This is the accepted version of the following article after peer review but before copy-editing by the publisher:

Himle, A., Havik, O., & Thimm, J. C. (2020). The Leiden Index of Depression Sensitivity-Revised (LEIDS-R) and its revision (LEIDS-RR): An investigation of the internal structure and conceptual validity in a Norwegian sample. Nordic Psychology, 72, 331-345. doi: 10.1080/19012276.2020.1727359

Abstract

The purpose of this study was to evaluate the internal consistency, factor structure, and validity of the Leiden Index of Depression Sensitivity-Revised (LEIDS-R) and a recent revision of the LEIDS-R (LEIDS-RR) in Norway. The LEIDS-R is a self-report inventory measuring cognitive reactivity. Cognitive reactivity is defined as the relative ease with which negative thinking is activated by mild low mood and has been shown to be a strong predictor of relapse of depression. Hospital employees and psychology students (N = 240) completed the LEIDS-R and measures of depression, repetitive negative thinking, and mindfulness. The results showed that Cronbach's alpha was equally high for both the LEIDS-R and LEIDS-RR total score (α = .92), indicating good internal consistency. Confirmatory factor analysis of the LEIDS-R suggested an acceptable model fit for the original first-order six-factor model. Confirmatory factor analyses of the LEIDS-RR suggested the best fit for a bifactor five-factor model. Correlational analyses showed positive associations of the LEIDS-R and LEIDS-RR scales with depression and repetitive negative thinking and negative relationships with mindfulness. It is concluded that the Norwegian versions of the LEIDS-R and LEIDS-RR appear to be both reliable and valid for future use.

Introduction

Depression is a major public health problem afflicting people worldwide. The WHO reports that more than 300 million people struggle with depression in 2015 (WHO, n.d.), and the illness is a leading cause of disability worldwide and has been related to increased mortality (WHO, n.d.). At least half of those with a first-onset depressive episode suffer one or more new episodes of depression in their lifetime (Burcusa & Iacono, 2007; Eaton et al., 2008). As many as 90% of those with three or more episodes will suffer from further depressive episodes (Burcusa & Iacono, 2007; Monroe & Harkness, 2011).

Cognitive models of depression propose that dysfunctional attitudes, such as negative assumptions about the self, the world, and the future, play a central role in the onset, maintenance, relapse and recurrence of depression (e.g., Beck, 1967). Dysfunctional attitudes are often prominent in depressive episodes and tend to decrease during remission but can be reactivated by stressful situations or sad mood (Scher, Ingram, & Segal, 2005). The disposition to respond to dysphoric mood with depressive thinking has been referred to as cognitive reactivity (CR; Segal, Gemar, & Williams, 1999). CR has been defined as "the relative ease with which maladaptive cognitions or cognitive styles are triggered by mild (nonpathological) mood fluctuations" (Williams, Van der Does, Barnhofer, Crane, & Segal, 2008, p. 84). CR was initially assessed using an experimental paradigm intended to induce a mild sad mood (e.g., with sad music) and measuring the change in maladaptive cognitions after mood induction (Segal et al., 1999; Weissman, 1979). However, this laboratory assessment procedure has proven to be difficult to implement in routine clinical practice settings (Jarrett et al., 2012). In addition, a considerable proportion of patients (25% in the Segal et al. (1999) study) do not respond to mood induction.

The Leiden Index of Depression Sensitivity (LEIDS; Van der Does, 2002) is a self-report inventory that was developed to measure CR without the need for mood induction. In the LEIDS, respondents are asked to imagine a situation that gives them a somewhat sad feeling. With this situation in mind and while experiencing a somewhat sad feeling, the respondents are asked to respond to 26 statements describing how maladaptive cognitions or cognitive styles are triggered by mood fluctuations, e.g., "I can only think positive when I am in a good mood" and "In a sad mood, I am bothered more by aggressive thoughts". The original LEIDS was subsequently revised and expanded into the LEIDS-R, which includes 34 items representing six group factors (Van der Does & Williams, 2003).

Several studies suggest that the LEIDS-R is an efficient, reliable, and valid measure of CR. For example, the LEIDS-R has been found to distinguish previously depressed individuals from never-depressed individuals (e.g., Elgersma et al., 2015; Raes, Dewulf, Van Heeringen, & Williams, 2009). The LEIDS-R has been shown to be a stronger predictor of relapse than commonly recognized clinical risk factors (previous depressive episodes and residual depressive symptoms) (Steenbergen, Sellaro, Van Hemert, Bosch, & Colzato, 2015). The LEIDS-R scores also correlate with genetic markers of depression (Antypa & Van der Does, 2010).

Recently, Solis, Antypa, Conijn, Kelderman, and Van der Does (2017) examined the psychometrics of the LEIDS-R and deleted four of the 34 items due to cross-loadings (items 6, 8, 33) and wording (item 1), resulting in a revised LEIDS-R (the LEIDS-RR) with 30 items and better psychometric qualities than the original LEIDS-R and with five subscales instead of six (Solis et al., 2017). Solis et al. (2017) recommended that the revised LEIDS-RR should replace the LEIDS-R in future research.

The purpose of this study was to investigate the psychometric properties of the Norwegian translation of the LEIDS-R and LEIDS-RR (Van der Does & Williams, 2003). This included the estimation of the internal consistency and the examination of the internal conceptual structure by confirmatory factor analyses. A second aim of the study was to examine the external validity by investigating the associations between the two versions of the LEIDS and depression, repetitive negative thinking, and mindfulness. Ehring et al. (2011) define repetitive negative thinking (RNT) as repetitive thinking that is difficult to disengage from, that is seen as unproductive by the individual and that captures mental capacity. RNT is thought to be a transdiagnostic phenomenon that contributes to the development, maintenance, and relapse of several mental disorders (Samtani & Moulds, 2017). The concepts of CR and RNT are partially overlapping (Drost et al., 2014), and we therefore expected that the LEIDS-R and LEIDS-RR would be positively correlated with a measure of RNT. Mindfulness is characterized by an observing and nonjudgmental attitude towards experiences (Bishop et al., 2004). Whereas CR refers to the tendency to react to low mood automatically with negative thinking, mindfulness involves the awareness of mood changes and the ability to decentre and disengage from negative cognitive processes. As such, mindfulness can be considered a counterpart to the core qualities of CR, and therefore, a negative correlation between the LEIDS-R and LEIDS-RR and a measure of mindfulness was expected.

Materials and Methods

Participants

Participants were recruited through emails sent to all employees of the REMOVED FOR PEER REVIEW and to psychology students at REMOVED FOR PEER REVIEW. The

email included a link to an online survey platform that contained the questionnaires used in this study. Participation was voluntary and anonymous, thus precluding the possibility of tracing the respondents electronically. To ensure the anonymity of the students, participants were not asked if they were students or hospital employees. Because students are a relatively age-homogeneous group, and only a limited number was invited to participate, there was a risk that students who are considerably older than the average student could be identified based on information about their status as student and their age. Participants were informed about the aim of the study and the voluntary nature of their participation and were provided with contact information for the researchers responsible for the project. The participants gave informed consent. No material or monetary incentive was provided. The Regional Committee for Medical and Health Research Ethics North decided that the study did not require ethical approval. The study followed the ethical guidelines of the Helsinki Declaration and the Norwegian Health Research Act.

Measures

The Leiden Index of Depression Sensitivity-Revised (LEIDS-R; Van der Does & Williams, 2003)

As described above, the LEIDS-R is a 34-item self-report inventory designed to assess CR. The respondent is asked to rate to what extent he/she can imagine a situation that makes him/her "somewhat sad" using three categories: "well", "somewhat" or "not at all". The respondent then rates the extent to which each item applies to him/her on a 5-point Likert scale (0 = not at all, 1 = a bit, 2 = moderately, 3 = strongly, and 4 = very strongly), with total scores between 0 and 136. The LEIDS-R has six subscales developed through factor analyses: hopelessness/suicidality (HOP; 5 items, e.g., "When I feel down, I more often feel hopeless

about everything"); acceptance/coping (ACC; 5 items, e.g., "When I feel down, I have a better intuitive feeling for what people really mean"); aggression (AGG; 6 items, e.g., "In a sad mood, I am bothered more by aggressive thoughts"); perfectionism/control (CTR; 6 items, e.g., "When in a sad mood, I become more bothered by perfectionism"); risk aversion/harm avoidance (RAV; 6 items, e.g., "When in a low mood, I am more inclined to avoid difficulties or conflicts"); and rumination (RUM; 6 items, e.g., "When I feel sad, I feel less able to cope with everyday tasks and interests").

The LEIDS-RR (Solis et al., 2017) comprises 30 items of the LEIDS-R. Items are grouped into five subscales: the subscales HOP and AGG are identical for both the LEIDS-R and LEIDS-RR. The CTR and ACC subscales correspond to the LEIDS-R subscales with the same labels but have slightly different item compositions. The avoidant coping (AVC) subscale of the LEIDS-RR consists of items from the RAV and RUM subscales of the LEIDS-R.

The three authors independently translated the LEIDS-R into Norwegian. Colleagues and psychology students tested this first translation and commented on the design and the language. A professional translation firm translated the Norwegian version back to English. Willem Van der Does at Leiden University (personal communication, May 29, 2017) approved the translation.

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983)

Symptoms of depression were measured by the depression subscale of the HADS (HADS-D)**.** The HADS-D comprises seven items measuring symptoms of depression in the past week rated on a 4-point scale from 0 to 3. The Norwegian translation of the HADS has satisfactory reliability and validity (Bjelland, Dahl, Haug, & Neckelmann, 2002). The internal consistency of the HADS-D in the present study was acceptable ($\alpha = .79$).

Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011)

RNT was measured by the PTQ. The PTQ comprises 15 items assessing RNT, independent of content, and the items are answered on a scale from 0 (never) to 4 (almost always). The PTQ scale has shown excellent internal consistency (α = .95) (Ehring et al., 2011). Cross-sectional and longitudinal associations with depression have been demonstrated (Raes, 2012). The internal consistency of PTQ in the current sample was excellent (α = .96).

Five Facet Mindfulness Questionnaire-Short Form (FFMQ-SF, Bohlmeijer, ten Klooster, Fledderus, Veehof, & Baer, 2011)

The FFMQ-SF is a shortened form of the 39-item Five Facet Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Dundas, Vøllestad, Binder, & Sivertsen, 2013). The respondents rate 24 statements on a 5-point Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). The FFMQ-SF comprises five subscales (observing, describing, acting with awareness, nonjudging of experience, and nonreactivity to inner experience). As recommended, the items in the observing subscale were not included when the FFMQ-SF total score was calculated, as the individuals in the present sample did not perform meditation training (e.g., Gu et al., 2016; Williams, Dalgleish, Karl, & Kuyken, 2014). In the present sample, the internal consistency of the FFMQ-SF without the observing subscale was acceptable (α = .83).

Statistical analyses

First, we obtained descriptive statistics of the LEIDS-R items and evaluated the internal consistency of the LEIDS-R and LEIDS-RR using Cronbach's alpha (α), and we supplemented this indicator with the omega coefficient total (ω_t), as we assumed lack of tau-equivalency in our sample (Cho, 2016; McDonald, 1978; McNeish, 2018; Revelle, 2018; Zinbarg, Revelle, Yovel, & Li, 2005). Since the LEIDS-R and LEIDS-RR are intended for use

as instruments for individual assessment, a high level of α and ω_t is desirable, preferably ≥ .90 (Drost, 2011). Item-to-total correlations were evaluated using Spearman's rho due to a nonnormal distribution.

Second, confirmatory factor analysis (CFA) was used to investigate the internal structures of the LEIDS-R and LEIDS-RR. Based on the study by Solis et al. (2017), a six-factor solution was tested for the LEIDS-R, and models with one, five, and six factors and a bifactor five-factor model were tested for the LEIDS-RR. In the analyses, the items were treated as ordinal variables, and the mean- and variance-adjusted weighted least quares (WLSMV) estimator was used because it does not assume normally distributed data, is well suited for skewed data and is specifically designed for ordinal data (Li, 2016). In the bifactor five-factor model, the five group factors of the LEIDS-RR were treated as orthogonal to the general factor. We report standardized factor loadings for manifest variables on latent variables. The model χ^2 value, model χ^2 value per degree of freedom (χ^2/df), root mean square error of approximation (RMSEA) with a 90% confidence interval, Bentler's comparative fit index (CFI), Tucker-Lewis index (TLI), and standardized root mean square residual (SRMR) were used to assess model fit. A nonsignificant χ^2 value and a χ^2/df value < 3 indicate a good model fit (Hooper, Coughlan, & Mullen, 2008). For the RMSEA, CFI, TLI and SRMR, cutoff values close to .06, .95, .95 and .08, respectively, indicate a relatively good fit (Hu & Bentler, 1999). We chose to use fit indices from the three categories: absolute fit (SRMR), parsimony correction (RMSEA) and comparative fit (CFI and TLI) (Brown, 2015).

The omega hierarchical (ω_h) (McDonald, 1999) was calculated as an index of the proportion of the variance in the LEIDS-R and LEIDS-RR due to a general factor (Revelle, & Zinbarg, 2009).

Third, the construct validity of the LEIDS-R and LEIDS-RR was examined using Spearman correlation analysis on the association with the HADS-D and the PTQ. In the examination of discriminant validity, bivariate Spearman correlation was used to assess the association between the total LEIDS-R and LEIDS-RR and the FFMQ-SF total score. Spearman correlation coefficients of $r > 0.1$, > 0.3 and > 0.5 were interpreted as small, medium and large effect sizes, respectively (Cohen, 1992).

Descriptive statistics and correlation analyses were performed using SPSS, version 24. Confirmatory factor analyses were conducted in Mplus 8 (Muthén & Muthén, 2017). Calculations of ω_t and ω_h were performed in R 3.4.2 using the psych package (Revelle, 2018).

Results

Participants

A total of 240 (34.5%) of the 723 invited individuals completed the questionnaires. Four participants were excluded from the analyses because they reported that they were unable to imagine a situation in which they would experience a mild sad mood. The final study sample thus comprised 236 participants (77.5% female, mean age = 39.8 years, *SD* = 12.5 years).

LEIDS-R and LEIDS-RR distribution characteristics

There were no missing values, as all participants had to answer all items to complete the forms. The means, standard deviations, range, skewness, kurtosis, and reliability coefficients of the LEIDS-R and LEIDS-RR total scores and subscales are presented in Table 1. There were no significant differences between men and women on the LEIDS-R ($t(234) = -0.86$, $p = .391$) and the LEIDS-RR ($t(234) = -0.90$, $p = .368$) total scores.

Skewness and kurtosis were evaluated using the acceptable range of z-values (absolute value/SE): between -3.29 and +3.29 for medium-sized samples (Kim, 2013). The skewness of

the LEIDS-R total score was 4.63 and outside the acceptable range. The kurtosis z-value of the LEIDS-R was 0.82 and within the acceptable range (see Table 1). The Shapiro-Wilk test resulted in the rejection of the null hypothesis ($p < .001$) for the LEIDS-R and LEIDS-RR total scores and all the subscale scores, rejecting that these scores were normally distributed (Kim, 2013). Severe skewness and kurtosis, using the criteria that skewness is >|2| or kurtosis is >|7| (Kim, 2013), was found for items 4, 7, 9, 24, 26, 28, 30, and 34. Item 26 of the aggression factor and items 30 and 34 of the hopelessness factor showed the highest skewness and kurtosis.

Internal consistency

The internal consistency reliability of the total LEIDS-R was excellent ($\alpha = .92$, $\omega_t = .95$). The item-to-total correlations of the LEIDS-R ranged from .20 to .72, except for item 8 ($r = -.17$). The internal consistency reliability of the six LEIDS-R subscales ranged from $\omega_t = .80$ (RAV) to $\omega_t = .91$ (HOP and RUM).

The internal consistency reliability of the LEIDS-RR was excellent and identical to that of the LEIDS-R ($\alpha = .92$, $\omega_t = .95$). The item-to-total correlations of the LEIDS-RR ranged from .18 to .72, with no negative correlations. The internal consistency reliability of the LEIDS-RR subscales ranged from $\omega_t = .86$ (AGG) to $\omega_t = .91$ (HOP).

Using Cronbach's alpha resulted in considerably lower estimates of the internal consistency reliability of the LEIDS-R and LEIDS-RR scales compared to using omega total (see Table 1).

Confirmatory factor analysis

The results of the CFAs showed mixed results for the original first-order six-factor model of the LEIDS-R (Table 2). The RMSEA, CFI and TLI suggested an acceptable model fit, but the SRMR did not. Factor loadings are displayed in Table 3. Item 8 ("Go out and do

more pleasurable activities") and item 19 ("Work harder") loaded inadequately on the CTR factor: -.22 and .24, respectively. Several factors of the LEIDS-R were strongly intercorrelated: RAV with RUM (r_s = 0.94) and CTR with RAV (r_s = 0.90) and RUM (r_s = 0.84). The other factors were moderately intercorrelated, ranging from .41 (ACC with AGG) to .77 (RAV with HOP).

Next, we examined the first-order factor models of the LEIDS-RR with one, five, and six factors. CFA suggested the best fit for the five-factor model (Table 2). All standardized factor loadings were acceptable, ranging from .42 to .94, with a median of .75. The interfactor correlations ranged from .41 (HOP and AGG with ACC) to .90 (CTR with AVC). We then examined the bifactor five-factor model of the LEIDS-RR, as proposed by Solis et al. (2017). Because the model with five orthogonal group factors examined by Solis et al. (2017) showed negative residuals in our sample, we tested a model in which the five group factors were allowed to correlate. The model fit indices suggested that this model had the best fit of the four LEIDS-RR models tested, with all fit indices in the acceptable range.

In the bifactor model with five specific factors, items 2 (AVC), 13 (AVC), and 32 (CTR) had nonsignificant loadings on their respective group factors. Items 11 (AVC) and 14 (AVC) showed negative significant loadings (Table 3). For all AVC items and most CTR items, factor loadings on the general factor (AVC: median = .68, CTR: median = .60) were stronger than on the group factors (AVC: median = .24, CTR: median = .31). In contrast, most group factor loadings were higher than the loadings on the general factor (median = .56 vs. .36).

The omega hierarchical for the LEIDS-R total score was .56 (Table 1), indicating that 59% of the reliable variance in the LEIDS-R total scores (ω_h/ ω_t: .56/.95 = .59) could be attributed to a general factor. Therefore, 36% (.95 - .59) of the reliable variance in the LEIDS-

R total scores could be attributed to the multidimensionality caused by the group factor, leaving 5% of the variance to random measurement error (Rodriguez, Reise, & Haviland, 2016).

The omega hierarchical for the LEIDS-RR total score was .60 (Table 1), indicating that 63% of the reliable variance in the LEIDS-RR total scores ($\omega_{t/}$ ω_{h}: .60/.95 = 63) could be attributed to a general factor. Thus, 32% (.95 - .63) of the reliable variance in the LEIDS-RR total scores could be attributed to the multidimensionality caused by the group factors, leaving 5% of the variance to random measurement error (Rodriguez et al., 2016).

The validity of the LEIDS-R and LEIDS-RR

The correlations between the LEIDS-R and LEIDS-RR and the HADS-D, the PTQ, and the FFMQ-SF are presented in Table 4. Correlations of the LEIDS-R and LEIDS-RR total scores with the HADS-D and the PTQ were moderately high and positive. The LEIDS-R and LEIDS-RR total scores were negatively correlated with the FFMQ-SF total score.

Discussion

Our first goal was to examine the internal consistency reliability of the Norwegian translation of the LEIDS-R and LEIDS-RR. The internal consistency reliability of both the LEIDS-R and LEIDS-RR total scores was excellent, and the internal consistency reliability of both the LEIDS-R and LEIDS-RR subscales was satisfactory.

Our findings on internal consistency reliability are in line with the findings reported in other studies of the LEIDS-R and LEIDS-RR (Beshai, Prentice, & Huang, 2018; Ostovar, Md Nor, Griffiths, & Chermahini, 2017; Senín-Calderón, Perona-Garcelán, Ruíz-Veguilla, & Rodríguez-Testal, 2017; Solis et al., 2017).

We found substantial differences between internal consistency as estimated with Cronbach's alpha and the omega total. This result illustrates that Cronbach's alpha gives lower-bound values of internal consistency reliability and results in underestimating reliability (McNeish, 2018; Sijtsma, 2009). This finding was especially true for the LEIDS-R subscales; the lowest Cronbach's alpha was .61 (ACC), while the lowest omega total was .80 (RAV).

In testing the proposed factor models of the LEIDS-R and LEIDS-RR (Solis et al., 2017), we found the same pattern of model fit as reported by Solis et al. (2017). We found support for the original six-factor model of the LEIDS-R showing acceptable model fit. Two of the 34 items on the LEIDS-R had low loadings (< .40). Similar to other studies on the LEIDS-R (Senín-Calderón et al., 2017; Solis et al., 2017), we found very high correlations between the RUM and RAV factors in the original six-factor model of the LEIDS-R, indicating redundant factors and suggesting that the two factors could be combined into one factor.

With respect to the LEIDS-RR, tests of different models revealed that the bifactor five-factor model showed the best fit. In the bifactor five-factor solution, five of the 30 items on the LEIDS-RR had low general factor loadings, and 16 items had low group factor loadings. These results for the LEIDS-RR are similar to the results of Solis et al. (2017). It should be noted, however, that the group factors in the current model were allowed to be correlated as distinguished from the bifactor five-factor model in the Solis et al. (2017) study. Both new subscales of the LEIDS-RR (AVC and CTR) showed low group factor loadings, while they showed higher loadings on a general factor. These results indicate that these subscales have a smaller unique contribution to the measures of CR beyond the general factor. The opposite was true for the ACC items of the LEIDS-RR, which had the highest loadings on the group factor. This result is similar to the findings of Ostovar et al. (2017) and Solis et

al. (2017), who reported high group factor loadings for the ACC factor, suggesting that ACC measures a distinct quality of CR related to increased interpersonal sensitivity, creativity, and acceptance. This subscale seems to differ from the other LEIDS subscales, e.g., it was the only LEIDS-RR subscale that did not differentiate between groups with no history of depression or anxiety and groups with lifetime depression and anxiety (Solis et al., 2017).

Although the LEIDS-RR bifactor five-factor model showed the best model fit across all analyses, it must be taken into account that poor measurement quality, defined as low standardized factor loadings, is rewarded when using model fit indices (McNeish, An, & Hancock, 2018), a phenomenon termed the *reliability paradox* (Hancock & Mueller, 2011). Another notable point is the tendency of bifactor models to show superior goodness of fit to any possible data compared to unidimensional factor models because the bifactor models accommodate unwanted noise (Bonifay, Lane, & Reise, 2017; Cucina & Byle, 2017). In the bifactor five-factor model for the LEIDS-RR, several items of the AVC subscale displayed nonsignificant (2, 13) or significant negative factor loadings (11, 14) on the group factor, while showing high factor loadings on the general factor. These findings suggest that the correlations between the items of the AVC subscale are in large part due to their associations with the general factor. Thus, these items can be used to calculate the LEIDS-RR total score. However, the AVC subscale should be used with caution. We suggest further studies of the factor structure of the Norwegian version of LEIDS-RR using larger samples from both normal and clinical populations.

Taken together, more research is needed to determine whether the LEIDS-RR should be preferred over the LEIDS-R.

We found that a major proportion of the variance in both the LEIDS-R and LEIDS-RR scores could be explained by a general factor (59% and 63%, respectively). These results are

comparable to the results of Solis et al. (2017), who reported that the general factor accounted for approximately 60% of the common variance. The model behind the LEIDS scales seems to be multidimensional, and we assume that the general factor is a measure of CR (Ostovar et al., 2017; Solis et al., 2017).

Construct validity was further explored by comparing the LEIDS scores with questionnaires measuring mindfulness, repetitive negative thinking, and depression. As predicted, CR, as measured by the LEIDS-R and LEIDS-RR, was positively correlated with repetitive negative thinking and negatively correlated with mindfulness, even after controlling for current depressive symptoms, as measured by the HADS-D. Repetitive negative thinking correlated the most with RUM, which is in accordance with studies presenting depressive rumination as one of the most prototypical forms of repetitive negative thinking (Ehring & Watkins, 2008). Being mindful protects against depression (Huijbers et al., 2012), while CR has been proven to be a vulnerability factor for depression. This finding is in accordance with the reported negative correlations between LEIDS-R and LEIDS-RR total scores and the FFMQ-SF scores in our study. This association was especially strong for the HOP and RUM subscales, which is consistent with the findings of studies that have found that individuals recovering from depression score higher on the RUM and HOP subscales of the LEIDS-R than do controls (Merens, Booij & Van der Does, 2008). Our findings regarding the relationship between CR and mindfulness are also corroborated by the findings of other studies (Beshai et al., 2018; Raes et al., 2009). It should be noted, however, that answering the LEIDS-R and LEIDS-RR requires a certain degree of mindfulness, i.e. the ability to recognize changes in cognition when one is in a dysphoric mood. Thus, the observed associations between CR and mindfulness in our study can be inflated by the way CR is assessed by the two versions of the LEIDS.

As predicted, CR, as measured by the LEIDS-R and LEIDS-RR, was positively correlated with current symptoms of depression, as measured by the HADS-D. The subscales HOP, RAV and RUM showed the highest correlations with the HADS-D. Previous studies have shown the same pattern of correlation between the LEIDS-R subscales and depression (Barnhofer & Chittka, 2010).

Limitations

First, all LEIDS-R and LEIDS-RR scales showed a nonnormal distribution. This finding could be due to our non-clinical sample. The inclusion of clinical samples may have offered a greater spread (Senín-Calderón et al., 2017). High skewness values might have led to high χ^2 estimates and thus resulted in the rejection of factor models (Boomsma & Hoogland, 2001; Gu et al., 2016). Second, our sample was restricted with respect to the type of population, size and background information. We do not know if our results can be generalized to clinical populations in Norway. The inventory should be tested using clinical populations. We have not found studies of LEIDS-R/LEIDS-RR and sex differences. Due to the known sex differences in depression (Goodwin & Gotlib, 2004; Nolen-Hoeksema, 1987), we recommend a study of this aspect of the LEIDS-R and LEIDS-RR. Our sample size was insufficient for exploring the presence of any sex differences on the LEIDS-R and LEIDS-RR using measurement invariance testing. Due to anonymity requirements, we used no socioeconomic variables, such as source of income, education and history of depression. Such variables should have provided more refined information about the LEIDS-R and LEIDS-RR and enabled a better basis for generalization of the results from this study. The exact response rate of this study could not be calculated due to the method of data collection.

Further studies of the Norwegian version of the LEIDS-R and LEIDS-RR should include a test-retest reliability analysis. Norm data are needed for use of the two instruments in individual assessment.

Conclusion

The present findings suggest that the Norwegian translation of the LEIDS-R and LEIDS-RR are reliable and valid. However, there is a need to confirm this result in larger samples and in samples from other populations, e.g., clinical populations.

References

Antypa, N., & Van der Does, A. J. W. (2010). Serotonin transporter gene, childhood emotional abuse and cognitive vulnerability to depression. *Genes, Brain, and Behavior*, *9*, 615–620. https://doi.org/10.1111/j.1601-183X.2010.00593.x

Baer, R. R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, *13*, 27–45. https://doi.org/10.1177/1073191105283504

Barnhofer, T., & Chittka, T. (2010). Cognitive reactivity mediates the relationship between neuroticism and depression. *Behaviour Research and Therapy*, *48*, 275–281. https://doi.org/10.1016/j.brat.2009.12.005

Beshai, S., Prentice, J. L., & Huang, V. (2018). Building blocks of emotional flexibility: Trait mindfulness and self-compassion are associated with positive and negative mood shifts. *Mindfulness*, *9*, 939–948. https://doi.org/10.1007/s12671-017-0833-8

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., … Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*, 230–240. https://doi.org/10.1093/clipsy/bph077

Bjelland, I., Dahl, A. A., Haug, T. T., & Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale: An updated literature review. *Journal of Psychosomatic Research*, *52*, 69.

Bonifay, W., Lane, S. P., & Reise, S. P. (2017). Three concerns with applying a bifactor model as a structure of psychopathology. *Clinical Psychological Science*, *5*, 184–186. https://doi.org/10.1177/2167702616657069

Bohlmeijer, E., ten Klooster, P. M., Fledderus, M., Veehof, M., & Baer, R. (2011). Psychometric properties of the Five Facet Mindfulness Questionnaire in depressed adults

and development of a short form. *Assessment, 18*, 308-320. https://doi.org/10.1177/1073191111408231

Boomsma, A., & Hoogland, J. J. (2001). The robustness of LISREL modeling revisited. In R. Cudeck, S. du Toit, & D. Sörbom (Eds.), *Structural Equation Modeling: Present and Future: A Festschrift in Honor of Karl Jöreskog* (Preliminar, pp. 139–168). Chicago: Scientific Software International. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.11.684&rep=rep1&type=pdf

Burcusa, S. L., & Iacono, W. G. (2007). Risk for recurrence in depression. *Clinical Psychology Review*, *27*, 959–985. https://doi.org/10.1016/j.cpr.2007.02.005

Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York: Guilford Press.

Cho, E. (2016). Making reliability reliable. *Organizational Research Methods*, *19*, 651–682. https://doi.org/10.1177/1094428116656239

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*, 155–159.

Cucina, J., & Byle, K. (2017). The bifactor model fits better than the higher-order model in more than 90% of comparisons for mental abilities Test Batteries. *Journal of Intelligence*, *5*, 27. https://doi.org/10.3390/jintelligence5030027

Drost, E. A. (2011). Validity and reliability in social science research. *Education Research and Perspectives*, *38*, 105–123.

Drost, J., Van der Does, J. A. W., van Hemert, A. M., Penninx, B. W. J. H., & Spinhoven, P. (2014). Repetitive negative thinking as a transdiagnostic factor in depression and anxiety: A conceptual replication. *Behaviour Research and Therapy*, *63*, 177–183. https://doi.org/10.1016/j.brat.2014.06.004

Dundas, I., Vøllestad, J., Binder, P.-E., & Sivertsen, B. (2013). The Five Factor Mindfulness

Questionnaire in Norway. *Scandinavian Journal of Psychology*, *54*, 250–260. https://doi.org/10.1111/sjop.12044

Eaton, W. W., Shao, H., Nestadt, G., Lee, B. H., Bienvenu, O. J., & Zandi, P. (2008). Population-based study of first onset and chronicity in major depressive disorder. *Archives of General Psychiatry, 65*, 513-520. https://doi.org/10.1001/archpsyc.65.5.513

Ehring, T., & Watkins, E. R. (2008). Repetitive negative thinking as a transdiagnostic process. *International Journal of Cognitive Therapy*, *1*, 192–205. https://doi.org/10.1680/ijct.2008.1.3.192

Ehring, T., Zetsche, U., Weidacker, K., Wahl, K., Schönfeld, S., & Ehlers, A. (2011). The Perseverative Thinking Questionnaire (PTQ): Validation of a content-independent measure of repetitive negative thinking. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*, 225–232. https://doi.org/10.1016/j.jbtep.2010.12.003

Elgersma, H. J., De Jong, P. J., Van Rijsbergen, G. D., Kok, G. D., Burger, H., Van der Does, W., … Bockting, C. L. H. (2015). Cognitive reactivity, self-depressed associations, and the recurrence of depression. *Journal of Affective Disorders*, *183*, 300–309. https://doi.org/10.1016/j.jad.2015.05.018

Goodwin, R. D., & Gotlib, I. H. (2004). Gender differences in depression: The role of personality factors. *Psychiatry Research*, *126*, 135–142. https://doi.org/10.1016/j.psychres.2003.12.024

Gu, J., Strauss, C., Crane, C., Barnhofer, T., Karl, A., Cavanagh, K., & Kuyken, W. (2016). Examining the factor structure of the 39-item and 15-item versions of the Five Facet Mindfulness Questionnaire before and after mindfulness-based cognitive therapy for people with recurrent depression. *Psychological Assessment*, *28*, 791–802. https://doi.org/10.1037/pas0000263

Hancock, G. R., & Mueller, R. O. (2011). The reliability paradox in assessing structural relations within covariance structure models. *Educational and Psychological Measurement*, *71*, 306–324. https://doi.org/10.1177/0013164410384856

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, *6*, 53–60. https://doi.org/10.1037/1082-989X.12.1.58

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Huijbers, M. J., Spijker, J., Donders, A. R. T., van Schaik, D. J. F., van Oppen, P., Ruhé, H. G., … Speckens, A. E. M. (2012). Preventing relapse in recurrent depression using mindfulness-based cognitive therapy, antidepressant medication or the combination: trial design and protocol of the MOMENT study. *BMC Psychiatry*, *12*, 125. https://doi.org/10.1186/1471-244X-12-125

Jarrett, R. B., Minhajuddin, A., Borman, P. D., Dunlap, L., Segal, Z. V, Kidner, C. L., … Thase, M. E. (2012). Cognitive reactivity, dysfunctional attitudes, and depressive relapse and recurrence in cognitive therapy responders. *Behaviour Research and Therapy*, *50*, 280–286. https://doi.org/10.1016/j.brat.2012.01.008

Kim, H.-Y. (2013). Statistical notes for clinical researchers: Assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics*, *38*(1), 52–54. https://doi.org/10.5395/rde.2013.38.1.52

Li, C. H. (2016). Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behavior Research Methods*, *48*, 936–

949. https://doi.org/10.3758/s13428-015-0619-7

McDonald, R. P. (1978). Generalizability in factorable domains: Domain validity and generalizability. *Educational and Psychological Measurement*, *38*, 75–79. https://doi.org/10.1177/001316447803800111

McDonald, R. P. (1999). *Test Theory: A Unified Treatment*. New York London: Taylor & Francis.

McNeish, D. (2018). Thanks coefficient alpha, we'll take it from here. *Psychological Methods*, *23*, 412–433. https://doi.org/10.1037/met0000144

McNeish, D., An, J., & Hancock, G. R. (2018). The thorny relation between measurement quality and fit index cutoffs in latent variable models. *Journal of Personality Assessment*, *100*, 43–52. https://doi.org/10.1080/00223891.2017.1281286

McNeish, D., & Hancock, G. R. (2018, March). The effect of measurement quality on targeted structural model fit indices: A comment on Lance, Beck, Fan, and Carter (2016). *Psychological Methods23*, 184–190. https://doi.org/10.1037/met0000157

Merens, W., Booij, L., & Van der Does, A. J. W. (2008). Residual cognitive impairments in remitted depressed patients. *Depression and Anxiety*, *25*, E27–E36. https://doi.org/10.1002/da.20391

Monroe, S. M., & Harkness, K. L. (2011). Recurrence in major depression: A conceptual analysis. *Psychological Review*, *118*, 655–674. https://doi.org/10.1037/a0025190

Muthén, L. K., & Muthén, B. O. (2017). *Statistical Analysis With Latent Variables User's Guide* (8th ed.). Los Angeles, California: Los Angeles, CA: Muthén & Muthén. Retrieved from https://www.statmodel.com/download/usersguide/MplusUserGuideVer_8.pdf

Nolen-Hoeksema, S. (1987). Sex Differences in Unipolar Depression: Evidence and Theory.

Psychological Bulletin, *101*, 259–282. https://doi.org/10.1037/0033-2909.101.2.259

Ostovar, S., Md Nor, M. B., Griffiths, M. D., & Chermahini, S. A. (2017). Cognitive reactivity: Cultural adaptation and psychometric testing of the Persian version of the Leiden Index of Depression Sensitivity Revised (LEIDS-R) in an Iranian sample. *International Journal of Mental Health and Addiction*, *15*, 621–638. https://doi.org/10.1007/s11469-016-9713-z

Raes, F. (2012). Repetitive negative thinking predicts depressed mood at 3-year follow-up in students. *Journal of Psychopathology and Behavioral Assessment*, *34*, 497–501. https://doi.org/10.1007/s10862-012-9295-4

Raes, F., Dewulf, D., Van Heeringen, C., & Williams, J. M. G. (2009). Mindfulness and reduced cognitive reactivity to sad mood: Evidence from a correlational study and a non-randomized waiting list controlled study. *Behaviour Research and Therapy*, *47*, 623–627. https://doi.org/10.1016/j.brat.2009.03.007

Revelle, W., & Zinbarg, R. (2009). Coefficients alpha, beta, omega and the glb: Comments on Sijtsma. *Psychometrika*, *74*, 145–154.

Revelle, W. (2018). Using R and the psych package to find ω. Retrieved from http://personality-project.org/r/psych/HowTo/R_for_omega.pdf

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016). Evaluating bifactor models: Calculating and interpreting statistical indices. *Psychological Methods*, *21*, 137–150. https://doi.org/10.1037/met0000045

Samtani, S., & Moulds, M. L. (2017). Assessing maladaptive repetitive thought in clinical disorders: A critical review of existing measures. *Clinical Psychology Review*, *53*, 14–28. https://doi.org/10.1016/j.cpr.2017.01.007

Scher, C. D., Ingram, R. E., & Segal, Z. V. (2005). Cognitive reactivity and vulnerability:

Empirical evaluation of construct activation and cognitive diatheses in unipolar depression. *Clinical Psychology Review*, *25*, 487–510. https://doi.org/10.1016/j.cpr.2005.01.005

Segal, Z. V., Kennedy, S., Gemar, M., Hood, K., Pedersen, R., & Buis, T. (2006). Cognitive reactivity to sad mood provocation and the prediction of depressive relapse. *Archives of General Psychiatry*, *63*, 749–755. https://doi.org/10.1001/archpsyc.63.7.749

Segal, Z. V, Gemar, M., & Williams, S. (1999). Differential cognitive response to a mood challenge following successful cognitive therapy or pharmacotherapy for unipolar depression. *Journal of Abnormal Psychology*, *108*, 3–10. https://doi.org/10.1037/0021-843X.108.1.3

Senín-Calderón, C., Perona-Garcelán, S., Ruíz-Veguilla, M., & Rodríguez-Testal, J. F. (2017). Leiden Index of Depression Sensitivity-Revised (LEIDS-R): Spanish validation proposal. *International Journal of Clinical and Health Psychology*, *17*, 139–150. https://doi.org/10.1016/j.ijchp.2017.02.001

Sijtsma, K. (2009). On the use, the misuse, and the very limited usefulness of Cronbach's alpha. *Psychometrika*, *74*, 107–120. https://doi.org/10.1007/s11336-008-9101-0

Solis, E., Antypa, N., Conijn, J. M., Kelderman, H., & Van der Does, W. (2017). Psychometric properties of the Leiden Index of Depression Sensitivity (LEIDS). *Psychological Assessment*, *29*, 158–171. https://doi.org/http://dx.doi.org/10.1037/pas0000326

Steenbergen, L., Sellaro, R., Van Hemert, S., Bosch, J. A., & Colzato, L. S. (2015). A randomized controlled trial to test the effect of multispecies probiotics on cognitive reactivity to sad mood. *Brain Behavior and Immunity*, *48*, 258–264. https://doi.org/10.1016/j.bbi.2015.04.003

Van der Does, W. (2002). Cognitive reactivity to sad mood: Structure and validity of a new measure. *Behaviour Research and Therapy, 40*, 105-119. https://doi.org/10.1016/S0005-7967(00)00111-X

Van der Does, A. J. W., & Williams, M. (2003). Leiden Index of Depression Sensitivity – Revised (LEIDS-R). Retrieved from https://www.dousa.nl/leids/

Weissman, A. N. (1979). *The Dysfunctional Attitude Scale: A validation study*. (Doctoral dissertation). University of Pennsylvania. Retrieved from http://repository.upenn.edu/edissertations

WHO. (n.d.). Depression. Retrieved May 23, 2018, from http://www.who.int/en/news-room/fact-sheets/detail/depression

Williams, J. M. G., Van der Does, A. J. W., Barnhofer, T., Crane, C., & Segal, Z. S. (2008). Cognitive reactivity, suicidal ideation and future fluency: Preliminary investigation of a differential activation theory of hopelessness/suicidality. *Cognitive Therapy and Research*, *32*, 83–104. https://doi.org/10.1007/s10608-006-9105-y

Williams, M. J., Dalgleish, T., Karl, A., & Kuyken, W. (2014). Examining the factor structures of the Five Facet Mindfulness Questionnaire and the Self-Compassion Scale. *Psychological Assessment*, *26*, 407–418. https://doi.org/10.1037/a0035566

Zigmond, A. S., & Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica, 67*, 361-370. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x

Zinbarg, R. E., Revelle, W., Yovel, I., & Li, W. (2005). Cronbach's α, Revelle's β, and McDonald's ωH:Their relations with each other and two alternative conceptualizations of reliability. *Psychometrika*, *70*, 123–133. https://doi.org/10.1007/s11336-003-0974-7