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Dimensional Structure and Measurement Invariance of the Youth Self-Report Across Gender and Age

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A B S T R A C T

Purpose: The aim of the present work was to examine the correlated eight-syndrome model of the Youth Self-Report (YSR) proposed by Ivanova et al [1], using a confirmatory factor analysis for ordinal data. Likewise, we explored the measurement invariance of the YSR across gender and age using multigroup comparisons, and checked whether there were differences in the latent means.
Methods: The sample was made up of 4,868 nonclinical adolescents (47.6% males), with a mean age of 14.6 years (SD = 1.6).
Results: The correlated eight-syndrome model proposed by Ivanova et al [1] showed a reasonable fit to the data, both for the total sample and by participants' gender and age. Moreover, the factor-equivalence analysis showed that the hypothesized dimensional model was invariant across gender and age. Statistically significant differences were found when comparing latent means between the groups.
Conclusions: These results coincide with those found in the literature and are in support of the replicability, generalizability, and consistency of the eight-syndrome model of the YSR, as well as its measurement invariance across gender and age. Future studies should explore the measurement invariance of this model through multigroup comparisons across cultures.

The assessment of emotional and behavioral problems in children and adolescents is a priority issue for public health policy, clinical practice, and research. Standardized assessment by means of self-report allows the exploration of the prevalence rates, frequency and distribution of psychological disorders, and the analysis of the underlying structure. This helps in the drawing-up of empirically based taxonomies for purposes such as the comparison of groups from different cultures, communication between professionals, the setting of criteria for effective detection, prevention and intervention, and the study of etiological factors and protection mechanisms.

Among the taxonomic models obtained through multivariate statistical techniques is the Achenbach System of Empirically Based Assessment, which allows the gathering of information from a range of informants: parents—the Child Behavior Checklist (CBCL) [2], teachers—the Teacher's Rating Form (TRF) [2], and adolescents themselves—the Youth Self-Report (YSR) [2]. Specifically, the YSR is an instrument extensively used in a wide variety of cultures [1,3,4], has shown its value as an epidemiological tool, and presents adequate psychometric properties based on the evidence of validity, reliability, and temporal stability [2,5–9].

The factor studies derived from the YSR have permitted a numerical or quantitative taxonomy to be drawn up, consisting in a set of eight first-order syndromes, namely Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problems, Thought Problems, Attention Problems, Rule-Breaking Behavior, and Aggressive Behavior, and two second-order factors, namely internalizing and externalizing scores (U.S. model) [2]. Psychopathology is

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thus organized in an empirical taxonomy with a mathematical basis, and is based on the correlations found between symptoms, signs, and behavior; the internalizing dimension would include anxiety and depression syndromes, whereas the externalizing dimension would cover behavior problems, substance abuse, and hyperactivity. It is understood that the syndromes or disorders would share biological or genetic vulnerability mechanisms, based on the continuity of the experiences of normal and abnormal behavior [10].

Past studies attempted to test this dimensional taxonomy or structure, using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), yielding diverse results [1,11–15]. For example, de Groot et al [15], using EFA and CFA in a sample of 1,139 Dutch clinical adolescents, found a six-factor dimensional structure similar to that of the U.S. model, even though the Dutch model, in which most items making up the U.S. Anxious/Depressed and Withdrawn syndromes formed a single syndrome, showed a slightly better fit to the data. In another study, Lemos et al [12], using EFA with a sample of 2,833 Spanish adolescents, found an eight-syndrome dimensional structure quite similar to that proposed by Achenbach and Rescorla [2]; Lambert et al [13], using a sample of 625 Jamaican adolescents, and carrying out a CFA based on the construction of item parcels, found that the data did not fit well with the U.S. model; and O'Keene et al [11], in a sample of 938 American adolescents using EFA and CFA based on a smaller number of items, found a seven-factor structure in which some factors were very similar to those of the U.S. model (Delinquent Misbehavior, Somatic Complaints, and Anxious-Depressed), whereas others were not replicated (Social Problems, Thought Problems, and Withdrawal). Recently, Ivanova et al [1] carried out a multi-country study on a population of 30,243 adolescents from 23 societies. According to the results of the CFA, the correlated eight-syndrome model showed adequate goodness-of-fit indexes in all 23 cultures, and coincided with that derived from the information provided by parents (CBCL) [2] and teachers (TRF) [2]. This is clearly indicative of the generalizability of the model across cultures and informants. These data point to a general model of behavioral and emotional problems made up of eight general syndromes, although even this model is not without its criticisms, which refer to the number and content of dimensions underlying the YSR, the large number of items and scarcity of information provided by some of them, and the study of the measurement invariance across gender, age, and/or culture [11,13,14].

The phenotypical expression of the eight syndromes of the YSR appears to vary according to adolescents' gender and age, quite similar results being found across different studies [1,3,4,16–19]. In general, females tend to score higher than males in the YSR syndromes related to internalization (e.g., Anxious-Depressed), whereas males score higher in syndromes related to externalization patterns (e.g., Rule-Breaking Behavior). By age, younger adolescents (aged: 11–14 years) tend to score systematically lower than older ones (aged: 15–18 years) in the majority of YSR syndromes. Nevertheless, it is important to point out on comparing mean scores of the central YSR syndromes across groups (e.g., male/female) that the measurement invariance should be checked. In comparisons between groups, it is typically assumed that both the measurement instrument and the psychological construct underlying that measurement instrument behave in exactly the same manner and have the same significance (clinical and public health) across the groups being compared [20,21]. However, from a methodological point of view, this affirmation is completely untenable if measurement invariance is not tested previously. If the data do not hold invariance, or if this has not been tested, the validity of the inferences and interpretations extracted from the data could be completely erroneous or unfounded [20,22].

Although the YSR has been widely used, there are still psychometric issues that need to be addressed. Within this research context, our first objective was to examine the dimensional structure of eight correlated syndromes of the YSR proposed by Ivanova et al [1], using CFA for ordinal data. The second goal was to examine, by multigroup comparisons, whether the eight central syndromes of the YSR were invariant across gender and age and to observe whether there were differences in the comparisons of the latent means. We are guided in this by the hypothesis that the model proposed by Ivanova et al [1] will show a reasonable fit to the data, both in the total sample and by gender and age, and that, moreover, this model will show invariance across the groups compared. Our goals have important implications at both substantive and methodological level because they will permit to: (a) draw up empirically derived taxonomies of emotional and behavioral problems in adolescents that make it possible to compare studies and cultures; (b) confirm the generalizability of this model in an independent sample of the general adolescent population; (c) explore in more depth the emotional and behavioral characteristics of a developmental stage for the emergence of different psychological disorders; (d) further our understanding of dimensional models of developmental psychopathology; and (e) provide highly advantageous measurement instruments that allow the rapid and effective assessment of psychological problems in adolescence in both clinical and research contexts.

Methods

Participants

Participants were 4,868 students (52.4% females), from different secondary schools and technical training institutions in the regions of Asturias (in northern Spain) and Madrid. Part of this sample was used in a previous study [12]. Efforts were made to ensure representativeness of the sample by selecting it from different geographical regions and socioeconomic strata. Mean age of participants was 14.6 years (SD = 1.6), ranging from 11 to 18 years. In accordance with previous studies, we created two age groups: adolescents aged 11–14 years (n = 2,199) and 15–18 years (n = 2,669). Sample distribution according to gender and age is shown in Table 1.

Instrument

The YSR [23] is an easy-to-apply self-report made up of 112 items with Likert-type response format comprising three cate-

Table 1
Sample description by gender and age

Age	Males	Females	Total	%
11	71	56	127	2.6
12	196	162	358	7.4
13	334	399	733	15.1
14	465	516	981	20.2
15	476	565	1,041	21.4
16	478	517	995	20.4
17	239	268	507	10.4
18	56	70	126	2.6
Total	2,315	2,553	4,868	100

gories (0 = "not true;" 1 = "somewhat true or sometimes true;" 2 = "very true or often true"), 16 of which assess the frequency of socially desirable behaviors. All the items refer to symptoms and experiences from the past 6 months. Following the guidelines of Achenbach and Rescorla [2], the instrument yields a total score on problem behaviors, another on socially desirable behaviors, eight scores on narrow-band syndromes (Anxious-Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problems, Thought Problems, Attention Problems, Rule-Breaking Behavior, and Aggressive Behavior), and two on broad-band syndromes (externalizing and internalizing). In the 2001 version of the YSR [1], six items were modified (2, 4, 5, 28, 78 and 99), although this did not alter its psychometric properties, and the instrument maintained high levels of correlation with the 1991 version. Specifically, in that study, we used the 89 items on problem behaviors from the work by Ivanova et al [1]. In the present study, we used the version adapted and validated for Spanish samples by Lemos et al [24], which has shown adequate psychometric properties, based on the evidence of validity, internal consistency, and test–retest reliability [12,16,17,25]. Internal consistency levels in the present study estimated by means of Cronbach's alpha ranged from .60 (Somatic Complaints) to .80 (Aggressive Behavior), being .93 for the total score.

Procedure

The questionnaire was administered in groups of 10–30 students, during normal school time, under the constant supervision of a researcher. Participants were told that the questionnaire was part of a research project on diverse personality characteristics, and were assured of the voluntary nature of their participation and the confidentiality of their responses. For those aged <18 years, parents were asked to provide written informed consent. The study was approved by the Research and Ethics Committees at the University of Oviedo and the Department of Education of the Principality of Asturias.

Data analysis

First, we carried out different CFAs for testing the correlated eight-dimension model proposed by Ivanova et al [1]. Given the ordinal nature of the data, for the estimation of parameters we used the weighted least squares method, using a diagonal weight matrix with standard errors and a mean-adjusted χ^2 test statistic that uses a full-weight matrix [26]. To identify the scale of measurement models in CFA, we fixed one of the factor loadings to a value of 1 for each factor. Evaluation of goodness-of-fit to the sample data was determined on the basis of multiple criteria: the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), and the root-mean-square error of approximation (RMSEA). Hu and Bentler [27] suggested that RMSEA should be ≤.06 for a good model fit and CFI and TLI should be ≥.95, although any value >.90 tends to be considered acceptable.

Second, we tested the measurement invariance across gender and age of the correlated eight-syndrome model hypothesized by Ivanova et al [1]. Measurement invariance is frequently tested by multigroup comparisons using structural equation modeling within the framework of a CFA. Using multigroup comparisons for categorical data in Mplus (Delta parameterization), testing of the measurement invariance was carried out in two hierarchical and progressive steps [26], starting with the determination of a well-fitting multigroup baseline model, and continuing with the establishment of successive equivalence constraints in the model parameters across groups. The first step established the configural invariance model, in which items were constrained to load on the same factors across groups, but all item thresholds and factor loadings were free to vary across groups; for the models to be identified, we fixed all item scale factors to one and all factor means to zero in both groups. In a second step, we established a strong invariance model, which contained cross-group equality constraints on all factor loadings and item thresholds, as well as on the covariance between the two factors. As required by the model, scale factors were fixed to one in one group and were free in the other, and factor means were fixed to zero in one group and were free in the other [26]. The confirmation of this model permits comparison of the latent means between the two groups [28].

The models analyzed can be seen as nested models to which constraints are progressively added. For the comparison of the nested models, we proposed criteria such as the ΔCFI (practical perspective) or chi-square difference tests ($\Delta\chi^2$) (traditional perspective) [21,29]. Given the limitations of the $\Delta\chi^2$ regarding its sensitivity to sample size, Cheung and Rensvold [29] proposed a more practical criterion, the ΔCFI, to determine whether the compared models are equivalent. Thus, when there is >.01 change in the CFI between two nested models, the least constrained model is accepted and the other is rejected, that is, the most restrictive model does not hold. If the change in CFI is <.01, it is considered that all specified equal constraints are tenable, and we can therefore continue with the next step in the analysis of measurement invariance. The statistical analyses were carried out using the programs SPSS 15.0 (SPSS Inc, Chicago, IL) and Mplus 5 [26].

Results

Confirmatory factor analysis

Table 2 shows the goodness-of-fit indexes for the total sample and by gender and age. As can be seen, Ivanova et al's [1] model fits the data reasonably well in all the groups except that of the 15–18-year-olds. The CFI and TLI were >.90, and the RMSEA value was <.06. All the standardized factor weights estimated were statistically significant, both for the total sample and by gender and age, ranging from .16 to .90. Standardized factor weights for the total sample, together with their range in the four groups, are shown in Table 3. These results indicate that the model proposed by Ivanova et al [1] fits the data well for all groups.

Measurement invariance across gender and age

Measurement invariance across gender and age for the dimensional model hypothesized by Ivanova et al [1] was studied. We first tested a configural invariance model for gender, in which items were constrained to load on the same factors across groups, but all item thresholds and factor loadings were free to vary across groups; for the models to be identified, we fixed all item scale factors to one and all factor means to zero in both groups. The configural invariance model showed a good fit to the data. Subsequently, the strong invariance model was tested, which contained cross-group equality constraints on all factor loadings and item thresholds, as well as on the covariance between the two factors. As required by the model, scale factors

Table 2
Goodness-of-fit indexes for the model by Ivanova et al (2007), and tests for measurement invariance

Model	χ^2	*df*	CFI	TLI	RMSEA	ΔCFI
Total sample (n = 4,868)	46,120.6	3,799	.908	.905	.048	
Male (n = 2,315)	21,427.2	3,799	.920	.918	.045	
Female (n = 2,553)	24,456.6	3,799	.916	.913	.046	
11–14 years (n = 2,199)	21,244.6	3,799	.923	.921	.046	
15–18 years (n = 2,669)	29,746.5	3,799	.889	.886	.051	
Multigroup comparison						
Gender						
Configural model	45,921.1	7,598	.918	.915	.046	
Strong model	49,262.6	7,760	.911	.910	.047	−.01
Age						
Configural model	51,123.2	7,598	.906	.903	.049	
Strong model	50,597.3	7,760	.907	.906	.048	−.01

CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; RMSEA = root-mean-square error of approximation.

were fixed to one in one group and were free in the other, and factor means were fixed to zero in one group and were free in the other. In this case, the ΔCFI was <.01; therefore, according to the recommendations by Cheung and Rensvold [29], strong invariance was accepted. Thus, the results support configural and strong invariance across gender.

Subsequently, measurement invariance of the eight YSR syndromes across age was analyzed, and the configural invariance model showed a good fit to the data, demonstrating that the basic factor structure fits the data in both age groups. Next, we incorporated the equality constraints on all factor loadings and item thresholds, and the difference in ΔCFI between the configural and the strong invariance models did not exceed .01. Therefore, we can conclude that the structure proposed by Ivanova et al [1] was operating equivalently across the different ages of the adolescents.

Comparisons in the latent means

Latent mean differences across gender were estimated, fixing the latent mean values to zero in males. Latent mean differences across age were also estimated, fixing the latent mean values to zero in the 11–14-year age groups. The group in which the latent mean was fixed to zero was considered as the reference group. Statistical significance associated with differences between the latent mean(s) for the reference group and those freely estimated for the other group(s) is determined on the basis of the z-statistic. Comparison of the gender groups in the latent means for the eight YSR syndromes revealed statistically significant differences ($p < .001$) (Table 4). Females scored higher than males in all the YSR dimensions, except for the Rule-Breaking Behavior syndrome. With regard to the interpretation of the latent means, for example, in the Anxious/Depressed dimension, the .395 value indicated that, on average, females scored .395 U higher than the mean score for males. On comparing the latent means according to age, statistically significant differences were also found ($p <$ .001). In this case, the 15–18-year age group scored higher than the 11–14-year age group in all YSR syndromes, with the exception of the Somatic Complaints dimension, in which there were no statistically significant differences.

Discussion

The principal goal of the present study was to examine the dimensional structure of the eight-syndrome model derived from the YSR and proposed by Ivanova et al [1] by means of CFA for ordinal data. Likewise, through multigroup comparisons using structural equation modeling, we explored the measurement invariance across gender and age and checked whether there were differences in the latent means. Our findings are in line with those in the literature, and support the replicability and generalizability of the correlated eight-syndrome model of the YSR, as well as its measurement invariance across gender and age.

This work has succeeded in faithfully replicating the model proposed by Ivanova et al [1] in an independent sample representative of the general adolescent population. The results showed a reasonable fit of this hypothesized correlated eight-syndrome model to the data, both for the total sample and by participants' gender and age; however, marginal CFI and TLI values were found for some of the models, and in particular, the 15–18-year-olds did not fit the model. Ivanova et al [1] found that the correlated eight-syndrome model showed adequate goodness-of-fit indexes in 23 cultures. This dimensional structure has also been replicated on the basis of other self-reports, such as the CBCL [2] and the TRF [2], and this is clearly indicative of the generalizability, stability, and consistency of this model across different groups, cultures, and informants (parents, teachers, and adolescents) [1,30–33].

Likewise, the eight syndromes of the YSR emerged as invariant across gender and age. In addition to the methodological significance, given the confirmation of factorial equivalence through multigroup comparisons for ordinal data, the results have clear substantive implications. The findings indicate that in both males and females, and in adolescents from all age groups, there is the same underlying factor structure, they perceive and interpret the content of the items in a similar way, and the syndromes are found on the same scale or measurement unit. Regarding the measurement invariance and its use in the YSR, to the authors' knowledge, this is the first and only study to have explored this issue using multigroup comparisons within CFA, even though Ivanova et al [1] recommend the use of this procedure. Previous studies have examined measurement invariance in the framework of Item Response Theory, but with inconsistent results [14]. Overall, these findings support a general, empirically derived taxonomy of behavioral and emotional problems made up of eight correlated general syndromes. The identification of taxonomies by means of multivariate techniques permits improved communication between professionals, the study of etiological mechanisms and potential risk and protective factors, the establishment of prevention, intervention, and treatment

Table 3
Standardized coefficients of the eight-syndrome model proposed by Ivanova et al (2007)

Items	Total sample	Range	Items	Total sample	Range
Anxious/depressed			46. Twitching	.47	.43–.52
14. Cries a lot	.58	.56–.63	58. Picks skin	.53	47–.59
29. Fears	.33	.29–.36	66. Repeats acts	.54	.53–.56
30. Fears school	.58	.52–64	70. Sees things	.63	.59–.67
31. Fears doing bad	.40	.39–.43	76. Sleeps less	.49	.46–.51
32. Must be perfect	.42	.41–.44	83. Stores things	.44	.40–.48
33. Feels unloved	.78	.74–.79	84. Strange behavior	.65	.62–.68
35. Feels worthless	.76	.71–.76	85. Strange ideas	.68	.64–.70
45. Nervous, tense	.42	.39–.43	100. Trouble sleeping	.61	.58–.63
50. Fearful, anxious	.57	.52–.61	Attention problems		
52. Feels too guilty	.56	.54–.58	1. Acts young	.35	.33–.39
71. Self-conscious	.66	.63–.67	8. Can't concentrate	.52	.47–.57
91. Suicidal ideation	.77	.74–.80	10. Can't sit still	.40	.38–.41
112. Worries	.52	.47–.55	13. Confused	.69	.65–.71
Withdrawn/depressed			17. Daydreams	.56	.54–.56
42. Rather be alone	.49	.44–.53	41. Impulsive	.44	.37–.48
65. Refuses to talk	.62	.60–.68	61. Poor schoolwork	.42	.37–.47
69. Secretive	.41	.38–.43	Rule-breaking behavior		
75. Shy, timid	.33	.30–.35	26. Lacks guilt	.24	.16–.30
102. Lacks energy	.47	.43–.52	39. Bad friends	.68	.66–.72
103. Sad	.85	.80–.90	43. Lies, cheats	.60	.57–.60
111. Withdrawn	.40	.36–.47	63. Prefers older kids	.51	.47–.55
Somatic complaints			67. Runs away	.72	.69–.74
47. Nightmares	.57	.53–.58	72. Sets fire	.70	.66–.76
51. Feels dizzy	.37	.34–.40	81. Steals at home	.69	.63–.73
54. Overtired	.70	.64–.74	82. Steals outside home	.67	.60–.73
56a. Aches, pains	.66	.64–.68	90. Swearing	.62	.59–.64
56b. Headaches	.55	.54–.55	96. Thinks of sex too much	.54	.51–.61
56c. Nausea	.68	.65–.71	101. Truant	.60	.56–.66
56d. Eye problems	.40	.38–.41	105. Uses drugs	.61	.57–.71
56e. Skin problems	.48	.41–.54	Aggressive behavior		
56f. Stomach aches	.61	.51–.71	3. Argues a lot	.51	.48–.55
56g. Vomiting	.61	.52–.67	16. Mean to others	.32	.26–.40
Social problems			19. Demands attention	.48	.47–.50
11. Too dependent	.33	.28–.40	20. Destroys own things	.66	.66–.68
12. Lonely	.68	.61–.74	21. Destroys others' things	.60	.56–.65
25. Doesn't get along	.47	.41–.54	22. Disobedient at home	.56	.52.–60
27. Jealous	.55	.53–.59	23. Disobedient at school	.54	.53–.56
34. Others out to get him	.67	.65–.69	37. Gets in fights	.56	.55–.59
36. Accident-prone	.60	.53–.67	57. Attacks people	.63	.60–.68
38. Gets teased	.51	.50–.53	68. Screams a lot	.59	.56–.64
48. Not liked	.66	.65.–67	86. Stubborn, sullen	.47	.42–.49
62. Clumsy	.48	.41–.54	87. Mood changes	.64	.61–.66
64. Prefers younger kids	.37	.29–.44	89. Suspicious	.49	.45–.53
79. Speech problems	.46	.45.–49	94. Teases a lot	.61	.59–.64
Thought problems			95. Temper	.45	.43–.47
9. Can't get mind off	.59	.55–.62	97. Threatens others	.62	.57–.70
18. Harms self	.83	.80–.85	104. Loud	.56	.53–.60
40. Hears things	.62	.58.–66			

guidelines, and an understanding of cross-national and cross-cultural differences in norms and expectations for behavior and in diagnostic classifications of psychopathology.

In line with past research, the phenotypical expression of adolescents in the eight YSR syndromes varies as a function of gender and age [1,3,4,16–19]. In the present study, females scored higher than males in the central YSR syndromes related to the internalization pattern; conversely, males scored higher in the externalizing syndrome of Rule-Breaking Behavior. By age, older adolescents (aged: 15–18 years) reported more emotional

Table 4
Comparisons in latent means

Group	Anxious-depressed	Withdrawn/depressed	Somatic complaints	Social problems	Thought problems	Attention problems	Rule-breaking behavior	Aggressive behavior
Gender	.395	.195	.312	.110	.112	.065	−.084	.093
Age	.144	.212	.041*	.058	.302	.171	.096	.162

Latent factor means for the males was fixed to zero. Latent factor means for the 11–14-year age group were fixed to zero. This group operates as a reference group, against which latent means for the other group are compared.
All comparisons are statistically significant ($p < .001$) except * $p > .05$.

and behavioral problems than the younger ones (aged: 11–14 years). These results coincide closely across different studies. The only divergence was found in the Aggressive Behavior syndrome, in which previous studies have found males to score higher than females [3,19], even though other research finds no such relationship [4,17], or finds that females return higher scores in Verbal Aggressiveness; [16] even so, it should be borne in mind that comparison between studies is hindered by the use of different types of statistical analysis. In this regard, here we compare the latent means derived from the CFA, rather than based on the raw scores, making it possible to draw less ambiguous inferences and conclusions from the data [20,22].

Our results should be interpreted with the following limitations. First, the assessment of emotional and behavioral problems was based solely on informants' capacity to report on their own experiences and behaviors, so that it would have been advantageous to use a multiple-informant report. Second, adolescence is a period of substantial changes in relation to the formation of identity and to family, as well as social and biological changes, in which the very maturational process of development may be playing a relevant role in the phenotypical expression of affective and behavioral symptomatology. Finally, it should be stressed that the proposed model, although plausible, is just one among other, equally acceptable proposals worthy of being tested [1].

Future research should explore measurement invariance across cultures, or should be based on Computer-Adaptive Testing. Likewise, it would be useful to examine the relationship between the YSR syndromes and other psychophysiological, clinical, and environmental variables, such as cognitive endophenotypes or psychosocial stressors.

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