

## The Index of Parental Activities, Context and Experiences (I-PACE)

Hughes, Claire; Devine, Rory T.; White, Naomi; Fink, Elian

DOI:

[10.1007/s10826-024-02793-3](https://doi.org/10.1007/s10826-024-02793-3)

License:

Creative Commons: Attribution (CC BY)

*Document Version*

Publisher's PDF, also known as Version of record

*Citation for published version (Harvard):*

Hughes, C, Devine, RT, White, N & Fink, E 2024, 'The Index of Parental Activities, Context and Experiences (I-PACE): Psychometric Properties of a New Brief Early Parenting Questionnaire', *Journal of Child and Family Studies*, vol. 33, no. 4, pp. 1280-1296. <https://doi.org/10.1007/s10826-024-02793-3>

[Link to publication on Research at Birmingham portal](#)

### General rights

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

### Take down policy

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact [UBIRA@lists.bham.ac.uk](mailto:UBIRA@lists.bham.ac.uk) providing details and we will remove access to the work immediately and investigate.



# The Index of Parental Activities, Context and Experiences (I-PACE): Psychometric Properties of a New Brief Early Parenting Questionnaire

Claire Hughes<sup>1</sup> · Rory T. Devine<sup>2</sup> · Naomi White<sup>1</sup> · Elian Fink<sup>3</sup>

Accepted: 14 January 2024 / Published online: 11 March 2024  
© The Author(s) 2024

## Abstract

Time pressures make brevity important for parent self-report measures, yet evidence highlights the multi-faceted nature of parenting and contextual influences. To straddle these competing goals, we developed a brief (23-item) yet broad Index of Parental Activities, Context, and Experiences (I-PACE) aimed at parents of toddlers and pre-schoolers. In two studies we assessed the validity and reliability of the I-PACE. Study 1 involved 870 caregivers (95% female, 75% with degrees, 90% White British) and examined I-PACE ratings alongside; (a) ratings of children's social-emotional skills and behavior problems; and (b) child age and parental depressive symptoms, to assess its sensitivity to contrasts in child development and parental experience. Study 2 included 191 families with 14-month-olds, for whom 188 mothers and 178 fathers completed the I-PACE and an index of life satisfaction. Supporting the replicability of findings from the I-PACE, both studies showed the same differentiated 5-factor structure (i.e., parental experiences, parenting activities, home environment quality, neighborhood environment quality and childcare environment quality). Supporting the I-PACE's validity, Study 1 showed that all 5 factors were independently related to both children's social-emotional skills and behavior problems, with predicted associations with child age and parental depressive symptoms. Supporting the I-PACE's inter-rater reliability, within-couple associations were significant for parenting activities, home environment, neighborhood quality and childcare quality. Together, these findings indicate that the I-PACE offers a broad yet brief index of early parenting with good psychometric properties and we discuss promising avenues for future research.

**Keywords** Parenting · Measurement · Assessment · Psychometrics · Environment

## Highlights

- The new Index of Parental Activities Context and Experiences (I-PACE) showed promising psychometric properties.
- The I-PACE measure captures the multi-faceted nature of parenting.
- I-PACE subscales were associated with both child social and emotional skills and behavioural problems.
- Mother and father reports on the I-PACE are equivalent.

The COVID-19 pandemic has both exposed and exacerbated major pre-existing inequalities in children's early environments

(e.g., Bischoff & Owens, 2019; Memmott et al., 2021). Strengthening the economic argument for investing in the early years (e.g., Heckman, 2011) low-cost interventions can boost parental support for young children's development and adjustment (e.g., McCoy et al., 2020; Dowdall et al., 2021; Scott et al., 2010). However, a major challenge for researchers and practitioners is the scarcity of reliable and valid tools for measuring children's early social environments. For example, in a systematic review of 164 parenting questionnaires (Hurley et al., 2014), only 25 had any evidence of psychometric validity, and comprehensive psychometric data were available for just 5 measures.

✉ Elian Fink  
e.fink@sussex.ac.uk

<sup>1</sup> Centre for Family Research, University of Cambridge, Cambridge, UK

<sup>2</sup> Centre for Developmental Science, School of Psychology, University of Birmingham, Birmingham, UK

<sup>3</sup> School of Psychology, University of Sussex, Falmer, UK

In part, psychometric weaknesses in existing parenting measures reflect definitional problems. That is, in the absence of any general unified theory (O'Connor, 2002), assessment measures focus on specific parental qualities (e.g., sensitivity, warmth), practices (e.g., safe-guarding, cognitive stimulation) or feelings (e.g., satisfaction, stress). This differentiated model of parenting helps identify the specific factors that promote distinct child skills. For example, children's abilities to regulate positive and negative emotions are, respectively, associated with maternal warmth and response to distress (Davidov & Grusec, 2006). In practice, however, different aspects of parenting are often closely entwined, such that broad assessment measures are also needed. Illustrating this point, parental stress has an 'in the moment' impact on parents' feeding behaviors (Berge et al., 2017), a developmental impact on parents' reading behaviors (Hill & Palacios, 2021) and bi-directional longitudinal associations with parental technology use and child behavior problems (e.g., McDaniel & Radesky, 2018).

Research on the impact of poverty on child development highlights the need for parenting measures that assess feelings as well as behaviors. Specifically, rather than simply documenting contrasts in the parenting practices of high- and low-income families, such as the 30-million-word gap first identified by Hart and Risley (1992), contemporary studies focus on parents' experiences of poverty-related stressors and highlight the resilience shown by many low-income families (e.g., Baker & Brooks-Gunn, 2020; Ho et al., 2022). Consistent with this paradigm shift, other studies document the importance of contextual factors such as household chaos, or positive/negative neighborhoods. For example, findings from a subsample of 3656 families in the Fragile Families and Child Wellbeing study demonstrate that, alongside effects of mothers' parenting quality and stress, neighborhood quality predicted independent variation in children's problem behaviours and cognitive development at ages 3 and 5 (Choi, Kelley, & Wang, 2018). Similar neighborhood effects on 3-year-old children's academic and socio-emotional profile have been reported in the Family Life Project, a longitudinal study of 1292 children living in rural poverty in North Carolina and Pennsylvania (Iruka et al., 2018). Indeed, in a review of three decades of parenting research, Taraban and Shaw (2018) concluded that contextual factors are of pivotal importance.

Together, the above findings demonstrate the need for early parenting measures to include parental feelings and contextual factors alongside parenting practices. However, brevity is also key to an instrument's practical utility. Thus, the over-arching aim of the current study was to establish the reliability and validity of a new brief but comprehensive measure of parenting, the Index of Parental Activities, Context and Experiences (I-PACE).

## Study 1

As noted earlier, contemporary models of parenting have shifted from a traditional focus on overall quality (e.g., authoritativeness) towards differentiated accounts in which multiple distinct aspects of parenting influence child outcomes (Grusec, 2017; Grusec & Davidov, 2010; Taraban & Shaw, 2018). As an example of the evidence base for this broad approach, decades of research findings demonstrate that the impact of parental depressive symptoms on young children's development involves multiple pathways including reduced responsiveness, sensitivity, warmth, stimulation, and safeguarding, coupled with increased intrusiveness and hostility (for recent reviews, see Goodman et al., 2020; Silva-Rodrigues et al., 2022). Recent parenting instruments therefore include multiple subscales. However, as outlined above, current views of parental influences also highlight the need to consider contextual effects (e.g., quality of the home or neighborhood; Taraban & Shaw, 2018). While researchers can usually apply a battery of measures to assess different aspects of children's social environments, practitioners would benefit from a single instrument that encompasses contextual effects as well as distinct facets of parenting.

The overall aim of Study 1 was to establish the reliability and validity of a 23-item parent-friendly questionnaire, the Index of Parental Activities, Context, and Experiences (I-PACE), that is developmentally appropriate across early childhood (10- to 48-months), and suitable for examining parental influences on early emotional and behavioral problems. More specifically, we aimed to examine whether, despite its relative brevity, this instrument could capture the multi-faceted nature of social influences on young children's development and adjustment. To this end, we examined the reliability of the I-PACE by applying confirmatory factor analysis to test the latent factor structure of parental responses. We examined the fairness of the I-PACE using differential item functioning (DIF) analyses to test if items were equivalent across different child characteristics (i.e., sex, age) and parent characteristics (i.e., ethnicity, education). DIF occurs if a measure is unduly influenced by characteristics other than the underlying construct of interest (i.e., parenting) (Brown, 2015). Establishing the fairness of a measure allows for meaningful group comparisons.

Study 1 also aimed to assess the validity of scores on the I-PACE. Specifically, we examined I-PACE scores as predictors of children's positive and negative behaviours, indexed via parental ratings on the Brief Infant Toddler Social Emotional Assessment (BITSEA; Brigg-Gowan et al., 2004). This reliable instrument yields two distinct subscales (i.e., problem behaviors and social-emotional competencies) that together provide both sensitivity and

specificity as a screen for children with socio-emotional difficulties. As such, the BITSEA is widely used in parenting studies as a child outcome measure (e.g., Dalgaard et al., 2022). Adopting the same approach, we hypothesised that meaningful associations (i.e., negative associations with problem behaviors and positive associations with social competence) with scores on the BITSEA would support the validity of I-PACE scores.

Finally, we examined construct validity by exploring whether the I-PACE was sensitive to (i) contrasts in parental responses related to child age and (ii) differences in parental depressive symptoms. We anticipated that, compared with parents of infants, parents of older toddlers and pre-schoolers would report higher frequencies of activities such as creative play and bedtime stories. Previous studies have reported age-related increases in parent-child conflict (e.g., Kurdek, 1996) and reductions in parent-child quality (Nomaguchi, 2012), as well a significant increase in parental reports of child-rearing difficulties after children's second birthdays (O'Brien, 1996). Based on these findings, we expected that, in addition to reduced parental satisfaction among parents with depressive symptoms, parents of toddlers and pre-schoolers would also report less positive parenting experiences than parents of infants.

## Method

### Participants

Participants were recruited from across the UK and Ireland through nurseries, shopping centers and participant databases. In total, the I-PACE and BITSEA were completed by 910 respondents, however 40 participants were excluded as they did not provide information about their child's age or reported having a child younger than 10 months or over 48 months of age. The final sample comprised 870 caregivers (94.9% female,  $M_{\text{age}} = 32.39$  years,  $SD = 4.77$ , range: 17–47 years), of whom 75% had completed a degree and 94% identified as White (i.e., the majority ethnic group). Participants completed the questionnaires focusing on a single child within the age range (i.e., 10–48 months), if parents had more than one child within this age range they were instructed to focus on the youngest child (53.1% boys,  $M_{\text{age}} = 22.20$  months,  $SD = 7.43$ , range: 10–48 months).

### Procedures

This study received ethical approval from the University of Cambridge Psychology Research Ethics Committee. All participants provided informed consent for their participation in the current study. In return for participation, a donation was made to a children's charity.

## Measures

### I-PACE

To generate items, we conducted focus groups in three locations across England involving a variety of stakeholders. Separate focus groups were conducted to gather insights from: (a) health visitors and nursery staff; (b) parents, and (c) volunteers from a home-visiting charity. These focus groups highlighted the importance of limiting questionnaire 'wordiness' to maximise accessibility to parents with low levels of literacy. In response, we designed items that invite respondents simply to choose a point between two opposing anchors (e.g., anxious-confident).

Using the information gathered from the focus groups we constructed a preliminary version of the I-PACE, focusing on children's home, neighbourhood and childcare environment, alongside parenting satisfaction, and activities. This version had 29 items; including 5 6-point items each across the parenting satisfaction, home, neighborhood and childcare scales, and 9 activity items (4 rated on a 4-point scale, and 5 more daily items rated on a 5-point scale). A free text box at the end of the questionnaire enabled parents to provide feedback on what they liked and did not like about the questionnaire. This preliminary version of the I-PACE was administered to 225 parents from the Cambridgeshire region via playgroups, stalls at libraries and shopping centres.

Based on feedback from these participants, as well as item-total correlations and internal consistency statistics, 4 items were dropped, one each across the home, neighbourhood, childcare and parenting satisfaction subscales. In addition, the remaining parenting satisfaction items were reframed as parenting experiences to ensure the scale was framed neutrally, and two items (swimming and painting/cooking) were dropped from the activities subscales as they were very rarely endorsed. Finally, for simplicity, all activities items were rated on the same 5-point scale.

The remaining 23-item I-PACE comprised 16 items used a 6-point scale between two opposing anchors to capture variation in four domains: *parenting experience* (Anxious – Confident; Unhappy-Happy; Stressed-Relaxed; Inconsistent-Consistent), *quality of the home environment* (Cold-Warm; Damp-Dry; Crowded-Spacious; Chaotic-Ordered), *quality of the neighborhood environment* (Unfriendly-Friendly; Unsafe-Safe; Dirty-Clean; Dull-Lively), and *quality of childcare* (Inexperienced-Experienced; Poorly Equipped-Well Equipped; Boring-Fun; Poorly Supervised-Well Supervised). A further 7 items enabled respondents to rate the frequency with which their child engages in specific *parent-child activities* with them or another adult (Bedtime

**Table 1** Study 1. I-PACE Descriptive Statistics

	N	$\alpha$	M	SD	Range	DIF child Sex	DIF Child age	DIF Ethnicity	DIF Education
<b>Experiences</b>									
1. Anxious – Confident	867		4.67	1.07	1–6	–0.27	0.07	0.50	–0.32
2. Unhappy - Happy	868		5.17	0.86	1–6	0.37*	0.35*	–0.66	0.28
3. Stressed - Relaxed	866		4.15	1.13	1–6	–0.37*	–0.08	–0.33	0.44*
4. Inconsistent - Consistent	863		4.80	0.86	1–6	0.32*	–0.27	0.32	–0.31
Total		0.75	18.79	2.98	6–24				
<b>Activities</b>									
1. Bedtime story	864		3.29	1.21	0–4	0.11	<b>–0.71**</b>	–0.42	–0.03
2. Set bedtime routine (e.g., lullaby)	868		3.79	0.68	0–4	0.56*	<b>0.78**</b>	<b>1.20**</b>	–0.08
3. Reading (not at bedtime)	869		3.41	0.79	0–4	–0.09	0.34*	0.35	–0.07
4. Singing (e.g., nursery rhymes)	868		3.53	0.71	0–4	–0.20	0.39*	–0.18	0.01
5. Going to the park	867		2.22	0.83	0–4	0.14	0.17	–0.32	0.16
6. Playgroup/play date	866		2.2	0.96	0–4	–0.08	0.50*	0.11	0.15
7. Creative play (e.g., finger painting)	867		2.23	1.04	0–4	–0.16	<b>–0.74**</b>	–0.17	–0.19
Total		0.60	13.60	2.64	1–20				
<b>Home</b>									
1. Cold – Warm	868		5.45	0.86	1–6	–0.02	–0.03	0.49	0.54**
2. Damp – Dry	867		5.50	0.95	1–6	0.08	–0.51*	–0.02	<b>0.68**</b>
3. Crowded – Spacious	867		4.88	1.16	1–6	–0.37*	0.04	–0.32	–0.57**
4. Chaotic – Ordered	863		4.58	1.09	1–6	0.35*	0.29	0.03	–0.13
Total		0.71	20.40	2.97	4–24				
<b>Neighborhood</b>									
1. Unsafe – Safe	868		5.38	0.81	1–6	–0.07	0.18	0.03	–0.09
2. Unfriendly – Friendly	868		5.35	0.85	1–6	–0.28	–0.07	<b>0.92**</b>	0.15
3. Dirty – Clean	867		5.26	0.91	1–6	0.09	0.07	0.16	0.49*
4. Dull – Lively	867		4.48	1.12	1–6	0.11	–0.11	<b>–0.65*</b>	–0.32
Total		0.77	20.47	2.88	4–24				
<b>Childcare</b>									
1. Inexperienced – Experienced	590		5.68	0.66	1–6	0.52	–0.22	0.85	–0.04
2. Poorly equipped – Well equipped	589		5.59	0.69	1–6	–0.05	0.16	–0.61	–0.18
3. Boring – Fun	589		5.65	0.64	1–6	0.12	–0.21	–1.74	<b>0.95*</b>
4. Poorly supervised – Well supervised	589		5.67	0.65	1–6	–0.49	0.19	1.17	–0.60
Total		0.91	22.58	2.33	4–24				

\* $p < 0.05$ , \*\* $p < 0.01$

Bold DIF values signify both a significant L-A-Lor value and one of large magnitude

routine, Bedtime Story, Reading (not at bedtime); Going to the park; Play group/date; Creative play). These items were rated on a 5-point scale ranging from ‘less than once a

month’ to ‘every day’. In all cases, higher scores indicated more positive evaluations / more frequent engagement in parent-child activities (see Table 1 for all items).



To ensure I-PACE items were written in accessible language based on the feedback from pilot participants, a readability analysis was conducted that considers sentence length, and number and length of words. The Flesch–Kincaid index is a frequently used index of readability and provides the approximate year level in which the average pupil would have a good understanding of the text in question. The items of the I-PACE reported a Flesch–Kincaid index of 6.7, suggesting that the reading skills needed to have a good understanding of the meaning of all the I-PACE items would be achieved by the end of primary school (approximately 12 years of age).

Table 1 presents missing data information at the item level for the I-PACE. Apart from the childcare subscale, which parents did not complete if their child was not currently in childcare (32%), each item was answered by an average of 99.62% of respondents.

### Parental depressive symptoms

The Patient Health Questionnaire-2 (PHQ-2; Kroenke et al., 2003) items were used to assess depressive symptoms. To reduce the language burden we limited the response scale for these items to “yes”, “no” for whether participants had been bothered by symptoms (i.e., “feeling down, depressed or hopeless”, and “feeling nervous, anxious or on edge”) during the past month. As these items were highly correlated,  $r(858) = 0.59$ ,  $p < 0.001$  and internally consistent, Cronbach’s  $\alpha = 0.741$ , they were summed to create a total depressive symptom score from 0 to 2,  $M = 0.55$ ,  $SD = 0.79$ .

### Child positive and negative behaviors

Parents completed the Brief Infant-Toddler Social and Emotional Assessment (BITSEA; Briggs-Gowan et al., 2004) as a measure of children’s behavior problems and competence. All items were rated on a 3-point Likert scale, 0 = not true/rarely, 1 = somewhat true/sometimes, 2 = very true/often. The BITSEA items assessing externalising (e.g., *destructive, breaks things*), internalising (e.g., *worries, is serious*) and emotion dysregulation (*cries, tantrums till exhausted*) were used as an index of problem behavior, Cronbach  $\alpha = 0.72$ . The competence scale was made up of 11 items (e.g., *affectionate with loved ones, plays well*), Cronbach  $\alpha = 0.65$ . Although originally designed for children between 12 and 36 months of age, the BITSEA has been used and validated for children up to 48 months (e.g., Briggs-Gowan et al., 2013). Given the broad age range of child in the current study we use child age adjusted BITSEA scores in all analyses.

### Analytic Strategy

Using *Mplus* (Muthén & Muthén, 2019) we first examined the factor structure of the I-PACE with Confirmatory Factor Analysis (CFA). A model was specified such that subscale items each loaded onto their respective latent factors, which were allowed to correlate. The Robust Maximum Likelihood (MLR) estimator was used as it can handle normal and non-normally distributed data, and can handle missing data in the model (Yuan et al., 2012).

Model fit was assessed using the following well-established criteria: Root Mean Square Error of Approximation (RMSEA)  $\leq 0.05$ , Comparative Fit Index (CFI)  $\geq 0.90$  and Tucker Lewis Index (TLI)  $\geq 0.90$  (Brown, 2015). Given the large sample size, Chi-square was not used to as a measure of model fit (Tanaka, 1987).

We applied differential item functioning (DIF) analyses to test if I-PACE items were equivalent across different child characteristics (i.e., sex, age) and parent characteristics (i.e., majority/minority ethnicity, degree/no degree). In a DIF analysis, differences in the probability of endorsing an individual item given an overall score on the specific subscale are compared across a target (e.g., boys) and reference (e.g., girls) group. Items are considered to behave differently across groups if individuals from each group with the same subscale score differ significantly in the probability of endorsing an individual item. The statistical approach taken to examine DIF was the Liu-Agresti Common logs ratio (L-A-LOR; Liu & Agresti, 1996) estimated using DIFAS 5.0 software (Penfield, 2005). Positive values indicate that the item is more difficult for the target group to endorse, while negative values indicate that the item is easier to endorse for the target group given the same overall level of the underlying construct as the reference group. To evaluate the magnitude of DIF, significant values were first noted and then interpreted according to the criteria set out in Penfield (2007); negligible: L-A-LOR  $< 0.43$ ; moderate: L-A-LOR between 0.43 and 0.64; large: L-A-LOR:  $> 0.64$ . Finally, we examined associations between subscales of the I-PACE and age-adjusted BITSEA problem behaviors and BITSEA competence scores within a structural equation modelling (SEM) analysis.

### Results

Table 1 reports descriptive statistics at the item and subscale level of the I-PACE. For all items of the I-PACE the full range of the scale was used by parents across the 5 subscales. Means across the different subscale suggest that most parents have a positive experience of parenting, and positive home and neighborhood environments, and think highly of their child’s childcare setting. Almost all parents

reported that their child had a set bedtime routine every day (88%), and over half of all parents sang (64%) and read to their child during the day (56%) and at bedtime (66%) every day.

### Factor Structure Of The I-PACE

Table 2 presents bivariate correlations between all 23 I-PACE items. Three different measurement models were constructed to examine the best fit for the indicators of the I-PACE. First, all 23 items were permitted to load on a single latent factor. Second, a three-factor solution was constructed such that parenting experiences items loaded onto one latent factor, parenting activities loaded onto a second latent factor, and descriptions of home, neighborhood and childcare quality loaded onto a third parenting context factor. Finally, a five-factor solution was constructed such that the parenting experiences, activities, home, neighborhood, and childcare quality items each loaded onto separate latent factors. In all three models, items were not permitted to load on multiple factors and no correlated errors were included. Table 3 presents the fit indices derived from the three confirmatory factor analyses models.

The five-factor model exhibited the best fit to the data, with Fig. 1 presenting the completely standardised parameter estimates from this solution. There was significant variance in all five latent factors,  $p < 0.001$ , and each latent variable explained a significant amount of variance in their respective indicators, with the exception of ‘set bedtime routine’ ( $p = 0.058$ ) from the Activities subscale: Experiences:  $R^2$  mean = 0.44, range = 0.27–0.56,  $p < 0.001$ ; Activities:  $R^2$  mean = 0.18, range = 0.07–0.31,  $p < 0.058$ ; Home:  $R^2$  mean = 0.40, range = 0.28–0.54,  $p < 0.001$ ; Neighborhood:  $R^2$  mean = 0.54, range = 0.16–0.68,  $p < 0.001$ , and Childcare quality:  $R^2$  mean = 0.71, range = 0.67–0.75,  $p < 0.001$ . The latent factors were significantly correlated.

### Differential Item Functioning

We used differential item functioning (DIF) to examine whether items of each I-PACE subscale were equivalent across child sex and age and parental ethnicity and education level. An age median split (22 months) was conducted to create younger ( $n = 412$ ,  $M_{\text{age}} = 15.62$  months,  $SD = 3.14$ ) and older ( $n = 458$ ,  $M_{\text{age}} = 28.11$  months,  $SD = 4.71$ ) child groups. Of the significant DIF values, only those considered large are interpreted (Penfield, 2007). Across child characteristics, no item differed as a function of child sex, while only those in the Activities subscales differed as a function of child age. Specifically, compared with parents of younger children, parents of older children were less likely to endorse having a set bedtime routine, but more

likely to report that they read their child a bedtime story and engaged in creative play with their child. When examining DIF as a function of parent majority compared to minority ethnic group, parents in the ethnic majority group were more likely than ethnic minority parents to report having a set bedtime routine, a friendly neighborhood, and less likely to describe their neighborhood as lively. However, these findings should be cautiously interpreted as the ethnic minority group was relatively small (only 6% of the total sample). Finally, two items showed DIF with respect to parental education level (higher tertiary degree vs. no degree): compared with parents without a degree, parents with a degree were more likely to describe their home spacious and their childcare provider as ‘fun’.

### I-PACE Sensitivity To Contrasts In Child Age And Parental Depression

Validity was also assessed by comparing the latent factors as a function of child age and parental depressive symptoms. In two separate models each I-PACE latent factor was regressed onto child age or parental depression. As predicted, for child age, parents reported more frequent engagement in activities (standardised estimate = 0.21,  $p < 0.001$ ) but less positive parenting experiences (standardised estimate =  $-0.13$ ,  $p = 0.001$ ) with increasing child age. Parents with more depressive symptoms reported less positive parenting experiences (standardised estimate =  $-0.11$ ,  $p = 0.023$ ).

### Associations Between I-PACE Factors And Children’s Problem Behaviors And Competence

We specified a model in which age-adjusted BITSEA problem behaviors and competence scores were each permitted to be correlated with the five-factors of the I-PACE. The model fit the data well, RMSEA = 0.04, CFI = 0.915, TLI = 0.90. Accounting for the significant negative association between the BITSEA competence and problem behavior subscales (standardised coefficient =  $-0.23$ ,  $p < 0.001$ ), all five subscales of the I-PACE were significantly positively associated with the BITSEA competence subscale, and negatively associated with the BITSEA problem behavior subscale. Figure 2 presents standardised coefficients for these associations.

We ran two sets of sensitivity analyses. First, given the small proportion of extreme scores on the BITSEA (greater than 3SDS above/below the mean, 12 children for the problems behavior subscale (1.4%) and 7 children for the competence subscale (0.8%)) we removed these outliers to examine if they impacted the model. Associations between the BITSEA and I-PACE subscales remained unchanged. Second, as the BITSEA was designed for children 12

**Table 2** Study 1. Bivariate Correlations Across I-PACE Items

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
Experiences																									
1 Anxious-Confident	–																								
2 Unhappy-Happy	0.47**	–																							
3 Stressed-Relaxed	0.54**	0.50**	–																						
4 Inconsistent-Consistent	0.33**	0.34**	0.38**	–																					
5 Bedtime story	0.09**	0.01	0.05	0.16**	–																				
6 Set bedtime routine	0.01	–0.03	0.04	0.05	0.13**	–																			
7 Reading	0.04	–0.04	–0.00	0.08*	0.30**	0.18**	–																		
8 Singing	0.06	0.08*	0.03	0.09**	0.10**	0.38**	0.11**	–																	
9 Going to the park	0.08*	0.05	0.09*	0.05	0.06	0.22**	0.12**	0.13**	–																
10 Playgroup/play date	0.05	0.06	0.04	0.04	0.11**	0.09*	0.16**	0.11**	0.21**	–															
11 Creative play	0.11**	0.07*	0.09**	0.09**	0.06	0.27**	0.20**	0.20**	0.24**	0.26**	–														
Home																									
12 Cold-Warm	0.15**	0.18**	0.17**	0.25**	0.12**	0.04	0.03	0.04	0.01	0.03	0.03	–													
13 Damp-Dry	0.10**	0.11**	0.11**	0.17**	0.06	0.04	0.04	–0.01	0.02	–0.01	0.00	0.60**	–												
14 Crowded-Spacious	0.16**	0.17**	0.18**	0.18**	0.08*	0.05	0.05	0.03	0.11**	0.01	0.02	0.29**	0.35**	–											
15 Chaotic-Ordered	0.20**	0.21**	0.25**	0.29**	0.14**	0.05	0.04	0.05	0.08*	–0.04	0.04	0.37**	0.31**	0.39**	–										
Neighborhood																									
16 Unsafe-Safe	0.18**	0.18**	0.16**	0.21**	0.07*	0.05	0.07*	0.08*	0.07*	0.03	0.01	0.29**	0.32**	0.39**	0.26**	–									
17 Unfriendly-Friendly	0.18**	0.18**	0.19**	0.19**	0.11**	0.08*	0.11**	0.04	0.06	0.06	0.04	0.28**	0.29**	0.34**	0.26**	0.66**	–								
18 Dirty-Clean	0.16**	0.21**	0.17**	0.23**	0.08*	0.07*	0.07*	0.04	0.04	0.06	–0.01	0.31**	0.31**	0.36**	0.31**	0.69**	0.64**	–							
19 Dull-Lively	0.16**	0.16**	0.16**	0.15**	0.07	0.09*	0.10**	0.09*	0.13**	0.05	0.10**	0.20**	0.18**	0.17**	0.23**	0.26**	0.41**	0.29**	–						
Childcare quality																									
20 Inexperienced-Experienced	0.08	0.17**	0.10**	0.16**	0.03	0.07	0.09*	–0.01	–0.00	0.04	0.08	0.17**	0.14**	0.17**	0.13**	0.24**	0.26**	0.21**	0.15**	–					
21 Poorly-Well equipped	0.13**	0.22**	0.12**	0.20**	0.01	0.04	0.05	0.04	–0.05	0.04	0.09*	0.12**	0.11**	0.17**	0.18**	0.19**	0.22**	0.22**	0.21**	0.70**	–				
22 Boring-Fun	0.10	0.21**	0.13**	0.20**	–0.01	0.05	0.07	0.01	–0.01	0.08	0.14**	0.12**	0.13**	0.16**	0.18**	0.21**	0.26**	0.23**	0.19**	0.71**	0.73**	–			
23 Poorly-Well supervised	0.13**	0.23**	0.14**	0.25**	0.03	0.07	0.06	0.04	–0.03	0.03	0.09*	0.15**	0.14**	0.17**	0.17**	0.27**	0.31**	0.24**	0.15**	0.75**	0.63**	0.71**	–		

\* $p < 0.05$ , \*\* $p < 0.01$



months and older, we removed the 21 participants (2.5%) below 12 months of age and re-ran the analysis examining the association between the I-PACE and BITSEA age-adjusted competence and problem behaviors subscales, again results remained unchanged.

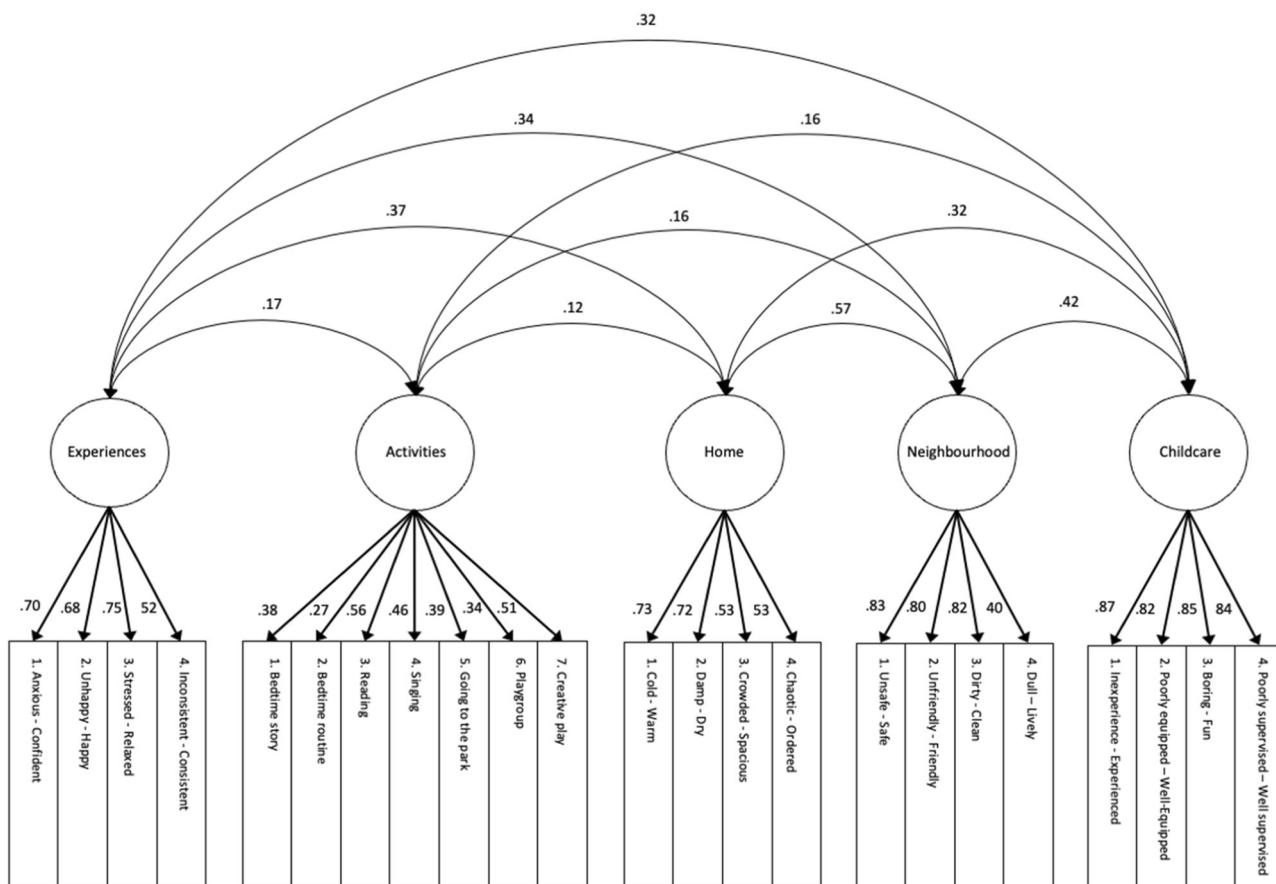
To ensure that this pattern of associations remained after controlling for demographic features of the children and parents, the BITSEA competence and problems behaviours subscales and all I-PACE latent factors were regressed on child gender, child age, parent ethnicity, parent education. These models demonstrated an identical pattern of associations between the BITSEA subscales and I-PACE factors.

### Discussion

The findings from Study 1 were encouraging in three respects. First, our CFA results indicated that, despite its brevity, the I-PACE provides a broad-based assessment with five distinct subscales: one frequency subscale (parent-child activities) and four global subscales (parenting experiences; and quality of the home, neighborhood, and childcare environments). Second, supporting contemporary differentiated and contextually sensitive models of parenting (Davidov & Grusec, 2006; Taraban & Shaw, 2018), each of these latent factors showed independent positive associations with BITSEA ratings of child competence, as well as negative associations with BITSEA ratings of child problem behaviors. Third, again despite its overall brevity, the I-PACE also appeared sensitive to expected developmental shifts in parental experiences (i.e., less positive for parents of toddlers/pre-schoolers than infants) and parent-child activities. Specifically, compared with parents of infants, parents of toddlers/pre-schoolers were less likely to report having a clear bed-time routine, but more likely to engage in bed-time stories and creative play with their child.

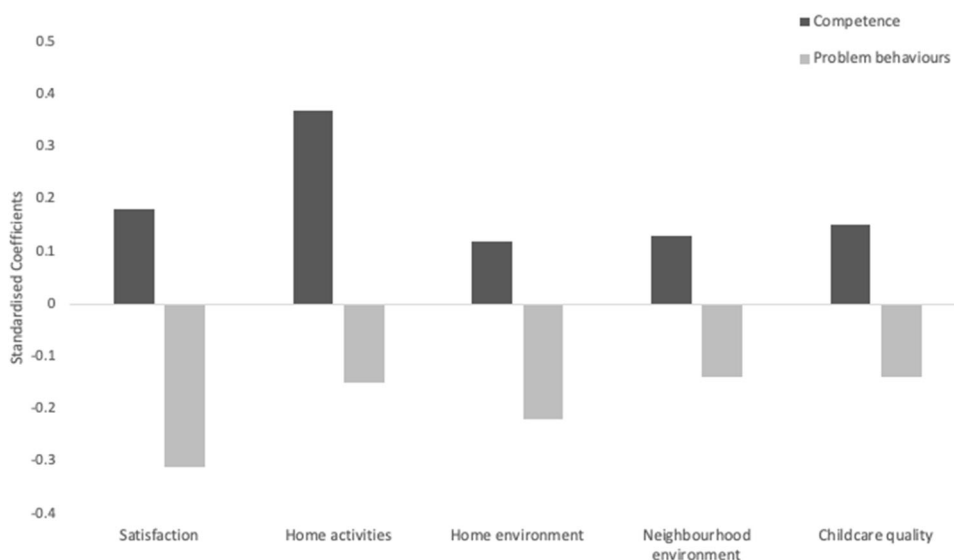
**Table 3** Study 1. Measurement Models For I-PACE Subscales

Model	RMSEA [90% CI]	CFI	TLI
One latent factor (Model 1)	0.10 [0.10–0.11]	0.50	0.44
Three latent factors (Model 2)	0.08 [0.08–0.09]	0.68	0.63
Five latent factors (Model 3)	0.04 [0.04–0.05]	0.92	0.91



**Fig. 1** Study 1. Factor Structure Of The I-PACE With Standardised Coefficients

**Fig. 2** Study 1. Standardised Coefficients For The Association Between I-PACE Subscales And Age-Adjusted BITSEA Scores. Note. All associations  $p < 0.01$



Two study limitations deserve note. First, the DIF analysis suggest that some items may elicit different responses from ethnic majority/minority parents. Our study sample was ethnically homogenous (only 6% of participants reported belonging to a minority ethnic group), and so further research on the I-PACE with a more diverse sample is clearly needed. Second, the very large majority of respondents were mothers, such that we could not compare maternal and paternal responses to the I-PACE or assess agreement between parents. Study 2 addresses this second limitation by examining the factor structure of the I-PACE within a study involving both mothers and fathers of infants at 14 months, allowing us to both to test the replicability of our CFA findings, inter-parent agreement, and address associations between the I-PACE subscales and measures of household deprivation and parent-report life satisfaction.

## Study 2

In Study 2 we aimed to extend the findings of Study 1 by assessing the factor structure of the I-PACE in a separate sample with both mother and father informants. As outlined above, Study 1 involved 870 families with children aged between 10 and 48 months, who were recruited via shopping centres and toddler groups across the UK. In contrast, the 366 participants for Study 2 completed the I-PACE questionnaires at the 14-month wave of a longitudinal study (AUTHOR) that began with prenatal visits to expectant first-time parents living in East Anglia (UK). In terms of geographical address, birth parity and age of child, this sample was more homogeneous than the Study 1 sample.

Two features of this sample enabled us to extend the findings from Study 1 to further examine the reliability and the validity of the I-PACE. First, Study 2 enabled us to test

the replicability of the factor structure in an independent sample. Second by gathering ratings from two parents for the same child Study 2 allowed us to assess both the inter-rater reliability of the I-PACE as well as the equivalence of the measure across mothers and fathers (i.e., measurement invariance).

Third, as additional tests of validity we included measures of; (i) socio-economic status to examine the specificity in associations between I-PACE subscales and family income and neighbourhood deprivation, (ii) parent-report measures of life satisfaction, enabling us to examine whether I-PACE subscales predict general life satisfaction. We expected that the home, neighbourhood and childcare subscales would be most sensitive to variation in family income and neighbourhood deprivation, whereas parenting experiences would be sensitive to differences in general life satisfaction.

## Method

### Participants

Participants comprised families living in the United Kingdom from the 14-month wave of the New Fathers and Mothers study (NewFAMS, see Hughes et al., 2018). To be included in the study all families had to be first time parents of a typically developing toddler, with no history of serious mental health problems and to speak English as a primary language with their child. At this wave of the NewFAMS study 191 families took part and I-PACE data were available for 188 mothers and 178 fathers. Mean mother age at target child's birth was 32.59 years ( $SD = 3.61$  years), and mean father age at target child's birth was 33.98 years ( $SD = 4.37$  years). Children (55.4% male) were on average

**Table 4** Study 2: Descriptive Statistics At The Subscale Level For I-PACE Across Mothers And Fathers

	Mother					Father					<i>r</i> <sup>a</sup>
	<i>N</i>	$\alpha$	<i>M</i>	<i>SD</i>	Range	<i>N</i>	$\alpha$	<i>M</i>	<i>SD</i>	Range	
Experiences	188	0.70	19.24	2.61	11–24	178	0.81	19.01	2.87	9–24	0.03
Activities	188	0.47	18.73	2.56	11–25	178	0.59	18.61	2.63	9–25	0.22
Home	188	0.72	20.38	2.98	7–24	178	0.70	19.67	2.74	10–24	0.10
Neighborhood	188	0.75	21.13	2.36	13–24	178	0.69	20.35	2.40	1–24	0.37
Childcare	146	0.83	22.78	2.04	16–24	133	0.87	22.28	2.17	15–24	0.20

<sup>a</sup>Based on extracted factor scores

14.42 months at the time of questionnaire completion (*SD* = 0.59 months, range: 13.10–18.40 months). Average household monthly income was £4075.43 (*SD* = £1577.82, range: £1000–£11000), with all but one household earning between 3 standard deviations from the mean income score. For reference, the average monthly income in the United Kingdom at the time of data collection for the study was £2275 (ONS, 2018).

## Procedures

The National Health Service (NHS UK) Research Ethics Committee (London Bloomsbury) approved the study protocol. Mothers and fathers provided informed consent for their participation in this study prior to completing the questionnaires. As a token of appreciation for participation in the NewFAMS study, mothers and fathers were paid a nominal amount (£10) and children received a small gift.

## Measures

### I-PACE

The I-PACE comprised the same items in the same order as reported for Study 1. Mothers and fathers completed the I-PACE separately. In total, 188 mothers and 178 fathers completed the I-PACE, with no missing data at the item level, except for the childcare questions, which parents were instructed not to complete if their child was not in childcare (22% of mothers, and 25% for fathers).

### Life satisfaction

Life satisfaction was assessed with the short (5-item) Satisfaction with Life Scale (Diener et al., 1985). Items (e.g., “The conditions of my life are excellent” and “In most ways my life is close to my ideal”) are rated on a 7-point scale from “strongly agree” to “strongly disagree”. Internal consistency for the Satisfaction with Life Scale was good for both mothers, Cronbach  $\alpha$  = 0.83, and fathers, Cronbach  $\alpha$  = 0.87. There was no significant association between mother and father life satisfaction,  $r(174)$  = 0.09,  $p$  = 0.244.

Scores were reversed so that higher scores implied more positive life satisfaction.

### Socio-economic status

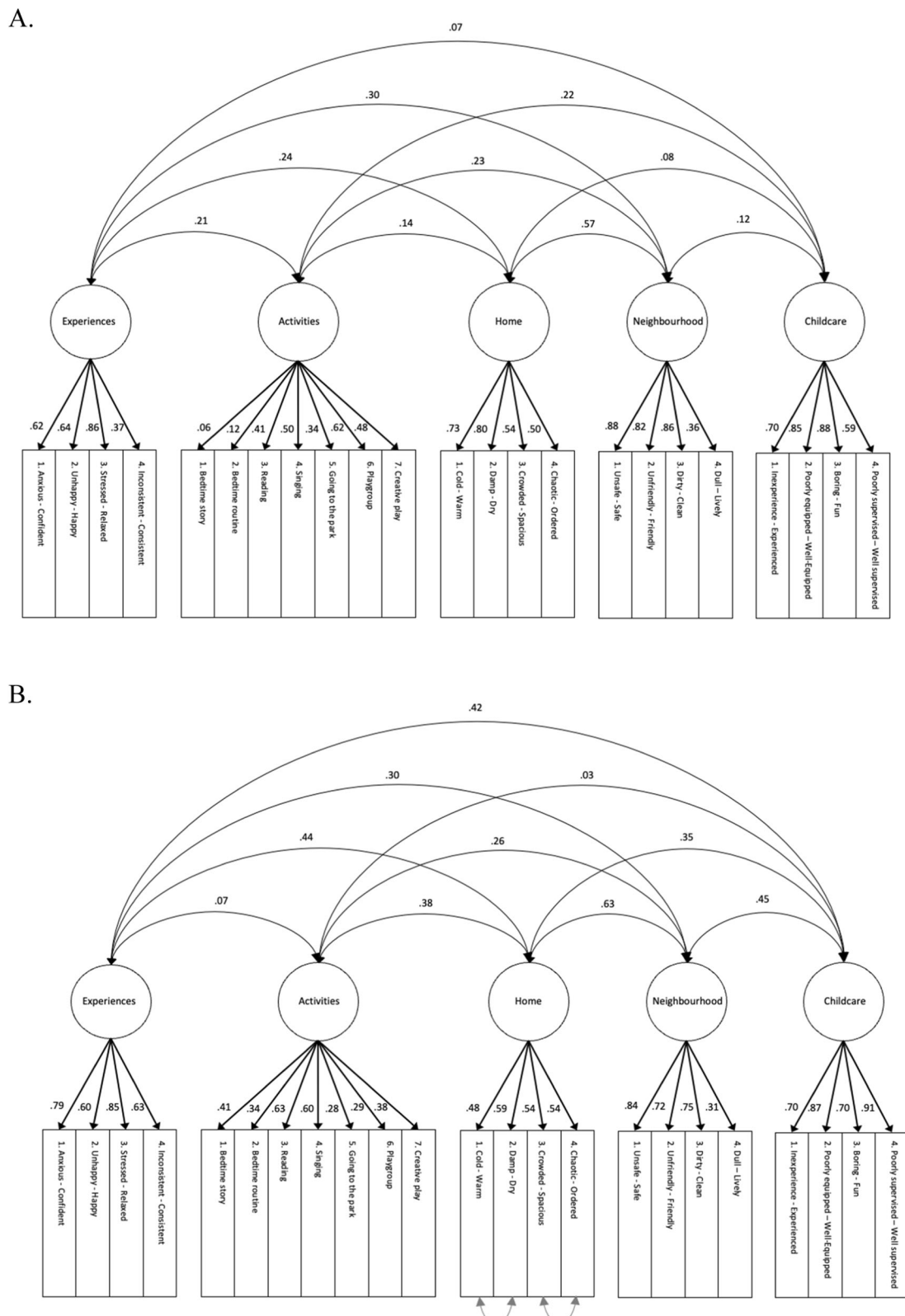
Three measures of socio-economic status were employed. First, household monthly income was based on the average of mother and father report. Second, the Index of Mean Deprivation (IMD) decile score was used. IMD is a measure of relative deprivation of neighborhoods in England and is derived by categorising the 32,844 neighborhoods into deciles, from the most deprived 10% of neighborhoods to the least deprived 10% of neighborhoods nationally across England. Third, a specific IMD index that focuses on deprivation impacting children was used (Income Deprivation Affecting Children Index; IDACI) which specifically assess the proportion of all children between 0 and 15 years living in income deprived families. As expected there was a significant positive association between household income and both IMD scores,  $r(188)$  = 0.18,  $p$  = 0.014, and IDACI,  $r(188)$  = 0.33,  $p$  < 0.001.

## Results

Table 4 reports descriptive statistics for the five subscales of the I-PACE for mothers and fathers, including mean subscale scores for mothers and fathers across. Internal consistency was good for all subscales, except for the Activities subscale.

### I-PACE Factor Structure For Mothers And Fathers

To examine whether the I-PACE factor structure was comparable to that of the five latent factor model in Study 1, a CFA for mothers and fathers was constructed, such that the four items of the parenting experiences, home, neighborhood and childcare quality subscales, and seven items of the activities each loaded onto separate latent factor (see Fig. 3). For mothers, fit statistics demonstrated a well-fitting model; RMSEA = 0.04, CFI = 0.94, and TLI = 0.94. There was significant variance in all latent factors,  $p$  < 0.017,



**Fig. 3** Study 2. Factor Structure Of The I-PACE With Standardised Coefficients For Mothers (A) And Fathers (B)

except for the Activities factor,  $p = 0.787$ . Each latent variable explained a significant amount of variance in their respective indicators, with the exception of items from the Activities subscale ('bed-time story', 'set bedtime routine', 'going to the park' and 'creative play'), Experiences:  $R^2$  mean = 0.42, range = 0.13–0.73,  $p < 0.033$ ; Activities:  $R^2$  mean = 0.17, range = 0.00–0.38,  $p < 0.786$ ; Home:  $R^2$  mean = 0.43, range = 0.25–0.46,  $p < 0.008$ ; Neighborhood:  $R^2$  mean = 0.58, range = 0.13–0.77,  $p < 0.010$ ; and Child-care quality:  $R^2$  mean = 0.59, range = 0.34–0.78,  $p < 0.001$ .

For fathers, the model fit the data well; RMSEA = 0.04, CFI = 0.93, and TLI = 0.92, after allowing the error terms for the 'warm' and 'dry' and the 'spacious' and 'ordered' home items to correlate. There was significant variance in all latent factors,  $p < 0.048$ . Each latent variable explained a significant amount of variance in their respective indicators, with the exception of four items from the Activities subscale 'set bedtime routine' and 'going to the park', 'play date' and 'creative play'): Experience:  $R^2$  mean = 0.53, range = 0.40–0.73,  $p < 0.001$ ; Home:  $R^2$  mean = 0.29, range = 0.23–0.35,  $p < 0.003$ , Activities:  $R^2$  mean = 0.19, range = 0.08–0.40,  $p < 0.265$ , Neighbourhood:  $R^2$  mean = 0.47, range = 0.10–0.71,  $p < 0.036$ , and Childcare quality:  $R^2$  mean = 0.65, range = 0.49–0.83,  $p < 0.001$ .

The association across mother and father latent factors for each subscale was examined separately, and each showed significant correlation (Activities: 0.56,  $p = 0.009$ , Home: 0.69,  $p < 0.001$ ; Neighbourhood: 0.48,  $p < 0.001$ ; Childcare: 0.37,  $p < 0.001$ ), with the notable exception of parenting experiences (0.17,  $p = 0.066$ ). Factors scores from the full 5-factor CFA were saved for mothers and fathers. Paired-samples t-tests comparing the mean factor scores showed no significant difference between mothers' and fathers' scores on any I-PACE subscale (see Table 4).

### Measurement Invariance Across Mothers And Fathers

We tested for measurement invariances to examine if the I-PACE items measured the same latent construct in both mothers and fathers. To establish measurement invariance, the multi-group CFA model was subjected to a series of parameter constraints to test for the equivalence of the measurement properties across informant. Measurement invariance at each step can be demonstrated if these additional constraints do not result in a decrease of model fit. For measurement invariance across mothers and fathers, three steps are necessary: (i) *configural invariance* signifying an equivalent factor structure, (ii) *metric invariance* signifying equivalent factor loadings, and (iii) *scalar invariance* signifying equivalent intercepts (Brown, 2015). To test if a constrained model reduces

model fit a series of nested chi-square tests were conducted. Table 5 shows the results from the measurement invariance analyses. Overall findings suggested that partial measurement invariance was achieved across all subscales, with some equality constraints needing to be released for each of the five subscales of the I-PACE. Measurement invariance findings for each subscale in turn are described below.

Configural invariance was achieved for the Experiences subscale suggesting that the factor structure of this subscale is equivalent for mothers and fathers. Full metric invariance resulted in a significant degradation of model fit, however releasing item 4 (Inconsistent – Consistent) resulted in a non-significant change in  $\chi^2$  and good model fit, suggesting that the remaining three items loaded equivalently on the latent factor across mothers and fathers. Scalar invariance was achieved for this subscale, highlight that the remaining 3 items have equivalent intercepts across the groups (see Table 5).

Configural invariance was achieved for the Activities subscale. Constraining item loadings to equality to test for metric invariance resulted in a significant degradation of model fit, however releasing items 6 and 7 ('play group' and 'creative play') resulted in a non-significant change in  $\chi^2$  and good model fit, suggesting that the remaining five items loaded equivalently on the latent factor across mothers and fathers. Finally, scalar invariance was only achieved with the additional constraint on item 3 ('reading') released suggesting partial invariance for this subscale (see Table 5).

Configural and metric invariance was achieved for the Home subscale, suggesting that the factor structure and factor loading for mothers and fathers was equivalent. Full scalar invariance resulted in a significant degradation of model fit, however, releasing the equality constraint for items 3 and 4 ('crowded – spacious' and 'chaotic – ordered') resulted in non-significant change in  $\chi^2$  and good model fit suggesting partial invariance for this subscale (see Table 5).

Configural and metric invariance was achieved for the Neighbourhood subscale, suggesting that the factor structure and factor loading for mothers and fathers was equivalent. Full scalar invariance resulted in a significant degradation of model fit, however, releasing the equality constraint for items 3 and 4 ('dirty – clean' and 'dull – lively') resulted in non-significant change in  $\chi^2$  and good model fit suggesting partial invariance for this subscale (see Table 5).

Finally, configural invariance was achieved for the Childcare subscale suggesting that the factor structure is equivalent for mothers and fathers. Full metric invariance was not achieved, however, releasing the equality constraint for item 4 ('poorly supervised – well supervised') resulted

**Table 5** Study 2: Measurement Invariance Models For I-PACE Subscales Across Mothers And Fathers

	$\chi^2$	df	$\chi^2_{diff}$	$\Delta df$	RMSEA (90% CI)	CFI	TLI	SRMR
Experiences								
Configural	9.06	15	–	–	0.00 [0.00–0.04]	1.00	1.00	0.03
Metric	19.88	18	10.82*	3	0.02 [0.00–0.07]	0.99	0.99	0.10
Partial Metric (releasing 4)	11.24	17	2.18	2	0.00 [0.00–0.04]	1.00	1.00	0.04
Scalar	13.25	20	2.00	3	0.00 [0.00–0.03]	1.00	1.00	0.05
Activities								
Configural	81.67	69	–	–	0.03 [0.00–0.06]	0.96	0.95	0.07
Metric	100.89	75	19.22*	6	0.04 [0.02–0.06]	0.92	0.91	0.08
Partial Metric (releasing 6 & 7)	84.51	73	2.84	4	0.03 [0.00–0.05]	0.97	0.96	0.07
Partial Scalar (releasing 6 & 7)	101.56	78	17.05*	5	0.04 [0.01–0.06]	0.93	0.92	0.08
Partial Scalar (releasing 3, 6 & 7)	91.89	77	7.38	5	0.03 [0.00–0.05]	0.96	0.95	0.07
Home								
Configural	12.90	12	–	–	0.02 [0.00–0.08]	1.00	1.00	0.04
Metric	16.04	15	3.17	3	0.02 [0.00–0.07]	1.00	1.00	0.06
Scalar	29.41	19	13.37*	4	0.05 [0.00–0.09]	0.98	0.97	0.08
Partial Scalar	21.04	17	5.00	2	0.04 [0.00 – 0.08]	0.99	0.99	0.08
Neighborhood								
Configural	28.45	15	–	–	0.07 [0.03–0.11]	0.97	0.93	0.05
Metric	32.23	18	3.79	3	0.06 [0.03–0.10]	0.96	0.94	0.07
Scalar	60.25	22	28.01*	4	0.10 [0.07–0.13]	0.90	0.87	0.08
Partial Scalar (releasing 3 & 4)	35.49	20	3.26	2	0.06 [0.03–0.10]	0.96	0.94	0.07
Childcare								
Configural	18.36	15	–	–	0.04 [0.00 – 0.09]	0.99	0.98	0.06
Metric	26.99	18	8.65*	3	0.06 [0.00 – 0.10]	0.97	0.95	0.22
Partial Metric (releasing 4)	18.670	17	0.32	2	0.03 [0.00– 0.08]	0.99	0.99	0.09
Scalar	25.74	20	7.07	3	0.04 [0.00 – 0.09]	0.98	0.97	0.11

\*significant reduction in model fit,  $p < 0.05$

$\chi^2_{diff}$  = nested  $\chi^2$  difference, *RMSEA* Root mean square error of approximation, *CI* Confidence interval, *SRMR* Standardised root mean residual

in a non-significant change in model fit. Scalar invariance was achieved for the remaining items suggesting partial invariance for this subscale (see Table 5).

### I-PACE Subscales, SES And Life Satisfaction

To examine associations between measures of SES and the I-PACE, we specified a model in which IMD, IDACI and monthly income were each permitted to be correlated with the five-factors of the I-PACE for mothers and fathers. All three measures of SES were positively associated with father-reported neighborhood quality, standardised coefficients  $> 0.25$ ,  $p < 0.001$ , while for mothers, only IMD and IDACI were associated with neighborhood quality, standardised coefficients  $> 0.17$ ,  $p < 0.039$ . For both parents, greater affluence was associated with more positive ratings of neighborhood. IMD was also associated with mother-reported childcare quality, such that

those mothers living in more deprived areas reported lower quality childcare, standardised coefficients =  $-0.202$ ,  $p = 0.004$ .

To examine associations between measures, mothers' and fathers' life satisfaction and the I-PACE, we specified a model where both mother and father life satisfaction were  $p$  correlated with the five-factors of mother-reported I-PACE and, separately, father-reported I-PACE. Associations between I-PACE subscales and parental life satisfaction showed specificity of associations within parent. That is, mother-reported parenting experiences were significantly positively associated with mother-reported life satisfaction (standardised coefficient =  $0.351$ ,  $p < 0.001$ ) but not father-reported life satisfaction (standardised coefficient =  $0.008$ ,  $p = 0.928$ ). Similarly, father-reported parenting experiences were significantly positively associated with only father-reported life satisfaction (standardised coefficient =  $0.376$ ,  $p < 0.001$ ) not mother-reported life satisfaction



(standardised coefficient = 0.070,  $p = 0.429$ ). For both parents, their life satisfaction was also significantly associated with their own ratings of neighbourhood quality, (fathers: standardized coefficient = 0.268,  $p = 0.001$ , mother: standardised coefficient = 0.222,  $p = 0.005$ ), and for fathers only life satisfaction was significantly associated with more frequency engagement in activities with their child (standardised coefficient = 0.327,  $p < 0.001$ ).

## Discussion

Four findings emerged from Study 2. First, supporting the reliability of the I-PACE, parental ratings in Study 2 showed the same differentiated factor structure as in Study 1. Second, while informants in Study 1 were predominantly mothers, Study 2 participants included an approximately equal number of mothers ( $N = 188$ ) and fathers ( $N = 178$ ). Here our results showed that mothers' and fathers' ratings were very similar, in terms of factor structure, mean subscale scores and in the positive associations between I-PACE subscale scores and reported life satisfaction. Given significant asymmetry in childcare responsibilities in this sample, this similarity between mothers and fathers in the strength of associations between I-PACE scores and life-satisfaction is striking. While primary caregivers in this sample were, almost exclusively, mothers, the fathers in this study clearly attached considerable importance to family life. Third, by gathering ratings from both parents in the home in Study 2, we were able to supplement the findings from Study 1 by assessing inter-rater reliability and measurement invariance for the I-PACE. Again, our results were reassuring, in that the ratings for parenting activities, home environment, neighborhood quality and childcare quality all showed significant within-couple associations. Finally, highlighting the individual nature of parenting experiences and the need for researchers, educators, and family-focused practitioners to include information from both parents, Study 2 showed little within-couple concordance in ratings for parenting experience.

Two limitations of Study 2 deserve note. First, like Study 1, the sample was not representative of the broader population of the UK. Clearly further research with the I-PACE with at-risk, low-income and ethnically diverse samples is needed. Nonetheless, there was some diversity in income deprivation indices and these metrics were meaningfully associated with mother- and father-reported neighbourhood quality. Second, relatedly, it is likely that the well-resourced nature of the sample meant that many items in the Activities subscales were skewed, with the majority of families reading and singing to their children daily and having a set bedtime routine.

## General Discussion

Reliable and valid measures of parenting are important for intervention work to reduce early childhood inequalities, yet only a handful of existing measures are supported by psychometric data. Moreover, very few offer practitioners the combination of breadth and brevity needed to capture meaningful information efficiently. Responding to this challenge we developed a brief measure, the Index of Parenting Activities, Context and Experiences (I-PACE). In Study 1, we examined whether I-PACE items can yield fair ratings across different child characteristics (e.g., sex, age) by testing for differential item functioning. We also assessed the validity of I-PACE scores by examining associations with ratings on the BITSEA, a widely used measure of children's social and emotional competence. In Study 2, we asked a new sample of mothers and fathers to complete the I-PACE, as well as a measure of life satisfaction and questions about family demographics. This enabled us to explore similarities and contrasts in maternal and paternal ratings on the I-PACE, and to assess within-couple inter-rater agreement. Below, we consider two key findings to emerge from these two studies; we also discuss the strengths and limitations of the I-PACE as a quick tool for gathering a broad-brushstroke picture of early individual differences in parenting activities, context, and experiences.

### Does The I-PACE Capture The Multi-Faceted Nature Of Parenting?

Consistent with contemporary models of parenting that highlight the differentiated nature of parenting (e.g., Grusec & Davidov, 2010; Huang et al., 2022), the CFA results in Study 1 yielded five distinct subscales and both maternal and paternal ratings in Study 2 confirmed these findings. Of these five subscales, four captured parents' global ratings of the quality of home, neighborhood, and childcare environments as well as parental experiences, while the fifth provided frequency ratings for parent-child educational activities. Strengthening the view that parenting encompasses multiple distinct facets, each of these subscales showed independent associations with both the social competence and problem behavior components of the BITSEA. Thus, despite its brevity, the I-PACE allows one to capture relatively specific aspects of parenting that matter for children's social and emotional development. In addition, the subscales appeared distinct in the extent to which ratings varied by child age: as expected, ratings of the quality of home, neighborhood, and childcare environments did not differ by child age. By contrast, and in line with previous literature, parental experience appeared to become less positive with child age (perhaps reflecting the challenges of juggling childcare with a return to work/additional

children in the family). Likewise, the parent-child activities scale showed nuanced age-related changes (with age, creative play and bed-time stories became more frequent, but bed-time routines became less clear). Despite the relative brevity of the I-PACE, responses to this instrument appear sufficiently fine-grain to capture meaningful information about the multiple aspects of early parenting.

### Are I-PACE Scores Similar For Mothers And Fathers?

In Study 1, mothers comprised 95% of respondents; to meet this imbalance, Study 2 included both mothers and fathers. Study 2 highlighted the similarity in mothers' and fathers' ratings on the I-PACE, both in mean subscale scores and in their positive associations with reported life satisfaction. For parental ratings of the environment (i.e., home, neighborhood, and childcare) and parental activities, this similarity is reassuring. Furthermore, the I-PACE demonstrated partial invariance across mothers and fathers; this is common in psychological research examining measurement invariance across groups more broadly (e.g., Putnick & Bornstein, 2016) and across mothers and fathers specifically (Dyer, 2022). Note that primary caregivers in Study 2 were almost exclusively mothers; given this asymmetry in caregiving roles, the across-parent similarity in associations between I-PACE scores and life satisfaction is striking and highlights the importance of the parental role for fathers' life satisfaction. The results from the measurement invariance analyses also provide preliminary evidence that that I-PACE can be administered with equivalent confidence to primary and non-primary caregivers.

At the same time, it is worth noting that the results from Study 2 do not indicate the spillover effects within families reported in other studies (e.g., Stroud et al., 2011). For example, a recent US-based study of more than 500 adoptive families, Taraban et al. (2019) found that associations between depression and over-reactive parenting appeared weaker in the context of partners' satisfaction with social support. By contrast, Study 2 showed no within-couple association in parenting experience and no cross-over effects between partners' parenting experience and self-reported life satisfaction. Together, these findings indicate that mothers' and fathers' parenting experiences are relatively independent, such that despite the lack of mean differences, gathering responses from both parents may be useful to get a complete picture of family life.

In developing the I-PACE, we conducted focus groups with both parents and family-oriented support workers across three regions of England. This consultation process was valuable, both in generating relevant items, and in

ensuring the accessibility of the scale (e.g., by designing questions to minimise 'wordiness'). This feature, coupled with the multi-componential findings from our CFA, indicates that the I-PACE's key strength hinges on its combination of breadth of scope and brevity/simplicity of items. In addition, by adopting a multi-faceted approach to assessing the contextual and experiential features of parenting, the I-PACE may be a promising tool for testing wider influences on parenting and the broader context of children's development (Little et al., 2021).

### Study Limitations

Beyond the previously acknowledged limitations of Studies 1 and 2, two further limits deserve note. First, given its brevity, the I-PACE cannot provide an in-depth index of any one of the aspects of family influence covered; as such, its utility is likely to be limited to initial screening. At the same time, it is important to retain the I-PACE's brevity as having a quick and easy-to-use measure is crucial to engaging and retaining families in challenging circumstances.

Second, to avoid burdening participants, we did not include other parenting measures and so further work is needed to assess the convergent validity of the I-PACE. Given the growing ubiquity of smartphones, future studies might go beyond comparing the I-PACE with other parenting surveys to examine the agreement between I-PACE scores and in-the-moment ratings of parenting experiences, gathered via ecological momentary assessment (e.g., Shiffman et al., 2008). If future studies support the convergent validity of the I-PACE, we hope that the brevity and breadth of this measure can meet the evaluative needs of both researchers and practitioners in planning their work to develop and deliver initiatives to support such families and ensure that all young children can grow up in supportive family environments.

**Funding** This work was funded by the Foundation Years Trust and the Economic and Social Research Council.

### Compliance with Ethical Standards

**Conflict of interest** The authors declare no competing interests.

**Ethical approval** Ethics for Study 1 was approved by the ethics review board located at the institution of the first author and Study 2 was approved by the ethics board of the National Health Service (Bloomsbury, UK).

**Informed consent** Informed consent was received from all participants prior to their participation in these studies.

**Publisher's note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Average household income (2018) UK: Financial year ending 2017, *Office of National Statistics, UK*, <https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/householddisposableincomeandinequality/financialyearending2017>.
- Baker, C. E., & Brooks-Gunn, J. (2020). Early Parenting and the Intergenerational Transmission of Self-Regulation and Behavior Problems in African American Head Start Families. *Child Psychiatry & Human Development*, 51(2), 220–230. <https://doi.org/10.1007/s10578-019-00921-5>.
- Berge, J. M., Tate, A., Trofholz, A., Fertig, A. R., Miner, M., Crow, S., & Neumark-Sztainer, D. (2017). Momentary Parental Stress and Food-Related Parenting Practices. *Pediatrics*, 140(6). <https://doi.org/10.1542/peds.2017-2295>
- Bischoff, K., & Owens, A. (2019). The Segregation of Opportunity: Social and Financial Resources in the Educational Contexts of Lower- and Higher-Income Children, 1990–2014. *Demography*, 56(5), 1635–1664. <https://doi.org/10.1007/s13524-019-00817-y>.
- Briggs-Gowan, M. J., Carter, A. S., Irwin, J. R., Wachtel, K., & Cicchetti, D. V. (2004). The Brief Infant-Toddler Social and Emotional Assessment: Screening for Social-Emotional Problems and Delays in Competence. *Journal of Pediatric Psychology*, 29(2), 143–155. <https://doi.org/10.1093/jpepsy/jsh017>.
- Briggs-Gowan, M. J., Carter, A. S., McCarthy, K., Augustyn, M., Caronna, E., & Clark, R. (2013). Clinical Validity of a Brief Measure of Early Childhood Social-Emotional/Behavioral Problems. *Journal of Pediatric Psychology*, 38(5), 577–587. <https://doi.org/10.1093/jpepsy/jst014>.
- Brown, T. A. (2015). *Confirmatory factor analysis for applied research, 2nd Edition*. The Guildford Press.
- Choi, J.-K., Kelley, M. S., & Wang, D. (2018). Neighborhood Characteristics, Maternal Parenting, and Health and Development of Children from Socioeconomically Disadvantaged Families. *Am J Community Psychol*, 62, 476–491. <https://doi.org/10.1002/ajcp.12276>.
- Dalgaard, N. T., Filges, T., Viinholt, B. C. A., & Pontoppidan, M. (2022). Parenting interventions to support parent/child attachment and psychosocial adjustment in foster and adoptive parents and children: A systematic review. *Campbell Systematic Reviews*, 18, e1209 <https://doi.org/10.1002/cl2.1209>.
- Davidov, M., & Grusec, J. E. (2006). Untangling the Links of Parental Responsiveness to Distress and Warmth to Child Outcomes. *Child Development*, 77(1), 44–58. <https://doi.org/10.1111/j.1467-8624.2006.00855.x>.
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of personality assessment*, 49(1), 71–75. [https://doi.org/10.1207/s15327752jpa4901\\_13](https://doi.org/10.1207/s15327752jpa4901_13).
- Dowdall, N., Murray, L., Skeen, S., Marlow, M., De Pascalis, L., Gardner, F., Tomlinson, M., & Cooper, P. J. (2021). Book-Sharing for Parenting and Child Development in South Africa: A Randomized Controlled Trial. *Child Development*, 92(6), 2252–2267. <https://doi.org/10.1111/cdev.13619>.
- Dyer, W. J. (2022). Fatherhood Measurement and Assessment. In S. Molloy, P. Azzam & A. Isacco (Eds), *Handbook of the Psychology of Fatherhood* (pp. 29–42). Cham: Springer International Publishing. 10.1007/978-3-031-14498-1. .
- Goodman, S. H., Simon, H. F. M., Shamblaw, A. L., & Kim, C. Y. (2020). Parenting as a Mediator of Associations between Depression in Mothers and Children's Functioning: A Systematic Review and Meta-Analysis. *Clinical Child and Family Psychology Review*, 23(4), 427–460. <https://doi.org/10.1007/s10567-020-00322-4>.
- Grusec, J. E., & Davidov, M. (2010). Integrating Different Perspectives on Socialization Theory and Research: A Domain-Specific Approach. *Child Development*, 81(3), 687–709. <https://doi.org/10.1111/j.1467-8624.2010.01426.x>.
- Grusec, J. E. (2017). A domains of socialisation perspective on children's social development. In N. Ludwig, E. Turiel, & P. Zelazo (Eds). *New Perspectives on Human Development* (pp. 165–181). Cambridge University Press. <https://doi.org/10.1017/CBO9781316282755.011>
- Hart, B., & Risley, T. R. (1992). American parenting of language-learning children: Persisting differences in family-child interactions observed in natural home environments. *Developmental Psychology*, 28(6), 1096–1105. <https://doi.org/10.1037/0012-1649.28.6.1096>.
- Heckman, J. J. (2011). The economics of inequality: The value of early childhood education. *American Educator*, 35(1), 31–47.
- Hill, T., & Palacios, N. (2021). The influence of parental warmth and stress on reading through approaches to learning: Racial/ethnic variation. *Infant and Child Development*, 30(2), e2210 <https://doi.org/10.1002/icd.2210>.
- Ho, L. L. K., Li, W. H. C., Cheung, A. T., Luo, Y., Xia, W., & Chung, J. O. K. (2022). Impact of Poverty on Parent-Child Relationships, Parental Stress, and Parenting Practices. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.849408>
- Huang, W., Weinert, S., von Maurice, J., & Attig, M. (2022). Specific parenting behaviors link maternal education to toddlers' language and social competence. *Journal of Family Psychology*, 36(6), 998–1009. <https://doi.org/10.1037/fam0000950>.
- Hughes, C., Devine, R. T., Mesman, J., & Blair, C. (2018). *The New Fathers and Mothers Study*; UK Data Service, <https://doi.org/10.5255/UKDA-SN-853278>.
- Hurley, K. D., Huscroft-D'Angelo, J., Trout, A., Griffith, A., & Epstein, M. (2014). Assessing Parenting Skills and Attitudes: A Review of the Psychometrics of Parenting Measures. *Journal of Child and Family Studies*, 23(5), 812–823. <https://doi.org/10.1007/s10826-013-9733-2>.
- Iruka, I. U., De Marco, A., & Garrett-Peters, P. (2018). Profiles of academic/socioemotional competence: Associations with parenting, home, child care, and neighborhood. *Journal of Applied Developmental Psychology*, 54, 1–11. <https://doi.org/10.1016/j.appdev.2017.11.002>.
- Kroenke, K., Spitzer, R. L., Janet, B. W., & Williams (2003). The Patient Health Questionnaire-2: Validity of a Two-Item Depression Screener. *Medical Care*, 41(11), 1284–1292. <http://www.jstor.org/stable/3768417>
- Kurdek, L. A. (1996). Parenting satisfaction and marital satisfaction in mothers and fathers with young children. *Journal of Family Psychology*, 10(3), 331–342. <https://doi.org/10.1037/0893-3200.10.3.331>.
- Little, M. T., Roelen, K., Lange, B. C. L., Steinert, J. I., Yakubovich, A. R., Cluver, L., & Humphreys, D. K. (2021). Effectiveness of

- cash-plus programmes on early childhood outcomes compared to cash transfers alone: A systematic review and meta-analysis in low- and middle-income countries. *PLOS Medicine*, 18(9), e1003698 <https://doi.org/10.1371/journal.pmed.1003698>.
- Liu, I. M., & Agresti, A. (1996). Mantel-Haenszel-Type Inference for Cumulative Odds Ratios with a Stratified Ordinal Response. *Biometrics*, 52(4), 1223–1234. <https://doi.org/10.2307/2532838>.
- McCoy, A., Melendez-Torres, G. J., & Gardner, F. (2020). Parenting interventions to prevent violence against children in low- and middle-income countries in East and Southeast Asia: A systematic review and multi-level meta-analysis. *Child abuse & neglect*, 103, 104444. <https://doi.org/10.1016/j.chiabu.2020.104444>.
- McDaniel, B. T., & Radesky, J. S. (2018). Technofence: Parent Distraction With Technology and Associations With Child Behavior Problems. *Child Development*, 89(1), 100–109. <https://doi.org/10.1111/cdev.12822>.
- Memmott, T., Carley, S., Graff, M., & Konisky, D. M. (2021). Sociodemographic disparities in energy insecurity among low-income households before and during the COVID-19 pandemic. *Nature Energy*, 6(2), 186–193. <https://doi.org/10.1038/s41560-020-00763-9>.
- Muthén, L., & Muthén, B. (2019). *Mplus. The comprehensive modelling program for applied researchers: user's guide*, 5.
- Nomaguchi, K. M. (2012). Parenthood and psychological well-being: Clarifying the role of child age and parent–child relationship quality. *Social Science Research*, 41(2), 489–498. <https://doi.org/10.1016/j.ssresearch.2011.08.001>.
- O'Brien, M. (1996). Child-Rearing Difficulties Reported by Parents of Infants and Toddlers. *Journal of Pediatric Psychology*, 21(3), 433–446. <https://doi.org/10.1093/jpepsy/21.3.433>.
- O'Connor, T. G. (2002). Annotation: The 'effects' of parenting reconsidered: findings, challenges, and applications. *Journal of Child Psychology and Psychiatry*, 43(5), 555–572. <https://doi.org/10.1111/1469-7610.00046>.
- Penfield, R. D. (2005). DIFAS: Differential Item Functioning Analysis System. *Applied Psychological Measurement*, 29(2), 150–151. <https://doi.org/10.1177/0146621603260686>.
- Penfield, R. D. (2007). An Approach for Categorizing DIF in Polytomous Items. *Applied Measurement in Education*, 20(3), 335–355. <https://doi.org/10.1080/08957340701431435>.
- Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review*, 41, 71–90. <https://doi.org/10.1016/j.dr.2016.06.004>.
- Scott, S., Sylva, K., Doolan, M., Price, J., Jacobs, B., Crook, C., & Landau, S. (2010). Randomised controlled trial of parent groups for child antisocial behaviour targeting multiple risk factors: the SPOKES project. *Journal of Child Psychology and Psychiatry*, 51(1), 48–57. <https://doi.org/10.1111/j.1469-7610.2009.02127>.
- Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological Momentary Assessment. *Annual Review of Clinical Psychology*, 4(1), 1–32. <https://doi.org/10.1146/annurev.clinpsy.3.022806.091415>.
- Silva-Rodrigues, A. P. C., Oliveira, M. R. E., Silva, T. B. F., & Loureiro, S. R. (2022). Positive Parenting of Mothers with Depression and Children's Behaviors: A Systematic Review. *Trends in Psychology*, 30(2), 400–423. <https://doi.org/10.1007/s43076-021-00105-y>.
- Stroud, C. B., Durbin, C. E., Wilson, S., & Mendelsohn, K. A. (2011). Spillover to triadic and dyadic systems in families with young children. *Journal of Family Psychology*, 25(6), 919–930. <https://doi.org/10.1037/a0025443>.
- Tanaka, J. S. (1987). How Big Is Big Enough?: Sample Size and Goodness of Fit in Structural Equation Models with Latent Variables. *Child Development*, 58(1), 134–146. <https://doi.org/10.2307/1130296>.
- Taraban, L., & Shaw, D. S. (2018). Parenting in context: Revisiting Belsky's classic process of parenting model in early childhood. *Developmental Review*, 48, 55–81. <https://doi.org/10.1016/j.dr.2018.03.006>.
- Taraban, L., Shaw, D. S., Leve, L. D., Natsuaki, M. N., Ganiban, J. M., Reiss, D., & Neiderhiser, J. M. (2019). Parental Depression, Overreactive Parenting, and Early Childhood Externalizing Problems: Moderation by Social Support. *Child Development*, 90(4), e468–e485. <https://doi.org/10.1111/cdev.13027>.
- Yuan, K.-H., Yang-Wallentin, F., & Bentler, P. M. (2012). ML Versus MI for Missing Data With Violation of Distribution Conditions. *Sociological Methods & Research*, 41(4), 598–629. <https://doi.org/10.1177/0049124112460373>.