Separating Common from Unique Variance Within Emotional Distress: An Examination of Reliability and Relations to Worry

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**Abstract**

High comorbidity rates among emotional disorders have led researchers to examine transdiagnostic factors that may contribute to shared psychopathology. This study utilized bifactor modeling to evaluate the common and unique variance between depression, anxiety, and stress and their subsequent relations to worry. First, the bifactor model of the Depression Anxiety and Stress Scale (DASS) was replicated and the reliabilities of the resulting general Emotional Distress and domain-specific Depression, Anxiety, and Stress factors were examined. Next, structural models were tested to examine which of the general and domain-specific factors were incremental predictors of Worry. Results suggested the DASS bifactor model is generalizable to a U.S. community sample and the general Emotional Distress factor accounts for most of the reliable variance in item scores. Although caution should be taken when interpreting the domain-specific factor variances, results supported the notion that worry is a transdiagnostic factor that is strongly predicted by non-specific emotional distress.

*Key Words:* bifactor, tripartite, comorbidity, transdiagnostic, worry

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The comorbidity of emotional disorders (i.e., mood and anxiety disorders) has been well established (Brown, Campbell, Lehman, Grisham, & Mancill, 2001; Kaufman & Charney, 2000; Kessler et al., 2003). Furthermore, the diagnosis of comorbid emotional disorders has been associated with increased impairment and social costs over and above that of a single mood or anxiety diagnosis (Brown et al., 2001). This has led to a greater emphasis on examining plausible factors that may be common to, or shared by, anxiety and mood disorders (Barlow, Allen, & Choate, 2004). These common, or transdiagnostic factors, are shared between multiple forms of psychopathology, contributing to specific disorders as well as comorbidity between disorders. Increased empirical understanding of these factors is both theoretically and clinically important as new therapeutic interventions are developed to address comorbidity and, more specifically, these transdiagnostic factors (Drost, van der Does, van Hemert, Penninx, & Spinhoven, 2014; Fisher, 2015).

Transdiagnostic factors that have been evaluated to date include general worry, rumination, avoidance (Chen, Liu, Rapee, & Pillay, 2013; McEvoy & Brans, 2013; McEvoy, Watson, Watkins, & Nathan; 2013), and post-event processing (McEvoy, Mahoney, & Moulds, 2010). Worry has specifically been defined as a cognitive avoidance response consisting of repetitive, uncontrollable, negatively-valenced cognitions and has been associated, primarily, with anxiety (e.g., Generalized Anxiety Disorder; Clark & Beck, 2010; McEvoy et al., 2010). Rumination, on the other hand, has been defined as behavioral and cognitive attention on one’s depressive symptoms and their meaning and has therefore primarily been associated with depression (e.g., Major Depressive Disorder; McEvoy et al., 2010). However, McEvoy and colleagues (2013) recently characterized both worry and rumination as two forms of repetitive negative thinking (RNT), and Topper, Molenaar, Emmelkamp, and Ehring (2014) indicated that worry and rumination were “better conceived as belonging to the same latent construct labeled, RNT, than as two separate, albeit related, constructs” (p. 370). Furthermore, recent empirical evaluations have supported the hypothesized relations between the common variance of the RNT construct and both anxiety and depressive disorders (McEvoy & Brans, 2013; Spinhoven, Drost, van Hemert, & Penninx, 2015).

Recent evaluations of RNT have utilized bifactor models which allow for the estimation of both general and domain-specific latent variables that are modeled directly from the indicator variables. The general factor indicates commonality among all the items while the specific factors indicate domain exclusive item response variances that are not accounted for by the general factor. The bifactor model differs from the conventional hierarchical model, where indicators load on primary factors and the primary factors subsequently load on higher-order factors. Thus, hierarchical models imply that all of the primary factors relate to each other because of the common or shared higher order factor whereas bifactor models imply that shared variance of the indicators is explained by a common general factor as well as by separate domain-specific factors (Brown, 2015). Because of this difference, bifactor models allow for relations to be modeled between both domain-specific and general factors.

Gomez (2013) applied bifactor modeling to the Depression Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1995) as an examination of the tripartite theory of anxiety and depression. The tripartite model states that anxiety and depression have common factors, including negative affectivity and general distress, as well as unique factors, such as anhedonia for depression and physiological hyperarousal for anxiety (Clark & Watson, 1991). Since the DASS measures both depression and anxiety and thus includes both common and unique factors, it requires a modeling technique that is able to capture this complexity. Gomez (2013) was the first to evaluate the structure of the DASS utilizing a bifactor model in a sample of 366 Australian adults. This model includes four orthogonal factors consisting of the general Emotional Distress factor that explains the covariance across all of the depression, anxiety, and stress items and the three specific factors that explain the unique variance of each Depression, Anxiety, and Stress subscale. Results indicated that, based on global fit indices, both the bifactor model and the three-factor oblique model fit the data well, while the 1-factor did not. Furthermore, difference testing indicated that the bifactor model was the best fitting model. This provided support for the tripartite model when assessing anxiety and depression symptomology; however, Gomez (2013) failed to examine the reliabilities of the newly demonstrated bifactor scales.

Additionally, the bifactor model of the DASS provides a means for evaluating the relations between specific transdiagnostic factors (e.g., worry) and variance common across emotional distress as compared to variance specific to depression, anxiety, and stress. Previous research examined how the variance common across worry and rumination (i.e., RNT) relates to different facets of emotional disorders (McEvoy & Brans, 2013; Spinhoven et al., 2015). While findings suggests this common variance, RNT, is related to both mood and anxiety disorders, it does not test whether either symptom (e.g., worry) is related to variance that is common to both mood and anxiety disorders. However, the bifactor model of the DASS will allow for further empirical evaluation of how a proposed transdiagnostic factor relates generally to symptoms of emotional disorders as well as how it differentially relates to anxiety and depression. For example, worry has largely been associated with anxiety (Clark & Beck, 2010), but recent theories suggest that worry may be related to emotional disorders in general (McEvoy et al., 2010; Olantunji, Broman-Fulks, Bergman, Green, & Zlomke, 2010). This can be directly evaluated by examining the relations between worry and the Emotional Distress, Depression, Anxiety and Stress factors of the DASS bifactor model.

The first aim of the current study was to replicate the bifactor model of the DASS utilizing confirmatory factor analysis (CFA). The second aim of the study was to evaluate the reliabilities of the bifactor scales to determine the portion of reliable variance accounted for by the Emotional Distress, Depression, Anxiety, and Stress factors. Finally, the current study sought to examine the relation between Worry and the Emotional Distress, Depression, Anxiety, and Stress factors utilizing structural equation modeling (SEM). This will allow for further investigation of a proposed transdiagnostic factor, specifically worry, and how it differentially relates to emotional distress in general as well as to specific depression, anxiety, and stress constructs.

**Methods**

**Participants**

Participants were 456 adults (*M­age* = 35.9, *SDage* = 12.7) who were United States residents, 18 years of age or older, and fluent in English. Participants were those who completed both questionnaires as part of a larger sample originally examined to construct a new measure of perceived muscle tension (Marshall, Mumma, Littlefield, & Periera, 2016) and were re-examined for this study. The sample consisted of 279 females (61.2%) and 177 males (38.8%). The majority of the sample identified as Caucasian (79.2%), followed by African-American (6.4%), Hispanic (5.9%), Asian (5.0%), and other (3.5%). Additionally, 37.3% of participants reported that they had been diagnosed with or treated for anxiety, worry, or panic.

**Procedure**

Participants were recruited using Mechanical Turk, an online crowdsourcing market that allows Workers (e.g., participants) to complete small tasks which are paid for by Requesters (e.g., researchers; Paolacci & Chandler, 2014). Mechanical Turk guided interested participants to the online survey website via a hyperlink where, after providing consent, they completed a battery of distress related measures. All participants were then monetarily compensated for their time ($.30). Procedures were approved by the authors’ university Institutional Review Board.

**Materials**

**Depression Anxiety Stress Scale**. The Depression Anxiety Stress Scale(DASS; Lovibond & Lovibond, 1995) is a 42-item public-domain self-report questionnaire measuring the three dimensions of depression, anxiety, and stress. Each item utilizes a 4-point rating scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). Gomez (2013) provided initial support for the bifactor model of the DASS and high internal consistency reliabilities for the Depression (α = 0.91), Anxiety (α = 0.83), and Stress (α = 0.85) subscales. While Gomez did not examine convergent and discriminant validity, previous research on the traditional three-factor oblique model exhibited good convergent and discriminant validity in both clinical (e.g., panic disorder, social phobia, n = 258) and non-clinical (n = 49) samples (Antony, Bieling, Cox, Enns, & Swinson, 1998). For purposes of comparison to the earlier 3 factor-based models and scales, in the current study, *α* = 0.96, α = 0.93, and α = 0.95, for the Depression, Anxiety, and Stress scales, respectively. Furthermore, the average subscale score fell within the mild range for Depression (*M* = 10.84, *SD* = 10.85), Anxiety (*M* = 8.29, *SD* = 8.43), and Stress (*M* = 14.45, *SD* = 10.37; Lovibond & Lovibond). However, the large standard deviations indicate that participants ranged widely on their levels of emotional distress.

**Penn State Worry Questionnaire.** The Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) is a public-domain self-report measure of severity and uncontrollability of worry. Utilizing a 5-point rating scale ranging from 1 (not at all typical) to 5 (very typical), individuals are asked to rate 16 items such as “my worries overwhelm me” and “I worry all the time”. Brown, Antony, and Barlow (1992) found a one-dimensional structure and high internal consistency (α = 0.93) in both clinical (n = 436) and non-clinical (n = 32) samples. In the current study, α = 0.95 for the PSWQ. Additionally, the average score (*M* = 50.65, *SD* = 16.27) fell above 45, the cut-off value for generalized anxiety disorder (GAD) that Behar, Alcaine, Zuellig, & Borkovec (2003) found provided the most optimal balance of sensitivity (0.99) and specificity (0.98). Standard deviations again demonstrated that participants varied widely on their level of worry.

**Results**

All analyses were conducted within MPlus v7.11 (Muthén & Muthén, 2012) using weighted least squares means and variances method (WLSMV). First, confirmatory factor analysis (CFA) was utilized to replicate the bifactor model of the DASS presented by Gomez (2013). Goodness-of-fit was assessed using global fit indices and Hu and Bentler’s (1999) suggested cut-offs of RMSEA less than .08 and CFI greater than .90. Next, coefficient omega and omega hierarchical were calculated to provide an estimate of the DASS general and domain-specific factor reliabilities (Rodriguez, Reise, & Haviland, 2015). Finally, structural equation modeling was utilized to test the relations between worry, and the general Emotional Distress, Depression, Anxiety, and Stress factors for the DASS bifactor model.

**Bifactor Replication**

Confirmatory factor analysis was utilized to replicate the bifactor model of the DASS presented by Gomez (2013) in which each of the 42 items are constrained to load onto both the general Emotional Distress factor as well as one of three domain-specific factors; Depression, Anxiety, or Stress. Due to the ordinal nature of the DASS response scales, items were modeled as categorical indicators. Item loadings for this model are presented in Table 1. Global fit indices suggest this model demonstrated good fit χ2(777) = 1642.67, RMSEA = 0.05, CFI = 0.98 (Bentler & Bonet, 1980; Hu & Bentler, 1999). Furthermore, only items 9 (λanxiety = 0.10, “Anxious”) and 30 (λanxiety = 0.03, “Fear of being thrown”) demonstrated non-significant loadings on their respective unique factor after accounting for the general Emotional Distress factor. Overall, this provides initial support for the generalizability of the DASS bifactor model suggested by Gomez (2013).

**Factor Reliability**

Coefficient omega was calculated to provide a model-based estimate of internal consistency reliability that is more appropriate for congeneric tests (i.e., measures in which item loadings are not assumed to be equal) than coefficient alpha (Rodriguez et al., 2015). Omega was found to be high for all scales with estimates of 0.99, 0.98, 0.96, and 0.97 for the general Emotional Distress, Depression, Anxiety, and Stress factors, respectively. In order to provide an estimate of the percent of the total score variance that was attributable to the Emotional Distress factor, omega hierarchical was also calculated. Omega hierarchical was high (0.90), suggesting that the general Emotional Distress factor accounts for a large portion of the reliable variance in total scores by itself. Furthermore, this suggests that the Emotional Distress factor may be interpreted as a unidimensional representation of the targeted construct of distress regardless of the multidimensionality of the data (Rodriguez et al., 2015). Finally, to provide an estimate of the reliability of the Depression, Anxiety, and Stress factors after accounting for the Emotional Distress factor, omega hierarchical subscale was calculated for each subscale. While omega hierarchical subscale was found to be low to moderate for Depression (0.28), Anxiety (0.15), and Stress (0.19), Rodriguez and colleagues (2015) suggest this is to be expected because they are residualized factors. Overall, these results suggest that, while the general Emotional Distress factor accounts for a majority of the variance in the items, the Depression, Anxiety, and Stress factors still account for a modest proportion of the residual variance in items.

**Comparison to Traditional 3 Factor (M=3) Model**

A confirmatory factor analysis of the traditional oblique three-factor model (M=3) with Depression, Anxiety, and Stress as three correlated factors was fit and tested using model fitting procedures as described above. This model demonstrated adequate fit χ2(819) = 3828.48, RMSEA = 0.09, CFI = 0.92 with correlations between factors of *r*(Depression,Anxiety) = .74, *p* < .001; *r*(Depression,Stress) = .72, *p* < .001, and *r*(Anxiety,Stress) = .78, *p* < .001. Although the CFA model fitting approach used with the ordinal-level response format for items does not permit (to our knowledge) a test for comparing the overall fit of non-nested models (such as BIC; see Prisciandaro, 2005), an approximate comparison of models via the MPlus DIFFTEST option suggested that the bifactor model demonstrated significantly better fit compared to the M=3 factor model (χ2­diff(42) = 944.87, *p* < 0.01).

Table 1 reports the loadings from the M=3 model as well as the bifactor model loadings for the 42 DASS items on the General Emotional Distress (GED) and the 3 specific distress factor. Several results are notable. The correlation between the loadings for the Bifactor Depression and M=3 Depression scale (*r* = .94) are high, suggesting that the former is assessing the very similar configuration of item loading components as the traditional M=3 Depression factor. In contrast, the very low correlation (*r = .12)* of the M=3 Depression items with the loading of the same items on the Bifactor General Distress factor is due to the very small variance of the GED factor loadings for the depression items (*SD* = 0.03), indicating that each of these 14 items is making a roughly comparable contribution to GED. Second, the negative correlation (r = -.77) of the Bifactor Anxiety factor item loading with the M=3 Anxiety item loadings, despite adequate variability in loadings of both is probably a function of the near perfect correlation of the M=3 Anxiety factor loadings with those items as loading on the Bifactor GED factor (*r* = .99). A similar situation is present for the M=3 Stress factor loadings -- the correlation of M=3 Stress item loadings with the loadings on the Bifactor GED factor is very high (*r* = .80), whereas the correlation with the Bifactor Stress item loadings is not significant (*r* = .17). These results are consistent with the lower proportion of reliable variance in the bifactor Anxiety and Stress specific scales (see above).

**Relation with Worry**

Structural equation modeling was utilized to estimate the relations between the latent constructs of Worry, Emotional Distress, Depression, Anxiety, and Stress. In the initial model, Emotional Distress was modeled as an exogenous latent variable (i.e., not predicted by other variables) predicting the Worry factor. The DIFFTEST option (Muthén & Muthén, 2012) was then utilized to examine whether unique depression, anxiety, and stress variances would improve the fit of the model by adding paths from the Depression, Anxiety, and Stress factors to Worry. The initial model demonstrated good fit χ2(1552) = 2641.01, RMSEA = 0.04, CFI = 0.96.

Results of DIFFTEST indicated that adding paths from both Depression (χ2(1) = 9.396, *p* < 0.01) and Anxiety (χ2(1) = 5.194, *p* = 0.02), but not Stress (χ2(1) = 0.80, *p* = 0.37), to Worry significantly improved the fit. Thus, the final model included Emotional Distress (*pr* = 0.81, *p* < 0.001), Depression (*pr* = -0.13, *p* = 0.002), and Anxiety (*pr* = -0.19, *p* = 0.002) as significant incremental predictors of Worry. This model demonstrated good fit, χ2(1550) = 2622.72, RMSEA = 0.04, CFI = 0.96 and is shown in Figure 1. Similarly, bivariate analyses indicated GED (*r* = 0.84, *p* < 0.001), Depression (*r* = -0.14, *p* = 0.002), and Anxiety (*r* = -0.20, *p* = 0.002) but not Stress (*r* = 0.01, *p* = 0.91) significantly predicted Worry.

**Discussion** To examine the replicability of the bifactor model of the DASS (Gomez, 2013), this study conducted a CFA in a community sample of U.S. adults. Results demonstrated support for the bifactor model of the 42-item version of the DASS in which all items load on a general factor (i.e., Emotional Distress) and one of three domain-specific factors (i.e., Depression, Anxiety, or Stress), promoting its generalizability in a U.S. community population. Reliability estimates for the general Emotional Distress factor and the three domain-specific factors (i.e., Depression, Anxiety, and Stress) were all strong (> 0.96). Furthermore, the omega hierarchal and omega hierarchical subscale estimates indicated that the general Emotional Distress factor accounted for a substantial portion of the reliable variance in total scores whereas the Depression, Anxiety, and Stress factors only accounted for modest portions of the reliable variance. Although this suggests that the Emotional Distress factor and its relations may be reliably interpreted, it also suggests that one should exercise caution when interpreting the three domain-specific factors. It is worth noting, as pointed out by Rodriguez and colleagues (2015), that there are limitations to the interpretation of omega hierarchal subscale including that; 1) by definition, subscales are expected to be less reliable than a general factor, 2) coefficients do not represent easily observed subscale scores, and 3) if items representing broader (or narrower) constructs are not included, then one cannot control for multidimensionality.   
 This study also examined the relations between worry and the common (i.e., Emotional Distress) and unique (i.e., Depression, Anxiety, and Stress) factors of the bifactor model of the DASS. As a proposed component of repetitive negative thinking (RNT), Worry was found to be significantly predicted by Emotional Distress, Depression, and Anxiety, but was not significantly predicted by Stress. Specifically, Emotional Distress was a large, positive incremental predictor of Worry whereas Depression and Anxiety were small, negative incremental predictors. This suggests that the largest portion of variance is positively predicted by the variance that is common across all symptoms of emotional disorders, i.e., worry is an outcome of non-specific emotional distress. Although these results were obtained in a community, web-based sample where no diagnostic interviews were administered, these results further support the notion that worry is a transdiagnostic factor and not necessarily domain-specific.

The small, negative contributions of Depression and Anxiety in predicting Worry are less easily interpreted; however, the bivariate relations disqualify suppressive effects as an explanation. The similar effect sizes again suggest that worry is not uniquely related to anxiety but instead a transdiagnostic factor of emotional disorders. The direction (i.e., negative) is contrary to what would be expected and seems to suggest that, after accounting for the common variance in emotional distress, worry decreases as the unique variances attributable to anxiety and depression increase. This interpretation is further complicated by the low omega hierarchical subscale estimates obtained for both Depression and Anxiety which suggest their specific relations may be difficult to replicate and therefore should be interpreted with caution (Rodriguez et al., 2015). Alternatively, given that the three specific scales from the bifactor model are based on scores after residualizing on the General Emotional Distress factor and that each is based on fewer items than the latter scale, these negative path coefficients might be most parsimoniously interpreted as chance findings.

Although the current study provides support for the generalizability of the DASS bifactor model and its relation to worry, results should be interpreted with the consideration of several limitations. One limitation includes the possibility of alternative models that may be used to explain the factor structure of the DASS or its relation to worry (Tomarken & Waller, 2005). For example, while our results support the replicability of the bifactor model proposed by Gomez (2013), there may be other alternative models whose fit is comparable. Furthermore, due to the cross-sectional nature of the data, directionality of the relations in the final structural model cannot be determined. Another potential limitation is the low omega hierarchal subscale coefficients of the Depression, Anxiety, and Stress factors. These estimates limit a researcher’s ability to draw specific conclusions about the relationship of these subscales with other factors. Finally, although participants included in this study had self-reported symptoms of depression, anxiety, and worry, future studies should examine the generalizability of the bifactor model of the DASS in clinical populations. Replication within a sample of individuals with diagnosed emotional disorders, including some with comorbid anxiety and depressive disorders may be particularly enlightening.

**Conclusions**

The results of this study provide initial support for the validity of the bifactor model of the DASS within a U.S. community sample as well as provide insight into the reliability of the resulting general and domain-specific factors. Furthermore, it is the first study to examine relations between these factors and a theoretically related construct, worry. Although low omega hierarchical subscale estimates prevented subscale specific inferences from being made, overall findings further support the idea that worry is a transdiagnostic factor shared across emotional disorders and, therefore, likely contributes to their high comorbidity rate.

**Conflicts of Interests**

All authors declared no conflicts of interest.

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