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Psychometric properties of the revised Norwegian dispositional resilience (hardiness) scale

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In the 30 years that have elapsed since it was first introduced, the concept of hardiness has continued to attract the attention and interest of researchers from all over the world. The purpose of this study was to examine the reliability and factor structure of a revised Norwegian hardiness scale (Dispositional Resilience Scale 15; DRS-15). Using exploratory and confirmatory factor analytic strategies with a large sample of working adults (N = 7,280), support was found for a hierarchical structure comprising a general hardiness dimension and three sub-dimensions (commitment, control, and challenge). Overall, the results support the reliability and validity of the revised DRS-15 and underscore the importance of examining the psychometric properties and cultural appropriateness of translated scales.

Key words: Personality hardiness, factor analysis, personality assessment, scale validation.

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INTRODUCTION

In their initial work, Kobasa, Maddi and colleagues (Kobasa, 1979; Kobasa, Maddi & Kahn, 1982; Kobasa, Maddi & Zola, 1983) defined hardiness as a constellation of personality characteristics that function as a resilience resource in the encounter with stressful life events. In one research article, they state that:

> Persons high in hardiness involve themselves in whatever they are doing (commitment), believe and act as if they can influence the events forming their lives (control), and consider change to be not only normal but also a stimulus to development (challenge). (Kobasa *et al*., 1983, p. 42)

As typically defined then, hardiness describes a generalized style of functioning characterized by a strong sense of commitment, control, and challenge that serves to mitigate the negative effects of stress. Empirical evidence from a variety of populations supports this notion, suggesting that hardiness protects against stress and predicts healthy functioning (Bartone, 1989; Beasley, Thompson & Davidson, 2003). Over the years, research has confirmed and expanded the original hardiness research across a number of groups, including army and police officers, nurses, teachers, emergency personnel, and professional athletes, and consistently found that hardiness moderates the stress–health relationship (Barton, Vrij & Bull, 2004; Bartone, Ursano, Wright & Ingraham, 1989; Bohle, 1997; Chan, 2003; Golby & Sheard, 2004; Zach, Raviv & Inbar, 2007). The areas of study have also expanded to include the relationship between hardiness and cardiovascular functioning (Hallas, Thornton, Fabri, Fox & Jackson, 2003), persistence to graduate among university students (Lifton, Seay, McCarly, Olive-Taylor, Seeger & Bigbee, 2006), success in sports (Maddi & Hess, 1992), and coping with discrimination and childhood abuse (Feinauer, Hilton & Callahan, 2003; Foster & Dion, 2003).

However, there has not always been consistency in how hardiness has been measured. Some researchers have used improvised or makeshift scales (e.g., Kuo & Tsai, 1986), while others have used existing scales of constructs not always theoretically appropriate to measuring hardiness (e.g., Nakano, 1990). Nevertheless, most researchers today use either some version of the Personal Views Survey (PVS; Maddi *et al*., 2006) or the Dispositional Resilience Scale (DRS; Bartone *et al*., 1989).

To date, hardiness instruments have been translated into numerous Asian, Middle-Eastern, and European languages (Maddi, 2004). Unfortunately, hardiness research outside English-speaking countries has often been hampered by measurement problems, such as lower scale and subscale reliability (e.g., Chan, 2000; Ghorbani, Watson & Morris, 2000). This was also true for the original Norwegian translation of the 15-item DRS (Bartone, Johnsen, Eid, Brun & Laberg, 2002). In order to improve the Norwegian version of the hardiness scale, more elaborate techniques for cultural test adaption were applied (Hambleton, 2005). First, a Differential Item Functioning (DIF) analysis was done on the original DRS-15 (Bartone, 1995), comparing responses across American and Norwegian samples. This revealed several items that appeared to be functioning differently across these two languages and cultures. Further analysis of these items, including interviews with bilingual samples, showed that some items and phrases carried somewhat different meanings in the Norwegian and the English. For example, one of the original commitment items used the term ‘‘worthwhile’’, as in ‘‘most of my life gets spent doing things that are worthwhile.’’ In the Norwegian, this appeared as ‘‘lønner seg’’, which was interpreted as ‘‘pays off’’ with a negative connotation of money and gambling for many respondents. This and similar problem expressions identified through the DIF analysis and interviews were rephrased so as to be comparable in the two languages. For example, the new Norwegian version of the above commitment items is ‘‘Mesteparten av mitt liv blir brukt til å gjøre ting som er meningsfulle.’’ (See Appendix for complete Norwegian version of the DRS-15.) More information on this process is available in Bartone (2008) and Bartone, Eid, Hystad, Johnsen and Laberg (2008).

The purpose of this paper is to examine and report on the psychometric properties of this revised hardiness scale. There is a lack of clarity in the literature about the structural model that underpins scales to measure hardiness. Previous factor analyses have identified both a unidimensional structure and a multidimensional structure with three factors (e.g., Bartone *et al*., 1989; Breed, Cilliers & Visser, 2006; Kobasa *et al*., 1982). This lack of consensus is further reflected in the hardiness ratings that are used for research purposes. Some researchers often report and use a total hardiness sum or composite scale, and in so doing implicitly accept a unidimensional structure (Funk, 1992). Others have analyzed the three dimensions individually, using separate subscales scores for the commitment, control and challenge dimensions (Florian, Mikulincer & Taubman, 1995). While the former approach runs the risk of losing important information regarding the contribution of each dimension in the hardiness-stress mechanism across situations, it is also in accordance with the original theoretical formulation of hardiness as a general personality style comprising three interrelated dimensions. Analyzing the dimensions separately, on the other hand, takes into account the fact that the dimensions sometimes relate differently to health outcomes (see, e.g., Florian *et al*., 1995), while not necessarily shedding much light upon the importance of the hardiness construct as a whole. Complicating matters further is the fact that early studies of the hardiness dimensions often demonstrated weak intercorrelations (Funk, 1992), suggesting the possibility that the three dimensions are separate variables rather than parts of a broader hardiness construct.

The uncertainty regarding the factor structure can be resolved, in principle, with a hierarchical model. In hierarchical models, items or indicators load on several first-order factors, which then load on one or more second-order factors. Thus, hardiness may be organized hierarchically according to the breadth of the behavior domains represented. Starting at the lowest level of the hierarchy, several characteristic styles of behavior combine to form traits or first-order factors. These first-order factors subsequently combine to constitute a broader personality dimension, the second-order factor. In the only study yet to test this proposition, Sinclair and Tetrick (2000) concluded that a hierarchical structure was superior to both a unidimensional and multidimensional model with three factors.

Thus, the primary aim of the study was to provide a test of the hierarchical structure of the revised DRS-15 in a large sample of Norwegian Armed Forces employees. We began our analyses with an exploratory factor analysis in which we tried to identify three first-order factors equivalent to the three dimensions of challenge, control, and commitment. To further explore the proposed hierarchical structure, we performed a second-order exploratory factor analysis of the correlations among the three first-order factors. Lastly, we conducted confirmatory factor analyses (CFA) to replicate and validate the proposed hierarchical model, while at the same time comparing this with a single-factor model and a model with three uncorrelated (orthogonal) factors.

We chose not to test a correlated (oblique) three-factor model. However, it is important to note that, mathematically, a hierarchical model with three first-order factors is equivalent to a model with three oblique factors. That is, the second-order model introduces no additional constraints, is not more restricted, and thus has the same number of parameters as the correlated three-factor model. Evidence of a good fit for the hierarchical CFA model is therefore also indicative of an oblique three-factor model. Thus, the choice of retaining a hierarchical model must be based on substantiated as well as statistical grounds. Many of the dominant models of normal personality are hierarchical in nature (e.g., Costa & McCrae, 1992; Watson, Clark & Harkness, 1994). Hardiness, too, can be conceived of as hierarchical, in light of its broad-based conceptualization as a ‘‘general orientation toward self and world expressive of commitment, control, and challenge’’ (Ouellette, 1993, pp. 93–94). Thus, a hierarchical structure seems to make most theoretical sense and has the advantage of both describing and summarizing the interrelations among items, in that items unite into traits with a higher-order factor accounting for both the shared communality of these traits and correlations among them (Zinbarg & Barlow, 1996).

METHOD

Participants

The sample consisted of 7,280 employees (84.2% male) from the Norwegian Armed Forces who had completed hardiness questionnaires as part of an annual personnel survey. As the sample was drawn from a general working population, participants varied greatly in age with 1,513 (20.8%) 29 years old or younger, 2,077 (28.5%) between 30 and 39 years old, 2,083 (28.6%) between 40 and 49 years old, and 1,607 (22.1%) 50 years or older.

Measure

The revised Norwegian hardiness scale consists of 15 statements with which respondents are required to indicate agreement on a four-point scale (where 0 = *not at all true*, and 3 = *completely true*). An example item is: ‘‘Most of my life gets spent doing things that are meaningful.’’ The scale contains six items that are negatively keyed. After reversing these negatively keyed items, a total hardiness score can be obtained by summing responses to all items. In addition, three subscale scores can be created by summing the relevant five items for each of the commitment, challenge, and control subscales.

Data analyses

The full sample ($N = 7{,}280$) was split randomly into two equal samples for analysis. These two samples were then analyzed using exploratory and confirmatory methods. The gender ratio was preserved when the split was made (84% men), and chi-square and independent samples *t*-tests indicated that the two samples were not significantly different from one another in respect to age and hardiness. The few missing data points (0.04%) were imputed based on maximum likelihood estimates.

First-order principal component analysis using promax rotation, second-order principal component analysis, and coefficient alpha were all conducted using SPSS 15. Multiple criteria were used to determine the number of factors to extract. The two most common decision rules, the scree-plot test and the eigenvalues-greater-than-one rule, have proven problematic, typically overestimating the number of components (Zwick & Velicer, 1986). Thus, we applied two additional decision rules, Velicer's (1976) minimum average partial (MAP) test and Horn's (1965) parallel analysis, both of which have proven superior to other methods (Zwick & Velicer, 1986).

Parallel analysis involves comparing the eigenvalues derived from actual data with the eigenvalues derived from random data. Factors are retained as long as their eigenvalues are greater than the eigenvalues derived by chance from the random data. In our analyses we generated 1,000 random data sets. The MAP test involves examining a series of partial correlation matrices. In the first matrix, the first factor is partialed out of the correlations between the variables of interest, and the average squared partial correlation from the resulting matrix is computed. In the next matrix, the first two factors are partialed out of the original correlation matrix, and the average squared partial correlation is again computed. When these computations have been repeated for as many variables as there are in the data set minus one, the average squared partial correlations are lined up, and the number of factors is determined by the step in the analysis that produced the lowest average squared partial correlation.

The CFA used maximum likelihood estimation with LISREL 8.8 software (Jöreskog & Sörbom, 1996). To provide a more stringent test of the proposed structure of the DRS-15, we further split the sample into a calibration group (n = 1,820) and a validation group (n = 1,820). The data from the calibration group was used to test the proposed hierarchical and two alternative structures of the DRS-15. The three models were as follows (see Fig. 1):

(1) *Model 1.* A single-factor model in which all items load on one hardiness factor.
(2) *Model 2.* An orthogonal three-factor model consisting of commitment, control, and challenge.
(3) *Model 3.* A hierarchical model consisting of three first-order factors (commitment, control, and challenge) and a second-order hardiness factor.

Given evidence of a plausible and well-fitting hierarchical model, the data from the validation group was then used to cross-validate this model.

RESULTS

Table 1 presents means, coefficient alphas, and intercorrelations for the scores on hardiness and the three subscales.

Exploratory factor analysis

The principal component analysis revealed the presence of four factors with eigenvalues exceeding one, explaining 27.2%, 12.1%, 11.2%, and 7.8% of the variance, respectively. An inspection of the scree-plot revealed a break after the fourth factor, also suggesting extracting four factors. However, both the parallel analysis and MAP test indicated extraction of only three factors. Current practice in parallel analysis is to compare the eigenvalues from the actual data to the eigenvalues that correspond to the desired percentile of the distribution of random eigenvalue data (typically the 95th; Cota, Longman, Holden, Fekken & Xinaris, 1993). Only the eigenvalues of the first three factors from the actual data were clearly larger than the corresponding first three 95th percentile random data eigenvalues (4.07, 1.81, and 1.68, respectively). The fourth eigenvalue from the actual data (1.17) was only slightly larger than the corresponding 95th percentile random data eigenvalue (1.13). Similarly, the smallest average squared partial correlation was 0.03, corresponding to the third factor.

Based on these results, we decided to extract three factors and proceeded to rotate the matrix obliquely. Table 2 presents the first-order factor pattern matrix for the three-factor solution after promax rotation. The three factors combined explained 50.41% of the total item variance. As can be seen in Table 2, the first factor was marked by items tapping the control dimension of hardiness, the second factor by items tapping the commitment dimension, and the third factor by items tapping the challenge dimension. With three exceptions all items belonging to the same subscale of the DRS-15 loaded together on a common factor. The control item "I

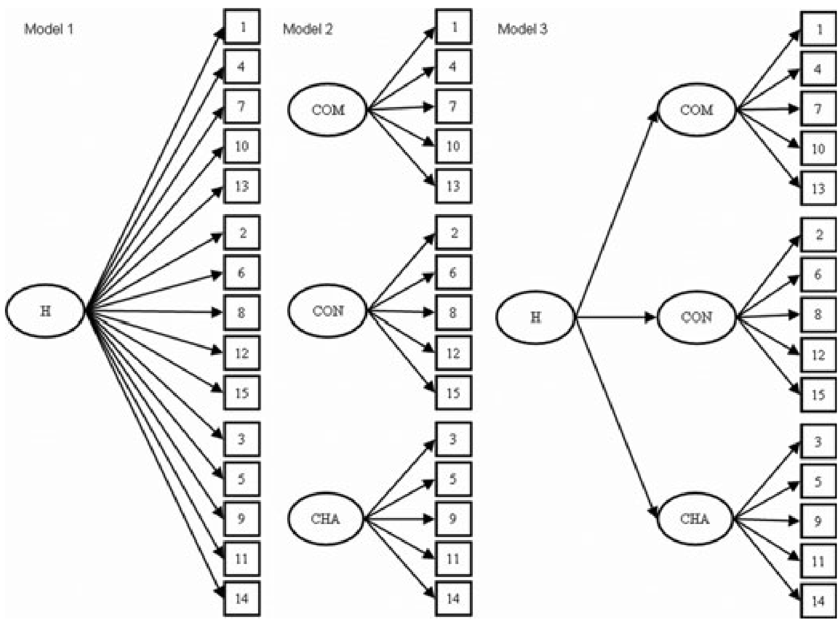

Fig. 1. Confirmatory factor analytic models tested in this study.
Notes: Model 1, single-factor model; Model 2, orthogonal three-factor model; Model 3, hierarchical model; H, hardiness; CON, control; CHA, challenge; COM, commitment. Item error terms were omitted from the models for space and clarity.

Table 1. *Means (SD), intercorrelations, and coefficient alphas for scores on hardiness and subscales*

Variable	1	2	3	4
1. Hardiness	**0.79**			
2. Commitment	0.75**	**0.76**		
3. Challenge	0.69**	0.27**	**0.62**	
4. Control	0.77**	0.40**	0.29**	**0.74**
M	31.60	10.79	9.91	10.90
SD	5.34	2.40	2.31	2.52

** $p < 0.01$, two-tailed.
Note: Coefficient alphas are presented in boldface along the diagonal.

don't think there's much I can do to influence my own future" and the challenge item "I enjoy the challenge when I have to do more than one thing at a time" both had their largest factor loading on a different factor than the other items belonging to their respective subscales. The challenge item "Changes in routine are interesting to me" loaded 0.40 on both the factor tapping the challenge dimension and the factor tapping the control dimension.

Next, the first-order factor correlation matrix was factor analyzed; resulting in one higher-order factor (the eigenvalues equaled 1.50, 0.88, and 0.62). The loadings of the three first-order factors on the higher-order factor were 0.76, 0.79, and 0.54, respectively. Table 3 presents the factor loadings on the higher-order factor and the three first-order factors after a Schmid–Leiman transformation was applied. The Schmid–Leiman transformation divides the variance of each item into that part that can be accounted for by higher-order factors and that part that can be accounted for by second-order factors, thus allowing an examination of the relative and independent impact of both first-order and second-order factors on the primary variables.

The results depicted in Table 3 seem to support the validity of a more general, higher-order factor. The general factor accounted for 52.6% of the variance explained, and all 15 DRS items had loadings of 0.30 or greater on it. According to Gorsuch (1983, p. 253), a general factor is of "definite interest" if it contributes between 40% and 50% of the extracted variance. Regarding the factor loadings in Table 3, one further point is worth noticing. The two items found in the first-order factor analysis not to load on their anticipated first-order factor seemed to be more related to the general factor than any of the first-order factors. Both items loaded relatively high on the general factor (0.47 and 0.57 for the control and challenge item, respectively), and only 0.24 on their respective first-order factors.

Confirmatory factor analysis

To assess model fit, we examined the comparative fit index (CFI), the goodness of fit index (GFI), the incremental fit index (IFI), and the standardized root mean square residual (SRMR). Generally, a CFI, GFI, and IFI ≥ 0.90 and SRMR ≤ 0.08 indicate good model fit (Hu & Bentler, 1999; Kline, 1998). We placed less importance on the traditional χ^2 statistic when judging model fit. The χ^2 statistic is conservative and sensitive to sample size, and it tends to yield substantial values when the sample size is large (Bentler & Bonnet, 1980). Thus, findings of well-fitting models based on the χ^2 statistic (i.e. a non-significant χ^2 value) are often unrealistic when working with large samples.

When fitting the models, the modification indices provided by LISREL suggested that one should allow an error covariance between the two commitment items "I feel that my life is somewhat empty of meaning" and "life in general is boring for me." Error correlation between item pairs can be justified because it often indicates perceived redundancy in item content or repre-

Table 2. *First-order pattern matrix for the dispositional resilience scale after promax rotation*

	Factor		
Item	1	2	3
2. By working hard you can nearly always achieve your goals	**0.64**	0.08	–0.03
6. How things go in my life depends on my own actions	**0.79**	–0.02	–0.07
8. I don't think there's much I can do to influence my own future	0.23	0.18	**0.28**
12. It is up to me to decide how the rest of my life will be	**0.81**	–0.07	–0.01
15. My choices make a real difference in how things turn out in the end	**0.80**	–0.03	–0.01
1. Most of my life gets spent doing things that are meaningful	0.19	**0.64**	–0.17
4. I feel that my life is somewhat empty of meaning	–0.21	**0.78**	0.09
7. I really look forward to my work activities	0.21	**0.62**	–0.08
10. Most days, life is really interesting and exciting for me	0.15	**0.74**	–0.05
13. Life in general is boring for me	–0.20	**0.79**	0.12
3. I don't like to make changes in my regular activities	–0.01	–0.05	**0.75**
5. Changes in routine are interesting to me	**0.40**	–0.13	**0.40**
11. It bothers me when my daily routine gets interrupted	–0.13	0.11	**0.63**
9. I enjoy the challenge when I have to do more than one thing at a time	**0.37**	0.19	0.29
14. I like having a daily schedule that doesn't change very much	0.00	–0.05	**0.79**
Eigenvalue after rotation	3.34	3.19	2.16
Factor correlations			
Factor 1	—		
Factor 2	0.37	—	
Factor 3	0.15	0.19	—

Note: Boldface indicates the highest factor loading of each item.

Table 3. *First-order and second-order factor loadings after Schmid–Leiman solution*

Item	Second-order factor	First-order factor		
	General	1	2	3
2. By working hard you can nearly always achieve your goals	0.54	**0.42**	0.05	–0.03
6. How things go in my life depends on my own actions	0.54	**0.51**	–0.01	–0.06
8. I don't think there's much I can do to influence my own future	0.47	0.15	0.11	**0.24**
12. It is up to me to decide how the rest of my life will be	0.56	**0.53**	–0.04	–0.01
15. My choices make a real difference in how things turn out in the end	0.58	**0.52**	–0.02	–0.01
1. Most of my life gets spent doing things that are meaningful	0.56	0.12	**0.39**	–0.14
4. I feel that my life is somewhat empty of meaning	0.50	–0.14	**0.48**	0.07
7. I really look forward to my work activities	0.60	0.13	**0.38**	–0.07
10. Most days, life is really interesting and exciting for me	0.67	0.10	**0.46**	–0.04
13. Life in general is boring for me	0.53	–0.13	**0.49**	0.10
3. I don't like to make changes in my regular activities	0.36	–0.01	–0.03	**0.63**
5. Changes in routine are interesting to me	0.42	0.26	–0.08	**0.34**
11. It bothers me when my daily routine gets interrupted	0.33	–0.08	0.07	**0.53**
9. I enjoy the challenge when I have to do more than one thing at a time	0.57	0.23	0.11	**0.24**
14. I like having a daily schedule that doesn't change very much	0.39	0.00	–0.03	**0.66**
% Variance explained	52.6	15.8	13.4	18.2

Note: Boldface indicates the highest first-order loading of each item.

sents non-random error due to method effects (Byrne, Baron & Campbell, 1993). On these grounds, we considered it theoretically justified to include an error correlation between said items because both are negatively keyed and similar in content (the two items appear to elicit responses reflecting the same mental set).

The CFA confirmed that the hierarchical model containing three first-order factors and a second-order factor provided a better fit to the data than did either the one-factor model or the orthogonal three-factor model. As indicated in Table 4, only the hierarchical model provided an acceptable fit to the data, as indicated by the goodness of fit indices (CFI = 0.92, GFI = 0.93, IFI = 0.92, and SRMR = 0.068). However, two of the problem items from the EFA reappeared in this analysis. As the EFA had indicated, both the control item "I don't think there's much I can do to influence my own future" and the challenge item "I enjoy the challenge when I have to do more than one thing at a time" tended to exhibit substantial cross-loadings on the other factors. For instance, the modification indices reported by LISREL informed of substantial increases in fit if the items were allowed to cross-load on the other factors. The final hierarchical model is presented in Fig. 2 with its standardized parameter estimates.

Having identified the hierarchical model as the best fitting model, we then proceeded to determine whether the higher-order, general hardiness factor could be regarded as a coherent factor. Specifically, we subjected the model solution to a Schmid–Leiman transformation and estimated the total test variance accounted for by the general factor. The ratio of this variance to the variance explained by all indicators provides an estimate of the general factor saturation (GFS; Zinbarg, Barlow & Brown, 1997). Zinbarg *et al*. (1997) have suggested that values above 0.50 are consistent with a coherent factor. The GFS in the present study was 0.67, suggesting that the second-order hardiness factor truly is a general factor.

To address the issue of cross-validation of the findings from the calibration sample, the hierarchical model was tested for invariance across the validation group. To achieve this, a multi-group CFA model, in which the first-order and second-order factor loadings were constrained to equality for the calibration and validation groups, was compared with a baseline model in which all parameters were allowed to vary between groups. Traditionally, a non-significant difference in χ^2 ($\Delta\chi^2$) between models is considered evidence of the tenability of the imposed constraints. However, like χ^2 tests of overall model fit, the $\Delta\chi^2$ test has been shown to be sensitive to sample size (Kelloway, 1995). Thus, in large samples, the $\Delta\chi^2$ tends to yield significant values even for trivial differences between groups. In the present data, the $\Delta\chi^2$ value was 29.48 with 18 degrees of freedom, which is significant ($p = 0.04$). For the reason outlined above, Cheung and Rensvold (2002) have

Table 4. *Confirmatory factor analysis of DRS-15*

Models[a]	df	χ^2	CFI	GFI	IFI	SRMR
1. One-factor	89	2848.08***	0.80	0.83	0.80	0.091
2. Orthogonal three-factor	89	1543.53***	0.88	0.90	0.88	0.90
3. Hierarchical[b]	86	1038.99***	0.92	0.93	0.92	0.068

CFI, comparative fit index; GFI, goodness of fit index; IFI, incremental fit index; SRMR, standardized root mean square residual.
[a] All models contained a correlation between the error terms of two items.
[b] The hierarchical model contained three first-order factors that each load on a single second-order factor.
*** $p < 0.001$.

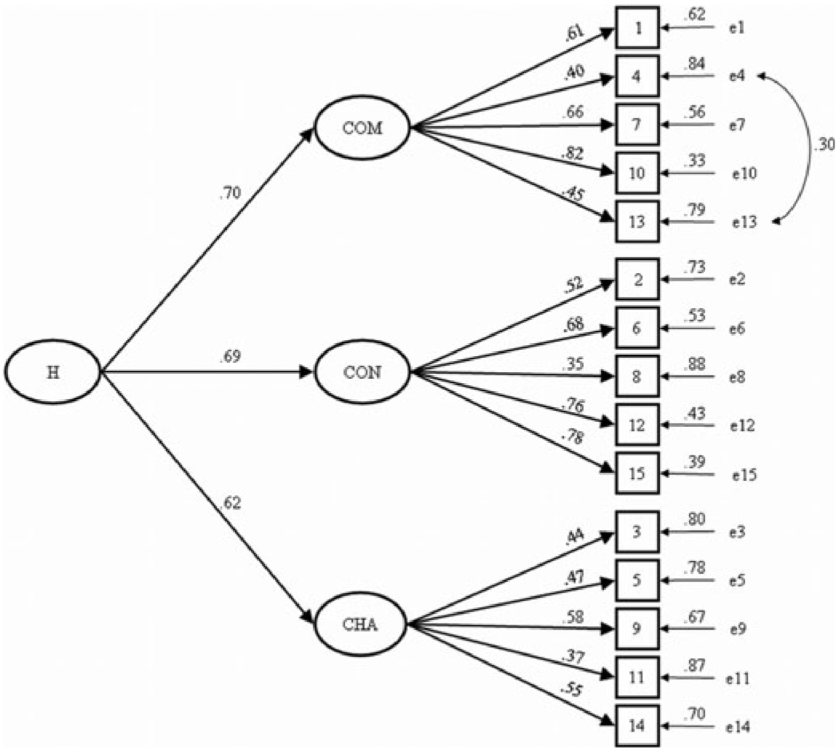

Fig. 2. Hierarchical model of DRS-15, with χ^2 = 1038.99 (df = 86, p < 0.001), CFI = 0.92, GFI = 0.93, IFI = 0.92, and SRMR = 0.068.
Notes: All factor loadings are standardized and statistically significant at p < 0.001. H, hardiness; CON, control; CHA, challenge; COM, commitment; CFI, comparative fit index; GFI, goodness of fit index; IFI, incremental fit index; SRMR, standardized root mean square residual.

recommended using the difference in goodness of fit indices instead. Specifically, they demonstrated that both the difference in CFI (ΔCFI) and MacDonald's (1989) noncentrality index (ΔNCI) were robust statistics relatively unaffected by sample size. Based on these recommendations, the hierarchical model was considered to cross-validate satisfactorily across the validation sample. The ΔCFI of 0.0006 and ΔNCI of 0.001 in the present data were well below the recommended cutoff values of 0.01 and 0.02, respectively.

DISCUSSION

The present study reports the first results from a psychometric evaluation of a new and revised Norwegian hardiness measure. The hardiness construct is important and still pertinent in the stress-health field. When researchers use hardiness scales cross-culturally, they often neglect the issue of whether hardiness measures may need to be altered to fit the group being studied. That is, hardiness measures are often simply translated without further construct validation or considerations about the appropriateness of the scale to the particular culture. This frequently results in unsatisfactory measures and failure to support the proposed hypotheses. Such practices may in fact produce a prevailing opinion that there is no relationship between hardiness and relevant outcomes in situations where one actually exists. If we want to further elucidate the construct of hardiness, we need instruments that reliably and validly measure the construct in different cultures.

We propose that the revised DRS-15 is a reliable and valid scale of importance to researchers interested in conducting hardiness research in a Norwegian setting. The results from our study demonstrate that the scale has satisfactory internal consistency, as evident in Cronbach's alphas within the range typically reported for the 15-item scale and subscales (usually in the 0.60–0.70 range; e.g., Bartone, Roland, Picano & Williams, 2008; Britt, Adler & Bartone, 2001). Using both exploratory and confirmatory approaches, we demonstrated that the DRS-15 could best be represented as a hierarchical structure comprising a general hardiness dimension and the three sub-dimensions of commitment, control, and challenge.

In addition, this study also provides evidence of the cross-validity of the proposed model.

As previously noted, a hierarchical model is statistically equivalent to an oblique three-factor model. The exact same fit obtained for the hierarchical model in this study would be obtained for an oblique model as well, and thus there are no statistical reasons for preferring one model over the other. A hierarchical model will, however, be more parsimonious if more factors are added (i.e. fewer parameters to estimate). According to Ouellette (1993), the three hardiness dimensions were not intended to fully describe the construct. Thus, the construct of hardiness is thought to comprise additional aspects, and it is plausible that further dimensions or factors can be added in the future. For example, Bartone and colleagues (2008) have suggested that the hardy person is also characterized by future-orientation, a readiness to use humor, and a willingness to forgive or let go.

Of course, the mere demonstration of the presence of a second-order factor does not sufficiently prove the existence of a general hardiness factor, nor does it sufficiently justify deriving a sum score from the items to represent it. What is needed is proof that the general factor actually accounts for a substantial amount of the variance explained, which in the current study was estimated by the general factor saturation. This estimate indicated that the general hardiness factor explained over two thirds of the variance accounted for by the model, suggesting that the factor essentially is a coherent construct. In practice, this implies that using a total score of the item set as an indicator of hardiness can be justified.

However, evidence supporting the existence of a higher-order hardiness factor should not be interpreted as a rejection of the other, lower level factors. It may be that one level has a more important part in some phenomena whereas a second level is more important for other phenomena. For example, when investigating the effects of hardiness under highly stressful circumstances such as military training exercises, the challenge dimension may provide more information than the general hardiness factor (see, e.g., Eid, Johnsen, Saus & Risberg, 2004; Eid & Morgan, 2006). There may also be instances when it would make more sense to examine and focus on the individual dimensions rather than the global construct. One case in point is the current interest in developing training programs with a view to increasing hardiness. Researchers in such diverse areas as sports, palliative care, and officer training have expressed a need for intervention programs to increase hardiness levels and ensure effective functioning in individuals (Ablett & Jones, 2007; Golby & Sheard, 2004; Zach *et al*., 2007). Conceptualizing hardiness as broad personality style comprising three more specific factors makes it easier to tailor development programs aimed at increasing hardiness. The more specific sub-dimensions may provide a better starting point for developing the resilient style of hardiness than a more general and global dimension.

With that said, some caution is also advisable when using scores from the subscales. Both the exploratory and confirmatory analyses showed that one challenge and one control item did not load consistently on their respective factors. Results from our analyses suggest that these two items reflected the general hardiness factor to a degree that they perhaps should not be considered as "good" indicators of their respective dimensions or first-order factors in this sample. Thus, when using subscales researchers may want to consider including only those items that actually measure the intended dimension.

A final caveat is warranted in interpreting the findings from this study. One could argue that the sample of Norwegian Armed Forces employees in our study is not representative of the general population. It is not implausible that soldiers and people working in the armed forces differ on a number of characteristics pertinent to the hardiness construct. However, it should be stressed that this sample was drawn from all employees working in the Norwegian Armed Forces, and not exclusively active duty soldiers. Thus, the sample includes civilian employees as well (e.g., engineers and technicians), and one could therefore argue that it resembles a general working population as much as a population of soldiers. Unfortunately we did not have information that could be used to separate civilian and military employees, and thus could not examine any differences between these, or any other, groups.

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REFERENCES

Ablett, J. R. & Jones, R. S. P. (2007). Resilience and well-being in palliative care staff: A qualitative study of hospice nurses' experience of work. *Psycho-Oncology*, *16*, 733–740.

Barton, J., Vrij, A. & Bull, R. (2004). Shift patterns and hardiness: Police use of lethal force during simulated incidents. *Journal of Police and Criminal Psychology*, *19*, 82–89.

Bartone, P. T. (1989). Predictors of stress-related illness in city bus drivers. *Journal of Occupational and Environmental Medicine*, *31*, 657–663.

Bartone, P. T. (1995). A short hardiness scale. Paper presented at the Annual Convention of the American Psychological Society, New York, July.

Bartone, P. T. (2008). *International adaption of a brief human resiliency (hardiness) scale*. Manuscript in preparation.

Bartone, P. T., Eid, J., Hystad, S., Johnsen, B. H. & Laberg, J. C. (2008). Norwegian adaptation of the DRS – Dispositional Resilience Scale for measuring hardiness under stress. Poster presented at the American Psychological Association annual convention, Boston, MA, August.

Bartone, P. T., Johnsen, B. H., Eid, J., Brun, W. & Laberg, J. C. (2002). Factors influencing small-unit cohesion in Norwegian Navy officer cadets. *Military Psychology*, *14*, 1–22.

Bartone, P. T., Roland, R. R., Picano, J. J. & Williams, T. J. (2008). Psychological hardiness predicts success in US Army Special Forces candidates. *International Journal of Selection and Assessment*, *16*, 78–81.

Bartone, P. T., Ursano, R. J., Wright, K. M. & Ingraham, L. H. (1989). The impact of a military air disaster on the health of assistance workers – A prospective study. *Journal of Nervous and Mental Disease*, *177*, 317–328.

Beasley, M., Thompson, T. & Davidson, J. (2003). Resilience in response to life stress: The effects of coping style and cognitive hardiness. *Personality and Individual Differences*, *34*, 77–95.

Bentler, P. M. & Bonnnet, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*, 588–606.

Bohle, P. (1997). Does "hardiness" predict adaptation to shiftwork? *Work and Stress*, *11*, 369–376.

Breed, M., Cilliers, F. & Visser, D. (2006). The factor structure of six salutogenic constructs. *SA Journal of Industrial Psychology*, *32*, 74–87.

Britt, T. W., Adler, A. B. & Bartone, P. T. (2001). Deriving benefits from stressful events: The role of engagement in meaningful work and hardiness. *Journal of Occupational Health Psychology*, *6*, 53–63.

Byrne, B. M., Baron, P. & Campbell, T. L. (1993). Measuring adolescent depression: Factorial validity and invariance of the Beck Depression Inventory across gender. *Journal of Research on Adolescence*, *3*, 127–143.

Chan, D. W. (2000). Dimensionality of hardiness and its role in the stress-distress relationship among Chinese adolescents in Hong Kong. *Journal of Youth and Adolescence*, *29*, 147–161.

Chan, D. W. (2003). Hardiness and its role in the stress-burnout relationship among prospective Chinese teachers in Hong Kong. *Teaching and Teacher Education*, *19*, 381–395.

Cheung, G. W. & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, *9*, 233–255.

Costa, P. T. & McCrae, R. R. (1992). Four ways five factor are basic. *Personality and Individual Differences*, *13*, 653–665.

Cota, A. A., Longman, R. S., Holden, R. R., Fekken, G. C. & Xinaris, S. (1993). Interpolating 95th percentile eigenvalues from random data: An empirical example. *Educational and Psychological Measurement*, *53*, 585–596.

Eid, J., Johnsen, B. H., Saus, E. R. & Risberg, J. (2004). Stress and coping in a week-long disabled submarine exercise. *Aviation, Space, and Environmental Medicine*, *75*, 616–621.

Eid, J. & Morgan, C. A. (2006). Dissociation, hardiness, and performance in military cadets participating in survival training. *Military Medicine*, *171*, 436–442.

Feinauer, L. L., Hilton, H. G. & Callahan, E. H. (2003). Hardiness as a moderator of shame associated with childhood sexual abuse. *American Journal of Family Therapy*, *31*, 65–78.

Florian, V., Mikulincer, M. & Taubman, O. (1995). Does hardiness contribute to mental health during a stressful real-life situation: The roles of appraisal and coping. *Journal of Personality and Social Psychology*, *68*, 687–695.

Foster, M. D. & Dion, K. L. (2003). Dispositional hardiness and women's well-being relating to gender discrimination: The role of minimization. *Psychology of Women Quarterly*, *27*, 197–208.

Funk, S. C. (1992). Hardiness – A review of theory and research. *Health Psychology*, *11*, 335–345.

Ghorbani, N., Watson, P. J. & Morris, R. J. (2000). Personality, stress and mental health: Evidence of relationships in a sample of Iranian managers. *Personality and Individual Differences*, *28*, 647–657.

Golby, J. & Sheard, M. (2004). Mental toughness and hardiness at different levels of rugby league. *Personality and Individual Differences*, *37*, 933–942.

Gorsuch, R. L. (1983). *Factor analysis* (2nd edn). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hallas, C. N., Thornton, E. W., Fabri, B. M., Fox, M. A. & Jackson, M. (2003). Predicting blood pressure reactivity and heart rate variability from mood state following coronary artery bypass surgery. *International Journal of Psychophysiology*, *47*, 43–55.

Hambleton, R. K. (2005). Issues, designs, and technical guidelines for adapting tests into multiple languages and cultures. In R. K. Hambleton, P. F. Merenda & C. D. Spielberger (Eds.), *Adapting Educational and Psychological Tests for Cross-Cultural Assessment* (pp. 3–38). Mahwah, NJ: Lawrence Erlbaum Associates.

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, *30*, 179–185.

Hu, L. & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55.

Jöreskog, K. G. & Sörbom, D. (1996). *LISREL 8: Users' reference guide*. Chicago: Scientific Software International.

Kelloway, E. K. (1995). Structural equation modeling in perspective. *Journal of Organizational Behavior*, *16*, 214–224.

Kline, R. B. (1998). *Principles and practice of structural equation modeling*. New York: The Guilford Press.

Kobasa, S. C. (1979). Stressful life events, personality, and health – Inquiry into hardiness. *Journal of Personality and Social Psychology*, *37*, 1–11.

Kobasa, S. C., Maddi, S. R. & Kahn, S. (1982). Hardiness and health – A prospective study. *Journal of Personality and Social Psychology*, *42*, 168–177.

Kobasa, S. C., Maddi, S. R. & Zola, M. A. (1983). Type-A and hardiness. *Journal of Behavioral Medicine*, *6*, 41–51.

Kuo, W. H. & Tsai, Y. M. (1986). Social networking, hardiness and immigrant's mental-health. *Journal of Health and Social Behavior*, *27*, 133–149.

Lifton, D., Seay, S., McCarly, N., Olive-Taylor, R., Seeger, R. & Bigbee, D. (2006). Correlating hardiness with graduation persistence. *Academic Exchange Quarterly*, *10*, 277–282.

MacDonald, R. P. (1989). An index of goodness-of-fit based on noncentrality. *Journal of Classification*, *6*, 97–103.

Maddi, S. R. (2004). Hardiness: An operationalization of existential courage. *Journal of Humanistic Psychology*, *44*, 279–298.

Maddi, S. R. & Hess, M. J. (1992). Personality hardiness and success in basketball. *International Journal of Sport Psychology*, *23*, 360–368.

Maddi, S. R., Harvey, R. H., Khoshaba, D. M., Lu, J. L., Persico, M. & Brow, M. (2006). The personality construct of hardiness, III: Relationships with repression, innovativeness, authoritarianism, and performance. *Journal of Personality*, *74*, 575–597.

Nakano, K. (1990). Hardiness, Type-A behavior, and physical symptoms in a Japanese sample. *Journal of Nervous and Mental Disease*, *178*, 52–56.

Ouellette, S. C. (1993). Inquiries into hardiness. In L. Goldberger & S. Breznitz (Eds.), *Handbook of stress. Theoretical and clinical aspects* (2nd edn). New York: The Free Press.

Sinclair, R. R. & Tetrick, L. E. (2000). Implications of item wording for hardiness structure, relation with neuroticism, and stress buffering. *Journal of Research in Personality*, *34*, 1–25.

Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika*, *41*, 321–327.

Watson, D., Clark, L. A. & Harkness, A. R. (1994). Structures of personality and their relevance to psychopathology. *Journal of Abnormal Psychology*, *103*, 18–31.

Zach, S., Raviv, S. & Inbar, R. (2007). The benefits of a graduated training program for security officers on physical performance in stressful situations. *International Journal of Stress Management*, *14*, 350–369.

Zinbarg, R. E. & Barlow, D. H. (1996). Structure of anxiety disorders: A hierarchical model. *Journal of Abnormal Psychology*, *105*, 181–193.

Zinbarg, R. E., Barlow, D. H. & Brown, T. (1997). The hierarchical structure and general factor saturation of the Anxiety Sensitivity Index: Evidence and implications. *Psychological Assessment*, *9*, 277–284.

Zwick, W. R. & Velicer, W. F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin*, *99*, 432–442.

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APPENDIX

The revised Norwegian 15-item Dispositional Resilience Scale (DRS-15)

Item	Norwegian	English
1	Mesteparten av mitt liv blir brukt til å gjøre ting som er meningsfulle (CM).	Most of my life gets spent doing things that are meaningful (CM).
2	Ved å arbeide hardt kan du nesten alltid nå dine mål (CO).	By working hard you can nearly always achieve your goals (CO).
3	*Jeg liker ikke å gjøre endringer i mine vanlige aktiviteter (CH).	*I don't like to make changes in my regular activities (CH).
4	*Jeg føler at livet mitt er ganske innholdsløst (CM).	*I feel that my life is somewhat empty of meaning (CM).
5	Endringer i rutinene er interessante for meg (CH).	Changes in routine are interesting to me (CH).
6	Hvordan det går med meg i livet, avhenger av mine egne handlinger (CO).	How things go in my life depends on my own actions (CO).
7	Jeg ser virkelig frem til arbeidet mitt (CM).	I really look forward to my work activities (CM).
8	*Jeg tror ikke det er mye jeg kan gjøre for å påvirke fremtiden min (CO).	*I don't think there's much I can do to influence my own future (CO).

APPENDIX: *Continued.*

9	Jeg trives med utfordringen når jeg må gjøre mer enn en ting om gangen (CH).	I enjoy the challenge when I have to do more than one thing at a time (CH).
10	De fleste dager er livet virkelig interessant og givende for meg (CM).	Most days, life is really interesting and exciting for me (CM).
11	*Det plager meg når jeg blir forstyrret i mine daglige gjøremål (CH).	*It bothers me when my daily routine gets interrupted (CH).
12	Det er opp til meg å avgjøre hvordan resten av mitt liv skal bli (CO).	It is up to me to decide how the rest of my life will be (CO).
13	*Livet er generelt kjedelig for meg (CM).	*Life in general is boring for me (CM).
14	*Jeg liker å ha en daglig rutine som ikke endrer seg for mye (CH).	*I like having a daily schedule that doesn't change very much (CH).
15	Mine valg spiller en stor rolle for hvordan ting ender opp (CO).	My choices make a real difference in how things turn out in the end (CO).

Instructions:

Nedenfor følger noen påstander om livet som folk vil oppfatte ulikt. Vennligst indiker i hvor stor grad du synes hver påstand stemmer. Gi uttrykk for din oppriktige mening. Det er ingen rette eller gale svar.
Svaralternativer som følger: 0 = Slett ikke riktig; 1 = Litt riktig; 2 = Ganske riktig; 3 = Fullstendig riktig.
[Below are statements about life that people often feel differently about. Please show how much you think each one is true. Give your own honest opinion. There are no right or wrong answers.
Response options: 0 = Not at all true; 1 = A little true; 2 = Quite true; 3 = Completely true.]

Scoring:

Asterisks indicate items that are negatively keyed and are reversed before scoring (0 = 3; 1 = 2; 2 = 1; 3 = 0). To obtain scale and subscale scores, sum responses to items and appropriate subscale items.
CM, commitment; CO, control; CH, challenge.