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Measurement Invariance of the Higher-Order Model of Preschool Anxiety Scale (PAS) Across Child Age, Gender, Parental Anxiety, and Pandemic Period in England

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The Preschool Anxiety Scale (PAS) is a parent-report scale measuring young children's anxiety symptoms involving five specific anxiety symptoms (separation anxiety, physical injury fears, social phobia, obsessive-compulsive disorder, generalized anxiety) that load on a higher-order factor representing general anxiety shared by all specific anxiety symptom subtypes. Although the PAS has been widely used to assess anxiety symptoms in young children, few studies have tested its measurement invariance for group comparisons. Using data from a sample of 2,221 children and their parents/carers in the United Kingdom, this study investigated the measurement invariance of the higher-order model of the PAS across child age (4–6 years vs. 6–7 years), gender (girls vs. boys), parental anxiety (low vs. high level), and children's living circumstances (before vs. after the removal of COVID-19 restrictions). Our findings demonstrated the good factor structure, internal consistency, and convergent validity of the higher-order model of the PAS in all subgroups and supported its configural, metric, and scalar invariance across these subgroups. Therefore, the findings suggest that the PAS is a reliable and valid instrument for assessing specific anxiety symptoms and general anxiety among young children in the United Kingdom and that comparisons can be made between the subgroups under examination.

Public Significance Statement

The Preschool Anxiety Scale (PAS) is a reliable and valid instrument for assessing specific anxiety symptoms and general anxiety in young children in the United Kingdom. Furthermore, given that the findings indicate measurement invariance of the higher-order model of the PAS, the specific anxiety symptom subscales and general anxiety scale of the PAS can be compared across child age, child gender, parent/carers' anxiety levels, and children's living circumstances (e.g., before and after the removal of the COVID-19 restrictions).

Keywords: anxiety symptoms, Preschool Anxiety Scale, measurement invariance, group comparisons, early childhood

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The data that support the findings of this study are available from *MY-CATS*, but restrictions apply to the availability of these data, which were used with permission for the present study and so are not publicly available. The data are, however, available from the authors upon reasonable request and with the permission of *MY-CATS*. This study is based on the PhD dissertation of author SiYu Zhou.

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Anxiety disorders are among the most common mental health problems experienced by children and adolescents (Polanczyk et al., 2015). Over the decades, a great body of studies has expanded our knowledge about anxiety problems from middle childhood to adolescence (e.g., Polanczyk et al., 2015; Orgilés et al., 2016). However, increasing evidence indicates that many anxiety disorders emerge in early childhood. For example, the peak age for onset is 5.5 years (Solmi et al., 2022). Indeed, the worldwide prevalence of anxiety disorders is 8.5% in children aged 1–7 years old (Vasileva et al., 2021). Young children with an anxiety disorder are more likely to experience comorbid problems associated with low mood, oppositional and disruptive behaviors, and sleep compared to those without anxiety disorders (Dougherty et al., 2013; Franz et al., 2013). Furthermore, childhood anxiety problems have been demonstrated to persist into adolescence and adulthood (Bufferd et al., 2012) and are associated with future onset of other mental health problems, such as depression and substance use (Lavigne et al., 2015).

Given the prevalence, persistence, and impairment associated with anxiety problems in early childhood, it is critical to be able to measure anxiety symptoms in young children to guide research and practice. However, there is a lack of reliable and valid instruments for assessing anxiety symptoms in early childhood (Spence et al., 2001; Wang & Zhao, 2015). Although several psychometrically established measures, such as the Children's Moods, Fears and Worries Questionnaire (Bayer et al., 2006), the Strengths and Difficulties Questionnaire (Goodman, 1997), and the Child Behaviour Checklist (Achenbach, 1991) are often used for assessing early childhood anxiety problems, these instruments measure global aspects of internalizing problems (including anxiety) but provide little information about specific anxiety symptoms (Edwards et al., 2010). This is an important limitation as previous studies have highlighted that subtypes of anxiety symptoms are formed in early childhood, indicating the potential value of using symptom-specific measures to assess the extent and nature of anxiety problems in young children (Edwards et al., 2010; Spence et al., 2001). However, most existing symptom-specific measures for childhood anxiety problems (March et al., 1997; Reynolds & Richmond, 1978; Spence, 1998) were designed for older children. Given the variation in how anxiety symptoms are exhibited in young and older children (Steinsbekk et al., 2022; Weems, 2008), the age-appropriateness of these instruments in young children is questionable.

To the best of our knowledge, the Preschool Anxiety Scale (PAS; Spence et al., 2001) is the only measure specifically designed for assessing anxiety symptoms across multiple disorder subtypes in young children aged 3–7 years old. It was designed to be completed by parents because young children may not have sufficient cognitive capacity to understand and respond reliably to items. The PAS consists of 28 items generated based on the research literature, existing measures, diagnostic criteria, and psychiatric interviews; the age-appropriateness of the scale was agreed upon by parents and expert clinicians. Using data from a large Australian community sample of children aged 3–7 years, Spence et al. (2001) identified a five-factor model for the PAS: separation anxiety, physical injury fears, social phobia, obsessive-compulsive disorder, and generalized anxiety. A high level of covariation among five factors was also observed in this study, suggesting a higher-order model in which all five factors of specific anxiety symptoms loaded upon a higher-order factor representing general anxiety shared by all specific anxiety symptom subtypes.

Compared to the five-factor model, the higher-order model of the PAS showed better data fit in young Australian children and explained the covariance among first-order factors in a more parsimonious way with fewer parameters (Edwards et al., 2010; Spence et al., 2001). More importantly, the higher-order model captures general anxiety (i.e., higher-order factor) shared by the five specific anxiety symptom subtypes, which is consistent with the hierarchically structured model of anxiety disorders implied by the *Diagnostic and Statistical Manual of Mental Disorders, 5th edition* (American Psychiatric Association, 2013). That is, all specific anxiety symptoms have their own distinct features but share common elements (Zinbarg & Barlow, 1996). Consistent with that, extensive theoretical and empirical research has supported a transdiagnostic conceptualization of anxiety symptomatology (Norton & Paulus, 2016; Reinholt & Krogh, 2014). Clinical research has also found tremendous overlap and comorbidity among specific anxiety symptoms in children and adolescents, making them difficult to treat in isolation (Kendall et al., 2001; Leyfer et al., 2013; Spence et al., 2018). Given that, a transdiagnostic approach to treating anxiety symptoms has been proposed and widely used in children and adolescents to address the common elements of all anxiety symptoms rather than exclusively focusing on one symptom subtype (Ewing et al., 2015; Smith et al., 2017). Testing the measurement properties of the higher-order model of the PAS could help us understand if the PAS is a reliable and valid tool for assessing both specific anxiety symptom subtypes and general anxiety in young children and, thus, can be applied as an assessment tool in both transdiagnostic and diagnosis-specific anxiety treatments for young children. However, unlike the measurement properties (e.g., reliability, construct validity, convergent validity) of the five-factor model of the PAS, which have been examined and supported in many countries (e.g., Almeida & Viana, 2013; Orgilés et al., 2016; Wang & Zhao, 2015), the higher-order model of the PAS has rarely been tested in samples outside Australia.

Measurement invariance is one important aspect of the measurement properties of an instrument. Specifically, measurement invariance assesses the psychometric equivalence of an instrument across individuals from different subpopulations (Meredith, 1993). The establishment of measurement invariance means that the instrument measures the same construct across groups, which is a major prerequisite for meaningful between-group comparisons. The violation of measurement invariance, however, indicates that the differences measured by the instrument could be partially due to the instrument operating differently across groups and, therefore, may not reflect the true differences between groups. In the case of the higher-order model of the PAS, measurement invariance implicates that the underlying measures of anxiety are grounded on the same theoretical structure for the subgroups under examination, and thus, the five specific anxiety symptom subtypes and general anxiety estimated by the higher-order model are comparable across those subgroups.

One factor that may influence the measurement invariance of the PAS is child age. Some studies found that parents of children aged 3–4 years reported higher anxiety symptoms for their children via the PAS than parents of children aged 5–6 years old (Spence et al., 2001; Wang & Zhao, 2015); while this may indicate a greater frequency of anxious behaviors in the younger age group, it may also reflect different parental response tendencies to the PAS items for children across different ages (Steinsbekk et al., 2022; Weems, 2008). For example, in parents' eyes, specific fears (e.g., "Is afraid of

insects and/or spiders” and “Is afraid of dark”) and separation anxiety (e.g., “Has nightmares about being apart from you”) may be normal for younger children but could be regarded as a problem for older children. A similar situation may also occur across the child’s gender. Due to specific gender role socialization effects, parents may respond to PAS items differently for girls and boys (e.g., “fear of insects,” “fear of darkness,” or “fear of being alone”; Holly et al., 2015) which may result in lack of measurement invariance of the PAS across child gender, as such, the results of group comparison may offer misleading insights into potential gender difference in anxiety symptoms in early childhood.

Another factor that is important to consider in relation to the measurement invariance of the PAS is parental anxiety levels. Previous studies have found that parents with anxiety problems tend to report higher anxiety levels for their children (Manley & Francis, 2022). While this may indicate higher anxiety symptoms among children of high-anxiety parents compared to children of low-anxiety parents, it should be noted that parental response tendencies to the PAS items may be influenced by parental anxious beliefs (Fjermestad et al., 2017; Grills & Ollendick, 2003; Hiller et al., 2016). For example, Francis (2014; Francis & Roemhild, 2021) found that parents with higher anxiety showed higher levels of anxiety sensitivity to their child, believing that their child’s anxiety sensations (e.g., appearing jittery, having a racing heartbeat) could lead to more severe and negative consequences. Consequently, parental anxiety levels may lead to different interpretations of children’s emotions and behaviors, which may influence how parents understand and respond to the PAS items.

The measurement invariance of the PAS may also be influenced by children’s living circumstances. Spence et al. (2001) generated the PAS items based on the agreement of parents and expert clinicians about the relevance and frequency of items for young Australian community children. However, parents’ expectations for children’s anxious emotions and behaviors described by the PAS may vary in different contexts, which may influence parents’ perceptions and responses to the items. For example, in the pandemic context, a high frequency of some behaviors (e.g., washing his/her hands over and over many times each day) may have been considered to be within the normal range by parents, whereas they may have been judged to be excessive prior to the pandemic. Therefore, using the marked change in children’s living circumstances before and after the removal of COVID-19 restrictions as an example, this study examined the psychometric equivalence of the PAS across different living circumstances.

Only a few studies have investigated the measurement invariance of the PAS, and most of them have focused on the five-factor model. For example, Wang and Zhao (2015) demonstrated the measurement invariance of the five-factor model of the PAS across age (3–4 vs. 5–6) and gender (boys vs. girls) in Chinese 3 to 6-year-old children. The measurement invariance of the higher-order model of the PAS has been rarely investigated. To address this gap, this study tested the measurement invariance of the higher-order model of the PAS across child age (4–6 years vs. 6–7 years), gender (girls vs. boys), parental anxiety (low vs. high level), and children’s living circumstances (before vs. after the removal of COVID-19 restrictions) with data provided by parents of a large sample of U.K. children aged 4–7 years.

Method

Transparency and Openness

This study’s design and its analysis were not preregistered. The data that support the findings of this study are available from the *Minimizing Young Children’s Anxiety Through Schools (MY-CATS)* project, but restrictions currently apply to the availability of these data, which were used with permission for the present study and are not yet publicly available. The data will, however, be available from the authors upon reasonable request and with permission from the MY-CATS project.

Participants

The data for the present study was collected from Reception, Year 1, and Year 2 classes of 95 mainstream primary/infant schools from different geographic locations in the United Kingdom. Schools and participants were recruited in five separate cohorts after the outbreak of the COVID-19 pandemic (between March 2021 and July 2022). Parents/carers of 2,355 children consented to participate and completed the PAS to report their child’s anxiety symptoms (see Table 1 for the time of data collection). One child was excluded due to a large number of missing items in her parent’s responses to the PAS ($\geq 30\%$). Some parents/carers completed the PAS for more than one child from the same family (i.e., siblings); as this may lead us to overestimate the measurement invariance of the scale, we randomly selected one child from the family and excluded their sibling(s)’s data ($n = 132$). The final sample was 2,221 children aged 4–7 years ($M = 6.04$, $SD = 0.90$) and their parents/carers. The sample included 49.1% girls and 80.1% White British children¹ (See more participant details in Table 1).

Procedure

This study used screening data from a cluster randomized controlled trial in the United Kingdom called MY-CATS. MY-CATS is evaluating a targeted anxiety prevention program aimed at identifying young children who are at risk of developing anxiety disorders through mainstream schools and offering them a therapist-supported, parent-led online intervention (Online Support and Intervention for Child Anxiety). The trial was approved by the University of Oxford’s Medical Sciences Interdivisional Research Ethics Committee (Reference: R62531/RE001). Full details of the MY-CATS trial have been reported by Reardon et al. (2022).

The MY-CATS trial recruited schools and participants in five separate cohorts between March 2021 and July 2022.² To maximize the representativeness of primary/infant schools in the United Kingdom, the characteristics of recruited schools were monitored considering variation in relation to geographic location, size of school and demographic profile (percentage of pupils eligible for free school meals (FSM), percentage of pupils on special educational needs (SEN) support, percentage of pupils with English as an additional language) and particular schools were targeted to increase the sample

¹ In 2019, 78.4% of the population in the United Kingdom and Wales identified their ethnic group as White British (UK Office for National Statistics, 2019).

² Data collection time of five cohorts: Mar–Apr 2021, May–Jul 2021, Oct–Nov 2021, Feb–Apr 2022, Jun–Jul 2022.

Table 1
Demographic Information of Participants

| Variable | Total sample (<i>N</i> = 2,221) |
|--|----------------------------------|
| Child mean age (<i>SD</i> , range) | 6.04 (0.90, 4.20–7.82) |
| Child gender | |
| Boys | 1,130 (50.9%) |
| Girl | 1,090 (49.1%) |
| Missing information | 1 (0.0%) |
| Parent/carer's relationship with child | |
| Mother | 2,037 (91.7%) |
| Father | 161 (7.2%) |
| Others | 21 (0.9%) |
| Missing information | 2 (0.1%) |
| Parent/carer's mean age (<i>SD</i> , range) | 36.9 (5.71, 19–64) |
| Parent/carer's highest education level | |
| School completion | 155 (7.0%) |
| Further education (college) | 759 (34.2%) |
| Higher education (undergraduate degree) | 657 (29.6%) |
| Postgraduate qualification | 554 (24.9%) |
| Missing information | 96 (4.3%) |
| Parent/carer's employment status | |
| Unemployed | 153 (6.9%) |
| Part-time employment (less than 30 hr/week) | 825 (37.1%) |
| Full-time employment (30+ hr/week) | 835 (37.6%) |
| Student | 48 (2.2%) |
| Homemaker | 226 (10.2%) |
| Others | 92 (4.2%) |
| Missing information | 42 (1.9%) |
| Parent/carer's anxiety level (GAD-7 score) | |
| Low level (0–9) | 1,709 (76.9%) |
| High level (10–21) | 487 (21.9%) |
| Missing information | 25 (1.2%) |
| Child ethnicity | |
| White-British | 1,779 (80.1%) |
| White-Irish or other White background | 115 (5.2%) |
| Asian or Asian British (Chinese, Indian, Pakistani, Bangladeshi, other Asian background) | 112 (5.1%) |
| Black or Black British (African, Caribbean, other Black background) | 43 (1.9%) |
| Mixed—White and Asian | 51 (2.3%) |
| Mixed—White and Black (African, Caribbean) | 22 (1.0%) |
| Mixed—Any other mixed background | 45 (2.0%) |
| Other ethnic groups | 7 (0.3%) |
| Missing information | 12 (0.5%) |
| Type of housing ^a | |
| Privately rented | 414 (18.6%) |
| Council rented | 156 (7.0%) |
| Housing association | 136 (6.1%) |
| Mortgage/fully owned | 1,436 (64.7%) |
| Others | 32 (1.4%) |
| Missing information | 47 (2.1%) |

Note. GAD-7 = Generalized Anxiety Disorder Scale-7.

^aIn 2019–2020, the private rented sector, council rented sector, housing association rented sector, and mortgage/fully owned sector accounted for 19%, 7%, 10%, and 65% of households in the United Kingdom, respectively (UK Ministry of Housing & Communities & Local Government, 2020).

representativeness. A total of 95 mainstream primary/infant schools from 43 local authorities across nine regions in the United Kingdom agreed to participate in the trial. In the participating schools, the number of pupils ranged from 158 to 895, with an average of 441 (± 151). Schools also varied in relation to the proportion of pupils eligible for FSM,³ the proportion of pupils with English as an

additional language, and the proportion of pupils on SEN⁴ support (45 schools [47.4%], 29 schools [30.5%], 51 schools [53.7%] above the national average for each respectively; UK Department of Education, 2019).

Electronic versions of study information were distributed to parents/carers of all children in reception, Year 1, and Year 2 classes of all participating schools (children aged 4–7). Parents/carers who agreed for their child to participate were asked to provide written consent via an online survey and complete a screening assessment. Children who screened positive on the basis of elevated anxiety symptoms, and/or behavioral inhibition, and/or parent/carer anxiety symptoms were eligible for the trial. Among the 2,221 children and their parents/carers participating in this study, 811 children (36.5%) screened positive for elevated anxiety (sum scores of the PAS were 34/112 or above, scaswebsite.com), 353 (15.9%) children screened positive on the basis of behavioral inhibition (sum scores of the approach-withdrawal subscale of the Short Temperament Scale for Children [STSC] were 30/42 or above, Bayer et al., 2006), 684 children (30.8%) screened positive on the basis of elevated parent anxiety (sum scores of the Generalized Anxiety Disorder Scale-7 [GAD-7] were 8 or above, Kroenke et al., 2007). However, this study used all the screening data, regardless of whether the child was eligible for the trial or not, to maximize the size and representativeness of our study sample.

Measures

PAS

PAS was used in this study to assess children's anxiety symptoms. The PAS is a 28-item parent-report measure consisting of five subscales: separation anxiety disorder (five items), physical injury fears (seven items), social phobia (six items), obsessive-compulsive disorder (five items), generalized anxiety disorder (five items; Spence et al., 2001). Parents/carers rated the items of each subscale on a 5-point Likert-type scale, ranging from 0 (*not at all true*) to 4 (*very often true*), with higher scores representing a higher level of child anxiety symptoms. The original PAS does not set a particular time period over which the judgment has to be made (Spence et al., 2001). To maintain consistency with other studies, we followed the standard wording, so we did not refer to a specific time period either.

GAD-7

The seven-item GAD-7 was used in this study to assess the anxiety level of parents/carers. The GAD-7 is a brief self-rating scale for evaluating anxiety levels. Parents/carers were asked to indicate how often, over the past 2 weeks, they have been bothered by each of the seven items. The answers were rated on a 4-point scale as 0 (*not at all*), 1 (*several days*), 2 (*more than half the days*), and 3 (*nearly every day*; Spitzer et al., 2006). The Cronbach's α value of the GAD-7 reported by parents/carers was 0.91, indicating good

³ FSM in the United Kingdom provide eligible students with a daily healthy school meal at no cost. This initiative supports children from low-income families.

⁴ SEN support in the United Kingdom provides extra or different help beyond the school's usual curriculum. The class teacher and special educational needs coordinator may receive advice or support from outside specialists.

internal consistency reliability of the GAD-7 in this study. The total scores of GAD-7 range from 0 to 21. According to Spitzer et al. (2006), we classified parents who reported a score of 0–9 on the GAD-7 as a low-anxiety group. Parents who reported a score of 10 or greater on the GAD-7 were classified as a high-anxiety group.

Demographic Information

A parent-report questionnaire was used to collect participant demographic information, including child age and gender, parents'/carers' relationship to the child, parent/carers' age, level of education, and employment status.

The Approach-Withdrawal Subscale of the STSC

Anxiety symptoms in early childhood often manifest as behavioral inhibition (Niditch & Varela, 2018), a temperamental trait marked by distress or avoidance of unfamiliar situations. The association between behavioral inhibition and anxiety symptoms in young children has been demonstrated in previous studies (Moehler et al., 2007). In order to test the convergent validity of the PAS in each subgroup, this study assessed child behavioral inhibition using the approach-withdrawal subscale of the STSC, which is a seven item, parent/carer-report scale, where total scores can range from 7 to 42 (each item scored from 1 to 6), with higher scores representing a greater degree of behavioral inhibition. The Cronbach's α value of this subscale reported by parents/carers was .97, indicating the good internal consistency reliability of the approach-withdrawal subscale of the STSC in this study.

Data Analysis

All data analyses were conducted using SPSS 21 and MPLUS 7.4. Since the items of the PAS have five response categories that measured ordered categories (i.e., 5-point Likert-type scale), the present study conducted Confirmatory Factor Analysis (CFA) in MPLUS 7.4 using the robust weighted least squares with mean and variance adjustment estimator (Flora & Curran, 2004; Liu et al., 2017). The pairwise deletion was used to handle missing data when weighted least squares with mean and variance adjustment estimators were conducted in MPLUS 7.4 (Muthén & Muthén, 1998–2017).

CFA

Before performing the measurement invariance tests, it is essential to identify the factor structure of the instrument in each subgroup separately (Brown, 2015). Therefore, we conducted a series of CFA in MPLUS 7.4 to test the higher-order model (i.e., five factors loading onto one higher-order factor) of the PAS proposed and supported by Spence et al. (2001) in each subgroup of child age, gender, parental anxiety level, and pandemic period. The model was deemed to be a good fit based on the Comparative Fit Index and Tucker–Lewis Index ≥ 0.90 (≥ 0.95 is ideal) and root-mean-square error of approximation ≤ 0.08 (≤ 0.06 is ideal; Hu & Bentler, 1999; Kline, 2010).

Internal Consistency

Before the test of measurement invariance, the Cronbach's α coefficient, omega, and mean interitem correlations were calculated to evaluate the internal consistency of the PAS total and subscales in

each subgroup. Cronbach's α s and ω above .60 were considered acceptable (Barker et al., 1994). Mean interitem correlations were acceptable when ranging from .15 to .50 (Clark & Watson, 1995).

Convergent Validity

Before the test of measurement invariance, the convergent validity of the PAS was examined in each subgroup using Pearson correlations between the sum scores of the PAS and a closely associated construct, that is, child behavioral inhibition assessed via the approach-withdrawal subscale of the STSC. The correlation coefficients were considered to be statistically significant when the p value $\leq .05$.

Measurement Invariance Testing

Measurement invariance was tested across child age (4–6 years vs. 6–7 years), gender (girl vs. boy), parental anxiety level (0–9 vs. 10–21 scores of GAD-7), living circumstances (before vs. after the removal of COVID-19 restrictions). To test the measurement invariance of the PAS across children's living circumstances (before vs. after the removal of COVID-19 restrictions), we classified participants recruited in the first two recruitment cohorts (between March 2021 and July 2021; when some COVID-19 restrictions were still in place, most schools were shut down and students needed to stay at home) as Period 1, and participants recruited in the last three cohorts (between October 2021 and July 2022; when most COVID-19 restrictions had been removed in the United Kingdom, schools were reopened and most students went back to school) as Period 2. Participants of Period 1 and Period 2 showed no significant difference in demographic information. It is also worth noting that parental psychological distress (including anxiety) significantly increased during the pandemic (Christie et al., 2022), indicating a potential interactive effect between parental anxiety and the pandemic period. To identify the independent influence of children's living circumstances (before vs. after the removal of COVID-19 restrictions) on the measurement invariance of the PAS, we tested the measurement invariance and the following group comparisons of the PAS before and after the removal of COVID-19 restrictions in parents with high- and low-anxiety level separately.

Measurement invariance was evaluated by testing and comparing the sequential models: configural, metric, and scalar invariance (Cheung & Rensvold, 2002; Chen et al., 2005). Parameter constraints were applied in these three sequential models to examine potential decreases in fit resulting from measurement or structural noninvariance between two groups, with one group as a reference (Hoffman, 2014; Millsap, 2011; Yoon & Millsap, 2007). Comparisons of model fit for nested invariance models were based on changes to the incremental fit indices. For each nested model comparison, a decrease of 0.010 or less in the Comparative Fit Index and an increase of 0.015 or less in the root-mean-square error of approximation were taken to indicate the existence of measurement invariance of the higher-order model of the PAS across groups (Chen, 2007).

Specifically, *configural invariance* was tested first to see if the PAS shows the same factor structure pattern across groups (i.e., if a questionnaire item loaded on the same first-order latent factors across groups and if all first-order latent factors loaded on the higher-order factor). The factor variance was fixed to 1, and the factor mean

was fixed to 0 in each group for model identification, such that all item factor loadings (one per item) and thresholds (four per item given five response options) were then estimated. The residual variances are not uniquely identified in the configural invariance model and, as such, were all constrained to 1 in both groups. If *configural invariance* was supported, we tested *metric invariance*, which requires the equivalence of unstandardized item loadings on the corresponding factors across groups. Item loadings refer to the regression slopes relating the items to their corresponding latent factors. Equivalence of item loadings shows that the first-order latent factors (i.e., five subscales of specific anxiety symptoms) are related to each questionnaire item in the same way across groups. The equivalence of unstandardized loadings of five first-order latent factors on the higher factor (i.e., general anxiety) was also tested to see if the higher-order latent factor is related to the five first-order latent factors in the same way. The factor variance of the reference group (i.e., younger children, boys, lower parental anxiety, participants before the removal of COVID-19 restrictions) was fixed to 1 for model identification but was freely estimated in the other group; the factor mean was fixed to 0 in both groups for model identification. All factor loadings were constrained to be equal across groups, all item thresholds were estimated, and all residual variances were constrained to 1 across groups. If *metric invariance* was supported, *scalar invariance* was tested. It requires the equivalence of unstandardized item intercepts (i.e., the value of an item when the corresponding latent factor is zero), thereby indicating the same scaling origin of each first-order latent factor across groups. The equivalence of unstandardized intercepts of five first-order latent factors on the higher factor was also tested to see if the higher-order factor had the same scaling origin across groups. The factor variance and mean were fixed to 1 and 0, respectively, in the reference group for model identification, but the factor variance and mean were then estimated for the other group. All factor loadings and item thresholds were constrained to be equal across groups; all residual variances were still constrained as equal to 1 in both groups.

Group Comparisons

Group comparisons of the first-order latent factors (e.g., specific anxiety symptoms) were conducted if the invariance of (a) factors

structure, (b) item loadings on first-order latent factors, and (c) item intercepts on first-order latent factors were established. Group comparisons of the higher-order factor (e.g., general anxiety) were conducted if the invariance of loadings and intercepts of first-order latent factors on higher-order factors were established. We performed group comparisons within a structural equation modeling (SEM) framework using structured means analysis (Dimitrov, 2006). Specifically, to estimate the difference between two group means estimated by the higher-order model of the PAS, one of the groups is chosen to serve as a reference group, and its mean estimated by the model is fixed to zero.

Results

CFA, Internal Consistency and Convergent Validity Test of the Higher-Order Model of the PAS

As Table 2 shows, the higher-order model of the PAS provided a good fit of the data in all subgroups. The internal consistency of all five subscales was acceptable and was excellent for the total scale (see Table 3). Correlations between the sum scores of the PAS and the approach-withdrawal subscale of the STSC were positive and significant in each subgroup, supporting good convergent validity of the PAS compared to children's temperament of behavioral inhibition (See Table 3).

Measurement Invariance Testing of the Higher-Order Model of the PAS

As Table 4 shows, all configural, metric, and scalar invariance models showed good model fits and the fit change between models was acceptable to support the configural, metric and scalar invariance of the higher-order model of the PAS across all subgroups. Such results indicated that the factor structure, the loadings and intercepts of items on corresponding first-order latent factors, as well as the loadings and intercepts of five first-order latent factors on the higher-order factor of the PAS, were invariant across children's age (4–6 years vs. 6–7 years), gender (girl vs. boy), parental anxiety level (0–9 vs. 10–21 scores of GAD-7), children's living circumstances (before vs. after the removal of COVID-19

Table 2
Fit Indices for the Higher-Order Model of the PAS in Confirmatory Factor Analysis

| Subgroup | WLSMV χ^2 | df | CFI | TLI | RMSEA (90% CI) |
|--|----------------|-----|-------|-------|----------------------|
| Children aged 4–6 ($n = 1,090$) | 1926.437*** | 345 | 0.932 | 0.925 | 0.065 [0.062, 0.068] |
| Children aged 6–7 ($n = 1,129$) | 2197.667*** | 345 | 0.934 | 0.928 | 0.069 [0.066, 0.072] |
| Girl ($n = 1,090$) | 2062.045*** | 345 | 0.938 | 0.932 | 0.068 [0.065, 0.070] |
| Boy ($n = 1,130$) | 2208.616*** | 345 | 0.928 | 0.921 | 0.069 [0.066, 0.072] |
| Low-anxiety parents/carers ($n = 1,709$) | 2992.915*** | 345 | 0.925 | 0.917 | 0.067 [0.065, 0.069] |
| High-anxiety parents/carers ($n = 487$) | 1164.185*** | 345 | 0.921 | 0.914 | 0.070 [0.065, 0.074] |
| Pandemic period 1 ($n = 929$) | 1830.389*** | 345 | 0.934 | 0.927 | 0.068 [0.066, 0.071] |
| Pandemic period 2 ($n = 1,267$) | 2386.952*** | 345 | 0.934 | 0.928 | 0.068 [0.066, 0.071] |

Note. Low-anxiety parents/carers = parent/carers with 0–9 scores of GAD-7; High-anxiety parents/carers = parents/carers with 10–21 scores of GAD-7; Pandemic period 1 = before the removal of COVID-19 restrictions; Pandemic Period 2 = after the removal of COVID-19 restrictions. PAS = Preschool Anxiety Scale; WLSMV χ^2 = chi-square test of model fit and its associated degrees of freedom (*df*) based on the robust weighted least squares with mean and variance adjustment (WLSMV); CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA (90% CI) = root-mean-square error of approximation and its 90% confidence interval (CI); GAD-7 = Generalized Anxiety Disorder Scale–7.

*** $p < .001$.

Table 3*Internal Consistency and Convergent Validity of the PAS in Each Subgroup*

| Subgroup | Cronbach's α (GAD/SP/PIF/ SAD/OCD/Total) | Omega (ω) (GAD/SP/PIF/ SAD/OCD/Total) | MIIC (GAD/SP/PIF/ SAD/OCD/total) | Pearson correlation coefficient (r) between PAS total score and STSC |
|-----------------------------|--|---|-------------------------------------|--|
| Girl | .89/.86/.67/.79/.70/.92 | .89/.86/.68/.79/.71/.92 | .62/.51/.23/.44/.34/.30 | 0.60*** |
| Boy | .87/.86/.69/.78/.69/.92 | .87/.86/.70/.78/.70/.92 | .58/.50/.25/.43/.33/.30 | 0.60*** |
| Children aged 4–6 | .86/.85/.68/.77/.67/.92 | .87/.86/.68/.76/.68/.92 | .57/.49/.23/.42/.30/.29 | 0.61*** |
| Children aged 6–7 | .89/.86/.68/.79/.72/.92 | .89/.86/.69/.79/.73/.92 | .62/.51/.24/.45/.36/.30 | 0.60*** |
| Low-anxiety parents/carers | .87/.86/.66/.76/.65/.91 | .87/.86/.67/.75/.66/.91 | .58/.50/.22/.41/.30/.27 | 0.59*** |
| High-anxiety parents/carers | .86/.84/.67/.76/.71/.91 | .86/.85/.68/.76/.72/.91 | .56/.48/.23/.40/.34/.28 | 0.59*** |
| Pandemic period 1 | .89/.86/.69/.80/.70/.92 | .89/.86/.69/.80/.71/.92 | .62/.50/.24/.47/.33/.33 | 0.60*** |
| Pandemic period 2 | .87/.86/.67/.77/.70/.91 | .88/.86/.68/.76/.71/.92 | .59/.51/.23/.42/.35/.30 | 0.61*** |

Note. Cronbach's α = Cronbach's α coefficient; Omega (ω) coefficient is a model-based estimate of internal consistency that takes into account the magnitude of item factor loadings as well as any residual covariance between item pairs, which has been shown to outperform Cronbach's α (Bentler, 2009; Revelle & Zinbarg, 2009); MIIC (mean inter-item correlation) is calculated by taking the average correlation between each pair of items on the scale, which assess the extent to which items in a scale are related to each other and measuring the same underlying construct; PAS = Preschool Anxiety Scale; GAD = Generalized Anxiety Disorder; SP = social phobia; PIF = physical injury fears; SAD = Separation Anxiety Disorder; OCD = Obsessive-Compulsive Disorder. STSC = the approach-withdrawal subscale of the Short Temperament Scale for Children.

*** $p < .001$.

restrictions in parents with high- and low-anxiety level separately). Therefore, the measurement invariance of the higher-order model of the PAS was supported across the above subgroups.

Group Comparisons

As the assumption of measurement invariance was met, group comparisons were performed on first- and second-order latent factor means (i.e., specific anxiety symptoms and general anxiety scale) within an SEM framework using structured means analysis. As Table 5 shows, compared to children aged 4–6 years, children aged 6–7 years were reported to have significantly higher scores on the general anxiety scale and all specific anxiety symptom subscales except for physical injury fears. Girls scored significantly higher on physical injury fears than boys. No gender differences were found in the general anxiety scale or other specific anxiety symptom subscales. High-anxiety parents/carers reported significantly higher scores for their children on all specific anxiety symptom subscales and the general anxiety scale than low-anxiety parents/carers. There were no significant differences in the general anxiety scale or any specific anxiety symptom subscales across living circumstances (before vs. after the removal of COVID-19 restrictions) except for separation anxiety symptoms. Low-anxiety parents who completed the PAS after the removal of COVID-19 restrictions reported significantly higher separation anxiety symptoms for their children compared to those who completed the PAS before the removal of COVID-19 restrictions. However, this pattern was not observed in the subgroup of high-anxiety parents.

Discussion

The primary goal of this study was to test the measurement invariance of the higher-order model of the PAS across various factors, including child age, child gender, parents/carers' anxiety levels, and children's living circumstances (i.e., before vs. after the removal of COVID-19 restrictions). The higher-order model showed good factor structure, internal consistency, and convergent validity in all subgroups and, thus, could be used for measurement invariance testing. The results of measurement invariance testing

supported the configural, metric, and scalar invariance of the specific anxiety symptom subscales and general anxiety scale of the PAS across all subgroups of interest. Our findings provide additional evidence for the hierarchical model of anxiety in young children within a large community sample of young children in the United Kingdom, which was consistent with the findings of previous studies on young Australian children (Edwards et al., 2010; Spence et al., 2001) and highlight the potential value of the PAS as an assessment tool for both transdiagnostic and diagnosis-specific anxiety treatments for young children.

Although parents' expectations for children's anxiety manifestations may change as children grow up, our findings support the measurement invariance of the higher-order PAS across children aged 4–6 and 6–7 years, which was in line with the findings of Wang and Zhao (2015) who demonstrated the measurement invariance of the five-factor PAS across children aged 3–5 and 5–6 years in the Chinese context. One possible explanation is that the age gap between the two age groups in this study was small, so parents' expectations of their child's anxiety manifestations may be less likely to change markedly.

Previous research has suggested that parents may have gender-specific expectations relating to their child's emotional expression (Chaplin et al., 2005). However, our findings support the measurement invariance of the higher-order PAS model across child gender. One possible explanation is that parental gender-specific expectations of children's negative emotional expression may increase as the child grows older (Chaplin & Aldao, 2013) and may not manifest in early childhood. It would be of interest for future studies to investigate how parental gender-specific expectations of children's negative emotional expression may change with child age and how that may influence parental reporting of child anxiety symptoms.

Our findings also supported the measurement invariance of the PAS across parents with low- and high-anxiety levels, indicating that PAS outcomes could be compared across parents with low- and high-anxiety levels. However, it should be noted that our result can only support the PAS as a safe instrument for investigating the relationship between parental anxiety levels and children's anxiety levels perceived by parents rather than the relationship between parental anxiety levels and children's anxiety levels, according to other

Table 4*Results of Measurement Invariance Test Based on Higher-Order Model of the PAS*

| Model | WLSMV χ^2 | df | CFI | TLI | RMSEA (90% CI) | Δ Model | Δ CFI | Δ RMSEA |
|--|----------------|-----|-------|-------|----------------------|----------------|--------------|----------------|
| Across child age | | | | | | | | |
| M1. Configural | 4125.557*** | 690 | 0.933 | 0.927 | 0.067 [0.065, 0.069] | | | |
| M2. Metric (invariance of item loadings) | 3199.056*** | 713 | 0.952 | 0.949 | 0.056 [0.054, 0.058] | M2–M1 | +0.020 | –0.012 |
| M3. Metric (invariance of latent factor loadings on the higher-order factor) | 2873.353*** | 717 | 0.958 | 0.946 | 0.052 [0.050, 0.054] | M3–M2 | +0.008 | –0.003 |
| M4. Scalar (invariance of item intercepts) | 3239.577*** | 824 | 0.953 | 0.957 | 0.051 [0.050, 0.053] | M4–M3 | –0.005 | +0.011 |
| M5. Scalar (invariance of latent factor intercepts on the higher-order factor) | 3309.350*** | 828 | 0.952 | 0.956 | 0.052 [0.050, 0.054] | M5–M4 | –0.001 | +0.001 |
| Across child gender | | | | | | | | |
| M1. Configural | 4270.978*** | 690 | 0.933 | 0.927 | 0.068 [0.066, 0.070] | | | |
| M2. Metric (invariance of item loadings) | 3332.799*** | 713 | 0.951 | 0.948 | 0.058 [0.056, 0.060] | M2–M1 | +0.019 | –0.011 |
| M3. Metric (invariance of latent factor loadings on the higher-order factor) | 3015.081*** | 717 | 0.957 | 0.955 | 0.054 [0.052, 0.056] | M3–M2 | +0.006 | –0.004 |
| M4. Scalar (invariance of item intercepts) | 3406.736*** | 824 | 0.952 | 0.956 | 0.053 [0.051, 0.055] | M4–M3 | –0.005 | +0.001 |
| M5. Scalar (invariance of latent factor intercepts on the higher-order factor) | 3377.741*** | 828 | 0.952 | 0.957 | 0.053 [0.051, 0.055] | M5–M4 | –0.000 | +0.001 |
| Across parent/carer anxiety level | | | | | | | | |
| M1. Configural | 3965.290*** | 690 | 0.928 | 0.921 | 0.066 [0.064, 0.068] | | | |
| M2. Metric (invariance of item loadings) | 3199.926*** | 713 | 0.945 | 0.942 | 0.056 [0.054, 0.058] | M2–M1 | +0.017 | –0.010 |
| M3. Metric (invariance of latent factor loadings on the higher-order factor) | 2923.951*** | 717 | 0.951 | 0.949 | 0.053 [0.051, 0.055] | M3–M2 | +0.006 | –0.007 |
| M4. Scalar (invariance of item intercepts) | 3076.018*** | 824 | 0.950 | 0.955 | 0.050 [0.048, 0.052] | M4–M3 | –0.001 | –0.003 |
| M5. Scalar (invariance of latent factor intercepts on the higher-order factor) | 3065.227*** | 828 | 0.951 | 0.955 | 0.050 [0.048, 0.051] | M5–M4 | +0.001 | 0 |
| Across the pandemic period in low-anxiety parent/carers | | | | | | | | |
| M1. Configural | 3195.736*** | 690 | 0.929 | 0.913 | 0.065 [0.063, 0.067] | | | |
| M2. Metric (invariance of item loadings) | 2659.145*** | 713 | 0.945 | 0.942 | 0.057 [0.054, 0.059] | M2–M1 | +0.016 | –0.008 |
| M3. Metric (invariance of latent factor loadings on the higher-order factor) | 2433.442*** | 717 | 0.952 | 0.949 | 0.052 [0.051, 0.055] | M3–M2 | +0.007 | –0.005 |
| M4. Scalar (invariance of item intercepts) | 1053.206*** | 824 | 0.952 | 0.957 | 0.049 [0.047, 0.051] | M4–M3 | 0 | –0.003 |
| M5. Scalar (invariance of latent factor intercepts on the higher-order factor) | 2422.577*** | 828 | 0.953 | 0.957 | 0.049 [0.046, 0.051] | M5–M4 | +0.001 | 0 |
| Across pandemic period in high-anxiety parent/carers | | | | | | | | |
| M1. Configural | 1464.385*** | 690 | 0.925 | 0.917 | 0.068 [0.063, 0.073] | | | |
| M2. Metric (invariance of item loadings) | 1383.801*** | 713 | 0.935 | 0.931 | 0.062 [0.057, 0.067] | M2–M1 | +0.010 | –0.006 |
| M3. Metric (invariance of latent factor loadings on higher-order factor) | 1347.376*** | 717 | 0.939 | 0.935 | 0.060 [0.055, 0.065] | M3–M2 | +0.004 | –0.002 |
| M4. Scalar (invariance of item intercepts) | 1522.753*** | 824 | 0.941 | 0.946 | 0.055 [0.050, 0.059] | M4–M3 | +0.002 | –0.005 |
| M5. Scalar (invariance of latent factor intercepts on higher-order factor) | 1519.774*** | 828 | 0.942 | 0.947 | 0.054 [0.050, 0.058] | M5–M4 | +0.001 | –0.001 |

Note. PAS = Preschool Anxiety Scale; WLSMV χ^2 = Chi square test of model fit, and its associated degrees of freedom (*df*) based on the robust weighted least squares with mean and variance adjustment (WLSMV); CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; RMSEA (90% CI) = root-mean-square error of approximation and its 90% confidence interval (CI); Δ = change relative to the preceding model; M = model.

*** $p < .001$.

reporters. Going forward, in addition to the issue of measurement invariance, studies investigating the relationship between parent and child anxiety using the PAS should also take into account the potential bias of the PAS as a parent-report instrument when interpreting the results.

Our findings also supported measurement invariance of the PAS before and after the removal of COVID-19 restrictions. This finding was consistent with previous studies indicating that stressful events, like the COVID-19 pandemic, do not always change the measurement properties of scales for emotion-related problems (Hawes et al., 2023; Olino et al., 2022). The current findings provide preliminary evidence for the feasibility of comparing the measurement outcomes of the PAS across various living circumstances of children and provide a basis for future studies to test the measurement invariance of the PAS across more diverse living circumstances (e.g., different cultural backgrounds, clinical/nonclinical settings).

Given the support for measurement invariance across groups, group comparisons were performed within an SEM framework using structured means analysis. Compared to children aged 4–6 years, children aged 6–7 years were reported to have significantly higher scores on the general anxiety scale and all specific anxiety symptom subscales except for physical injury fears, possibly due to their increased ability to recognize and express their emotions, enabling parents to better identify their anxiety symptoms (Creswell et al., 2021). Older children may also encounter a broader range of challenging experiences compared to their younger counterparts (e.g., increased social demands and academic pressure), which could trigger more anxious reactions. In addition, girls were reported to have significantly higher levels of physical injury fears than boys. This trend may be a consequence of gender role socialization, which has typically emphasized that boys should be brave in the face of situations that may trigger physical injury fears (e.g., dark, dogs,

Table 5*Group Comparison Results Based on Structured Means Analyses*

| Comparison between subgroup | GAD | SP | PIF | SAD | OCD | General Anxiety Scale |
|---|---------|---------|---------|---------|---------|-----------------------|
| Children aged 4–6 versus children aged 6–7 | 0.39*** | 0.25*** | 0.03 | 0.24*** | 0.21*** | 0.30*** |
| Boys versus girls | 0.01 | 0.02 | 0.12* | 0.09 | –0.04 | 0.05 |
| Low-anxiety parents/carers versus high-anxiety parents/carers | 0.77*** | 0.52*** | 0.69*** | 0.87*** | 0.79*** | 0.91*** |
| Pandemic period 1 versus pandemic period 2 (in low-anxiety parents/carers) | –0.01 | 0.05 | –0.02 | 0.11* | –0.10 | 0.02 |
| Pandemic period 1 versus pandemic period 2 (in high-anxiety parents/carers) | –0.13 | 0.03 | –0.09 | –0.05 | –0.18 | –0.09 |

Note. Reference group (mean was fixed to 0 for model identification): Children aged 4–6; Boys; Low-anxiety parents/carers; Pandemic Period 1 in low/high-anxiety parent/carers. GAD = Generalized Anxiety Disorder; SP = social phobia; PIF = physical injury fears; SAD = Separation Anxiety Disorder; OCD = Obsessive–Compulsive Disorder.

* $p < .05$. *** $p < .001$.

spiders, thunderstorms, and swimming). As a result, boys may present themselves as fearless or inhibit their expression of fears in such situations (Gong et al., 2023). We also found that high-anxiety parents/carers reported significantly higher scores on the specific anxiety symptom subscales and the general anxiety scale for their children compared to low-anxiety parents/carers. This result may indicate elevated anxiety symptoms among children of high-anxiety parents, or it may reflect the higher sensitivity of high-anxiety parents/carers to their child's potential expressions of anxiety (Francis & Roemhild, 2021). Finally, low-anxiety parents who completed the PAS after the removal of COVID-19 restrictions reported significantly higher separation anxiety symptoms for their children compared to those who completed the PAS before the removal of COVID-19 restrictions. One possible explanation is that before the removal of COVID-19 restrictions, children spent most of their time at home with their parents, thus minimizing potential triggers for separation anxiety symptoms. However, this pattern was not found in the subgroup of high-anxiety parents, possibly because high-anxiety parents who completed the PAS before and after the removal of COVID-19 restrictions both reported relatively higher separation anxiety symptoms for their children.

Limitations and Future Directions

This study has several limitations. First, all participants in this study were recruited from mainstream primary/infant schools in the United Kingdom, with 80.1% of children identified as White British, which may limit the generalizability of the study results to other cultures or settings. Future studies are needed to test the measurement invariance of the PAS across diverse cultures and settings. Second, most of the data were provided by mothers in this study. Future studies should collect data from both mothers and fathers and investigate the measurement invariance of the PAS across parents' genders. Third, this study did not include an instrument that is related to but distinct from anxiety to test the discriminant validity of the PAS. Future studies should address this gap for a more comprehensive understanding of the PAS's psychometric properties. Fourth, without longitudinal data, our findings can only support the measurement invariance of the PAS across child age horizontally. Verification of the longitudinal measurement invariance of the PAS will be critical for future studies to investigate the developmental trajectories of anxiety symptoms

across early childhood. Fifth, our sample size of the high- and low-anxiety parent/carer groups was unbalanced (487 vs. 1,709), which may reduce sensitivity to model invariance (Yoon & Millsap, 2007). Future studies should replicate this study with balanced samples to get more robust evidence. Sixth, this study categorized child gender as a binary variable (i.e., girls and boys). Future research would benefit from a more inclusive approach to gender identification, considering diverse gender identities and expressions.

Although this study supported the measurement invariance of the higher-order model of the PAS across certain subgroups, and thus, the comparability of specific anxiety symptom subscales and general anxiety scale of the PAS across these subgroups, caution is necessary when asserting that differences in child anxiety symptoms estimated by the PAS fully reflect the true differences of child anxiety symptoms between subgroups. Other biases may influence the accuracy of measurement outcomes and results of group comparisons other than measurement noninvariance. Future studies using the PAS for group comparisons should also consider the influence of other sources of bias when interpreting their results.

Finally, this study tested the measurement invariance of the higher-order factor model of the PAS within an SEM framework. Therefore, our results can only provide support for the comparability of the specific anxiety symptom subscales and the general anxiety scale of the PAS based on the higher-order model of the PAS using the SEM approach (i.e., structured mean analysis). However, most previous studies examining group differences in anxiety symptoms measured by the PAS have used a traditional approach of comparisons between composite scores such as multivariate analysis of variance and t test (Edwards et al., 2010; Wang & Zhao, 2015; Zhou & Li, 2022), in which the levels of specific anxiety symptoms and general anxiety are represented by the sum scores of the PAS subscales and total scale. Composite scores comparisons are widely used in current research and clinical practice for simplicity, convenience, and ease of generalizability; however, it has been well-established that group comparison on latent variables estimated by the SEM approach may generate more accurate results as the latent factor means estimated by the SEM are less influenced by the measurement errors (Dimitrov, 2006; Ployhart & Oswald, 2004). Future studies are needed to examine the justification of using the sum scores of the PAS subscales and total scale to assess young children's specific anxiety symptoms and general anxiety and test the measurement invariance of these sum scores for group comparisons.

Conclusion

This study demonstrated the reliability and validity of the higher-order model of the PAS within a large sample of young U.K. children and supported its measurement invariance across child age (4–6 years vs. 6–7 years), child gender (girls vs. boys), parental anxiety (low vs. high level), and children's living circumstances (before vs. after the removal of COVID-19 restrictions). These findings suggest that the PAS is a reliable and valid instrument for assessing specific anxiety symptoms and general anxiety among young children in the United Kingdom and that comparisons can be made between the subgroups under examination.

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