Running Head: DASS FOR CHILDREN AND ADOLESCENTS

Depression anxiety stress scale (DASS): Is it valid for children and adolescents?

Jeff Patrick

University of Southern Queensland

Murray Dyck

Griffith University

Paul Bramston

University of Southern Queensland

Correspondence to:
Jeff Patrick, Psychology Department, University of Southern Queensland, Toowoomba, Queensland, Australia, 4350
Tel: +61 7 4631 2898
Fax: +61 7 4631 2721
E-mail: patrick@usq.edu.au

Accepted Version of: Patrick, Jeff and Dyck, Murray and Bramston, Paul (2010) *Depression Anxiety Stress Scale: is it valid for children and adolescents?* Journal of Clinical Psychology, 66 (9). pp. 996-1007. ISSN 1097-4679. doi: 10.1002/jclp.20696
Accessed from USQ ePrints: http://eprints.usq.edu.au/8643/

Abstract: The Depression Anxiety Stress Scale (Lovibond & Lovibond, 1995) is used to assess the severity of symptoms in child and adolescent samples although its validity in these populations has not been demonstrated. We assessed the latent structure of the 21-item version of the scale in samples of 425 and 285 children and adolescents on two occasions, one year apart. On each occasion, parallel analyses suggested that only one component should be extracted, indicating that the test does not differentiate depression, anxiety, and stress in children and adolescents. The results provide additional evidence that adult models of depression do not describe the experience of depression in children and adolescents.

Keywords: Child and adolescent depression, Depression Anxiety Stress Scale, structure of affect

The Depression Anxiety Stress Scale (DASS) and its short form (DASS-21; Lovibond & Lovibond, 1995) were designed to maximize measurement of the distinct features of depression, anxiety and stress, which typically co-occur in adults (Sanderson, Ni Nado, Rapee & Barlow, 1990), and to minimize measurement of what these states have in common. The original principal component analysis of DASS items revealed that a stable three-factor solution of depression, anxiety and stress was the optimal fit (Lovibond & Lovibond, 1995). Subsequent research has replicated the three-factor solution in adult populations in both the complete test (Crawford & Henry, 2003) and in the shorter version (Clara, Cox & Enns, 2001).

In commenting on the use of the DASS as a screening instrument, Lovibond and Lovibond (1995) asserted that "given the necessary language proficiency, there seems no compelling case against use of the scales for comparative purposes with children as young as 12 years. It must be born in mind, however, that the lower age limit of the development samples was 17 years" (p.3). Recent research has applied the self-report version of the DASS to children and adolescents between the ages of 7 and 15 (Duffy, Cunningham & Moore, 2005; Szabó & Lovibond, 2006; Szabó, 2009). Such use presupposes that adult models and measures of the structure of affect and depression can be applied to childhood and adolescence, despite evidence that they may not be suited to the experience of depression by children and adolescents (Finch, Lipovsky & Casat, 1989).

Although there is good evidence that the criteria used to diagnose depression in adults are no less valid when used with adolescents (Lewinsohn, Pettit, Joiner & Seeley, 2003), it is also true that the prominence of some depression symptoms varies across development (e.g., Weiss & Weisz, 1988; Weiss et al., 1992) and, following puberty, the prevalence of depression among females changes from being about the same as in males to about twice that of males (Lewinsohn, Hops, Roberts, Seeley & Andrews, 1993; Roberts, Lewinsohn & Seeley, 1995). And as Hammen and Compas (1994) noted, one thing that distinguishes each developmental epoch is the extent to which depression is comorbid with other disorders and with which other disorders it is comorbid. Among other issues, Hammen and Compas pointed out that in childhood, depression typically co-exists with anxiety or anger. Most evidence suggests that depression, anxiety and stress are largely indistinguishable in children and adolescents (Cole, Truglio & Peeke, 1997; Lahey, Applegate & Waldman, 2004), and some researchers have concluded that there is no clear distinction between these states during childhood or adolescence (e.g., Finch, Lipovsky & Casat, 1989). Among adolescents, in 8 out of 10 cases, depression co-occurs with a significant anxiety and/or oppositional or severe disruptive behavior problem (Herman, Ostrander, Walkup, Sylva & March, 2007; cf. Young, Mufson & Davies, 2006). Like children, adolescents who are depressed experience concomitant anxiety and/or anger and it is not clear that these states can be readily distinguished from each other.

Szabó and Lovibond (2006) failed to replicate the three-factor solution evident in the DASS among adults using exploratory factor analysis with a sample of children and adolescents aged 7 to 14 years old. Duffy, Cunningham and Moore (2005) also failed to replicate the three-factor solution with the DASS-21 using confirmatory factor analysis in their study of 216 adolescents aged between 11 and 15 years old. Intriguingly, Szabó (2009) tested 8 different models ranging from 1 to 4 factors on data from adolescents who completed both the DASS and DASS-21. All the models could be rationalized and all had significant and nearly identical fit statistics. In the end, Szabó conceded that correlations among the factors (however they were conceptualized) was “high”, which renders their interpretability as distinct subscale scores mute. Ultimately, the exercise failed to offer conclusive support for the superiority of any one model, and hence could not resolve the issue of the how adolescent affect is structured. For the moment, there is no compelling evidence that interpreting subscale scores for the DASS or DASS-21 is valid for children or adolescents.

Another issue is how the latent structure of the DASS and other symptom scales should be assessed in children/adolescents. Antony, Bieling, Cox, Enns and Swinson (1998) used exploratory principal components analyses in their study of adults, as did Brown, Chorpita, Korotitsch and Barlow (1997), but in both cases, the researchers relied on a combination of a scree test and the eigenvalue>1 rule to decide how many principal components to extract. The eigenvalue>1 rule typically overestimates the number of factors to extract and the reliability of the scree test is low (O’Connor, 2000).

Lovibond and Lovibond (1995) used a confirmatory factor analysis in their original study of the DASS, and it has become standard procedure to use confirmatory factor analyses to assess the goodness of fit of different structural models. However, in practice this procedure has not been useful (Cliff, 1983; Breckler, 1990; Tomarken & Waller, 2003, 2005). The rationale for using confirmatory analyses is that they facilitate the testing of specific hypotheses, but the typical finding is that two or more different models provide equally good (or poor) fits to the data (e.g., Chorpita, 2002; Lonigan, Carey & Finch, 2003; Turner & Barrett, 2003). Where only one structural model is assessed (as is often the case), and the fit statistics of this model are considered adequate, no further (and potentially better-fitting) model is assessed. This over-reliance on fit ignores the limitations of the underlying methodology, which have been pointed out repeatedly (e.g., Breckler, 1990; Cliff, 1983; Tomarken & Waller, 2003; 2005). To be more precise, confirmatory factor analysis is constrained to the proposed model, to which a binary question (good fit, poor fit) is posed. This approach is akin to trying to understand someone you have just met by exclusively asking closed questions. Understanding will eventually come, but its progress is slowed, and at times biased by the closed questions one poses.

One solution to these problems would be to test the fit of multiple plausible models – although this could be construed as using Confirmatory Factor Analysis in an exploratory way. This practice was evident in the work of Szabó (2009) who, as already noted, tested 8 different models and failed to find clear support for one model over another. A better approach would be to use an unconstrained analysis to identify the best possible structural model. Exploratory principal components analysis, where total variance is analysed and the model is not constrained (so as not to manufacture the result) offers more compelling evidence about the latent structure of the DASS for this population if the model can be replicated. Rather than use the scree test or other unreliable procedures, this approach would involve parallel analysis to more reliably determine the number of components to extract (Fabrigar, Wegener, MacCallum & Strahan, 1999; O'Connor, 2000). According to Gorsuch (2003, p. 157), "simulation studies have found parallel analysis to be a prime candidate for the best procedure for estimating the number of exploratory factors." Parallel analyses involve the analysis of sets of random data of the same order (number of variables and participants) to specify the magnitude of eigenvalues that reflect random 'sources' of shared variation. In the real analyses, only eigenvalues that exceed the 95th percentile of eigenvalues yielded by random data are extracted and rotated. The validity of the latent structure is then established by means of unconstrained replication, either by means of splitting one's sample or with an independent sample (Gorsuch, 2003).

The aim of this study was to assess the latent structure of the DASS-21 with a child/adolescent sample, and in particular to assess whether the scale measures three distinct constructs, namely, depression, anxiety and stress. In order to test whether the observed structure is replicable, a longitudinal design was used to assess whether the structure was stable across a one-year period.

Method

Participants and Procedure

A community sample of 425 students, stratified for age (the overall average was 13.2 years) and sex (male=48.4%, female=51.6%), was recruited from eight schools in rural/remote southwest Queensland after the research protocol had received ethical approval and the permission of Education authorities (see Table 1). Four age groups were sampled: ages 11 (n=105), 12 (n=153), 15 (n=110) and 17 years (n=57). In terms of socioeconomic status, 71% of the sample came from families with household incomes above the Australian average, although few earned more then twice the average. In 32.4% of families, one or both parents had a trade certificate or diploma, and in 19.4% of families, one or both parents had a university degree. Ethnicity was not recorded, but in this region, the overwhelming majority of residents is of European origin, with about 1.67% of persons being of Asian descent, about 0.26% of persons being of South Pacific Islander descent, and about 0.23% being of Aboriginal or Torres Strait Islander descent (Australian Bureau of Statistics, 2008).

INSERT TABLE 1 ABOUT HERE

Students were followed-up approximately one year later. A 33% attrition rate eroded the sample to 285 participants at Time 2. Students who did not participate at follow-up did not differ significantly from students who did participate on any Time 1 measure. Of eligible students who could be located (n=401), the parents of 18% did not give consent, 1% themselves refused to participate, 3% were not able to complete the study due to poor reading skills or inattention, 2% did not complete for other reasons, and 5% were students with special learning needs who were excluded from the study. The DASS-21 was administered during class time.

Measures

There are two versions of the DASS – the 42-item version and the 21-item short form (Lovibond & Lovibond, 1995). Antony et al. (1998) reported that the 21-item version has a more cohesive and replicable structure than the 42-item version. For this reason, together with the fact that the short form is more widely used in clinical practice, we chose the short form for this study. The DASS-21 is a set of 21 statements designed to assess depression, anxiety, and stress by getting participants to rate how well each statement describes them. The rating is along a five-point Likert scale in each case. The DASS-21 has been shown to have excellent psychometric qualities for adults (Antony et al., 1998; Daza, Novy & Stanley, 2002; de Beurs, Van Dyck & Marquenie, 2001). The internal consistency of each of the subscales is high (Depression α=.97, Anxiety α=.92, Stress α=.95; Antony et al., 1998). The DASS-21 also demonstrates strong convergent validity with other measures of depression (e.g., Beck Depression Inventory; r=.79) and anxiety (e.g., Beck Anxiety Inventory; r=.85) and stress (e.g., State-Trait Anxiety Inventory-Trait; r=.68; Antony et al.). Antony et al. observed that differences among clinical samples were consistent with expectation (e.g., depression scores highest in the major depression sample, all scores relatively low in a specific phobia sample), as were differences between clinical and non-clinical samples, with average scores in the non-clinical sample of adults appropriately low (depression mean=2.12, SD=3.64, mean=1.22, SD=1.77, and stress mean=3.51, SD=3.78).

Results

Two sets of analyses were conducted to assess the latent structure of the DASS-21, the first in the initial sample (Time 1: n=425) and the second in the retest sample (Time 2: n=285). In each sample, the Kaiser-Meyer-Olkin statistic indicated that the matrix had definite latent structure (KMO=.95 at Time 1 and KMO=.95 at Time 2). Parallel analysis was used to determine the number of principal components to extract (Gorsuch, 2003). In each case, parallel analysis (O'Connor, 2000) indicated that there was only one component with an eigenvalue above the 95th percentile of eigenvalues of 100 random datasets of the same dimensions (see Table 2). For this reason, only one component was extracted for each matrix. These principal components accounted for 47.7% of total variance at Time 1 and 49.3% of total variance at Time 2. Item loadings and communalities are presented in Table 3.

INSERT TABLE 2 AND TABLE 3 ABOUT HERE

Table 3 shows that the item loading pattern at Time 2 closely resembles what was observed at Time 1: the two structures are nearly identical. In both cases, all items have substantial loadings on the component, and the communalities reveal that the component accounts for between 27% and 61% of the variance of each item.

By way of confirming these unidimensional results, we also conducted Velicer's Minimum Average Partial (MAP) Test. This procedure assesses the fit of all possible component solutions (k-1) as well as a zero component solution. In each case, the principal component is partialed out of the correlations between the variables, and the average squared coefficient in the off-diagonals of the resulting partial correlation matrices is computed (O'Connor, 2000). The solution with the lowest average squared correlation represents the optimal representation of the systematic variance (the best fit). In this case, the MAP test showed that Velicer's Average Squared Correlation (ASC) for both datasets was lowest with a one-component solution (ASC=.066 and ASC=.066, respectively). By way of bolstering these results with the more commonly used confirmatory factor analysis, we conducted one-factor, two-factor, and three-factor solutions. The Root Mean Square Error of Approximation (RMSEA) was .02, .14, and .17 respectively, again suggesting that that a one-factor solution is the most defensible interpretation.

We then used Time 1 data to conduct additional parallel analyses to assess whether the same structure is evident in each of the child (ages 11 and 12 years) and adolescent (ages 15 and 17 years) samples, and in each of the male and female samples. In each case, the results indicated that only the first eigenvalue exceeded the 95th percentile of eigenvalues of 100 random data sets of the same dimensions. For the child sample, the first three observed eigenvalues were λ_1=11.01; λ_2=1.05; λ_3=0.95 and those derived from random datasets were λ_1=1.78; λ_2=1.64; λ_3=1.54. The values for the other samples were as follows: adolescents (observed: (λ_1=8.43; λ_2=1.73; λ_3=1.19; random: λ_1=2.03; λ_2=1.83; λ_3=1.67); females (observed: (λ_1=10.18; λ_2=1.30; λ_3=1.03; random: λ_1=1.87; λ_2=1.72; λ_3=1.58); and males (observed: (λ_1=10.52; λ_2=1.31; λ_3=1.04; random: λ_1=1.94; λ_2=1.72; λ_3=1.59).

Table 1 indicates the average scores by age and gender of the total DASS score. Table 1 also indicates that the same unidimensional structure was evident for all age groups. The internal reliability of the total DASS score was high (α>.80) in each age and gender cohort, with no improvement afforded by any item removal. Table 1 also indicates some variability in average scores among boys and girls, and among age groups. In order to test the meaningfulness of this we conducted a 2x4 ANOVA (gender by age group) with the DASS-21 score as the dependent variable. There was no significant difference for gender (p>.05), nor was there a significant interaction between age and gender (p>.05). There was a significant effect for age (F(3,279)=3.71,p<.05). Post hoc analysis (Tukey's HSD) revealed that the 17 year olds had lower DASS-21 scores than the other age groups. There is a possibility that this effect is an artefact of the violation of the assumption of homogeneity of variance (Levene's $F(7,279)=4.43, p<.05$). The 17 year olds had noticeably less variability in their scores than the other age groups, so this effect may be nothing more than a Type I error. If the effect is real, then it is a statistically small effect ($\eta^2=.04$).

Discussion

The DASS-21 is a widely used scale that clearly distinguishes depression, anxiety and stress in adults (Henry & Crawford, 2005). Our results suggest that the test does not measure three distinct emotion dimensions in children or adolescents, and suggest that 'downsizing' adult theoretical constructs to childhood or adolescence is not a good idea (Hammen & Compas, 1994; Vasey & Dadds, 2000). Our results imply a fundamental change in the structure of affect from adolescence to adulthood and mean that we need to question whether and how the DASS-21 should be used with children and adolescents.

As a counter-point, this research falls short of identifying exactly when this change occurs, or explaining how or why it occurs. There is also no certainty that these results would apply to other demographic groups or to the interpretation of other similar measures (most obviously the DASS-42). Only independent replication and sequential variation in demographic samples could achieve this. Nor are these results a fundamental challenge to the content or criteria validity of the DASS, merely a caution to its construct interpretation for children and adolescents.

In order to clarify whether our finding of a consistent unidimensional structure in our data is due to our use of parallel analysis to identify how many principal components to extract, we conducted parallel analyses of adult data in the two cases where eigenvalues have been published (Antony et al., 1998; Brown et al., 1997) and in the one case of adolescent data (Duffy et al., 2005). In order to conduct this procedure, all one needs to know are the eigenvalues reported by the original author, the number of variables being structurally analysed (either 42 or 21 items depending on the questionnaire used), and the number of participants in the original study. With these key features one can generate multiple random datasets of the same dimensions as the original in order to conduct post-hoc parallel analyses. Brown et al. had administered the DASS to a sample of 437 patients presenting for assessment and treatment at an anxiety disorders clinic. In their principal components analysis, they extracted three components ($\lambda_1=16.46$; $\lambda_2=3.96$; $\lambda_3=2.53$) based on a scree test and the eigenvalue>1 rule. The results of our parallel analysis indicate that each of these eigenvalues exceeds the 95th percentile of the first three eigenvalues of 1000 random datasets of the same dimensions ($\lambda_1=1.71$; $\lambda_2=1.62$; $\lambda_3=1.56$), indicating that the extraction of these three components was appropriate. Because Brown et al. only reported the eigenvalues of the three components that were extracted, we cannot judge whether the results of parallel analysis would have suggested the extraction of more than three components.

Antony et al. (1998) administered the DASS to a sample of 258 outpatients with DSM-III-R diagnoses of an anxiety or mood disorder and conducted separate principal component analyses for both the 42-item and the 21-item versions of the test. Based on a scree test and the eigenvalue>1 rule, Antony et al. extracted three components in each analysis. In the 42-item analysis, the three eigenvalues (λ_1=28.92; λ_2=4.24; λ_3=2.06) all exceed the 95th percentile of the first three eigenvalues of 1000 random datasets of the same dimensions (λ_1=1.96; λ_2=1.83; λ_3=1.75). However, in the 21-item analysis, only the first two eigenvalues (λ_1=9.07; λ_2=2.89; λ_3=1.23) achieved the criterion value (λ_1=1.63; λ_2=1.52; λ_3=1.43). Based on these results, the extraction of three (or more) components was appropriate for the 42-item scale, but only two components should have been extracted for the 21-item scale.

Duffy et al. (2005) administered the DASS-21 to a sample of 216 adolescents, but because they conducted a confirmatory factor analysis, they did not report eigenvalues. However, at our request, one of the authors conducted a factor analysis of the data and shared the results with us (E. Cunningham, personal communication, 27 August 2007). These results show that only the first eigenvalue (λ_1=6.90; λ_2=1.46; λ_3=1.30) exceeded the 95th percentile of eigenvalues derived from random data (λ_1=1.76; λ_2=1.59; λ_3=1.48), indicating that only one factor should have been extracted from the scale. It could be that the parallel analysis was underestimating, and hence producing this result for both independent adolescent data sets, except it seems unlikely given that parallel analysis yielded the same number of factors as confirmatory procedures with adult clinical and non-clinical samples. The difference between Duffy et al's 2-factor solution, and our 1-component solution is therefore more likely due to the confirmatory procedure offering an adequate, but not an ideal fit.

What is clear from these results is that the difference in the structure of affect between adults and children or adolescents does not appear to be a function of our use of parallel analysis to decide how many principal components to extract. Our parallel analyses of previously reported adult data supported the extraction of three principal components in the two studies of the DASS (Antony et al., 1998; Brown et al., 1997) and the extraction of two principal components in the one study of the DASS-21 (Antony et al.). Similarly, our parallel analysis of the results of an exploratory analysis of adolescent DASS-21 data (Duffy et al., 2005) was consistent with our results in supporting the extraction of only one component. Parallel analysis consistently results in the extraction of one component in child and adolescent or adolescent data and in the extraction of three (or two) components in adult data.

However, it has been shown that parallel analysis can underestimate the number of real sources of common variation, especially when sample size is small (n=100) and the real structure of the correlation matrix is complex (e.g., Turner, 1998). Turner recommended that researchers use a number of tests, in addition to parallel analysis, to determine how many components to extract. Had we used scree tests, the result would have been the same in each analysis. More importantly, we relied on replication across time and across samples (i.e., the Duffy et al., 2005, dataset) to show that a unidimensional structure is consistently obtained. The findings of Duffy et al., based on confirmatory factor analysis, illustrate how difficult it is to impose a multidimensional structure onto DASS-21 adolescent data. When testing a 3-factor structure, not only were their fit statistics poor, "the magnitude of the correlations between the factors anxiety and stress (r=.91; s.e.=.05), anxiety and depression (r=.90; s.e.=.05) and stress and depression (r=.95; s.e.=.06) revealed that the factors were not empirically distinguishable" (Duffy et al., p. 679). They were only able to force an interpretable 2-factor solution with reasonable fit statistics by eliminating an item, correlating the error terms of two other items, and contrasting a small set (n=4) of physiological arousal items with all other items (n=16), which still resulted in a factor intercorrelation of 0.71.

The fact that dividing our sample into older and younger groups yielded no difference in result provides a hint as to the stage in development when the structure of affect becomes differentiated. Most research on the structure of affect has been conducted using undergraduate samples aged in their early 20s (e.g., Watson & Walker, 1996; Watson, Clark et al., 1995; Watson, Weber et al., 1995), and so it is clear that the adult structure has emerged by early adulthood. Based on our results, we can now anticipate that the change occurs during late adolescence. However, we are not aware of any theory that can account for such marked differentiation in the structure of affect between middle adolescence and early adulthood.

Our results provide additional evidence that the experience of depression in childhood and adolescence is more closely bound to other negative affects than is true of adult samples. When a self-report scale like the DASS-21 is used with children and adolescents, it is not measuring three discriminable emotion dimensions as it does in adults. Rather, it appears to be measuring a single distress dimension and, in the absence of other information, it cannot be clear that this single dimension is more closely related to depression, to anxiety, or to general distress, or even that it is possible to draw distinctions between these states. It may be the case that when a child or adolescent has been diagnosed with one or more specific anxiety, mood, or other disorder, the DASS-21 is a useful index of the severity of a mixed affective and/or oppositional/disruptive behavior disorder (Herman et al., 2007) which has symptoms of anxiety or depression as a core feature. That, however, will also need to be the subject of future research.

References

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W. & Swinson, R. E. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. Psychological Assessment, 10, 176-181.

Australian Bureau of Statistics (2008). 2006 census community profile series: Toowoomba (Statistical Subdivision)]. Retrieved May 17, 2009 from http://www.censusdata.abs.gov.au/ABSNavigation/prenav/ViewData?&action=404&documentproductno=LGA36900&documenttype=Details&tabname=Details&areacode=LGA36900&issue=2006&producttype=Community%20Profiles&&producttype=Community%20Profiles&javascript=true&textversion=false&navmapdisplayed=true&breadcrumb=PLD&&collection=Census&period=2006&producttype=Community%20Profiles&#Basic%20Community%20Profile.

Breckler, S. (1990). Applications of covariance structure modeling in psychology: Cause for concern? Psychological Bulletin, 107, 260-273.

Brown, T., Chorpita, B., Korotitsch, W. & Barlow, D. (1997). Psychometric properties of the Depression Anxiety Stress Scales (DASS) in clinical samples. Behaviour Research & Therapy, 35, 79-89.

Chorpita, B. F. (2002). The tripartite model and dimensions of anxiety and depression: An examination of structure in a large school sample. Journal of Abnormal Child Psychology, 30, 177-190.

Clara, I. P., Cox, B. J. & Enns, M. W. (2001). Confirmatory factor analysis of the Depression–Anxiety–Stress Scales in depressed and anxious patients. Journal of Psychopathology & Behavioral Assessment, 23, 61-67.

Cliff, N. (1983). Some cautions concerning the application of causal modelling methods. Multivariate Behavioral Research, 18, 115-126.

Cole, D. A., Truglio, R. & Peeke, L. (1997). Relation between symptoms of anxiety and depression in children: A multitrait-multimethod-multigroup assessment. Journal of Consulting & Clinical Psychology, 65, 110-119.

Crawford, J. R. & Henry, J. D. (2003). The Depression Anxiety Stress Scales (DASS): Normative data and latent structure in a large non-clinical sample. British Journal of Clinical Psychology, 42, 111–131.

Daza, P., Novy, D., Stanley, M. & Averill, P. (2002). The Depression Anxiety Stress Scale-21: Spanish translation and validation with a Hispanic sample. Journal of Psychopathology & Behavioral Assessment, 24, 195-205.

de Beurs, E., Van Dyck, R., Marquenie, L.A. (2001). De DASS: Een vragenlijst voor het meten van depressie, angst en stress. = The DASS: A questionnaire for the measurement of depression, anxiety, and stress. Gedragstherapie, 34, 35-53.

Duffy, C. J., Cunningham, E. G. & Moore, S. M. (2005). The factor structure of mood states in an early adolescent sample. Journal of Adolescence, 28, 677-680.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. Psychological Methods, 4, 272-299.

Finch, A. J., Lipovsky, J. A., & Casat, C. D. (1989). Anxiety & depression in children & adolescents: Negative affectivity or separate constructs? In P. C. Kendall & D. Watson (Eds.), Anxiety & depression: Distinctive & overlapping features. New York, NY: Academic Press.

Gorsuch, R. L. (2003). Factor analysis. In J. A. Schinka & W. F. Velicer (Eds.), Handbook of psychology: Volume 2 Research methods in psychology (pp. 143-164). Hoboken, NJ: Wiley.

Hammen, C., & Compas, B. E. (1994). Unmasking unmasked depression in children and adolescents: The problem of comorbidity. Clinical Psychology Review, 14, 585-603.

Henry, J. D. & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. British Journal of Clinical Psychology, 44, 227-239.

Herman, K., Ostrander, R., Walkup, J., Sylva, S. & March, J. (2007). Empirically derived subtypes of adolescent depression: Latent profile analysis of co-occurring symptoms in the treatment of adolescents with depression study. Journal of Consulting & Clinical Psychology, 75, 716-728.

Lahey, B. B., Applegate, B. & Waldman, I. D. (2004). The structure of child and adolescent psychopathology: Generating new hypotheses. Journal of Abnormal Psychology, 113, 358-385.

Lewinsohn, P. M., Hops, H., Roberts, R. E., Seeley, J. R., & Andrews, J. A. (1993). Adolescent psychopathology: I. Prevalence and incidence of depression and other DSM-IIIR disorders in high school students. Journal of Abnormal Psychology, 102, 133-144.

Lewinsohn, P. M., Pettit, J. W., Joiner, T. E., & Seeley, J. R. (2003). The symptomatic expression of major depressive disorder in adolescents and young adults. Journal of Abnormal Psychology, 112, 244-252.

Lonigan, C. J., Carey, M. P. & Finch, A. J. (1994). Anxiety and depression in children and adolescents: Negative affectivity and the utility of self-reports. Journal of Consulting & Clinical Psychology, 62, 1000-1008

Lovibond, S. H., & Lovibond, P. F. (1995). Manual for the Depression Anxiety Stress Scales. Sydney: Psychology Foundation.

O’Connor, B. P. (2000). SPSS, SAS, and MATLAB programs for determining the number of components using parallel analysis and Velicer's MAP test. Behavior Research Methods, Instruments & Computers, 32, 396-402.

Roberts, R. E., Lewinsohn, P. M., & Seeley, J. A. (1995). Symptoms of DSM-IIIR major depression in adolescence: Evidence from an epidemiological survey. Journal of the American Academy of Child & Adolescent Psychiatry, 34, 1608-1617.

Sanderson, W. C., DiNardo, P. A., Rapee, R. M. (1990). Syndrome comorbidity in patients diagnosed with a DSM-III-R anxiety disorder. Journal of Abnormal Psychology, 99, 308-312.

Szabó, M. (2009). The short version of the depression anxiety stress scales (DASS-21): Factor structure in a young adolescent sample. Journal of Adolescence, doi:10.1016/j.adolescence.2009.05.014

Szabó, M. & Lovibond, P. (2006). Anxiety, depression, and tension/stress in children. Journal of Psychopathology and Behavioral Assessment, 28 (3), 195-205.

Tomarken, A. & Waller, G. (2003). Potential problems with "well fitting" models. Journal of Abnormal Psychology, 112, 578–598.

Tomarken, A. & Waller, G. (2005). Structural equation modeling: Strengths, limitations, and misconceptions. Annual Review of Clinical Psychology, 1, 31–65.

Turner, C. & Barrett, P. M. (2003). Does age play a role in structure of anxiety and depression in children and youths? An investigation of the tripartite model in three age cohorts. Journal of Consulting & Clinical Psychology, 71, 826-833.

Turner, N. E. (1998). The effect of common variance and structure pattern on random data eigenvalues: Implications for the accuracy of parallel analysis. Educational & Psychological Measurement, 58, 541-569.

Vasey, M. W. & Dadds, M. R. (2000). (Eds.) The developmental psychopathology of anxiety. London, Oxford University Press.

Watson, D., Clark, L., Weber, K., Assenheimer, J., Strauss, M., & McCormick, R. (1995). Testing a tripartite model: II. Exploring the symptom structure of anxiety and depression in student, adult, and patient samples. Journal of Abnormal Psychology, 104, 15-25.

Watson, D., & Walker, L. (1996). The long-term stability and predictive validity of trait measures of affect. Journal of Personality & Social Psychology, 70, 567-577.

Watson, D., Weber, K., Assenheimer, J., Clark, L., Strauss, M., & McCormick, R. (1995). Testing a tripartite model: I. Evaluating the convergent and discriminant validity of anxiety and depression symptom scales. Journal of Abnormal Psychology, 104, 3-14.

Weiss, B., & Weisz, J. (1988). Factor structure of self-reported depression: Clinic-referred children versus adolescents. Journal of Abnormal Psychology, 97, 492-495.

Weiss, B., Weisz, J., Politano, M., Carey, M., Nelson, W. M., & Finch, A. (1992). Relations among self-reported depressive symptoms in clinic-referred children versus adolescents. Journal of Abnormal Psychology, 101, 391-397.

Young, J., Mufson, S., & Davies, M. (2006). Impact of comorbid anxiety in an effectiveness study of interpersonal psychotherapy for depressed adolescents. Journal of the American Academy of Child & Adolescent Psychiatry, 45, 904-912.

Acknowledgements

We wish to thank the Darling Downs Public Health Unit (Queensland Health) for its support of the South-West Queensland Longitudinal Study of Adolescent Students project, Marcus Jenick and Georgie Clarke for project management, the Centre for Organizational Research and Evaluation and the Centre for Rural and Remote Area Health for their support.

Table 1

DASS-21 means, variability, range and internal consistency by age and gender

	N	Mean	*SD*	Range	Alpha	PA
Male						
Age 11	46	22.26	14.86	58	.94	1
Age 12	83	15.86	15.49	61	.96	1
Age 15	52	14.93	12.25	43	.93	1
Age 17	26	11.83	8.23	30	.86	1
Female						
Age 11	59	15.31	15.40	55	.95	1
Age 12	70	18.76	15.84	52	.95	1
Age 15	58	15.00	12.52	49	.93	1
Age 17	31	7.80	6.09	26	.83	1

Note. *SD*=Standard deviation; PA=Parallel Analysis indicates N components above the upper 95th percentile eigen values of 100 random data sets.

Table 2
Parallel Analysis of Time 1 and Time 2 datasets

	Time 1		Time 2	
Latent Root	Actual eigenvalues	Upper 95th percentile eigenvalues of 100 random data sets	Actual eigenvalues	Upper 95th percentile eigenvalues of 100 random data sets
1	10.02	1.51	10.35	1.63
2	1.03	1.42	1.13	1.52
3	0.95	1.36	0.97	1.42
4	0.89	1.31	0.86	1.35
5	0.86	1.26	0.76	1.30
6	0.77	1.21	0.74	1.24
7	0.73	1.16	0.71	1.19
8	0.68	1.12	0.65	1.14
9	0.56	1.09	0.59	1.10
10	0.53	1.05	0.54	1.05
11	0.52	1.01	0.53	1.02
12	0.51	0.98	0.49	0.97
13	0.44	0.95	0.43	0.92
14	0.43	0.91	0.40	0.88
15	0.37	0.87	0.35	0.86
16	0.36	0.84	0.31	0.82
17	0.32	0.81	0.28	0.77
18	0.29	0.78	0.26	0.74
19	0.27	0.73	0.25	0.69
20	0.25	0.69	0.23	0.66
21	0.23	0.66	0.17	0.60

Table 3

Comparison of item loadings at Time 1 and Time 2

Item	Component 1 Time 1	Component 1 Time 2	Average Communality
1	.54	.59	.33
2	.52	.51	.27
3	.53	.68	.38
4	.67	.62	.42
5	.61	.69	.43
6	.62	.62	.39
7	.69	.63	.44
8	.75	.69	.52
9	.71	.66	.48
10	.71	.73	.52
11	.75	.76	.57
12	.76	.75	.57
13	.73	.78	.57
14	.69	.68	.48
15	.74	.72	.54
16	.76	.79	.61
17	.76	.76	.58
18	.64	.75	.49
19	.73	.73	.53
20	.75	.77	.59
21	.75	.75	.57