84) when correcting for depression history.

Examination of Alternative Factor Structures of the LEIDS-R

Data screening. Prior to conducting EFA, all items and descriptive statistics such as means and standard deviations were carefully investigated. The means for the items varied between 1.3 and 2.3. The inter-item correlation matrix showed poor to moderate correlations (range .18 - .53). Bartlett's Test of Sphericity indicated sufficient inter-item correlation to perform a factor analysis, χ^2 = 21833.15 (df .56), $p < .001$. None of the correlations in the data were > 0.9 indicating no threat of multicollinearity in the data (Field, 2009). The communalities for the items were retrieved from a six-factor PCA and were generally satisfactory. However the following items had low communalities (< .05), indicating that they would likely fit poorly in any factor model (Field, 2005): items 4 (.40; *"more creative than usual"*), 6 (.34; *"busy trying to keep images and thoughts at bay"*), 8 (.30; *"go out and do more pleasurable activities"*), 10 (.46; *"more helpful"),* 15 (.40; *"better intuitive feeling"),* 19 (.44*; "work harder"),* 24 (.38; *"feel more like myself"*), 26 (.48*; "do more risky things"*), 28 (.47; "*nicer than usual"*)*;* and 33 (.49*; "think how my life could have been different"*).

Exploratory factor analysis. EFA was conducted to investigate alternative models. The Guttman criterion (eigenvalue > 1 in absolute value) suggested a five-factor model (fifth factor = 1.144 and sixth factor = .994). Investigation of the scree plot (**Figure 1**) also appeared to support a five-factor model. While parallel analysis suggested an 11-factor solution, MAP supported a four-factor solution. The results of the parallel analysis may in part be due to the large sample size, which may lead to an overestimation of the number of factors (Warne & Larsen, 2014). The four-, five-, and six-factor model accounted for more than 50% of the total common variance: 57.24%, 60.60%, and 63.52% respectively. To compare several alternative models, EFA was performed using three-, four-, five-, and six-factor structures. The 11-factor solution was not further inspected because each factor would have very few items.

Model fit results. Table 4A shows the fit indices and the percentage of residual correlations > .1 (in absolute value) of the four models tested in EFA when using all 34-items. The theoretical concepts of the factors of the four EFA models were compared to the original subscales of the LEIDS-R, namely, Hopelessness / Suicidality (HOP); Acceptance / Coping (ACC); Aggression / Hostility (AGG); Control / Perfectionism (CON); Risk Aversion (RAV); and Rumination (RUM).

The model fit statistics of the three-factor solution were acceptable. However, the three-factor solution had a substantially higher percentage, 7.91%, of residual correlations in comparison to the other models. The number of item loadings per factor was unbalanced. Factor one included 16 items with distinct factor loadings from the original RAV (e.g. "*take fewer risks*"), RUM (e.g. "*more overwhelmed*"), and CON subscales (e.g. "*more time thinking about what my moods reveal about me*"). Factor two contained nine items from the AGG and HOP subscales and factor three contained five items with distinct factor loadings from the ACC and CON items. Considering factor interpretability, the combination of items in factor one did not result in a clear theoretical concept. Moreover, factors one and two were strongly correlated, r = .76. Factor three appeared to be unrelated to factors one and two, r = .016 and r = .018, respectively. The three-factor model was not further examined considering the indistinct theoretical interpretability of the first factor and the relatively poorer fit of the model in comparison to the other models.

The four-factor model showed a good model fit and a small percentage, 2.14%, of item residual correlations between .1 and .2 (in absolute value). Despite the good model fit, only three items loaded distinctly on factor three, an indicator of a poor model fit. Factor one, for example, contained 13 items with distinct factor loadings from the original RAV (e.g. "*avoid difficulties or conflict*"), RUM (e.g. "*more problems concentrating*"), CON (e.g. "*permit myself fewer mistakes*") and HOP (e.g. "*feel hopeless about everything*") subscales.

Factor two contained five items with distinct factor loadings from the ACC and CON subscales. Nine items cross-loaded on two factors and the model thus failed to show a simple structure. The underlying theoretical concepts behind three factors were difficult to interpret. In this model, the inter-factor correlations ranged from .17 to .56, which demonstrated acceptable correlations. However, this model was not optimal due to the item cross-loadings and unclear theoretical interpretability of the factors.

The model fit statistics of the five-factor model revealed an excellent model fit. There was a very small percentage, .89%, of inter-item residuals between .1 and .2 (in absolute value), indicating that this model reproduced the observed correlation matrix well. There were more than three distinct item loadings per factor, but seven items cross-loaded on two or three factors. For all the factors, the underlying concepts were clear. Four factors related conceptually and had items previously included in the original subscales of the LEIDS-R, including ACC, CON, HOP, and AGG. The remaining factor consisted of items from the RUM and RAV subscales and conceptually related to aspects of *avoidance coping* (AVC). Inter-factor correlations ranged from .23 to .55. The latent variables were thus moderately conceptually related.

The six-factor solution of the EFA had an excellent model fit according the model fit statistics. There were no inter-item residuals > .1 (in absolute value). Contrary to the model fit indices, the six-factor model contained two factors with only two distinct item loadings, indicating a generally poor model fit. Another factor contained items from the original RUM subscale and RAV subscale. The other three factors related to the original ACC, AGG, and HOP subscales. In general, seven items cross-loaded on two, three, or four factors. Inter-factor correlations ranged from .21 to .58, showing moderate associations between the latent variables. Considering the number of factors with few items and the cross-loadings, the six-factor model showed a poorer fit for the data and was not further examined.

Examination of an Abbreviated Version of the LEIDS-R

Removal of poor items. The LEIDS-R was examined for potentially poor items by examining the factor loading patterns in the EFA models with 4, 5, and 6 factors. The selected items, including items 1, 6, 8, and 33, were further examined for their theoretical compatibility with the corresponding factors, inter-item correlations, item-total correlations, residual correlations, item means, and communalities. Item **6** ("*more busy keeping images and thoughts at bay"*), item **8** ("*go out and do more pleasurable activities*"), and item **33** ("*think about how my life could have been different*") cross-loaded on more than one factor across three or more models in EFA. In comparison to the other poor items, items 6, 8, and 33 had the lowest range of inter-item correlations, residual correlations, means, and communalities, and were therefore deleted from the questionnaire. Item 1 was also selected for deletion because it failed to load clearly in any one factor in the five- and six-factor models, and it did not fit conceptually with the factors. The item wording of item 1 also deviated from the similar conditional formulation of other items: *I can only think positive when I am in a good mood.* For these reasons, item 1 was excluded.

Exploratory factor analysis. To investigate the factor structure of the LEIDS-R after removing items 1, 6, 8, and 33, four-, five-, and six-factor EFA models were estimated. **Table 4B** shows the standardized model fit indices of the four-, five-, and six-factor structures from the EFA using 30-items**.**

The four-factor model demonstrated a good model fit to the data. The factor structure of the models using 30-items was also similar to that of the model using 34-items. The number of items per factor was again unbalanced. The first factor contained 15 items, but factor three retained only three items. There were only three items with cross-loadings, items **17** ("*I think I can make no one happy*"), **24** ("*feel more like myself*"), and **26** ("*do more risky things*"), showing an improvement in the factor structure. Considering theoretical interpretability, factor two related to ACC, factor three related to HOP, and factor four related to AGG. Factors two and four were very similar to the ACC and AGG factors in the 34-item model. The underlying latent concept for factor one, however, was difficult to interpret as it contained items relating to avoidance, hopelessness, control, and rumination. The inter-factor correlations ranged from .16 to .55, similar to the 34-item model.

The five-factor model showed a good model fit for the data. The factor loading pattern, structure, and therefore theoretical interpretability remained the same in the 30-item model. Items **2** ("*take fewer risks*"), **12** ("*permit myself fewer mistakes*"), and **13** ("*more overwhelmed*") had bipolar factor loadings. The inter-factor correlations ranged from .15 to .55, similar to the 34-item model.

The six-factor model also had an excellent fit for the data and appeared to have a better fit than the five-factor model. However, the items loaded distinctly on only four of the six factors. Two factors contained no items. The remaining four factors were conceptually difficult to interpret. The inter-factor correlations of the six-factor model ranged from .01 to .53. Unsurprisingly, the two factors with no items correlated poorly with the other factors, range -.10 to -.04 and .01 to .26 with the fifth and sixth factors, respectively. Based on these results, we rejected the six-factor model.

Considering model fit indices, distribution of items into factors, and conceptual interpretation of the factors, the five-factor model was preferred over the four- and the alternative six-factor model. The newly revised 30-item, five-factor version of the LEIDS-R demonstrated a better fit for the data than the 34-item, five-factor version of the LEIDS-R.

Validation of EFA structure in NESDA and student sample

Confirmatory factor analysis (Sample 1, 34-items). The alternative models of the LEIDS-R, including the four- and five-factor solutions of the EFA, were further evaluated using CFA. In the four-factor solution, the model fit indices were representative of an acceptable model fit, the RMSEA = .060, CFI = .936, and TLI = .931. There was one weak item loading (< .50), item 8 = .106. The modification indices of item 8 indicated that it loaded on more than one factor. Freeing the parameters of item 8, however, slightly improved the model fit: RMSEA = .059, CFI = .939, and TLI = .934. To further improve model fit due to cross-loadings, the parameters of an additional eight items were freed in a step-wise approach: RMSEA = .050, CFI = .957, and TLI = .953. The inter-factor correlations ranged from .30 to .69, showing a moderate and acceptable conceptual relationship between the factors.

The five-factor model showed acceptable model fit: RMSEA = .060, CFI = .937, and TLI = .932. There was one weak item loading (< .50) in the model, item 8 = .119. Similar to the previous model, item 8 cross-loaded on more than one factor. Freeing the parameters of item 8 slightly improved the model fit: RMSEA = .058, CFI = .942, and TLI = .936. Checking the modification indices and freeing parameters in a stepwise approach for an additional three items (9, 30, and 34) improved the model fit to good levels: RMSEA = .050, CFI = .956, and TLI = .952. Freeing the parameters of fewer items than the four-factor model was necessary for a better model fit in the five-factor model. The inter-factor correlations ranged from .362 to .822, showing a moderate to high association between factors. The factors CON and RAVRUM, r = .82, and HOP and RAVRUM, r = .82, were highly correlated, suggesting that these factors measure similar concepts. Considering the model fit, the five-factor solution was marginally better than the four-factor solution. However, because the four-factor solution had one factor with three item loadings, the five-factor solution was favored.

The CFA of the original LEIDS-R six-factor model was previously discussed**. Table 5** shows the CFA factor loadings and standardized Cronbach's alpha scores, α, of the original six-factor structure and the alternative five-factor model. Most of the factor loadings and factor interpretations between the original six-factor structure and alternative five-factor structure were similar for the first four factors (i.e. ACC, AGG, HOP, and CON). There were a few differences between the two models. First, items 6, 8, 19, 32, and 33 loaded on other factors in the five-factor structure than the original six-factor structure. Second, the fifth factor of the five-factor structure combined most of the items from the two factors, RAV and RUM, from the original six subscales, creating a new factor. This factor contained items that related to the concept of avoidance coping, *AVC*. The reliability estimates for the five-factor, 34-item model were higher than those in the original six-factor model.

Confirmatory factor analysis (Sample 1, 30-items). Similarly, the abbreviated 30-item alternative models of the LEIDS-R, including the four- and five-factor solutions of the EFA and the original LEIDS-R structure, were also evaluated using CFA. Exclusion of items 1, 6, 8, and 33 slightly improved the model fit of the solutions. Similar to the 34-item solution, the 30-item four-factor showed an acceptable model fit, the RMSEA = .062, CFI = .940, and TLI = .935. There were no weak item loadings. The inter-factor correlations ranged from .29 to .67, showing a moderate and acceptable conceptual relationship between the factors.

The five-factor model also showed acceptable model fit: RMSEA = .060, CFI = .945, and TLI = .940. There were no poor item loadings in the solution, however, the modification indices showed that freeing the parameters of items 5, 17, and 24 in a stepwise approach led to a good model fit across all model fit indices: RMSEA = .050, CFI = .962, and TLI = .958. The inter-factor correlations ranged from .37 to .82, showing a moderate to high association between factors. The factors CON and RAVRUM, $r = .82$ and HOP and RAVRUM, $r = .78$, were less highly correlated than in the 34-item model. However the former correlation was still relatively high.

An abbreviated version of the original six-factor solution of the LEIDS-R was tested. While the model fit indices showed an acceptable model fit, it was less than that of the four- and five-factor alternative models: RMSEA = .064, CFI = .937, and TLI = .930. In this model, item 19 loaded weakly in the CON subscale, .339. The inter-factor correlations ranged from .36 and .92, where factors RUM and RAV were very strongly correlated, $r = .92$. This high correlation supported the use of a five-factor model, where the RUM and RAV subscales would be combined. The poorer model fit indices also supported the use of an alternative model. Considering the model fit, the five-factor solution was favored. Modification indices for the four- and six-factor models were not investigated.

Confirmatory factor analysis (Sample 2, 34-items). CFA was conducted in sample 2 to cross-validate the model fit of the original six-factor structure of the LEIDS-R and the alternative five-factor model in a different sample. We investigated the 34-item and also the new 30-item version entering the same alternative factor structures into the analysis as those from the EFA. **Table 6** shows the model fit indices of the two alternative models (four- and five-factor) and the original six-factor LEIDS-R model using the 34- and 30-items of the LEIDS-R.

Using all 34-items (**Table 6A**), the model fit indices generally showed a poorer fit for the data than that in sample 1. The model fit indices in sample 2 did not reach acceptable levels across all models. In the four-factor model, for example, the model fit was less than acceptable: RMSEA = .072, CFI = .844, and TLI = .832. Regarding the factor structure, the original RAV, RUM, and CON factors appeared to be combined into one factor, abbreviated as RRC. There were 10 poor item loadings (< .50) in the RRC (items 2, 6, 11, 14, 16, 31, and 32) and ACC (items 4, 8, and 19) factors. The inter-factor correlations ranged from .22 to .64, showing moderate and acceptable factor correlations.

In the five-factor solution, the model fit was no different than that of the four-factor solution and did not reach acceptable levels: RMSEA = .072, CFI = .845, and TLI = .832. The five-factor model had eight weak factor loadings across the RAVRUM (items 2, 11, and 14), ACC (items 4, 8, and 19), CON (item 32), and HOP (item 6) factors. The inter-factor correlations ranged from .18 to .76, showing moderate and acceptable factor correlations.

The model fit indices of the original six-factor LEIDS-R structure was poor in this sample: RMSEA = .074, CFI = .838, and TLI = .823. While the four-factor and five-factor models demonstrated a similar fit, it was a better than that of the original six-factor LEIDS-R structure. In the six-factor model, there were also 10 weak item loadings (< .50) across the factors of RAV (items 2, 6, 11, and 14), CON (items 8, 19, and 31), ACC (item 4), and RUM (item 32). There was a strong inter-factor correlation (≥ .9) between the factors RUM and RAV, r = .94, which was problematic. The other inter-factor correlations ranged from .19 to .81.

In general, item 8 fit poorly, showing negative and weak loadings, ranging from -.235 to -.091, across all models. This showed additional support for removing poor items from the questionnaire. Considering the model fit indices and the number of weak item loadings, the five-factor model was again favored.

Confirmatory factor analysis (Sample 2, 30-items). In the 30-item questionnaire, models generally improved when compared to the 34-item models (**Table 6B**). The TLI and CFI values, however, still indicated a generally poor model fit.

In the four-factor model, the model fit for the data did not reach acceptable levels: RMSEA = .074, CFI = .857, and TLI = .844. There were seven poor item loadings (< .50) in the RRC (items 2, 11, 14, 16, 31, and 32) and ACC (item 19) factors. The inter-factor correlations ranged from .18 and .61, showing moderate and acceptable factor correlations.

In the five-factor solution, the model fit did not reach acceptable levels. However the fit did improve in comparison to the four-factor model: RMSEA = .072, CFI = .865, and TLI = .852. The five-factor model had six weak factor loadings. Examination of the modification indices of the five-factor model indicated that the poor model fit could in part be due to items 5, 17, and 25. Using a step-wise approach in which these items were allowed to cross load, the model fit indices improved substantially but still did not reach acceptable levels: RMSEA = .064, CFI = .896, and TLI = .884. The inter-factor correlations ranged from .16 and .68, showing moderate and acceptable factor correlations.

In the six-factor model, model fit remained poor: RMSEA = .076, CFI = .852, and TLI = .834. There were also six weak item loadings (items 2, 4, 11, 14, 19, and 32). The inter-factor correlation between the factors, RAV and RUM, remained high, r = .81, but was lower than that in the 34-item, six-factor model, r = .94. **Table 7** shows the factor loadings of the alternative five-factor and the original six-factor models using the selected 30-items. In the five- and six-factor models, the same six items loaded weakly (< .50): including items 2 ("*take fewer risks*"), 4 ("*more creative than usual*"), 11 ("*less inclined to express disagreement*"), 14 ("*avoid difficulties*"), 19 ("*work harder*"), and 32 ("*think about the causes of my moods*").

Considering the model fit and inter-factor correlations, the five-factor model showed the best general fit for the data. The inspection of the modification indices showed that Sample 2 was generally a less optimal sample than Sample 1, explaining the generally poor model fit results in Sample 2.

Psychometric Properties of the Abbreviated Structure (30 items)

Internal consistency. The Cronbach's alpha scores of the factors in the five-factor (30-items) model showed moderate to high internal consistency: ACC, α = .66, CON, α = .75, AGG, α = .79, HOP, α = .83, and AVC, α = .88. The internal consistency of the total scale was high, α = .91, but was slightly less than that of the six-factor model and 34-item five-factor model. The subscales, however, were more internally consistent compared to the subscales of the six-factor structure.

Predictive validity. Using 30-items, most of the subscales (AGG, CON, HOP, and AVC) correlated moderately with a history of depression (*r*s ranged from .23 to .36) except the ACC subscale, which correlated weakly with depression status, $r = .15$. The total abbreviated LEIDS-R score also correlated moderately with depression status, $r = .37$, suggesting good predictive validity. Alternating the removal of the ACC, AGG, and CON subscales from the total test score did not improve the test's ability to predict which individuals were associated with depression history (*r*s ranged from .37 to .38). Removal of the HOP and AVC subscales somewhat affected the correlation, suggesting that these factors were the strongest of the factors in predicting depression status, $r = .36$ and .34, respectively. All correlations were statistically significant, $p < .05$.

The scores of the five subscales were also correlated with the number of lifetime depressive symptoms (using the CIDI-WHO). The results were similar to the previous analysis. The HOP and AVC subscales were the most related to depressive symptoms, $r = .42$ and .44, respectively. The other subscales, ACC, AGG, and CON, ranged from .22 to .36. All correlations were statistically significant, $p < .05$.

The average total LEIDS-R 30-item scores between previously-depressed participants ($n = 772$, $M = 29.29$, $SD = 15.26$) and never-depressed participants ($n = 924$, $M = 17.97$, $SD = 13.48$) were significantly different and in the expected direction, $t(1553) = -16.04$, $p < .05$, showing higher levels of cognitive reactivity in participants with a history of depression. Further post-hoc inspection of the mean total LEIDS-R scores by gender suggested no differences between men ($M_{with} = 29.26$, $SD = 15.97$, $M_{without} = 16.85$, $SD = 14.03$) and women ($M_{with} = 29.30$, $SD = 14.97$, $M_{without} = 18.59$, $SD = 13.14$) when correcting for depression history. The average total score on the abbreviated version of the LEIDS-R was 23.12 ($SD = 15.39$). The highest possible score of the abbreviated 30-item version is 120.

Discussion

Main findings

This paper provides the first psychometric results on the LEIDS-R (Van der Does & Williams, 2003) and presents an abbreviated revision of the questionnaire: the LEIDS-30-R.

The six-factor structure of the LEIDS-R demonstrated an acceptable model fit and use of the scale should still provide satisfactory results. Rearrangement of the items into five subscales, rather than six subscales, and the removal of specific poor items improved the model fit of the scale.

Combining the RAV and RUM subscales seems logical considering the high correlation between these two subscales. In the LEIDS-30-R, the subscales are now as follows: Hopelessness / Suicidality (HOP), Acceptance / Coping (ACC), Aggression / Hostility (AGG), Control / Perfectionism (CON), and Avoidance Coping (AVC). While the use of the five-subscale, 30-item questionnaire (LEIDS-30-R), is recommended for future research, the factor structure in the LEIDS-30-R remains similar to the LEIDS-R (34 items), suggesting that the interpretation of previous studies using the LEIDS-R are not altered by these new results. The LEIDS-R and the LEIDS-30-R both showed good predictive validity, in accordance with similar results previously shown for the original LEIDS (Van der Does, 2002). Higher scores on the HOP and AVC subscales appeared to be the most indicative of a past depressive episode and had the highest predictive value.

The current study has several limitations. The student sample (sample 2) used to cross-validate the results was relatively smaller and was not equivalent to sample 1 in terms of participant age and educational level. However, the analysis met most of the necessary statistical assumptions, including the sample size requirement, which is one of the most essential aspects for a reliable factor analysis (Guadagnoli & Velicer, 1988).

During the analysis of the LEIDS-30-R, additional items, specifically items 5 (*"feel hopeless about everything"*) and 17 ("*think I can make nobody happy*"), had the tendency to cross-load when examining the five-factor model in both samples 1 and 2. Although the items were inspected during the EFA process and appear to fit conceptually into the questionnaire and their corresponding subscale, further analysis could be necessary to confirm that other items should remain in the questionnaire.

Moreover, the correlations between subscales remained generally high with the exception of the ACC subscale. This could be due to the mutual interdependence between concepts such that each subscale is related to a subset of depressive symptoms and behaviors. For instance, the AVC subscale relates to avoidance of difficulties and loss of pleasure for activities once enjoyed. The AGG subscale relates to irritation (Verhoeven et al., 2011), and the HOP subscale relates to feelings of hopelessness and suicidal ideation (Antypa et al., 2010).

For participants, the items of the ACC scale probably did not readily associate with depressive episodes. Considering the skewness of the ACC subscale, participants typically did not endorse the ACC items. For example, items such as “more creative than usual” or “more helpful” when in a sad mood do not provoke images of sadness and depression. However, the items in the ACC questionnaire relate to interpersonal sensitivity, acceptance of depressive symptoms, and coping with depressive symptoms. Because depressed individuals typically endorse such statements, the original LEIDS included these items.

Future Research

First, future research should attempt to replicate the results of the current report validation using a random split of a large sample. This can provide a strong case for the cross-validation of the questionnaire as the curve of one half can be assessed against the entire data set (Good & Hardin, 2003). Because factor loadings can be quite volatile, Osborne and Fitzpatrick (2012) suggest testing the squared difference of factor loadings (> .04 in squared difference marks volatility) from the EFA to CFA. This can only be tested using a split sample.

The concurrent validity of the LEIDS-30-R with other measures should also be tested. Including correlations of the Dutch translation of the Dysfunctional Attitudes Scale (DAS; Weisman, 1979) would strengthen the validation results by confirming that the LEIDS-R measures cognitive reactivity in a similar way to the commonly-used DAS. The DAS measures dysfunctional beliefs that implicitly reflect a person’s self-evaluation (Beevers, Strong, Meyer, Pilkonis, & Miller, 2007) and has to be used pre- and post- negative mood induction to measure cognitive reactivity (Beevers, Ellis, & Reid, 2011).

Future research should further investigate the ACC subscale. Statements such as those in the ACC subscale may be more typical of individuals with chronic sad mood, such as highly recurrent depression or dysthymia (i.e. sad mood with duration of at least two years). In such cases, a depressive identity may become internalized. Moreover, the ACC subscale may be related to endogenous depression, which implies an indiscernible trigger for the onset of depression. Again, because depression appears to occur from within, the individual may naturally internalize the depressive symptoms. A post-hoc preliminary inspection of the participants in the first sample with a lifetime disorder of dysthymia or MDD showed that the dysthymic group appeared to score higher on the LEIDS-R. Further investigation of subgroups is necessary to test the utility and conceptualization of the ACC subscale.

Lastly, those with recurrent depression and/or dysthymia appear to score higher on the LEIDS-R and should be further investigated in future work since specific risk factors such as the number of previous episodes and the severity of the last episode may affect cognitive reactivity (Hardeveld, Spijker, De Graaf, Nolen, & Beekman, 2013; Mueller, 1999). Participants with recurrent depression or dysthymia may have different vulnerability markers for relapse (Rijsbergen et al., 2013).

Norms using specificity and sensitivity cut-off scores should be established for the LEIDS-30-R to determine at which scores individuals are at a higher risk for depression. Research can also focus on correlating cognitive reactivity using the LEIDS-30-R with personality traits, such as neuroticism, which has been shown to be a vulnerability marker for depression (De Graaf, Bijl, Ravelli, Smit, & Vollebergh, 2002; Kendler, Gatz, Gardner, & Pedersen, 2006).

Conclusions

In sum, the LEIDS-R showed satisfactory psychometric properties. The five-factor, 30-item questionnaire, or LEIDS-30-R, was superior to the LEIDS-R structure and is recommended for future research when measuring cognitive reactivity. The HOP and AVC subscales are the strongest when relating to depression diagnoses. The utility of the ACC subscale and its criterion validity should be further examined. A separate mood induction procedure is not necessary, making it a convenient short self-report questionnaire to measure cognitive reactivity.

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Appendix

Table **1.**
Inter-Factor Correlations of the LEIDS-R Six-Factor Structure in Confirmatory Factor Analysis

	Factor						
Model	Factor	CON	RAV	ACC	AGG	RUM	HOP
Six-factor	CON		.834	.665	.588	.825	.682
	RAV	.834		.501	.591	.925	.784
	ACC	.665	.501		.361	.398	.384
	AGG	.588	.591	.361		.712	.669
	RUM	.825	.925	.398	.712		.794
	HOP	.682	.784	.384	.669	.794	

Table **2.**

Standardized Factor Loadings and Standardized Cronbach's Alpha Scores (α) of the LEIDS-R Six-Factor Model from the Confirmatory Factor Analysis: Sample 1

	Factor					
LEIDS-R Item Statement (Item No.)	ACC	HOP	HOP	CON	RAV	RUM
More creative than usual (4)	*.505*					
More helpful (10)	*.659*					
Better intuitive feeling for meaning (15)	*.703*					
Feel more like myself (24)	*.758*					
Nicer than usual (28)	*.680*					
Do more things I will regret (7)		*.715*				
Feel like breaking things (18)		*.753*				
Bothered by aggressive thoughts (21)		*.805*				
Feel cynical or sarcastic (22)		*.726*				
Take more risks (26)		*.732*				
Lose my temper easily (29)		*.700*				
Feel hopeless about everything (5)			*.871*			
Care less if I lived or died (9)			*.791*			
Think I can make nobody happy (17)			*.816*			
Feel I would be better off dead (30)			*.842*			
Think about harming myself (34)			*.762*			
Think about what mood says about me (3)				*.727*		
Go out and do pleasurable activities (8)				*.021*		
Permit myself fewer mistakes (12)				*.787*		
Bothered by perfectionism (16)				*.677*		
Work harder (19)				*.342*		
Higher need for control (31)				*.669*		
Think positively only in good mood (1)					*.670*	
Take fewer risks (2)					*.719*	
Busy keeping thoughts or images at bay (6)					*.614*	
Less inclined to express disagreement (11)					*.639*	
Avoid difficulties (14)					*.710*	
Want to escape everything (23)					*.839*	
Feel overwhelmed (13)						*.826*
Less able to cope with everyday tasks (20)						*.765*
Neglect tasks (25)						*.725*
Problems concentrating (27)						*.759*
Think about the causes of mood (32)						*.522*
Think about different life choices (33)						*.671*
α	.625	.794	.825	.649	.805	.818

Note. All 34-items were included in the analysis.

Figure 1. *Scree plot from the Exploratory Factor Analysis after Parallel Analysis.* The Eigen values of the factors (% variance explained) were as follows: 1 = 12.61 (37.09%), 2 = 3.10 (9.11%), 3 = 2.13 (6.26%), 4 = 1.626 (4.78%), 5 = 1.144 (3.36%), and 6 = .994 (2.92%).

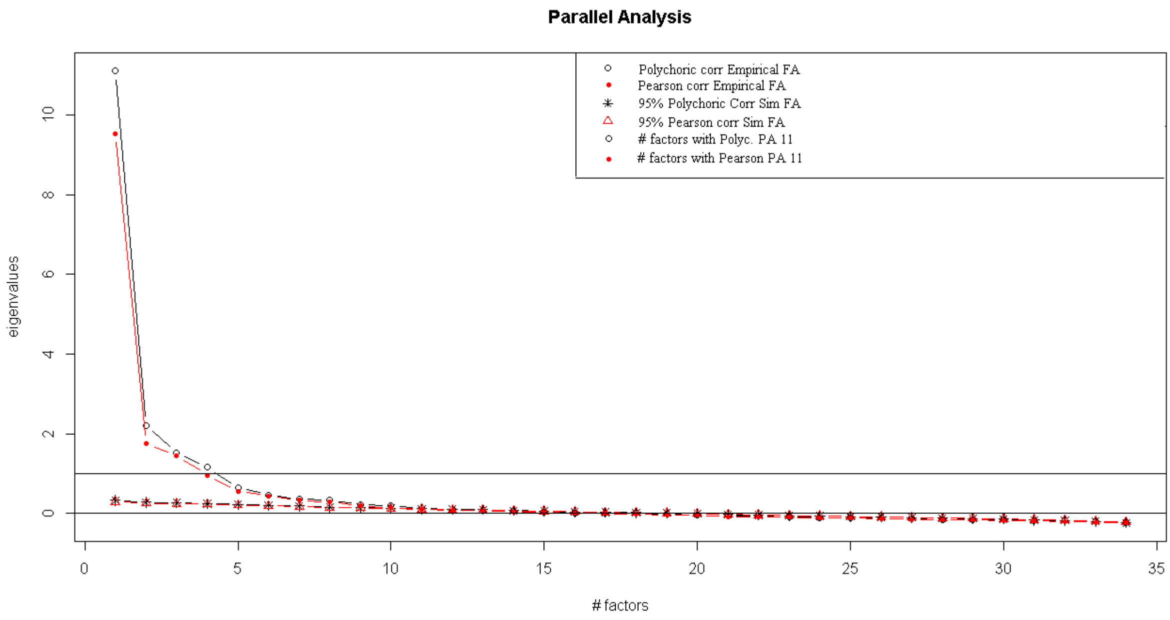

Table **3.**

Chi-Square Difference Test Results of the LEIDS-R Nested Models.

Model Comparison	CFA χ^2 (*df*)[d] Less-Restrictive	More-Restrictive	DiffTest χ^2 (*df*)
Six factor[a] – Five-factor[b]	4009.49 (*512*)**	4157.45 (*517*)**	141.66 (*5*)**
Five-factor[b]-Four-factor[c]	4157.45 (*517*)**	4481.54 (*521*)**	216.28 (*4*)**

*Note.*DiffTest = difference test. The difference test is based on the null hypothesis. [a] This model uses the original subscales of the LEIDS-R. See van der Does & Willams, 2003. [b] The original subscales RUM/RAV were combined into one factor. [c] The original subscales RUM, RAV, and CON were combined into one factor. [d] Chi-squares values from initial CFA.

**p* < .01, ***p* < .001.

Table **4.**

Model Fit Indices of Alternative LEIDS-R Models Tested in Exploratory Factor Analysis: Sample 1 using 34-items (A) and 30-items (B)

Model	χ^2	*df*	RMSEA	CFI	TLI	SRMR	% Residuals
A. 34-Items							
Three-factor	3213.77**	462	.059	.945	.933	.053	7.91[a]
Four-factor	1863.43**	431	.044	.971	.963	.037	2.14
Five-factor	1421.06**	401	.039	.980	.971	.030	.890
Six-factor	1055.41**	372	.033	.986	.979	.026	0
B. 30-Items[b]							
Four-factor	1505.97**	321	.047	.973	.963	.037	1.60
Five-factor	1064.54**	295	.039	.982	.974	.028	.36
Six-factor	740.24**	270	.032	.989	.983	.023	0

Note. RMSEA = root-mean-square error of approximation; CFI = comparative fit index; TLI = Tucker-Lewis Index; SRMR = standardized root-mean-square residual. % Residuals = percent inter-item residuals > .100 out of 561 unique correlations. [a] Model contained one residual > .200. [b] Items 1, 6, 8, and 33 were deleted from the analysis. *$p < .01$, **$p < .001$.

Table **5**.

Comparison of the Standardized Factor Loadings and Standardized Cronbach's Alpha Scores(α) of the Five-Factor Model (5FM) and LEIDS-R Six-Factor Model (6FM) from the Confirmatory Factor Analysis: Sample 1 with 34-Items.

	Factor											
	ACC		AGG		HOP		CON		RAV[a]		RUM	
LEIDS-R Item Statement (Item No.)	5FM	6FM	5FM	6FM	5FM	6FM	5FM	6FM	5FM	6FM	5FM	6FM
More creative than usual (4)	.534	.505										
More helpful (10)	.675	.659										
Better intuitive feeling for meaning (15)	.710	.703										
Feel more like myself (24)	.762	.758										
Nicer than usual (28)	.689	.680										
Do more things I will regret (7)			.716	.715								
Feel like breaking things (18)			.753	.753								
Bothered by aggressive thoughts (21)			.805	.805								
Feel cynical or sarcastic (22)			.726	.726								
Take more risks (26)			.732	.732								
Lose my temper easily (29)			.700	.700								
Feel hopeless about everything (5)					.840	.871						
Care less if I lived or died (9)					.768	.791						
Think I can make nobody happy (17)					.789	.816						
Feel I would be better off dead (30)					.822	.842						
Think about harming myself (34)					.740	.762						
Think about what mood says about me (3)							.732	.727				
Go out and do pleasurable activities (8)	**.119**							.021				
Permit myself fewer mistakes (12)							.792	.787				
Bothered by perfectionism (16)							.681	.677				
Work harder (19)	**.555**							.342				
Higher need for control (31)							.674	.669				
Think positively only in good mood (1)									.660	.670		
Take fewer risks (2)									.708	.719		
Busy keeping thoughts or images at bay (6)					**.631**					.614		
Less inclined to express disagreement (11)									.631	.639		
Avoid difficulties (14)									.699	.710		
Want to escape everything (23)									.824	.839		
Feel overwhelmed (13)									.825			.826
Less able to cope with everyday tasks (20)									.766			.765
Neglect tasks (25)									.727			.725
Problems concentrating (27)									.760			.759
Think about the causes of mood (32)							**.575**					.522
Think about different life choices (33)					**.700**							.671
α	.652	.625	.794	.794	.831	.825	.753	.649	.886	.805	—	.818

Note. All 34-items were included in the analysis. Items were italicized if the factor loading of the five-factor structure deviated from the original six-factor structure. [a] AVC factor in the five-factor model (5M).

Table **6**.
Model Fit Indices of Two Alternative LEIDS-R Models and the Original LEIDS-R Model Tested in Confirmatory Factor Analysis for Cross-Validation: Sample 2 with 34- and 30-items.

Model	χ^2	*df*	RMSEA	CFI	TLI
A. 34-Items					
Four-factor EFA	2720.19**	521	.072	.844	.832
Five-factor EFA	2701.35**	517	.072	.845	.832
Original six-factor[a]	2797.51**	512	.074	.838	.823
B. 30-Items[b]					
Four-factor EFA	2156.59**	399	.074	.857	.844
Five-factor EFA	2044.88**	395	.072	.865	.852
Original six-factor[a]	2209.50**	390	.076	.852	.834

Note. RMSEA = root-mean-square error of approximation; CFI = comparative fit index; TLI = Tucker-Lewis Index. [a] This model uses the original subscales of the LEIDS-R. See van der Does & Willams, 2003. [b] Items 1, 6, 8, and 33 were deleted from the analysis.
*p < .01, **p < .001

Table **7.**

Standardized Factor Loadings of the Five-Factor Model (5FM) and LEIDS-R Six-Factor Model (6FM) from the Confirmatory Factor Analysis for Cross-Validation: Sample 2 with 30-Items.

	Factor											
	ACC		AGG		HOP		CON		RAV[a]		RUM	
LEIDS-R Item Statement (Item No.)	5FM	6FM	5FM	6FM	5FM	6FM	5FM	6FM	5FM	6FM	5FM	6FM
More creative than usual (4)	.496	*.493*										
More helpful (10)	.604	*.583*										
Better intuitive feeling for meaning (15)	.661	*.656*										
Feel more like myself (24)	.728	*.767*										
Nicer than usual (28)	.735	*.736*										
Do more things I will regret (7)			.605	*.605*								
Feel like breaking things (18)			.759	*.758*								
Bothered by aggressive thoughts (21)			.763	*.764*								
Feel cynical or sarcastic (22)			.586	*.582*								
Take more risks (26)			.578	*.583*								
Lose my temper easily (29)			.697	*.697*								
Feel hopeless about everything (5)					.831	*.831*						
Care less if I lived or died (9)					.805	*.805*						
Think I can make nobody happy (17)					.739	*.740*						
Feel I would be better off dead (30)					.853	*.853*						
Think about harming myself (34)					.748	*.749*						
Think about what mood says about me (3)							.671	*.674*				
Permit myself fewer mistakes (12)							.656	*.632*				
Bothered by perfectionism (16)							.531	*.499*				
Work harder (19)	**.473**							*.178*				
Higher need for control (31)							.538	*.497*				
Take fewer risks (2)									.418	*.479*		
Less inclined to express disagreement (11)									.351	*.410*		
Avoid difficulties (14)									.383	*.451*		
Want to escape everything (23)									.736	*.835*		
Feel overwhelmed (13)									.768			*.774*
Less able to cope with everyday tasks (20)									.712			*.719*
Neglect tasks (25)									.651			*.659*
Problems concentrating (27)									.608			*.614*
Think about the causes of mood (32)							**.358**					*.270*

Note. Items 1, 6, 8, and 33 were excluded in the analysis. Items were italicized if the factor loading of the five-factor structure deviated from the original six-factor structure. [a] AVC factor in the five-factor model (5M).