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Assessing measurement equivalence of PSC-17 across teacher and parent respondents

Ruiqin Gao

Alyssa Raygoza

Christine Distefano

Fred Greer
College of Education, University of South Carolina, United States

Erin Dowdy
Department of Counseling, Clinical, and school psychology,
University of California at Santa Barbara, United States

Abstract

The Pediatric Symptom Checklist-17 (PSC-17) is a popular screening instrument used by parents and clinicians to assess children's behavioral functioning. However, more schools are examining the potential of the PSC-17 as part of a Multi-Tier System of Support framework. To investigate the potential of the PSC-17 in the schools, a sample of 1,779 U.S. preschool and kindergarten-aged children rated by parents (n = 667) and teachers (n = 1,112) was used to assess the measurement invariance of the PSC-17 across respondent groups. Multiple-group Confirmatory Factor Analysis supported partial scalar invariance for the PSC-17, indicating functional equivalence across teacher and parent respondents. Latent mean testing revealed teachers rated children as exhibiting a lower level of Externalizing Problems relative to parents; however, no significant differences in children's Internalizing Problems and Attention Problems were found between teacher and parent ratings.

Corresponding author:
Christine Distefano, 138 Wardlaw Hall, College of education, University of South Carolina, Columbia, SC. 29208, United States.
Email: Distefan@mailbox.ec.edu

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Introduction

The Pediatric Symptom Checklist-17 (PSC-17; Gardner et al., 1999) is a short measure designed to assess psychosocial problems and risk for children aged from 3 to 16 (http://www.massgeneral.org/psychiatry/assets/PSC-17_English.pdf). The PSC-17 has been used primarily in clinical settings by parents or clinicians (Blucker et al., 2014; Borowsky et al., 2003; Chaffin et al., 2017; Gardner et al., 2007; Murphy et al., 2016; Stoppelbein et al., 2012). The scale has been used in more than 40 published studies (Murphy et al., 2016) and translated into over two dozen languages (Bergmann et al., 2018). While the PSC-17 has been used in clinical settings, there have been some articles supporting its use in schools as part of a Multi-Tiered System of Supports (MTSS) framework of early intervention and assistance for children.

More specifically, an MTSS framework (including Response to Intervention[RTI] and Positive Behavioral Interventions and Supports [PBIS]), has been implemented in many K-12 public schools to provide academic, behavioral, and/ or social support to students with or at-risk for such disorders (Ziomek-Daigle et al., 2016). MTSS consists of three prevention tiers, including primary, secondary, and tertiary approaches (Averill et al., 2011; Barrett et al., 2013). In Tier 1 primary prevention, all students are screened with academic assessments and behavioral data to determine the level of their needs (Harlacher et al., 2014).

With the increased popularity of the MTSS framework, school-wide universal mental health screening is recognized as an efficient way to identify students at risk for mental health (Kettler et al., 2014; Lane et al., 2012). Within this context, the PSC-17 has been investigated for its potential as a universal screener (i.e., Tier 1 measure) (DiStefano et al., 2017; Liu et al., 2018; Liu et al., 2020a, 2020b). Using the PSC-17 as a screener presents several advantages, including minimal time investment required, free availability, multiple language choices, and feasibility of assessment administration. These criteria are recommended points for school administrators to consider when selecting a screening instrument (e.g., Dowdy et al., 2010b; Furr, 2011; Glover & Albers, 2007; Harrison et al., 2013).

As an instrument, the PSC-17 measures three dimensions of maladaptive behaviors: Internalizing Problems, Externalizing Problems, and Attention Problems with a brief 17-item scale. The constructs are operationalized as follows: Internalizing Problems measures interiorized behavior such as anxiety or mood disorder, Externalizing Problems assesses children's conduct disorder or disruptive behavior, and Attention Problems measures attention deficit or hyperactivity disorder. A total item score ranging from 0 to 34 indicates the overall mental health risk. Subscale total scores demonstrate the risk levels of the three subscales.

Previous studies have provided psychometric support for the PSC-17 as a measure that can accurately identify child risk. For example, the overall PSC-17 scale showed

sensitivity values of 0.69 and 0.81 and specificity values of 0.95 and 0.86 in different samples (Erdogan & Ozturk, 2011; Harahap et al., 2010). Scores associated with factors demonstrated moderate to high specificity (0.73-0.91) and sensitivity (0.75-0.87) (Gardner et al., 1999; Gardner et al., 2007). The PSC-17 displayed acceptable levels of internal reliability for the overall scale (range: 0.81-0.89) and subscales (range: 0.62-0.85) (Erdogan & Ozturk, 2011; Murphy et al., 2016; Wagner et al., 2015). The overall PSC-17 scores also yielded moderate to high test-retest reliability, ranging from 0.55 to 0.85 for time periods up to 6 months (Erdogan & Ozturk, 2011; Jacobson et al., 2019; Murphy et al., 2016).

Convergent and discriminate validities of the subscales of the PSC-17 were also supported (Jacobson et al., 2019; Parker et al., 2019). Additionally, the PSC-17 showed concurrent validity with other instruments, including the Behavioral and Emotional Screening System (BESS), Strengths and Difficulties Questionnaire (SDQ), Attention, Behavior, Language, and Emotion (ABLE) (DiStefano et al., 2017), Achenbach System of Empirically Based Assessment (ASEBA) or Child Behavior Checklist (Gardner et al., 2007; Liu et al., 2020a), and semi-structured psychiatric interviews (Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version) and Children's Depression Inventory (CDI) (Gardner et al., 2007). The three-factor structure of the PSC-17 has been confirmed with confirmatory factor analysis (CFA) with samples obtained from clinical settings (Bergmann et al., 2018; Blucker et al., 2014; Chaffin et al., 2017; Gardner et al., 1999; Murphy et al., 2016; Stoppelbein et al., 2012; Wagner et al., 2015) and school settings (DiStefano et al., 2017; DiStefano et al., 2019; Leiva et al., 2019; Liu et al., 2020a, 2020b). In sum, previous findings supported the psychometric qualities of the PSC-17 as a measure of psychosocial functioning of young children for using the English version of the PSC-17. Only two studies explored the PSC-17 in other language versions, including Turkish (Erdogan & Ozturk, 2011) and Spanish (Leiva et al., 2019); however, the results of this study may lend support for future invariance tests with other language forms.

In addition to the aforementioned psychometric properties, measurement invariance is an essential property of an instrument (Schmitt & Kuljanin, 2008; Steenkamp & Baumgartner, 1998; Vandenberg & Lance, 2000). Measurement invariance refers to how measurements conducted in different conditions show identical psychometric properties (Cheung & Rensvold, 1999). The measurement invariance aims to examine whether differences in observed variables are a function of the differences between groups rather than the differences in conceptualizations of the underlying construct (Finney & Davis, 2003). Establishing measurement invariance serves as a prerequisite for conducting group comparisons. Researchers who conduct comparative studies across groups or measurement occasions should focus on the item responses that depend only on latent construct rather than group membership or the time of measurement. As a result, assessing the actual differences in the latent construct arises from the differences in the observed scores rather than group or time differences.

Multiple-group confirmatory factor analysis (MG-CFA) is one of the most widely used methods to test measurement invariance due to its flexibility for testing individual

parameters (i.e., factor loadings, intercept or threshold, and unique variance) to gain a greater understanding of similarities and differences across different groups using the same scale (Brown, 2015; Jung & Yoon, 2016; Schmitt & Kuljanin, 2008; Vandenberg & Lance, 2000). Traditionally, invariance testing involves testing configural invariance, metric invariance, scalar invariance, and measurement error invariance as a series of sequential tests, where successive tests impose restrictions or equality restraints on model parameters. Restraints that result in acceptable fit are thought to be invariant and provide guidance as to what comparisons should be made.

Configural invariance signifies that different groups used equal conceptual groundings to interpret the items (Cheung & Rensvold, 2002; Schmitt & Kuljanin, 2008; Vandenberg & Lance, 2000). Metric invariance indicates that the strength of the relationship between items and an underlying factor is equivalent across groups (Cheung & Rensvold, 2002; Schmitt & Kuljanin, 2008; Vandenberg & Lance, 2000). The scalar invariance demonstrates that the origin of the item score on the latent variable is the same across groups (Meredith, 1993; Steenkamp & Baumgartner, 1998; Vandenberg & Lance, 2000). Finally, a test of the measurement error invariance test indicates that the level of measurement error in the items (i.e., variance unexplained by the factors) is equivalent across groups (Jung & Yoon, 2016). For interpretation of results, configural invariance and metric invariance are necessary to examine whether the structural relationships between the underlying constructs are the same across groups (Steenkamp & Baumgartner, 1998). Scalar invariance is needed for latent mean comparison across groups (Steenkamp & Baumgartner, 1998). Partial invariance occurs when invariance is not established as one of these steps. Partial invariance indicates that only a subset of the subgroup parameters (i.e., some factor loadings, some item intercepts) is the same across groups (Schmitt & Kuljanin, 2008).

Previous research including the PSC-17 in the U.S. has studied measurement invariance across diverse groups and results have illustrated mixed findings. For example, PSC-17 scores showed measurement error invariance (Liu et al., 2018) and scalar invariance across gender (Bergmann et al., 2018; Liu et al., 2020b). However, partial metric invariance (Stoppelbein et al., 2012) and scalar invariance (Liu et al., 2020b) were established across majority (e.g., white) and minority groups (e.g., African American, Hispanic, Mixed, Asian, and Indian). Liu et al. (2020b) reported scalar invariance of the PSC-17 across grade levels for children from the first and second grades. Although previous research investigated measurement invariance across different demographic groups of children, to our knowledge, no study has examined measurement equivalence of the PSC-17 across teacher and parent respondents. To contribute to the research in cross-respondent ratings of children's behavioral problems and the area of measurement invariance, we focused on testing measurement invariance in the PSC-17 across respondents (i.e., parents and teachers).

In school settings, both teachers and parents may be used to obtain information about children's behavioral problems, especially if children are young and cannot read or provide reliable ratings of their behavior. In school settings, teachers are more likely than parents to take a normative approach in judging a child's behavior (Konold et al., 2004). At the same time, parents may be a better judge of a child's behavior from a

more critical perspective (Konold et al., 2004), providing a more accurate assessment of internalizing problems in comparison to teacher respondents. As different informants may provide their unique perspectives on a child's behavior (Achenbach, 2006; Ferdinand et al., 2003; Konold et al., 2004), both sets of ratings may be helpful in providing a comprehensive view of a child's behavior at home and school.

If the PSC-17 screener is to be used by both parents and teachers to assess children's behavioral problems, we need to ensure that teachers and parents interpret the items in the same way. One precondition of conducting comparative studies is to assess the measurement equivalence across groups. Support for invariance shows the equivalence of the characteristics of the constructs being measured and can help researchers avoid misleading results (Davidov et al., 2014).

Given that no previous study has examined the measurement invariance of PSC-17 ratings across parent and teacher respondents, the present study will focus on two main objectives. First, we intend to evaluate the measurement invariance of the PSC-17 across teacher and parent respondents. Second, if the (partial) scalar invariance holds, we would examine whether differences in children's behavioral functioning exist between parent and teacher ratings. As such, the present study was designed to answer the following two research questions:

1. Does measurement invariance of the PSC-17 hold across teacher and parent respondents?
2. Do teachers and parents rate preschool and kindergarten-aged children's behavioral functioning differently?

Method

Participants

As a part of a larger grant investigating universal screening with early school children, teachers and parents of students from eight U.S. public schools, four in South Carolina and four schools in California, provided the PSC-17 ratings for young children. Children were attending public preschool programs and kindergarten programs in both states. Ratings obtained at the start of the academic year were combined across the life of the grant project (2016–2017, 2017–2018, 2018–2019). The sample consisted of 1,779 cases of children from four-year-old kindergarten (4 K) to five-year-old kindergarten (5 K) rated by either teachers (n = 1,112) or parents (n = 667). Institutional Review Board approval was obtained prior to data collection, and ethical treatment of subjects was followed during all data collection and interactions with school personnel.

Table 1 provides demographic information of the children rated in the sample. As summarized in Table 1, participants' ethnicity and grade level varied significantly across teacher and parent respondents, while participants' gender showed no significant difference across these two groups. The number of male and female children rated by both teachers and parents was evenly distributed. More non-Hispanic students were

Table 1. Demographic characteristics of participants(n = 1,779).

Variables	Teacher Form (N = 1,112) N (%)	Parent Form (N = 667) N (%)	chi-square test (*p* value)
Gender			0.462
Male	534(52.4%)	339(52.7%)	
Female	486(47.6%)	304(47.3%)	
Ethnicity			0.001*
Hispanic	428(47.7%)	172(38.4%)	
Non-Hispanic	469(52.3%)	276(61.6%)	
Grade			0.001*
4K	488(46.3%)	344(54.1%)	
5K	565(53.7%)	292(45.9%)	

rated by parents (61.6%) than by teachers (52.3%). Additionally, more students from 5 K were rated by teachers (53.9%) than by parents (45.9%).

Instrument

The Pediatric Symptom Checklist-17 (PSC-17; Gardner et al., 1999) assesses children's overall psychological functioning. It is a 3-point scale with anchors of "Never" = 0, "Sometimes" = 1, and "Often" = 2. The scale measures three dimensions of maladaptive behavior, including Internalizing Problems, Externalizing Problems, and Attention Problems. A sum score of the 17 items ranged from 0 to 34, with a higher score indicating a higher risk level. A total score of ≥ 15 indicates an overall risk level. Internalizing subscale scores ≥ 5 indicate risk. Subscale scores ≥ 7 indicate a risk for attention problems and externalizing problems (Murphy et al., 2016) (See Table 2 for PSC-17 items).

Data analysis

All statistical analyzes were conducted using Mplus 8.4 software (Muthén & Muthén, 2019). As a first step, we used confirmatory factor analysis (CFA) to estimate a measurement model within each group (parents and teachers). From previous studies, the three-factor congeneric model (i.e., each item is freely estimated to load on one of the three factors which correlate with each other) was examined. The PSC-17 uses a Likert- scale with three categories, leading us to choose the weighted least square with mean and variance correction (WLSMV) estimator for analyzes. As children were nested within teachers in this study, we considered the clustering design effects to provide more accurate parameter estimates as recommended by Raykov and DiStefano (2021).

Model fit was evaluated using the following indices commonly used with the analysis of categorical data (Finney & DiStefano et al., 2013): the p-value associated with the WLSMV-based Chi-square statistic fit statistic, comparative fit index (CFI), Tucker-Lewis Index (TLI), and root mean squared error of approximation (RMSEA)

Table 2. Subscale questions.

Sub-scale	Items
Internalizing Problems	Feels sad, unhappy
	Feels hopeless
	Is down on him or herself
	Seems to be having less fun
	Worries a lot
Attention Problems	Fidgety, unable to sit still
	Daydreams too much
	Has trouble concentrating
	Acts as if driven by a motor
	Distracted easily
Externalizing Problems	Refuses to share
	Fights with other children
	Blames others for his or her troubles
	Does not listen to rules
	Teases others
	Takes things that do not belong to him or her

and associated fit index. In cases of large sample sizes and or a complex model, chi-square is too sensitive to retain an acceptable model, and additional fit indices are often used in conjunction with a significant value (Brown, 2015). CFI compares the fit of a proposed model to the fit of an independent model with a value greater than 0.95 indicating a good model fit (Kline, 2010) and a value greater than 0.90 showing an acceptable model fit (Hu & Bentler, 1999). RMSEA was used to estimate the lack of fit between the population data and the model estimates. The value of RMSEA ranges from 0 to 1, with a value of less than 0.05 and 0.08 indicating a close fit and a good fit to the data, respectively (Marsh et al., 2004). TLI is used to test the improvement of model fit per degree of freedom of the target model over the independent model. A TLI value greater than 0.90 or 0.95 denotes a close or good model fit (Hu & Bentler, 1999; Little, 2013). Besides global model fit, local fit indices were also examined. Factor loadings should be greater than 0.30 (Costello & Osborne, 2005). Large standardized residuals (e.g., $|>4.0|$) were examined to identify possible local model misfit.

Three levels of factorial invariance, including configural, metric, and scalar invariance, were tested sequentially using an MG-CFA model. The factor structure was constrained to be identical across groups when testing configural invariance. This was the baseline model for the subsequent invariance tests. Once the configural invariance was established, we tested the metric invariance by constraining unstandardized item factor loadings to be equal across groups. We compared the configural invariance model results with those obtained from the metric invariance to examine the equality of factor loadings across groups. After establishing metric invariance, scalar invariance was tested by constraining item factor loadings and thresholds equal across groups. Upon establishing the scalar invariance, measurement error invariance was tested by

constraining the item residual variance to be equal between groups in addition to the constraint for metric and scalar invariance.

As WLSMV-based chi-square statistics across models are of different scales, the chi-square difference test with the DIFFTEST option in Mplus was used to evaluate whether the compared models were significantly different. A non-significant difference test value, $\Delta\chi^2$, indicated invariance. As the $\Delta\ \chi^2$ may overly reject acceptable models, we also used the difference between models' RMSEA values (Δ RMSEA) and the difference in CFI values (ΔCFI) to assess measurement invariance. Chen (2007) suggested that the differences between compared models may be considered insignificant when $\Delta CFI \leq 0.01$ is complemented by $\Delta RMSEA \leq 0.015$. In the case of a significant scaled chi-square difference test, we consulted modification indices to determine which factor loading (s) or threshold(s) differing across groups should be freely estimated for partial invariance. A minimum of two item factor loadings and intercepts should be equal across groups for latent means comparison (Lomazzi & Seddig, 2020). If partial scalar invariance was supported, factor means across teacher and parent respondents could be examined.

Results

Descriptive statistics

We calculated the average scores for the overall psychological functioning, Internalizing Problems, Externalizing Problems, and Attention Problems for samples rated by teachers and parents separately. Regarding teacher ratings, the average overall score was 7.3. The mean scores for Internalizing problems, Externalizing Problems, and Attention Problems were 1.4, 3.4, and 2.5 respectively. For parent ratings, the mean score for the overall scale was 7.1. The average scores for Internalizing Problems, Attention Problems, and Externalizing Problems were 1.1, 2.8 and 3.3. respectively. T-test results showed that there was a statistically significant difference between teacher and parent ratings of children's overall psychological functioning, internalizing problems, externalizing problems, and attention problems. Overall, teachers rated children as being at higher risk levels of Internalizing Problems and Attention problems but lower risk levels of Externalizing Problems than parents did.

Confirmatory factor analysis

Before examining invariance across rating groups, we tested a three-factor measurement model with CFA for the teacher-rated sample, parent-rated sample, and the overall sample separately. Table 3 illustrates model fit statistics for each model. The chi-square fit statistics for the CFA models were statistically significant for all groups; however, alternative fit indices were also examined. The three-factor solution yielded a good model fit for the teacher-ratings, parent ratings, and the overall sample; this model was used as a baseline model for the sequential tests of measurement invariance.

As shown in Table 4, the correlation between the three factors measured by the PSC-17 varied from 0.29 to 0.80. Internalizing Problems was highly and positively

Table 3. CFA model fit statistics.

Model	χ^2	df	*p-Value*	CFI	TLI	RMSEA [90% CI]
Teacher rated sample	473.812	116	<0.001	0.983	0.980	0.053(0.048-0.058)
Parent rated sample	413.294	116	<0.001	0.926	0.913	0.064 (0.057-0.070)
Overall sample	648.361	116	<0.001	0.968	0.963	0.052(0.048-0.056)

Note: RMSEA = the root mean square of approximation; CI = confidence interval; CFI = the comparative fit index TLI = Tucker- Lewis Index; df = degree of freedom.

Table 4. Correlations among the PSC-17 subscales.

Sample	Externalizing Problems & Internalizing Problems	Attention Problems & Externalizing Problems	Attention Problems & Internalizing Problems
Parent Sample	0.60	0.68	0.29
Teacher Sample	0.48	0.80	0.39
Overall Sample	0.48	0.75	0.38

Note: All the correlations are significant at a 0.001 level.

correlated with Externalizing Problems, indicating that children at a higher risk of internalizing problems were more likely to have externalizing problems. The correlation was stronger among the parent sample than for the teacher sample. The correlation coefficient between Attention Problems and Internalizing Problems and that between Attention Problems and Externalizing Problems was also large in magnitude and positive, indicating that children with a higher risk level of attention problems tend to be at a higher risk level of either internalizing problems or externalizing problems. Overall, correlations among latent factors in the teacher sample were stronger than those among the latent correlations in the parent sample.

Measurement invariance

We continued to examine the measurement invariance of the PSC-17 with Multiple-group Confirmatory Factor Analysis (MGCFA). Table 5 reports model fit results. The configural model demonstrated a good model fit. Next, a model in which the item factor loadings were constrained to be equal across two groups (i.e., metric invariance) was estimated. The model met the criteria for good model fit; the scaled chi-square difference test was not significant ($\Delta\chi^2(14) = 27.927$, $p > 0.01$), and ΔCFI and ΔRMSEA were below the recommended cut-off values, indicating metric invariance. Lastly, we examined a scalar invariance model in which both indicator loadings and thresholds were constrained to be equal across groups. While this model indicated a good model fit; the DIFFTEST

Table 5. MGCFA model fit across teacher and parent correspondents (n = 1,799).

Model	χ^2. (df)	ΔSB-χ2(Δdf)	CFI	ΔCFI	RMSEA [90% CI]	ΔRMSEA	TLI
Configural invariance	863.260* (232)	____	0.977	___	0.056[0.052-0.060]	___	0.973
Metric invariance	820.196* (246)	27.927 (14)	0.979	0.002	0.052[0.048-0.056]	0.004	0.977
Scalar Invariance	955.734*(275)	233.139*(29)	0.976	0.003	0.054[0.050-0.057]	0.002	0.976
Partial Scalar invariance	856.999*(263)	32.330(17)	0.979	0.000	0.051[0.047-0.055]	0.001	0.978

Note: The metric invariance model was compared with the configural model. The scalar and partial scalar invariance models were compared to the metric invariance model.

MGCFA = multigroup confirmatory factor analysis; SB-χ^2 = Satorra-Bentler scaled chi-square; df = degree of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; TLI = Tucker- Lewis Index; CI = confidence interval; Δ = difference.

*$p < 0.01$.

comparison did not support full scalar invariance ($\Delta\chi^2(29) = 233.139$, $p < 0.001$) even with ΔCFI and ΔRMSEA below the recommended cut-off values.

Attempting to improve the model, we consulted the modification indices to determine whether freeing the thresholds for a group achieves partial scalar invariance. Specifically, 12 out of the 34 threshold constraints were freed before a partially invariant model could be established. Most of these items varied at the higher thresholds, showing differences in higher risk ratings for teacher and parent respondents. For instance, with item 13 ("Acts as if driven by a motor"), teachers tended to endorse the higher frequency response ($\tau = 2.65$) compared to parents ($\tau = 1.47$). The scaled chi-square difference test between the metric invariance model and the partial scalar invariance model was nonsignificant ($\Delta\chi^2(17) = 32.330$, $p < 0.05$), with ΔCFI and ΔRMSEA below the recommended cut-off values.

As partial scalar invariance of the PSC-17 was supported, latent factor means across teacher and parent respondents were compared. Factor means were set to 0 within the parent group, and factor means for the teachers were estimated. The estimated factor means for Internalizing Problems and Attention Problems in the teacher group were found equal across teacher and parent raters (i.e., not statistically significant). However, the estimated factor means for externalizing problems were significant, with a value of −0.96 indicating that teachers rated students as being at a lower risk level for externalizing problems relative to parent ratings.

Discussion

Approximately one in six children between the ages of two and eight were diagnosed with mental, behavioral, or developmental problems in the United States (Cree et al., 2018). The rate is similar to a 10% to 20% prevalence of mental disorders among children and adolescents worldwide (Kieling et al., 2011). Within this context, using instruments to identify children at risk and comparing ratings across informants became critical issues to investigate. In the current study, we examined the measurement equivalence of the PSC-17 for parent and teacher respondents. The goal was to examine whether the PSC-17 functions in the same way across teacher and parent respondents and whether teacher and parent ratings of children's psychological functioning differ. The sample consisted of ratings for young children (4K-preschool and 5K-Kindergarten) from two states in the U.S.

While school-based universal screening of children for social, emotional, and behavioral (SEB) problems has been recommended as a means of identifying children at risk for SEB problems early in school (Dever et al., 2015; Dowdy et al., 2010a, 2010b; Glover & Albers, 2007; Kettler et al., 2014), selecting valid screening instruments to identify children at risk for SEB problems is highly important. However, before examining scores across groups, it is useful to ensure that the screening instrument measures the latent construct in the same way across groups or assessment time.

Factor structure of the PSC-17

The CFA results supported the underlying three-factor structure of the PSC-17 identified in the previous studies (DiStefano et al., 2017; DiStefano et al., 2019; Liu et al., 2020a,

2020b). The three underlying factors included Internalizing Problems, Attention Problems, and Externalizing Problems. The three factors are significantly interrelated. Children with a higher risk level of internalizing problems are more likely to develop attention problems and externalizing problems. The result was in line with the previous findings showing how externalizing problems, attention problems, and internalizing problems are interrelated (Liu et al., 2020b). Other studies also revealed that externalizing problems co-occurred with internalizing problems (Briggs-Gowan et al., 2006; Hinnant & El-Sheikh, 2013; Willner et al., 2016) and Attention-Deficit (Kuja-Halkola et al., 2015). The correlation between internalizing problems and externalizing problems was higher for children rated by parents, indicating that there was a higher possibility for these behavioral problems to co-occur in the home environments. The correlation between attention problems and externalizing problems or that between attention problems and internalizing problems was higher for children rated by teachers. These findings suggest that attention problems were more likely to co-occur with internalizing or externalizing problems in the school environment.

Measurement invariance of the PSC-17

The results of the MGCFA provided support for the configural, metric, and partial scalar invariances of the PSC-17 (i.e., equality of factor patterns, factor loadings, and the equality of 22 thresholds for 8 items across parent and teacher respondents). This partial scalar invariance met the condition of having at least two item factor loadings and thresholds equal across groups for comparing latent group means (Lomazzi & Seddig, 2020), indicating that the PSC-17 can be used for comparing children's psychosocial problems rated by teachers and parents. To our knowledge, this study is the first one to investigate the measurement invariance of the PSC-17 across teacher and parent respondents. Therefore, this study contributes to the psychosocial problems screening literature, highlighting evidence of measurement invariance across informants that may be used in the context of early school education.

As partial scalar invariance was established, we tested latent means differences. The analysis showed that teacher respondents tended to give a lower rating of children's Externalizing Problems. Comparing with parents, teachers rated children as having lower levels of Externalizing Problems. The finding is in line with the previous research that teachers have consistently lower ratings of behavior problems than parents (De Los Reyes et al., 2013). No significant differences were found in children's Internalizing Problems and Attention Problems when rated by both teachers and parents. The inconsistent findings exhibited across teacher and parent ratings are expected due to the lower levels of agreement among informants observing children at home or school (Van der Ende et al., 2012). Additionally, the role of informants' perspectives also contributed to the differences in informants' ratings (Van der Ende et al., 2012). As a result, teachers have access to compare an individual child's behavior with that of other children within the context of the classroom or grade level, whereas parents may not have such access. Similarly, parents may not have as much experience rating attention problems because they do not have the same context/comparison group. Understanding differences in

parent and teacher ratings has strong implications for intervention implementation across schools and home settings. In line with effective interventions, schools should put more emphasis on the communication between parents and teachers regarding children's behavioral problems. To support such efforts, teacher and parent communication about students' externalizing problems can assist in supporting those students at risk for externalizing problems.

Limitations

Despite the values and contributions, the current study has several limitations. First, the current study collected data from a sample of children from 4 K to 5 K in school settings so the results may not apply to children of older age groups or children in clinical settings. Future studies may investigate the measurement invariance of the PSC-17 across parents and clinicians and across parents and teachers for older children. Second, the current research examined the measurement invariance of the PSC-17 across parent and teacher informants. Given the importance of establishing measurement equivalence before making cross-group comparisons, other factors such as teacher characteristics (e.g., gender, educational background, years of teaching experiences, subject teaching, grade level teaching) and parent characteristics (e.g., gender, educational background, social-economic status, and the number of children) may also affect their ratings. Future researchers may investigate the measurement invariance of the PSC-17 related to these factors. Third, the current study only focused on measurement models of the PSC-17. Future research may investigate the structural models by also including outcome variables (e.g., academic performance, parent school involvement, or parent-teacher relationship) to determine whether different relations will be identified across teacher and parent informants. Finally, the current study used a sample from the U.S rated with the English version of the PSC-17. Therefore, the findings may not apply to other cultures. Future research may investigate the measurement invariance of the PSC-17 within different cultural contexts.

Implications

Findings from the current study have implications for research and practice. First, the English version of the PSC-17 may be considered as a psychometrically sound screening instrument for assessing the behavioral and emotional problems of preschool-aged children in the U.S. as part of an MTSS framework. The school-wide screening was included as the first tier of an MTSS framework (Glover & Albers, 2007). The advantage of being psychometrically sound, short, and freely distributed made the PSC-17 an efficient universal screening instrument for assessing a large number of children and targeting those flagged for Tier 2 and Tier 3 interventions. Second, practitioners can use the PSC-17 to compare children's subscale scores in internalizing problems, externalizing problems, and attention problems across teacher and parent respondents. However, school practitioners should be cautious with making comparisons across teacher and parent respondents at the item level, particularly for those items exhibiting

non-invariance in the thresholds. Non-invariance of those items indicates that teachers and parents possess different levels of response for those items. Third, as children demonstrated more externalizing problems at home over school settings, schools should provide support and guidance to families struggling with children's externalizing problems at home. Finally, as the internalizing problems, externalizing problems, and attention problems constructs were found to show moderate to high levels of interrelation, school interventions should target more broad aspects of emotional and behavioral problems. Overall, schools should not solely focus on one area of problem seeing that the occurrence of one problem may increase students' risk level in the other two areas.

Conclusion

This study examined the measurement invariance of the PSC-17 across parent and teacher respondents. Prior to invariance testing, CFA results identified three factors underlying the PSC-17, including Internalizing Problems, Externalizing Problems, and Attention Problems. These latent factors are significantly correlated. The PSC-17 demonstrated partial scalar invariance across teachers and the parents as respondents, indicating that teachers and parents interpreted the PSC-17 items similarly. School practitioners and researchers in the U.S. may use the PSC-17 to compare students' scores in internalizing problems, externalizing problems, and attention problems across teacher and parent rating groups. Latent mean testing revealed that parents rated children as exhibiting a higher level of externalizing problems relative to teachers. No significant differences in children's internalizing problems and attention problems were found between teacher and parent ratings. The main recommendation from this study prompts the usage of the PSC-17 as a universal screening instrument for assessing the behavioral and emotional problems of 4 K and 5 K children. In turn, providing parents with professional and evidence-based guidelines for reducing the risk level of externalizing problems in children within the home environment will be valuable.

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ORCID iDs

Ruiqin Gao https://orcid.org/0000-0001-9388-2919
Fred Greer https://orcid.org/0000-0003-1925-4863

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Author biographies

Ruiqin Gao is a doctoral candidate in the program of Educational Psychology and Research in the College of Education at the University of South Carolina. Her research interests include structural equation modeling with survey data and classroom assessment.

Alyssa Raygoza is a doctoral candidate in the program of Educational Psychology and Research in the College of Education at UofSC. Her research interests include social-emotional learning, MTSS, mindfulness-based educational interventions, emotion regulation, academic resilience, student voice, and motivation.

Christine DiStefano is the E.S. Gambrell Professor of Educational Studies at the University of South Carolina. Her research interests include structural equation modeling with survey data, survey construction, and investigations of universal screening for social-emotional/behavioral risk.

Fred Greer is a Research Associate Professor at the University of South Carolina Department of Educational Studies. A school psychologist, he has an interest in the assessment of social-emotional and behavioral risk in young children. Dr. Greer also studies the evaluation of preschool and kindergarten students' social and academic development.

Erin Dowdy is a professor of school psychology at the University of California-Santa Barbara. Dr. Dowdy conducts research in the areas of behavioral assessment and classification, specifically early identification of child behavior problems and strengths.