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The Hierarchical Factor Structure of the Spanish Version of Depression Anxiety and Stress Scale -21

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Abstract

The Depression Anxiety and Stress Scale-21 (DASS-21) is one of the most widely used self-reports for the measurement of emotional symptoms. However, some controversy remains concerning its factor structure. Additionally, more data of the psychometric properties of the Spanish version of the DASS-21 are needed. The aim of this study was to explore the hierarchical factor structure of the DASS-21 and to further analyze its psychometric properties in Spain and Colombia. Four samples with a total of 2980 participants completed the Spanish version of the DASS-21. Two of the samples were composed of undergraduates of each country and the other two samples were recruited online. The results strongly supported a hierarchical factor structure of the DASS-21 consisting of three first-order factors (depression, anxiety, and stress) and one second-order factor (emotional symptoms). Initial evidence of measurement invariance was found for country (Spain vs. Colombia) and sample (undergraduates vs. online). The DASS-21 showed good psychometric properties in all samples. The DASS-21 seems to be a good option to measure emotional symptoms in Spain and Colombia, and its hierarchical factor structure indicates that it provides general and specific measures of emotional symptoms that are theoretically meaningful.
Key words: depression, anxiety, DASS-21, factor hierarchical structure, emotional symptoms.

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Novelty and Significance

What is already known about the topic?

- The DASS-21 was designed to maximize the discrimination between the subjective perception of anxiety and depression.
- The DASS-21 has shown a three factor structure: depression, anxiety, and stress.

What this paper adds?

- The DASS-21 showed good psychometric properties in Spanish version.
- The DASS-21 showed a hierarchical factor structure with three first-order factors and a second-order factor.

Depression and anxiety disorders are the most frequent psychiatric complaints and the first cause of disability worldwide (e.g., Arrieta, Díaz, & González, 2013). These disorders have been classically considered as different diagnostic categories. However, a complex debate has occurred during the last decades with regard to the differentiation of depression and anxiety symptoms for two reasons. Firstly, depression and anxiety disorders present a high rate of comorbidity (e.g., Alonso, Angermaryer,

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Bernet, & Bruffaerst, 2004), with depression, generalized anxiety disorder (GAD), and panic disorder being the most comorbid disorders (Beuke, Fischer, & McDowall, 2003; Jiménez, Bojórquez, Blas, Landa, & Caraveo, 2005). Secondly, the instruments dedicated to measure depression and anxiety symptoms usually show very strong correlations with each other (Agudelo, Gómez, & López, 2014). These two interrelated facts complicate the differential assessment of depression and anxiety disorders (Mineka, Watson, & Clark, 1998; Rodríguez, Bruce, Pagano, Spencer, & Keller, 2004).

Given this state of affairs, some authors have opted for designing instruments that clearly differentiate between anxiety and depression symptoms. One of these efforts is represented by the Depression Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995), which was created with the aim of maximizing the discrimination between the subjective perception of anxiety and depression. The DASS is a 42-items, 4-point Likert-type scale in which respondents have to state how much some negative emotional states applied to them during the last week.

Although the first intention of the DASS developers was to differentiate between depression and anxiety, factorial studies yielded a third factor that was called Stress. Accordingly, the DASS consists of three subscales: Depression, which measures low affect, dysphoria, hopelessness, sadness and anhedonia; Anxiety, which measures physiological activation and the subjective experience of anxiety; and Stress, which measures symptoms more related to GAD such as tension, irritability, nervousness, and impatience. Subsequent studies conducted by Antony, Bieling, Cox, Enns, and Swinson (1998) focused on developing a reduced, 21-item version of the DASS: the DASS-21. These studies confirmed the three-factor structure of the DASS and DASS-21 both in clinical and nonclinical groups. Likely, due to its brevity and specificity, the DASS-21 has become a very popular measure of emotional symptoms. Accordingly, during the last few years, interest in analyzing the psychometric properties and factor structure of the DASS-21 in different samples (clinical vs. nonclinical samples) and languages has grown.

Overall, research has shown that the DASS-21 has good psychometric properties in different languages (e.g., Antúnez & Vinet, 2012; Fonseca, Paíno, Lemos, & Muñiz, 2010). With regard to the factor structure of the DASS-21, confirmatory factor analyses (CFA) have yielded somewhat mixed results. Some studies have found that two-factor solutions with Depression and Stress items loading in the same factor or with Anxiety and Stress items loading together (Duffy, Cunningham, & Moore, 2005) showed the best fit to the data. Most of the studies have found, however, that the three-factor solution described in Antony et al. (1998) shows the best fit to the data (e.g., Antúnez & Vinet, 2012; Daza, Novy, Stanley, & Averill, 2002; Fonseca *et al*., 2010; Norton, 2007; Tully, Zajac, & Venning, 2009).

Following the rationale of the original study (Lovibond & Lovibond, 1995), some authors have tried to test whether a hierarchical factor structure consisting of one general factor (i.e., Emotional Symptoms or Negative Affectivity) and three correlated, first-order factors (Depression, Anxiety, and Stress) showed a better fit to the data than the solution with only three correlated factors, using a CFA methodology (e.g., Antony et al., 1998; Daza et al., 2002; Fonseca Pedrero et al., 2010). The results in all these studies were that goodness of fit of the two competing models were identical. However, as stated by Brown (2015), when the first-order model has three factors, a solution that specifies a single higher order factor is just-identified and both models produce the same goodness-of-fit.

As it is impossible to compare the fit of the three correlated factors model and the

hierarchical factor model with one general factor and three correlated first-order factors through a CFA methodology, the current study aims to analyze this issue through the Schmid-Leiman transformation (Schmid & Leiman, 1957) as an alternative to the nested factors modeling. These analyses were conducted in four samples of two Spanish-speaking countries: Spain and Colombia. Whereas the DASS-21 has shown good psychometric properties in Spanish undergraduates (Fonseca *et al*., 2010), it has not been tested in Colombian samples. Accordingly, a secondary aim of this study was to extend the data on the psychometric properties of the DASS-21 in Spain and to explore them for the first time in Colombia. Four samples with a total of 2980 participants were analyzed.

Method

Participants

Sample 1. Consisted of 511 undergraduates (age range 18-68, *M*= 26.74, *SD*= 10.31) from four Spanish universities. Forty-four percent of the sample was studying Psychology. The other studies included Speech Therapy, Law, and Physics. Sixty-one percent were women. Of the overall sample, 19.4% of participants had received psychological or psychiatric treatment at some time, but only 4.3% were currently in treatment. Also, 3.7% of participants were taking some psychotropic medication.

Sample 2. Consisted of 762 undergraduates (age range 18-63, *M*= 21.16, *SD*= 3.76) from seven universities of Bogotá. Forty-six percent of the sample was studying Psychology. The other studies included Law, Engineering, Philosophy, Communication, Business, Medicine, and Theology. Sixty-two percent were women. Of the overall sample, 26% of participants had received psychological or psychiatric treatment at some time, but only 4.3% were currently in treatment. Also, 2.9% of participants were taking some psychotropic medication.

Sample 3. Consisted of 813 participants (71% females) with age ranging between 18 and 82 years (*M*= 34.74, *SD*= 10.87). The relative educational level of participants was: 34.5% primary studies (i.e., compulsory education) or mid-level graduates (i.e., high school or vocational training), 42.7% were undergraduates or college graduates, and 22.3% were currently studying or had a postgraduate degree. They responded to an anonymous Internet survey distributed through social media. All of them were Spaniards. Forty-four percent reported having received psychological or psychiatric treatment at some time, but only 16.8% were currently in treatment. Also, 13% of participants reported using psychotropic medication.

Sample 4. Consisted of 894 participants (67.4% females) with age ranging between 18 and 88 years (*M*= 29.16, *SD*= 10.13). The relative educational level of the participants was: 21.3% primary studies (i.e., compulsory education) or mid-level study graduates (i.e., high school or vocational training), 62.5% were undergraduates or college graduates, and 16.2% were currently studying or had a postgraduate degree. They responded to an anonymous internet survey distributed through social media. All of them were Colombian. Forty-seven percent reported having received psychological or psychiatric treatment at some time, but only 9.4% were currently in treatment. Also, 5.7% of participants reported using psychotropic medication.

Procedure

All participants provided informed consent previous to the inclusion in the study. In Samples 1 and 2, the administration of the questionnaire package was conducted in

the participants' classrooms at the beginning of a regular class. Participants in Samples 3 and 4 responded to an anonymous Internet survey distributed through social media.

Instruments

Depression, Anxiety, and Stress Scales 21 (DASS-21; Antony *et al*., 1998). The DASS-21 is a 21-item, 4-point Likert-type scale (3= "applied to me very much, or most of the time"; 0= "did not apply to me at all") consisting of sentences describing negative emotional states. It contains three subscales (Depression, Anxiety, and Stress) and has shown good internal consistency and convergent and discriminant validity. We administered the Spanish version of the DASS-21 by Daza *et al*. (2002), which showed good psychometric properties with Hispanic participants. This version also showed good psychometric properties in Spanish undergraduates (Fonseca Pedrero *et al*., 2010).

Data analysis

Prior to conducting factor analyses, all samples were examined, searching for missing values. Only 13 values of the DASS-21 were missing (one for Items 4, 6, 10, 12, 18, and eight for Item 21). These data were imputed using the matching response pattern method of LISREL© (version 8.71, Jöreskog & Sörbom, 1999), which was the software used to conduct the confirmatory factor analyses (CFA). In this imputation method, the value to be substituted for the missing value of a single case is obtained from another case (or cases) having a similar response pattern over the 21 items of the DASS-21. The responses of 10 Spanish undergraduates were eliminated due to null vector response pattern.

Confirmatory factor analyses were computed to compare the following five factor models of the DASS-21 in the overall sample and in each country: (a) a one-factor model; (b) a two-correlated-factor model with depression and stress items loading on the same factor; (c) a two-correlated-factor model with anxiety and stress loading on the same factor; (d) a three-correlated-factor model; and (e) the previous model with a general, second-order factor. As previously commented, when the first-order model has three factors, a solution that specifies a single higher order factor is just-identified, and both models produce the same goodness-of-fit (Brown, 2015). Accordingly, as in other studies (e.g., Herzberg et al., 2012), the Schmid-Leiman transformation (Schmid & Leiman, 1957) was computed to assess the presence of a higher order factor in this case (see below).

Because the DASS-21 uses a Likert-type scale measured on an ordinal scale, a robust unweighted least squares (ULS) estimation method using polychoric correlations was used to conduct CFA. Goodness of fit was examined by computing the following fit indexes: (a) the root mean square error of approximation (RMSEA); (b) the comparative fit index (CFI); (c) the non-normed fit index (NNFI); (d) the expected cross-validation index (ECVI); and (e) the standardized root mean square residual (SRMR). According to Kelloway (1998) and Hu and Bentler (1999), RMSEA values of .10 represent a good fit, and values below .05 represent a very good fit to the data. For the SRMR, values below .08 represent a reasonable fit, and values below .05 a good fit. With respect to the CFI and NNFI, values above .90 indicate well-fitting models, and above .95 represent a very good fit to the data. The ECVI was computed to compare the goodness of fit of the different models.

As commented above, and following the recommendations of Gignac (2007), the

Schmid-Leiman transformation (Schmid & Leiman, 1957) was conducted as an alternative to the nested factors modeling to explore the factor loadings of the items and the extracted variance accounted for by the general factor in the fifth model (i.e., three correlated first-order factors and a second-order factor). This statistical procedure performs a secondary exploratory factor analysis (EFA) using the latent factor intercorrelations obtained from the previous EFA and facilitates interpretation of primary factors (items) relative to higher order factors by computing direct relations between primary variables and second-order factors. Likewise, the proportion the general factor accounts for of the extracted variance is indicative of the presence of a general factor (range 40-50%; Gorsuch, 1983). The factor analysis was conducted with Factor 9.2© (Lorenzo Seva & Ferrando, 2006), adopting an ULS estimation method and using polychoric correlations. Additionally, the syntax developed by Wolf and Preising (2005) for SPSS was used to compute the total extracted variance accounted for by the higher order factor.

Additional CFAs were performed to test for measurement invariance across countries (Spain vs. Colombia) and type of sample (undergraduates vs. online). In so doing, the relative fit of two models was compared. The first model (the multiple-group baseline model) allowed the 21 unstandardized factor loadings to vary across countries and type of sample, whereas the second model (constrained model) placed equality constraints (i.e., invariance) on those loadings. Equality constraints were not placed on estimates of the factor variances because these are known to vary across groups even when the indicators are measuring the same construct in a similar manner (Kline, 2005). The parsimonious model (constrained model) was selected if the following four criteria suggested by Cheung and Rensvold (2002) and Chen (2007) were met: (a) the constrained model did not generate a significantly worse fit than the unconstrained model (the multiple-group baseline model) according to the chi-square test; (b) the difference in RMSEA (ΔRMSEA) was lower than .01; (c) the difference in CFI (ΔCFI) was greater than -.01; and (d) the difference in NNFI (ΔNNFI) was greater than -.01.

Lastly, Cronbach's alphas were computed on SPSS 19 to explore the internal consistency of the DASS-21 in all samples. Descriptive data were also calculated for each sample.

Results

Table 1 presents the goodness-of-fit indexes of the five factor models in the overall sample and in each country. The results were very similar in the three cases. The one-factor model showed an acceptable fit, but fit was better for the two, two first-order correlated factor models. However, the correlated three-factor model showed the best fit to the data. As expected, the fit of the correlated three-factor model plus a general factor was identical to the model with only three correlated factors.

Table 2 shows the explained variance of the second-order factor in the model with three correlated first-order factors according to the Schmid-Leiman transformation. This general factor accounted for more than 70% of the variance in all cases, a proportion clearly above the range considered as indicative of the presence of a general factor (40%-50%; Gorsuch, 1983). Additionally, all items seemed to represent the general factor because they showed loadings above .30 (Tabachnick & Fiddell, 2007).

Table 3 shows the fit indices for measurement invariance tests for the hierarchical model with three correlated factors. As can be seen, the multiple-group baseline models

Table 1. Goodness-of-Fit Indexes for the Factor Models in the Overall Sample and in Spain and Colombia.

Model		S-B χ^2	CFI	RMSEA (90% CI)	SRMR	NNFI	ECVI (90% CI)
Overall Sample *N*= 2980	1. One factor	3478.34 (189)	.98	.076 (.074, .079)	.053	.98	1.20 (1.13, 1.26)
	2. Two factors (depression + stress)	2845.51 (188)	.98	.069 (.067, .071)	.050	.98	.98 (.93, 1.04)
	3. Two factors (anxiety + stress)	1817.51 (188)	.99	.054 (.052, .056)	.042	.99	.64 (.59, .69)
	4. Three factors	1453.49 (186)	.99	.048 (.046, .050)	.038	.99	.52 (.48, .56)
	5. Three factors + General Factor	1453.49 (186)	.99	.048 (.046, .050)	.038	.99	.52 (.48, .56)
Colombian Samples *N*= 1656	1. One factor	1733.74 (189)	.98	.070 (.067, .073)	.053	.98	1.10 (1.02, 1.18)
	2. Two factors (depression + stress)	1590.73 (188)	.98	.067 (.064, .070)	.051	.98	1.01 (.94, 1.09)
	3. Two factors (anxiety + stress)	1138.21 (188)	.99	.055 (.052, .058)	.046	.99	0.74 (.68, .81)
	4. Three factors	983.55 (186)	.99	.051 (.048, .054)	.043	.99	0.65 (.59, .71)
	5. Three factors + General Factor	983.55 (186)	.99	.051 (.048, .054)	.043	.99	0.65 (.59, .71)
Spanish Samples *N*= 1324	1. One factor	2319.14 (189)	.97	.092 (.089, .096)	.062	.97	1.82 (1.70, 1.94)
	2. Two factors (depression + stress)	1601.89 (188)	.98	.075 (.072, .079)	.056	.98	1.28 (1.18, 1.38)
	3. Two factors (anxiety + stress)	1014.74 (188)	.99	.058 (.054, .061)	.045	.99	0.83 (.76, .91)
	4. Three factors	770.49 (186)	.99	.049 (.045, .052)	.041	.99	0.65 (.59, .72)
	5. Three factors + General Factor	770.49 (186)	.99	.049 (.045, .052)	.041	.99	0.65 (.59, .72)

Table 2. Percentage of Variance Explained by the General Factor in the Samples by Means of the Schmid-Leiman Transformation.

Samples	Variance explained by the General Factor	Variance explained by the first-order factors
Overall	75.1%	24.9%
Colombia	73.8%	26.2%
Spain	73.6%	26.4%

Table 3. Measurement Invariance across Countries (Colombia vs. Spain) and Samples (Undergraduates vs. Online) for the Hierarchical Model with Three Correlated Factors and one General Second-Order Factor.

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	RMSEA	ΔRMSEA	CFI	ΔCFI	NNFI	ΔNNFI
Measurement invariance across countries										
Model 1	1727.5	372			.049		.99		.99	
Model 2	1812.6	393	85.1	21	.049	.000	.99	.00	.99	.00
Measurement invariance across samples										
Model 1	1536.7	372			.046		.99		.99	
Model 2	1603.6	393	66.9	21	.045	.001	.99	.00	.99	.00

Notes: Model 1= Multiple-group Baseline Model; Model 2= Three correlated factors and one general factor.

(Model 1) fit the data very well, both across countries and type of sample. When equality constraints were placed on the factor loadings (Model 2), there was no significant decrement in goodness of fit, suggesting that the measures were invariant across country (Spain vs. Colombia) and type of sample (undergraduates vs. online). In both cases, all criteria recommended by Cheung and Rensvold (2002) and Chen (2007), except the chi-square test, were met. Specifically, the χ^2 diff tests were statistically significant across countries, $\chi^2_{(21)}$= 85.1, p <.01, and across type of sample ($\chi^2_{(21)}$= 66.9, p <.01), and the

differences in RMSEA were lower than .01, and the differences in CFI and NNFI were higher than -.01. Given the sensitivity of the chi-square test to sample size, we can assume that measurement invariance was broadly met in both cases.

Table 4 shows that Cronbach's alphas (internal consistency) of the complete DASS-21 were excellent with alpha values from .92 to .95. Alphas for the subscales were good, with the Depression subscale showing higher values (from .86 to .92) than the Anxiety (from .80 to .87) and Stress subscales (from .80 to .86).

Table 4. Cronbach's Alphas and Descriptive Data for Each Sample.

		DASS-21 Total	Depression	Anxiety	Stress
Sample 1: Spanish undergraduates	Alpha	.93	.87	.84	.81
	M	17.66	4.80	4.79	8.07
	SD	12.04	4.60	4.39	4.60
Sample 2: Colombian undergraduates	Alpha	.92	.86	.80	.80
	M	20.30	5.58	5.78	8.94
	SD	12.26	4.75	4.44	4.55
Sample 3: Online Spain	Alpha	.95	.92	.87	.86
	M	14.68	4.42	3.53	6.74
	SD	11.93	4.73	4.03	4.46
Sample 4: Online Colombia	Alpha	.93	.87	.80	.83
	M	19.36	5.40	5.44	8.52
	SD	12.48	4.79	4.38	4.70
Overall Sample	Alpha	.93	.88	.83	.83
	M	18.03	5.08	4.89	8.06
	SD	12.39	4.75	4.39	4.66

Discussion

The DASS-21 is a widely used scale to measure emotional symptoms, which was designed to maximize the discrimination between symptoms of depression and anxiety. However, factor analysis of the DASS-21 has yielded several factor structure models. Overall, the three-factor model showed good fit across different studies, but several alternative factor models have been suggested, including a correlated two-factor model with Depression and Stress or Anxiety and Stress items loading on the same factor. Nonetheless, a logical hierarchical structure with three first-order factors and a second-order factor has been deficiently explored using a CFA methodology because this model is mathematically identical to a correlated three-factor model.

In this study, we tested the goodness-of-fit of five alternative factor models using CFA in Spanish and Colombian samples. In view that the solution of the correlated three-factor model with a general, second-order factor produces the same goodness-of-fit as the correlated three-factor model (Brown, 2015), we computed the Schmid-Leiman transformation following an EFA methodology to analyze the proportion of variance accounted for by the general factor and loadings of each item on this factor. A secondary aim of this study was to extend the available data regarding the psychometric properties of the DASS-21 in Spain and Colombia.

The results of this study provide strong evidence that the Spanish version of the DASS-21 has good internal consistency and possesses a hierarchical factor structure consisting of three first-order factors (Depression, Anxiety, and Stress) and one second-order factor (Emotional Symptoms) in Spain and Colombia. This finding has several relevant implications. On the one hand, the presence of a general factor provides a theoretical

rationale for using the total score of the DASS-21 as a general measure of emotional symptoms. This score provides a general measure of emotional symptoms and not the mere aggregation of the three types of symptoms. On the other hand, the presence of a second-order factor provides more flexibility to researchers and practitioners because they can choose between separating responses in the DASS-21 in the three types of symptoms (depression, anxiety, and stress) or summarizing them in an overall measure of emotional symptoms.

Some limitations of this study are worth mentioning. Firstly, the functioning of the DASS-21 was tested only in nonclinical samples; therefore, further research is necessary in clinical samples to confirm the results obtained in this study. Secondly, we tested the factor structure of the DASS-21 only in two Spanish-speaking countries so that further studies are necessary to extend these findings to other Spanish-speaking countries. Thirdly, the results of this study are only applicable to the samples analyzed; hence, further studies might analyze whether the hierarchical factor structure of the DASS-21 is applicable to other languages and cultures.

In conclusion, the DASS-21 seems to be a reliable measure of emotional symptoms in Spanish and Colombian samples, consisting of a hierarchical factor structure with one general factor and three first-order factors. The DASS-21 provides researchers and clinicians with the option to investigate specific types of emotional symptoms and provides a theoretically meaningful reason for the use of the total score as a general measure of emotional symptoms.

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