Psychometric properties of the Resilience Scale for Adolescents (READ) using confirmatory factor analysis and exploratory structural equation modeling

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Abstract

Psychometric evaluations of The Resilience Scale for Adolescents (READ) have yielded inconsistent support for the original five-factor solution, with different modifications being proposed. The aim of the present paper was to investigate the psychometric properties and factor structure of the READ using both confirmatory and exploratory methods, and to evaluate how the scale fits within the theoretical framework of resilience. Data stem from the population-based youth@hordaland-study of 9382 adolescents from 16–19 years of age. Using confirmatory factor analysis (CFA), the original five-factor model yielded relatively poor fit. A better model fit was identified for a different five factor structure using exploratory methods including two new personal factors measuring (1) goal orientation and (2) self-confidence. This division was supported by low secondary loadings and moderate correlations between the factors, and gender differences in the mean scores. Although the READ is a multidimensional measure that includes individual, family and social factors related to the resilience process, some important aspects of resilience have not been included.

Keywords: resilience, adolescence, confirmatory factor analysis, exploratory structural equation modeling

Abbreviations: READ: Resilience Scale for Adolescents, RSA: Resilience Scale for Adults, EFA: Exploratory Factor Analysis, CFA: Confirmatory Factor Analysis, ICM: independent clusters model, PCA: Principal Components Analysis, ESEM: exploratory

structural equation modeling, SEM: structural equation modeling, SDQ: Strengths and Difficulties Questionnaire, FIML: Full Information Maximum Likelihood, MLR: maximum likelihood estimation with robust standard errors, TLI: Tucker-Lewis index, CFI: comparative fit index, RMSEA: root mean square error of approximation, MI: modification indices

Factor structure and psychometric properties of the Resilience Scale for Adolescents (READ).

Resilience can be defined as the process where an individual exposed to risk copes successfully and has a relatively good outcome despite risk exposure (Garmezy, Masten, & Tellegen, 1984; Luthar, Cicchetti, & Becker, 2000; Werner, 1995). Resilience thus involves reduced vulnerability to environmental stressors leading to more positive outcomes than would otherwise be expected (Rutter, 2006). Although the presence of risk is a prerequisite for the process of resilience to occur (Masten & Coatsworth, 1998), the main focus of resilience theory and research is on the protective processes and coping mechanisms that underlie positive development (Masten, 2001). Interest in the concept of resilience was sparked by large studies following children exposed to adversity over time, and demonstrating positive development in about one third of the children (Werner, 1992). A central focus was to identify common factors that characterized the children with positive development despite exposure to risk (Luthar et al., 2000).

One theoretical framework that has guided research on resilience is the notion that the resilience process is multidimensional, consisting of protective factors within the individual, in the family and in a person's broader social environment (Luthar et al., 2000; Werner, 1992). Decades of research investigating protective factors associated with resilience has yielded quite consistent findings, and Masten (2001) summarized the findings in a short list of factors associated with resilience in young people. The short list can be incorporated into the multidimensional framework, where individual factors include intelligence, problem-solving skills, self-control/emotion regulation/planfulness, motivation to succeed, self-efficacy, faith, hope, and belief that life has meaning. Protective factors in the family include effective caregiving and parenting quality. Factors in the broader social environment include close relationships with other capable adults besides parents, close friends and romantic partners. These also include more general factors, such as effective schools and neighborhoods

(Masten, 2001). When investigating resilience in adolescence, it is likely that factors related to close friends and the school context become increasingly important, in line with the developmental changes seen in this period.

Though resilience is defined as a dynamic developmental process rather than a personal trait that can be measured by a questionnaire (Fergus & Zimmerman, 2005; Luthar et al., 2000), it is possible to assess the protective factors related to the resilience process. As the process of resilience is multidimensional, the measurement instruments should include assessment of individual, family and social factors related to the resilience processes (Olsson, Bond, Burns, Vella-Brodrick, & Sawyer, 2003). The Resilience Scale for Adolescents (READ) was developed in 2006 by Hjemdal and colleagues (2006) based on the previously developed resilience scale for adults (RSA) to measure a broad, multidimensional resilience construct (Friborg, Hjemdal, Rosenvinge, & Martinussen, 2003; Hjemdal, Friborg, Martinussen, & Rosenvinge, 2001). Following content analysis of 29 articles describing characteristics related to resilience, Hjemdal and colleagues (2001) discovered 15 categories of protective factors; 1) Personal competence, 2) Self-efficacy, 3) Social support, 4) Internal locus of control, 5) Temperament, 6) Hope, 7) Stress, 8) Religion, 9) Structure and rules, 10) Social competence, 11) Problem solving skills, 12) Ego strength, 13) Education and work life, 14) Self-realization, and 15) Family. 295 statements assessing these categories were formulated, and reduced to 195 statements by removing very similar items. A questionnaire containing these statements was distributed to psychology students, and items were removed mainly on the basis of their loadings on the factors identified in a PCA. In this process, many of the original 15 categories were no longer included in the measure (Hjemdal et al., 2001).

The final version of the RSA consists of 41 statements (Friborg et al., 2003). In the construction of the READ, the wording of the items was simplified and two items that were not deemed appropriate for adolescents were removed. Further, all items were positively

formulated to ease both interpretation and completion of the questionnaire. Based on structural equation post hoc modelling and confirmatory factor analyses (CFA) a 28 item five factor structure was launched (Hjemdal et al., 2006). Like the RSA, it is originally organized into five subscales: Personal Competence, Social Competence, Structured Style, Family Cohesion and Social Resources. As the adjustments of both the RSA and the READ relied mainly on statistical findings, rather than theoretical considerations of what a resilience measure should include, it is pertinent to not only investigate the psychometric properties of the READ, but also whether the resulting measure covers the central protective factors and adheres to the theoretical framework of resilience.

Other studies investigating the psychometric properties of the READ suggest that the originally proposed factor structure could be problematic. With the exception of one Irish study (Kelly, Fitzgerald, & Dooley, 2017), all studies have found poor fit for the original 28-item five-factor solution using CFA, and many have modified the scale by removing potentially problematic items (Moksnes & Haugan, 2017; Ruvalcaba-Romero, Gallegos-Guajardo, & Villegas-Guinea, 2014; Stratta et al., 2012; Von Soest, Mossige, Stefansen, & Hjemdal, 2010). However, results have not been consistent regarding how many, and which, items should be removed. Some of these problems could related to the wording and structure of the READ. For instance, three of five items loading on the Social Support factor use the phrasing ‘friends/family’, and it is therefore not surprising that they also load on the factor Family Cohesion. Similarly, there seems to be some overlap between the Personal Competence and Structured Style factors, with items assessing goal orientation included in both factors. In addition, the Personal Competence factor includes items assessing both goal orientation and something closely resembling self-efficacy, which are two related, but distinct concepts (Bandura, 1977, 1982; Malouff et al., 1990). Thus, all items do not fit together conceptually, questioning the content validity of this factor. Though the previous

modifications have resulted in different solutions, all have included changes in this factor (Moksnes & Haugan, 2017; Ruvalcaba-Romero et al., 2014; Stratta et al., 2012; Von Soest et al., 2010).

Due to the inconsistent findings in the literature, there is clearly a need for more studies evaluating the psychometric properties of the READ (Moksnes & Haugan, 2017). However, as conducting more studies evaluating the READ by CFA could further complicate the matter, with yet another modified version, it could be more informative to investigate the structure itself using exploratory methods. Von Soest and colleagues (2010) conducted an exploratory factor analysis (EFA) where they obtained a five factor solution. Still, six items had item loadings below <.30 on the factors they were associated with (Personal Competence, Social Resources and Structured Style). It is unclear whether these are the highest loadings for these items, as the authors refer to the original factor names, but it nevertheless suggests that the factor structure could be improved.

Ruvalcaba-Romero and colleagues (2014) identified a new five factor structure when conducting principal component analysis (PCA) on the READ. The components Family Cohesion, Social Competence and Social Resources remained largely the same as in the original model. The Personal Competence component was substantially shortened from 8 to 4 items, where the remaining items seem to measure self-confidence. In addition, a new factor emerged, labeled Goal-Orientation, which consists of a combination of items from the Personal Competence and Structured Style components (items 1, 2, and 7) (Ruvalcaba-Romero et al., 2014). Stratta and colleagues (2012) identified a dimensional structure with four components when using PCA. The most important difference from the original model was the combination of the Personal Competence and Structured Style factors. However, many of the items saturated more than one component (cross-loadings >.40) (Stratta et al., 2012). It is important to emphasize that a possible limitation with these studies is that they

both use PCA instead of EFA. PCA uses the total variance of the indicators assuming measurement without error and thus has a different goal (data reduction) than EFA which focuses on extraction of common latent factors (Floyd & Widaman, 1995; Schmitt, 2011).

Even if a new factor solution is identified using exploratory methods, CFA might not be the most appropriate method to confirm the findings and evaluate measures like the READ. The independent clusters model (ICM) typically used in CFA require that each item only load on one factor, and thus does not allow for any cross-loadings where items can be related to multiple factors (Marsh, Morin, Parker, & Kaur, 2014). It has been argued that this assumption can often be too restrictive for research in psychology, where items are likely to have secondary loadings (Marsh, Ludtke, Nagengast, Morin, & Von Davier, 2013; Marsh et al., 2014). Indeed, following the EFA, Von Soest and colleagues (2010) had to make further modifications to the READ when using CFA. A solution could be to use exploratory structural equation modeling (ESEM) that integrates many of the advantages of EFA, CFA and structural equation modeling (SEM), while at the same time avoiding many of the difficulties linked to the ICM (Marsh et al., 2009). ESEM includes the flexibility of the EFA and allow for secondary loadings, while still making it possible to perform tests of measurement invariance that have traditionally been associated with CFA and SEM (Marsh et al., 2009). ESEM can have wide applicability to all disciplines of psychology that are based on the measurement of latent constructs (Marsh et al., 2010).

In addition to investigating the factor structure of the READ and the compliance of the factors with resilience theory, possible gender differences in adolescents' responses to the READ should be investigated further. Previous validations studies indicate that the READ is measurement invariant across gender (Kelly et al., 2017; Moksnes & Haugan, 2017), however, these studies only investigated invariance of the factor loadings (metric invariance). In addition, it is important to investigate whether the intercepts are also invariant, as this could

influence the validity of gender differences found for the READ factors. Another consideration is the construct validity of the READ, concerning whether the factors are associated with different outcomes as one would expect for protective factors related to resilience. The factors should, for instance, be negatively related to measures of mental health problems, as previous research has suggested (Hjemdal et al., 2006; Hjemdal, Vogel, Solem, Hagen, & Stiles, 2011; Von Soest et al., 2010).

Based on the above considerations, the main aim of the present study was to explore and validate the factor structure of the READ with the sample of 16-19 year old adolescents who participated in the youth@hordaland-study. The originally proposed structure was investigated using traditional CFA and alternative solutions were examined using exploratory methods in a split-half sample approach. Different factor solutions were compared on the basis of a scree-plot, parallel analysis, the fit indices and theoretical considerations. ESEM was used to validate the factor structure identified in the EFA in the second half of the sample. We further aimed to investigate possible gender differences in how adolescents respond to the READ and to assess construct validity. A further aim was to investigate how well the READ corresponds to the theoretical framework of resilience, and whether all important resilience domains are covered by the measure.

Methods

Data stem from the youth@hordaland-study, which was conducted in the county of Hordaland, Western Norway, in the spring of 2012. All adolescents born from 1993 to 1995 were invited to participate. Students enrolled in school received an invitation to participate, as well as login information to their school e-mail address. Adolescents outside of the school system received the same information by postal mail to their home address. The goal of the study was to gather information on a range of mental health problems, lifestyle factors,

sociodemographic factors, and health service use. The schools allocated one school hour (45 minutes) to completion of the web-based questionnaire. In addition, the adolescents could complete the questionnaire at their own convenience throughout the project period. School personnel were available during the completion in school to ensure confidentiality and answer questions. Survey staff were also available on telephone during the project period.

In accordance with Norwegian rules and regulation, the adolescents themselves consented to participate, while parents received written information about the study in advance. The study was approved by the Regional Committee for Medical and Health Research Ethics (REC) in Western Norway.

Study sample

A total of 10,257 adolescents completed the web-based questionnaire, which corresponds to a response rate of about 53% (19,430 adolescents were invited). The mean age of the participants was 17.0 and 52.7% were girls. Of the total sample, 9596 adolescents (93.6%) responded to the READ. A higher proportion of boys than girls did not complete the READ (8.2% and 4.6%, respectively, $p<0.001$), while no significant difference was found regarding age ($p=0.124$). For the purpose of exploratory analyses, the total sample (n = 9596) was randomly split into two samples (n = 4798 in each) using Stata 15 (StataCorp, 2017). The two samples contained 2624 (54.7%) and 2525 (52.6%) girls.

Measurement of resilience

The READ is a 28-item scale that is originally organized into the five subscales Personal Competence, Social Competence, Structured Style, Family Cohesion and Social Resources (Hjemdal et al., 2006). All items are positively formulated and are rated on a 5-point Likert scale ranging from ‘totally disagree’ (score of 1) to ‘totally agree’ (score of 5).

Higher scores in each of the subscales indicates a higher level of protective traits or qualities associated with resilience within a given area.

Measurement of mental health problems

Mental health problems were measured by the Strengths and Difficulties Questionnaire (SDQ). The SDQ is a brief mental health screening questionnaire for children between 4 and 16 years (Goodman, Ford, Simmons, Gatward, & Meltzer, 2000). The SDQ has good psychometric properties, also among adolescents (Bøe, Hysing, Skogen, & Breivik, 2016). It is comprised of five subscales; Emotional Problems, Conduct Problems, Hyperactivity/Inattention, Peer Problems and Prosocial Behaviors. The first four subscales constitute a composite problem score.

Statistical analyses

All analyses were conducted using Mplus version 8 (Muthén & Muthén, 1998-2017). As the READ items have five categories, the maximum likelihood estimation with robust standard errors (MLR) was used in the analyses (Rhemtulla, Brosseau-Liard, & Savalei, 2012). Full Information Maximum Likelihood (FIML) was used to handle missing data. The CFA was conducted using the entire sample from the youth@hordaland-study. Following poor fit of the CFA, EFA was conducted using a split-sample approach. The first half of the sample was used to investigate the appropriate number of factors and different factor solutions using EFA. The solutions were identified and evaluated using scree-plot, parallel analysis, fit indices and theoretical considerations. The resulting solution was tested using ESEM on the second half of the sample. The EFA and ESEM analyses were conducted using the oblique geomin rotation with an epsilon value of .5. This rotation was chosen due to the known correlations between the READ items and factors and its previous use in similar research (Marsh et al., 2010). In line with the original proposed dimensional structure, five factors

were specified for the CFA, while different solutions were explored using EFA. Following the validation analyses using the split-sample approach, Tucker's congruence coefficient was used to assess the similarity between the factors identified in the two samples. A value of .85-.94 indicated fair similarity between the factors, while a value of .95 or above implied good factor similarity (Lorenzo-Seva & ten Berge, 2006).

Model fit was assessed using the Tucker-Lewis index (TLI), the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). In the current study, TLI and CFI values greater than .90 indicate acceptable fit, while values greater than .95 reflect excellent fit to the data (Brown, 2006; Hu & Bentler, 1999). For the RMSEA, values below 0.080 were considered acceptable, while values under 0.060 were preferred, indicating a close fit to the data (Brown, 2006; Hu & Bentler, 1999).

Measurement invariance. For the ESEM model, measurement invariance of factor structure (configural invariance), in factor loadings (metric invariance) and intercepts (scalar invariance) across gender was examined using the whole sample. As the chi-square statistics are highly sensitive to sample size, ΔCFI was used to investigate measurement invariance. Comparing models where loadings and thresholds were held equal versus free to vary, a reduction in CFI (ΔCFI) of less than 0.01 suggests that the model is scalar and metric invariant (Chen, 2007; Putnick & Bornstein, 2016). For ΔCFI values above 0.01, loadings and intercepts were freed according to the modification indices (MI) for partial metric and scalar invariance, respectively, until a ΔCFI of less than 0.01 was obtained.

Results

As expected, the original 28-item, five-factor model, yielded a relatively poor model fit in terms of the CFI and TLI in the CFA (χ^2 (340) = 15052.965, p<.001, CFI = 0.870, TLI = 0.855, RMSEA = 0.067, 95% confidence interval (CI) for the RMSEA = 0.066-0.068, see

table 1). Further, the correlations between the factors were high, ranging from 0.63 to 0.88. The correlations between the factors Personal Competence and Structured Style, Personal Competence and Social Competence and Social Support and Family Cohesion were all above 0.80.

Exploratory analyses

Due to the poor fit identified for the originally proposed factor structure in the CFA, exploratory analyses were conducted in one half of the split sample to investigate the factor structure further. The scree-plot and the parallel analysis both suggested a four factor solution. In addition to this, three and five factor solutions were investigated. A three factor solution is consistent with the theoretical framework of resilience where protective factors are grouped into the dimensions: 1) family factors, 2) personal factors, and 3) factors in the broader social environment. The five factor solution was investigated as it is the originally proposed solution and has been identified in several other validation studies of the READ.

The three factor solution. The structure of the 3 factor solution is presented in table 2, and the model fit is presented in table 1. The first factor appears to be a predominantly social factor, the second factor is the original family cohesion factor with the addition of item 18 (‘In my family we have rules that simplify everyday life’), and the third factor contains personal traits. As such, the 3-factor solution is consistent with the overarching theoretical structure of protective factors associated with resilience, although there are some inconsistencies. Firstly, the social factor includes a personal item measuring goal orientation, which does not to fit conceptually with the other items. Secondly, item 16 (being good at talking to new people) had a loading above 0.40 on both the social and the personal factor. Further, there are two items measuring social aspects in the personal factor (item 16 and 22).

Four items have loadings below 0.40 on all three factors, item 2, 4, 12 and 25. Item 2 (aims and objectives) fits into the theoretical framework of resilience, measuring problem-solving skills and planfulness. Similarly, item 12 (realism) could be a coping mechanism related to self-control, and there is no theoretical reason why these two items should not be included in the measure. Item 4 (satisfied with life) seems to be a more general statement of life satisfaction that is not strictly related to the core components of protective factors, but rather an aspect of a resilient outcome. Such an interpretation is supported by the item having about equal loadings on all the factors. It is therefore less problematic that item 4 has low loadings in the three factor solution. Item 25 (good at comforting others) could be important in eliciting positive social responses from the environment. The loading of this item was close to 0.40 on the social factor (0.392).

The four factor solution. The four factor solution achieved better model fit than the three factor model, but still poor fit with regards to the TLI (see table 1). Similar to the three factor solution, it contains one personal factor and one family factor, but two social factors (see table 3). The second factor is the original Social Competence factor, while the third factor contains three of the five items from the original factor Social Support. In addition, item 1 (goal orientation) and item 10 (comfortable with my family) have loadings above .40 on this factor in addition to the first and fourth factor, respectively.

There are six items that do not have loadings above 0.40 on any of the factors in the four factor solution. Item 4 and 12 are shared with the three factor solution. Item 9 (friends stick together) could be related to social support in the friend group, while item 20 (confident in making the right choices) could be related to problem-solving skills. It is especially problematic that item 19 and item 23 have low factor loadings in the four factor solution. Item 19 (Have someone who can help) is clearly related to the important domain of social support, and item 23 (Believe in myself) is closely related to self-efficacy. There is no theoretical

reason why these items should not be included in a resilience measure, as they are both linked to central protective resources.

The five factor solution. Of the three solutions, the five factor solution yielded the best model fit and contained no cross loadings above 0.40 (see table 1 and 4). As in the original factor structure of the READ, it contains two personal factors, two social factors and a family factor, but also deviates from the original structure in several ways. The first personal factor consisted of a mixture of items from Personal Competence and Structured Style, and measured organization skills and goal orientation. The second factor was the same family factor that was identified in the 3 and 4-factor solutions. The third factor was the original Social Competence factor, with the exception of item 25 ('I always find something comforting to say to others when they are sad') which had a loading below 0.40. The fourth factor consisted of four items from the Personal Competence factor measuring self-confidence. The fifth factor was the original Social Support factor, without item 9 ('My friends always stick together'). Item 9 had a higher loading on the factor Social Competence than Social Support, but no loadings above 0.40 on any of the factors.

In addition to item 25 and 9, item 4 and 12 did not have loadings above 0.40 for any of the factors. As noted above, item 4 is more likely a resilient outcome than a protective factor, while item 12 could tap a coping mechanism related to resilience and item 9 and 25 could be indirectly related to social support. As in the tree factor solution, item 25 had a loading close to 0.40 on the factor social competence (0.347), and could contribute to how easily a person makes new friends.

Comparing the solutions. Although the four factor solution was suggested by the parallel analysis and scree-plot, it has several shortcomings. These include somewhat inadequate model fit, secondary factor loadings, and several items related to protective factors

central to the concept of resilience had factor loadings below 0.40. The three factor solution is attractive in its simplicity, with one factor measuring each of the three overarching domains of resilience. However, there are some inconsistencies in the distribution of items between the factors, limiting their content validity. Further, though it could be simplifying to collect all the personal items in one factor, it makes sense theoretically and conceptually to divide these factors into goal orientation and self-confidence as in the five factor model. Therefore, the five factor solution is the best both in terms of the model fit, the lack of cross-loadings between the factors and the adherence to the theoretical framework of resilience.

Exploratory structural equation modeling validating the five factor solution. In the ESEM validation in the second half of the sample, all 28 items of the READ were included in the same manner as in the EFA. Using ESEM to confirm the five factor solution resulted in a good model fit close to that found in the EFA, with an RMSEA of 0.053 (95% CI 0.051-0.054), χ^2 (248) = 3528.832, p<.001 , CFI = 0.942 and TLI = 0.912 (see table 1). The congruence coefficients were 0.982 for factor 1, 0.996 for factor 2, 0.984 for factor 3, 0.989 for factor 4 and 0.996 for factor 5. Further, the correlations between the identified factors were moderate (ranging from 0.30-0.50).

Measurement invariance. Multigroup ESEM based on gender were conducted for the total sample. Using the total sample, the model fit was good for the ESEM model (χ^2 (248) = 6664.987, p<.001, CFI = 0.943, TLI = 0.914, RMSEA = 0.052, 95% CI RMSEA 0.051-0.053)). Conducting the analyses for both genders separately yielded similar results, with acceptable model fit for both genders. Configural measurement invariance was investigated by a multi group model based on gender, yielding acceptable model fit close to that of the original model (χ^2 (496) = 6082.615, p<.001, CFI = 0.950, TLI = 0.924, RMSEA = 0.048, 95% CI RMSEA 0.047-0.050). Investigating metric invariance by constraining the factors loadings to be equal reduced the model fit, with a ΔCFI of 0.006, below the threshold of 0.01.

Investigating scalar measurement invariance by constraining the intercepts to be equal across gender similarly yielded a reduced model fit (χ^2 (524) = 7923.942, p<.001, CFI = 0.934, TLI = 0.905, RMSEA = 0.054, 95% CI RMSEA 0.053-0.055), with ΔCFI of 0.010, which was above the threshold. Partial measurement invariance was investigated by freeing intercepts based on the MIs. Acceptable model fit with a ΔCFI of 0.007 was obtained after freeing the intercept of item 17 ('I feel competent'). Boys had a higher intercept on item 17 compared to girls (3.895 compared to 3.525, respectively).

Gender differences in latent means

We further explored the mean differences on the factors across gender (see table 5). Loadings and intercepts were constrained to be equal across boys and girls, except for the single non-invariant item ('I feel competent') of which the intercept was free to vary across gender. The largest difference was found for the fifth factor measuring self-confidence, where boys had higher latent mean scores compared to the girls. The effect size of the difference was medium (Cohen's d= .47). There were significant differences also in the remaining factors (with the exception of factor 3 measuring social competence) with small effect sizes ranging from .11 to .27. Boys had higher scores on all the factors, with the exception of the factor Social Support where girls had higher scores (d=0.27). To explore the possible impact of the non-invariant item in the ESEM model ('I feel competent') we also conducted an analysis where the intercept was constrained to be equal on this particular item across gender. This had relatively little impact as the effect size of the gender difference on factor 4 only increased from d=0.47 to d=0.55.

Construct validity of the READ

The construct validity of the READ was investigated in the total sample, specifying an ESEM model including all 28 items of the READ. All the correlations between the SDQ

problem scales and the five READ factors were in the expected direction, with negative correlations between the READ factors and the problem scales, and a positive correlation with the scale measuring prosocial behavior (see table 6). The factors Social Competence and Social Support had higher correlations with Peer problems and Prosocial behavior compared to the other problem scales. The factor measuring Goal Orientation had the highest correlation with Hyperactivity/Inattention. The correlation with Emotional problems was highest for the Self-Confidence factor, and lower for the remaining factors.

CFA of the new factor solution

Due to the low cross loadings identified in the EFA and ESEM of the revised five factor solution, a CFA was conducted including the 24 items that had loadings above 0.40 in the EFA and ESEM. The CFA for the new five factor solution had better model fit compared to the CFA of the original solution, but inadequate fit in terms of the TLI (χ^2 (242) = 9963.602, p<.001, CFI = 0.900, TLI = 0.886, RMSEA = 0.065, 95% CI RMSEA 0.064-0.066). There were also high correlations between several of the factors (ranging from 0.626 to 0.833), similar to the results for the originally proposed factor solution. The correlations between the factors Goal Orientation and Self-Confidence and Social Support and Family Cohesion were above 0.80.

Discussion

The present study extends previous research by investigating different factor solutions of the READ using exploratory methods following poor model fit for the original five-factor, 28-item model using CFA. Comparing the three, four and five factor solutions, a better model fit as well as better compliance with the theoretical framework of resilience was identified for the five factor solution and confirmed in ESEM using a split-sample approach. A different factor structure was identified compared to the one originally proposed, including two new

personal factors based on the original factors Personal Competence and Structured Style. Measurement invariance analyses suggested metric invariance and partial scalar invariance concerning one item. The differences were small, however, and had relatively little influence on the gender difference on this particular factor. Boys had higher mean scores on the factor measuring self-confidence, with a medium effect size. The remaining effect sizes were small. The association between READ and the SDQ subscales supported the construct validity of the READ.

The present study confirms findings from previous validation studies of the READ reporting poor model fit for the originally proposed factor solution using CFA (Moksnes & Haugan, 2017; Ruvalcaba-Romero et al., 2014; Von Soest et al., 2010). These studies also concluded that modifications of the scale were necessary to achieve acceptable fit (Moksnes & Haugan, 2017; Ruvalcaba-Romero et al., 2014; Stratta et al., 2012; Von Soest et al., 2010). However, which items should be removed varied between all studies, precluding any firm conclusions. Using EFA to investigate different factor solutions, the five factor solution achieved both better model fit and a better fit with the theoretical framework of resilience compared to the tree and four factor solutions. In the original scale, the Personal Competence factor included items concerning both self-confidence and goal attainment, limiting its content validity. Both the present study and the study by Ruvalcaba-Romero and colleagues (2014) reduced this to one factor/component with focus on self-confidence, while the items concerning goal attainment were relocated to a new factor/component which also includes items from Structured Style. As previous validation studies of the READ have not agreed on the structure and items of the READ, it is uplifting that these two studies point to a similar alteration in the factor structure.

Interestingly, the correlation between these two factors was moderate (0.432), which supports the divide, and suggests that the factors measure different aspects of personal

protective factors. Further, the new factors are in line with the literature, where self-efficacy (which is closely related to self-confidence) and goal orientation are described as related, but distinct concepts (Bandura, 1977, 1982; Malouff et al., 1990) and are independently associated with academic performance (Bell & Kozlowski, 2002; Caraway, Tucker Carolyn, Reinke Wendy, & Hall, 2003; Hsieh, Sullivan, & Guerra, 2007). It is also consistent with previously identified core protective factors, where planfulness (which is related to organization skills and goal orientation) and self- efficacy (closely related to self-confidence) are considered as two distinct personal protective factors (Masten, 2001). Further, the gender difference in the latent means suggests that most of the gender difference found for the original Personal Competence factor (Hjemdal et al., 2006; Kelly et al., 2017; Von Soest et al., 2010) is due to differences in the items measuring self-confidence, as the gender difference in Goal Orientation is smaller. This is consistent with previous studies where girls score lower on the connected concept self-esteem compared to boys (Kling, Hyde, Showers, & Buswell, 1999). Similarly, the correlations with Emotional problems and Hyperactivity/Inattention differed for the factors measuring self-confidence and goal orientation, supporting their distinctiveness.

The analyses of measurement invariance showed metric and partial scalar invariance for the new five factor solution. This is similar to results of a resilience measure in the adult population (Liu, Fairweather-Schmidt, Burns, & Roberts, 2015) and in adolescence using the original READ (Kelly et al., 2017; Moksnes & Haugan, 2017). Noticeably, these studies have only investigated metric invariance, which is more often accomplished. In the analyses of partial scalar invariance in ESEM, acceptable fit was achieved after freeing one item belonging to the factor Self-Confidence. The gender differences for this factor was only slightly altered when taking this into consideration.

Correlations with an established measure of mental health problems were included to measure construct validity. In line with the hypothesis, and previous findings (Hjemdal et al., 2006; Hjemdal et al., 2011; Von Soest et al., 2010), there were negative correlations between mental health problems and the READ factors, and a positive correlation with prosocial behavior. Further, the correlations differ between the factors, in expected directions. For instance, the highest negative correlation for the factor measuring goal orientation and organizational skills was found for hyperactivity/inattention, and the highest negative correlations for social competence and social support were found for peer relationship problems and prosocial behavior. All the correlations were small to moderate. This is in line with the definition of resilience, where protective factors are not described as the direct opposite of negative outcomes, but rather factors that can modify or counteract the negative effects of risk exposure (Garmezy et al., 1984; Luthar et al., 2000; Rutter, 2006; Werner, 1995). It has been pointed out that individuals exhibiting resilience do not necessarily have as good outcomes as those not exposed to risk, and the impact of protective factors is expected to vary both according to the specific stressor the adolescents face and the outcome of interest (Fergus & Zimmerman, 2005).

A central advantage of the READ is the inclusion of all three main domains of protective factors outlined in the theoretical framework; personal, family and social. The family cohesion factor is an important part of a resilience measure for adolescents as a close relationship with a parent or other competent adult is often highlighted as the most important protective factor for child development (Masten, 2001; Werner, 1992). It is further a strength that Social Support from friends are included, as adolescents spend increasing time with peers and become gradually more independent of their parents through development (Larson & Richards, 1991; Steinberg, 1990). Still, the usefulness of the Social support factor is somewhat limited due to the phrasing family/friends in many of the items. Therefore, the

specific contribution of social support from family and friends is not clear. It would be useful if later revisions of the READ included separate items for social support from family and friends. Another important limitation is the lack of items assessing the broader context that influence the development of children and adolescents, such as effective schools and neighborhoods (Masten, 2001). This is especially troublesome in a resilience scale for adolescents as school becomes an increasingly important arena from childhood to adolescence.

Regarding the personal protective factors, it is an important improvement to distinguish between goal orientation and self-confidence. However, these two factors do not cover all important personal protective factors, and characteristics such as self-control, emotional regulation, intelligence, motivation to succeed, faith, hope and belief that life has meaning are not covered by the READ. Item 12 ('when it is impossible for me to change certain things I stop worrying about them') does not have a loading above .40 on any of the READ factors, but could be a coping mechanism related to self-control. It is possible that a separate factor measuring this coping mechanism would emerge if more items tapping it were included in the READ. Such additional items could have been lost in the statistically driven reduction of items in the development of the RSA. Including theoretical considerations in this process could have ensured that more of the 15 categories of resilience that was originally identified were kept on in the measure. Thus, while READ is the recommended resilience scale for use with adolescents (Windle, Bennett, & Noyes, 2011) and measure several of the central domains of resilience, it is clear that some important aspects have not been included.

Four items from the original 28-item READ did not have loadings above 0.40 in the new factor structure. Of note, item 25 (good at comforting others) had a loading of 0.347 on the factor social competence. It is likely that this item is indeed related to how easy it is to gain and maintain meaningful friendships, and it therefore seems to fit within this factor,

which could further elicit social support. Though the remaining three items with loadings below 0.40 do not seem to fit well in the present version of the READ, we do not recommend removing them from the READ before it is administered at the present time. Due to the inconsistencies between previous validations studies, it seems prudent that the present findings and factor structure are replicated in other samples before changes to the scale are made.

The present study suggests that ESEM could be a more suitable approach when evaluating the READ than the more traditional CFA. Though the CFA of the factor structure identified in the present study yielded better model fit compared to the original model, it was still inadequate and the ESEM model achieved better fit. Further, there were still high correlations between the factors when using CFA, underlining the usefulness of the ESEM approach.

Strengths and limitations

A central strength of the present study is the large sample size from a general population making it suitable for exploratory analyses. The within sample split-half replication enabled us to confirm that the factor structure identified in the EFA was not merely due to random noise, strengthening the findings. Previous studies have used this approach only to confirm the modifications made to the scale in CFA (Moksnes & Haugan, 2017; Von Soest et al., 2010). This is further the first study evaluating the READ with an ESEM approach.

However, the results of the study should be interpreted in light of the following limitations. The response rate on the READ was lower than the total sample in the youth@hordaland. This could be due to the placement of the READ last in a comprehensive survey. It took about 45 minutes to complete the entire questionnaire, and as the schools

allocated 45 minutes for completion, it is possible that not all the respondents had enough time to finish the questionnaire. Looking into the pattern of the responses, the majority of those who began responding responded to the entire instrument, and the missing is mostly due to adolescents who did not respond to any of the READ items.

Conclusion

The findings in the present study suggest some changes in the factor structure compared to the original model, with alterations in two factors measuring personal protective factors. The new factors measure (1) organizations skills and goal orientation and (2) self-confidence, and this division is supported by low secondary loadings between the factors and gender differences in the mean scores. It is our hope that the new factor structure discovered and validated in the present large sample will contribute to end the inconsistency which have plagued previous research on the READ.

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Table 1

Goodness-of-fit measures for the measurement models.

	Chi-square	CFI	TLI	RMSEA	95% CI
CFA					
Original 5-factor	15052.965	0.870	0.855	0.067	0.066-0.068
EFA					
3-factor solution	7507.820	0.873	0.838	0.071	0.070-0.073
4-factor solution	4974.547	0.917	0.885	0.060	0.059-0.061
5-factor solution	3448.941	0.944	0.914	0.052	0.050-0.053
ESEM					
5-factor solution	3528.832	0.942	0.912	0.053	0.051-0.054

Note: CFI: comparative fit index, TLI: Tucker-Lewis index, RMSEA: root mean square error of approximation, CI: confidence interval, CFA: confirmatory factor analysis, EFA: exploratory factor analysis, ESEM: exploratory structural equation model

Table 2

Factor structure of the 3 factor READ based on EFA.

	Item	Factor 1	Factor 2	Factor 3
1	Goal orientation	**0.416**	0.137	0.186
3	Encouragement from friends/family	**0.462**	0.372	-0.059
6	Positive social orientation	**0.660**	0.012	0.235
9	Friends stick together	**0.510**	0.112	0.137
11	Easily make friends	**0.556**	-0.122	0.349
14	Friends/family cares	**0.672**	0.289	-0.243
19	Have someone who can help	**0.416**	0.354	0.081
28	Appreciated by friends/family	**0.483**	0.355	0.041
5	Shared values in family	0.141	**0.629**	0.117
10	Comfortable with family	0.261	**0.698**	-0.108
15	Agreement in family	-0.079	**0.725**	0.182
18	Rules in family	-0.082	**0.458**	0.399
21	Common positive outlook in family	0.185	**0.580**	0.159
24	Family support	0.171	**0.752**	0.022
27	Shared activity in family	-0.020	**0.638**	0.212
7	Know how to reach goals	0.293	0.127	**0.458**
8	Planfulness	0.107	0.128	**0.463**
13	Organizational skills	0.101	0.153	**0.444**
16	Good at talking to new people	**0.416**	-0.082	**0.456**
17	Feeling competent	0.198	0.135	**0.608**
20	Confident in making the right choices	0.198	0.178	**0.505**
22	Find fun conversation topics	0.346	0.039	**0.465**
23	Believe in myself	0.030	0.163	**0.655**
26	Positive outlook despite hardship	0.080	0.146	**0.656**
2	Aims and objectives	0.315	0.091	0.258
4	Satisifed with life	0.292	0.295	0.278
12	Realism	0.064	0.074	0.337
25	Good at comforting others	0.392	0.042	0.298

Note. Loadings higher than .40 in bold. Abbreviated wording of items adapted from Von Soest et al., 2010.

Table 3

Factor structure of the 4 factor READ based on EFA.

	Item	Factor 1	Factor 2	Factor 3	Factor 4
1	Goal orientation	**0.499**	-0.009	**0.416**	-0.069
2	Aims and objectives	**0.572**	-0.041	0.302	-0.089
7	Know how to reach goals	**0.678**	0.081	0.196	0.004
8	Planfulness	**0.624**	0.023	0.033	0.064
13	Organizational skills	**0.466**	0.124	0.006	0.138
17	Feeling competent	**0.455**	0.317	-0.061	0.181
26	Positive outlook despite hardship	**0.400**	0.378	-0.122	0.246
6	Positive social orientation	0.143	**0.512**	0.395	-0.047
11	Easily make friends	0.025	**0.723**	0.195	-0.085
16	Good at talking to new people	0.012	**0.775**	0.038	0.020
22	Find fun conversation topics	0.103	**0.616**	0.037	0.140
25	Good at comforting others	0.074	**0.480**	0.155	0.078
3	Encouragement from friends/family	0.155	0.018	**0.521**	0.182
14	Friends/family cares	-0.014	0.087	**0.693**	0.069
28	Appreciated by friends/family	0.065	0.212	**0.442**	0.250
5	Shared values in family	0.175	-0.004	0.262	**0.520**
10	Comfortable with family	-0.012	-0.024	**0.432**	**0.541**
15	Agreement in family	0.082	0.017	0.065	**0.699**
18	Rules in family	0.206	0.165	-0.088	**0.509**
21	Common positive outlook in family	0.094	0.134	0.233	**0.527**
24	Family support	-0.008	0.047	0.316	**0.664**
27	Shared activity in family	0.075	0.093	0.064	**0.636**
4	Satisifed with life	0.291	0.178	0.233	0.229
9	Friends stick together	0.142	0.301	0.362	0.035
12	Realism	0.224	0.199	-0.047	0.113
19	Have someone who can help	0.055	0.231	0.367	0.278
20	Confident in making the right choices	0.399	0.289	0.038	0.198
23	Believe in myself	0.388	0.354	-0.156	0.273

Note. Loadings higher than .40 in bold. Abbreviated wording of items adapted from Von Soest et al., 2010.

Table 4

Factor structure of the 5 factor READ based on EFA.

	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1	Goal orientation	**0.508**	-0.054	0.026	0.321	0.068
2	Aims and objectives	**0.581**	-0.040	0.017	0.169	0.050
7	Know how to reach goals	**0.625**	0.031	0.098	0.070	0.183
8	Planfulness	**0.591**	0.128	0.070	-0.123	0.124
13	Organizational skills	**0.414**	0.171	0.142	-0.103	0.152
5	Shared values in family	0.237	**0.609**	0.103	0.103	-0.044
10	Comfortable with family	0.078	**0.568**	0.072	0.339	-0.078
15	Agreement in family	0.064	**0.734**	0.056	-0.016	0.083
18	Rules in family	0.092	**0.446**	0.099	-0.072	0.277
21	Common positive outlook in family	0.026	**0.412**	0.050	0.302	0.247
24	Family support	-0.035	**0.556**	0.000	0.374	0.176
27	Shared activity in family	0.007	**0.561**	0.053	0.093	0.206
6	Positive social orientation	0.220	0.033	**0.565**	0.230	-0.014
11	Easily make friends	0.064	0.010	**0.815**	0.011	-0.018
16	Good at talking to new people	-0.041	0.024	**0.716**	-0.022	0.195
22	Find fun conversation topics	-0.018	0.036	**0.450**	0.097	0.368
3	Encouragement from friends/family	0.244	0.200	0.083	**0.435**	-0.054
14	Friends/family cares	0.096	0.020	0.106	**0.708**	-0.068
19	Have someone who can help	0.025	0.167	0.147	**0.441**	0.191
28	Appreciated by friends/family	0.009	0.075	0.080	**0.599**	0.253
17	Feeling competent	0.248	0.045	0.142	0.021	**0.487**
20	Confident in making the right choices	0.235	0.070	0.135	0.113	**0.422**
23	Believe in myself	0.102	0.039	0.068	0.027	**0.682**
26	Positive outlook despite hardship	0.136	0.035	0.116	0.035	**0.638**
4	Satisifed with life	0.253	0.206	0.161	0.184	0.172
9	Friends stick together	0.203	0.079	0.347	0.248	-0.009

12	Realism	0.176	0.135	0.196	-0.117	0.127
25	Good at comforting others	0.016	0.007	0.370	0.185	0.238

Note. Loadings higher than .40 in bold. Abbreviated wording of items adapted from Von Soest et al., 2010.

Table 5

Gender differences in latent means on the READ scales.

	Females		Males			
	Mean	var	Mean	var	Cohen's d	p-value
Goal-Orientation	0.000	1.0	0.199	1.09	.20	<.001
Family Cohesion	0.000	1.0	0.112	0.72	.11	<.001
Social Competence	0.000	1.0	0.037	1.10	.04	.147
Self-Confidence	0.000	1.0	0.465	0.90	.47	<.001
Social Support	0.000	1.0	-0.271	1.36	.27	<.001

Note. var: variance

Table 6.

Correlations between SDQ problem scales and the ESEM factors.

	Emotional Problems	Conduct Problems	Hyperactivity/ Inattention	Peer Problems	Prosocial Behaviors
Self-Confidence	-0.448	-0.141	-0.243	-0.214	0.154
Goal Orientation	-0.248	-0.209	-0.330	-0.173	0.184
Social Competence	-0.297	-0.090	*-0.016* [n.s]	-0.477	0.312
Social Support	-0.111	-0.276	-0.154	-0.348	0.334
Family Cohesion	-0.252	-0.289	-0.248	-0.203	0.192

Note. All correlations are significant at the p<.001 level, except the correlation in cursive, marked with [n.s]