

Parents, parks and pediatric development: Age- and parent-specific benefits on emotion regulation

Lucas Shen, PhD^{1,*}; Michelle Z. L. Kee, PhD¹; Jian Huang, PhD¹; Ka Kei Sum, MSc^{1,2}; Keri McCrickerd, PhD^{1,3,4,5,6}; Gerard Chung, PhD⁷; Fabian Yap, MBBS⁸; Yung Seng Lee, PhD, MBBS⁵; Yap Seng Chong, MBBS, MD⁹; Keith M. Godfrey, PhD, BM¹⁰; Evelyn Law, MD⁵; Jonathan Y. Huang, PhD^{11,12,*}

Affiliations:¹ Institute for Human Development and Potential, Agency for Science, Technology and Research; ² Population Health Sciences, Bristol Medical School, University of Bristol; ³ Centre for Behavioural and Implementation Science Interventions, Yong Loo Lin School of Medicine, National University of Singapore; ⁴ Centre for Holistic Initiatives for Learning and Development, Yong Loo Lin School of Medicine, National University of Singapore; ⁵ Paediatrics, Yong Loo Lin School of Medicine, National University of Singapore; ⁶ Human Potential Translational Research Programme, Yong Loo Lin School of Medicine, National University of Singapore; ⁷ Department of Social Work, National University of Singapore; ⁸ KK Women's and Children's Hospital; ⁹ Department of Obstetrics and Gynaecology, Yong Loo Lin School of Medicine, National University of Singapore; ¹⁰ MRC Lifecourse Epidemiology Centre & NIHR Southampton Biomedical Research Centre, University of Southampton & University Hospital Southampton NHS Foundation Trust, Tremona Road, Southampton, SO16 6YD, UK; ¹¹ Centre for Quantitative Medicine, Duke-NUS Medical School, National University of Singapore; ¹² Thompson School of Social Work and Public Health, University of Hawai'i at Mānoa

Correspondence: Lucas Shen, Institute for Human Development and Potential, Agency for Science, Technology and Research (A*STAR), 30 Medical Drive Brenner Centre for Molecular Medicine Singapore 117609. Email: lucas_shen@a-star.edu.sg. Jonathan Y. Huang, Thompson School of Social Work and Public Health, University of Hawai'i at Mānoa. Email: jon.huang@hawaii.edu.

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Abbreviations: BRIEF-2, Behavior Rating Inventory of Executive Function, Second Edition; CD-RISC, Connor-Davidson Resilience Scale; CI, confidence interval; ERI, Emotion Regulation Index; GUSTO, Growing Up in Singapore Towards Healthy Outcomes; PCQ, Primary Caregiver Questionnaire; PMET, Professionals, Managers, Executives, and Technicians; PSDQ, Parenting Styles and Dimensions Questionnaire; SD, standard deviation.

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Abstract

We linked the Growing Up in Singapore Towards Healthy Outcomes (GUSTO) cohort with annually updated park access from birth through age 10. Outcomes were emotion regulation at age 7 (BRIEF-2 Emotion Regulation Index [ERI]; reverse-coded; $n = 506$) and psychological resilience at age 10 (Connor-Davidson Resilience Scale [CD-RISC]; $n = 429$). With paternal involvement in outings, park access was associated with 1.5-points higher ERI (95% CI 0.5 to 2.3) and 4.1-points higher CD-RISC (95% CI 1.2 to 7.1) per SD park increase at ages 3 and 1. With maternal involvement in outings, park access was associated with 1.1-point higher ERI (95% CI 0.2 to 2.1) at age 5 and 4.7-points higher CD-RISC (95% CI 1.6 to 7.8) at age 6. In contrast, for primary caregiver fathers, higher park access at ages 6–7 was associated with worse emotion regulation. The benefits of park access for children's socioemotional development may be timing- and parent-specific, with early involvement of fathers and later involvement of mothers particularly relevant.

1 Introduction

Neighborhoods children grow up in are increasingly recognized as determinants of physical, social, and psychological health,^{1–13} with parks particularly relevant for young children.^{14,15} These shared public spaces allow children to interact with others through unstructured peer play, which encourages cooperation, turn-taking, and negotiating social rules, and together with physical and rough-and-tumble play, builds emotional balance and the capacity to manage strong emotions.^{16,17}

These developmental benefits need not be contemporaneous, but can cascade beyond the period of exposure. That is, competencies developed earlier in childhood can form the foundation for capacities that emerge later.^{18–23} For neighborhood resources such as parks, this suggests that the timing of a child’s exposure may matter. Through repeated opportunities for play in parks during their early years, children build the type of emotion regulation that underpins social competence and resilient functioning into adolescence.^{17,24,25}

The developmental benefits depend not just on physical proximity but also family context. Young children typically depend on their caregivers to access such neighborhood spaces.²⁶ Beyond bridging access, parents are also the playmates of children in these settings, helping them navigate emotional arousal and gradually shift from co-regulated to self-regulated behavior.^{17,27} Mothers and fathers tend to be involved in their children’s play and daily activities in different ways—mothers through nurturing and emotionally attuned interactions that organize children’s routines and social worlds, and fathers through outdoor forms of play and unstructured activities that encourage exploration, risk-taking, and emotional competence.^{16,27,28} These differences may matter especially in early childhood as the child’s primary playmate.²⁶ Yet, whether the developmental benefits of neighborhood parks depend on parental involvement, which parent, and when, has received little empirical attention.

This study examines whether and when parental involvement in the child’s day-to-day activities, separately for mothers and fathers, modifies the association between families’ access to nearby parks and children’s socioemotional outcomes. Over the child’s first ten years, we link residential park accessibility (via network-based travel times), repeated measures of parental caregiving, and two complementary outcomes—emotion regulation at age seven (BRIEF-2 Emotion Regulation Index) and psychological resilience at age ten (Connor-Davidson Resilience Scale)—in year-specific models that trace the timing and parent-specific patterns of these moderating effects.

2 Methods

2.1 Study population

The Growing Up in Singapore Towards healthy Outcomes (GUSTO) cohort is a prospective longitudinal birth cohort which recruited women of all socioeconomic backgrounds during their first-trimester antenatal ultrasound scan at two public hospitals in 2009–2010.²⁹ Participants include healthy women in same-ethnic marriages residing in Singapore without significant medical conditions (e.g., type 1 diabetes mellitus, psychosis). The geographical distribution of participants (Figure 1) closely tracks the census geographical distribution of women in the same age range (95% bootstrapped CI for $r = [.93, .97]$; Appendix A.3).¹¹ Ethical approval was granted by DSRB (D/2009/00021) and CIRB (2018/2767/D, 2019/2655/E). Informed consent was obtained from parents.

2.2 Emotion regulation (BRIEF-2 ERI)

Emotion regulation was measured at age seven using the Emotion Regulation Index (ERI) of the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF-2), completed by parents ($n = 506$).^{30,31} The ERI comprises two subscales, each with 8 items: Emotional Control (e.g., “Small events trigger big reactions,” “Reacts more strongly to situations than other children,” “Becomes upset too easily”), and Shift (e.g., “Resists or has trouble accepting a different way to solve a problem,” “Has trouble getting used to new situations,” “Resists change of routine, foods, places, etc.”). Each item is rated by the parent on a 3-point scale (1 = Never, 2 = Sometimes, 3 = Often), and item scores are summed to yield a raw ERI total from 16 to 48. Higher raw values indicate greater difficulty with emotion regulation. To aid interpretation, we reverse-coded the ERI so that higher values indicate better emotion regulation.

2.3 Resilience (CD-RISC)

Psychological resilience was measured at age ten using the 25-item Connor–Davidson Resilience Scale (CD-RISC; $n = 429$).³² CD-RISC assesses domains such as adaptability, perseverance, and emotion regulation.³³ Each item is a statement (e.g., “I am able to adapt when changes occur,” “I give my best effort no matter what the outcome may be,” “I am not easily discouraged by failure”), which the child answers on a 5-point Likert scale from 0 (“not true at all”) to 4 (“true nearly all the time”). Internal consistency was good ($\alpha = 0.93$; Table A.1).^{32,33} Scores sum to a total from 0 to 100, with higher values indicating greater resilience.

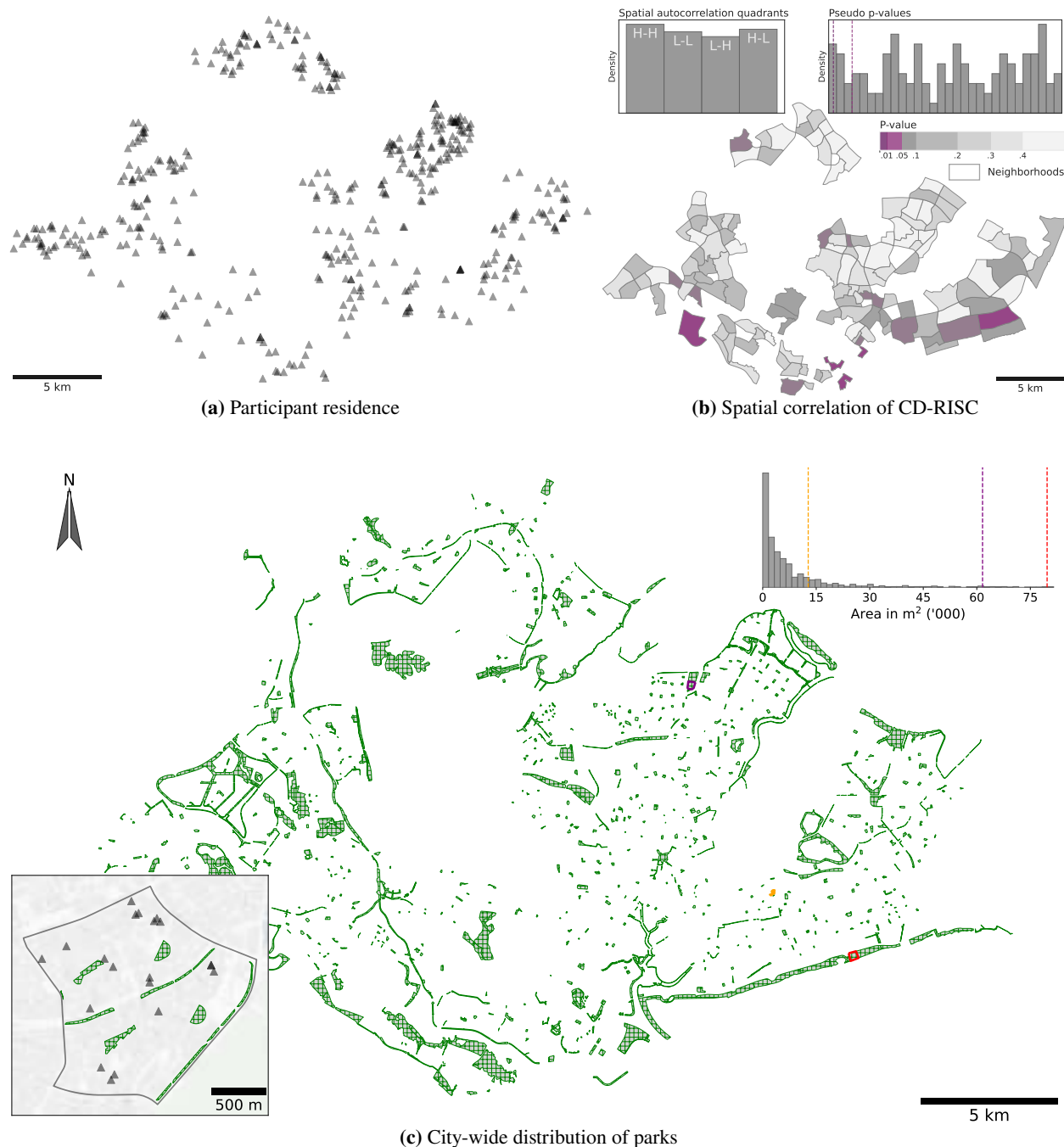


Figure 1 | Spatial distribution of participants, CD-RISC correlation, and park availability. Panel (a) shows the distribution of participants across the city (based on Year 10 residence). Panel (b) summarizes the spatial correlation analysis of the neighborhood-averaged CD-RISC measure. The map highlights neighborhoods based on pseudo p-values of spatial correlation from a permutation-derived null ($n = 10,000$). Panel (c) illustrates the city-wide distribution of parks ($n = 1425$), shaded in green. The legend shows park area (in '000 m^2), with three large parks marked for scale. The inset highlights the most populated participant neighborhood (black triangles).

2.4 Accessibility to nearby parks

Parks were identified from the official Urban Redevelopment Authority's land-use plan under *Parks*: zones and pedestrian linkages allocated to parks or gardens for public use.¹¹ We quantified access as the number

of parks reachable within a 15-minute trip (by walking or public transit) from each residence, a threshold consistent with how residents perceive their neighborhood boundaries.^{34–37} Travel times were computed over a tessellation of 0.11 km² hexagonal cells, using centroid-to-centroid distance via network-based routing that reflects real street networks, speed parameters, and transit access (Appendix A.4).^{10,11,13} Figure 2 illustrates this measure for one residence. For each year from birth to age ten, accessibility was assigned using the residential record closest in time to that birthday, capturing changes in location across childhood.¹¹



Figure 2 Illustration of quantifying the number of parks within a 15-minute commute to residence (point in the middle of the figure). Purple areas are hexagons within 15 minutes of the residence by public commute, including walking. Land parcels assigned to parks are shaded in green. The dashed black circle demarcates the 500-meter concentric circle around the residence as a reference.

2.5 Parental caregiving and involvement

Caregiving information was drawn from GUSTO caregiver questionnaires administered from Years 4–10, predominantly completed by mothers (about 80%; Figure A.7). We focused on three parental involvement modifiers from the PCQ,^{38,39} each coded as a binary indicator separately for mothers and fathers: (i) unstructured outings (“Which of the indicated caregivers take your child on unstructured outings most of the time?”; $m = 1$ if the mother/father is listed), (ii) play (“Which of the indicated caregivers play with your child most of

Table 1|Sample characteristics.

	ERI sample (<i>n</i> = 506)	CD-RISC sample (<i>n</i> = 429)
ERI score, mean (SD)	22.4 (5.4)	22.4 (5.3)
CD-RISC score, mean (SD)	59.9 (17.3)	60.0 (17.1)
Parks within 15 min, mean (SD)	9.7 (8.9)	9.4 (8.7)
≥ 1 park within 15 min, No. (%)	465 (97.1%)	394 (96.1%)
Child sex, No. (%)		
Female	243 (48.0%)	206 (48.0%)
Male	263 (52.0%)	223 (52.0%)
Child age at BRIEF-2, y, mean (SD)	7.4 (0.2)	7.4 (0.2)
Child age at CD-RISC, y, mean (SD)	10.9 (0.1)	10.9 (0.1)
Birth order, No. (%)		
1st	238 (47.6%)	203 (48.0%)
2nd	145 (29.0%)	119 (28.1%)
3+	117 (23.4%)	101 (23.9%)
Has domestic helper, No. (%)	66 (13.0%)	51 (11.9%)
Maternal age at delivery, y, mean (SD)	31.0 (5.1)	31.0 (5.1)
Maternal education, No. (%)		
Primary	25 (5.1%)	16 (3.8%)
Secondary	111 (22.5%)	109 (26.1%)
GCE/diploma	63 (12.8%)	45 (10.8%)
GCE A-level	132 (26.7%)	107 (25.6%)
College degree	163 (33.0%)	141 (33.7%)
Maternal ethnicity, No. (%)		
Chinese	253 (50.6%)	255 (60.3%)
Malay	162 (32.4%)	117 (27.7%)
Indian	84 (16.8%)	50 (11.8%)
Other	1 (0.2%)	1 (0.2%)
Household monthly income, SGD, No. (%)		
≤ 999	8 (1.7%)	8 (2.0%)
1000–1999	61 (12.9%)	55 (13.9%)
2000–3999	147 (31.1%)	114 (28.9%)
4000–5999	113 (23.9%)	99 (25.1%)
≥ 6000	144 (30.4%)	119 (30.1%)
Housing type, No. (%)		
1– or 2-room public	22 (4.5%)	18 (4.3%)
3-room public	98 (19.8%)	85 (20.3%)
4– or 5-room public	306 (61.9%)	258 (61.7%)
Public condominium	33 (6.7%)	23 (5.5%)
Condominium	21 (4.3%)	20 (4.8%)
Landed	9 (1.8%)	12 (2.9%)
Other	5 (1.0%)	2 (0.5%)

Notes: ERI sample = participants with BRIEF-2 Emotion Regulation Index at age 7 (*n* = 506). CD-RISC sample = participants with Connor-Davidson Resilience Scale at age 10 (*n* = 429). Columns overlap (participants with both outcomes appear in both columns). BRIEF-2 indicates Behavior Rating Inventory of Executive Function, Second Edition; CD-RISC, Connor-Davidson Resilience Scale; ERI, Emotion Regulation Index; SGD, Singapore dollars.

the time?”; *m* = 1 if the mother/father is listed), and (iii) primary caregiver (“Who you think is the primary 71
caregiver to your child?”; *m* = 1 if the mother/father is marked). Primary caregiver status was collected at 72
Years 4–10, play and unstructured outing were collected at Years 4–6. Each developmental year from birth 73
to the year of outcome assessment draws from the nearest available caregiving measure ([Appendix A.6](#)). 74
Across waves, approximately 295 mothers (70%) and 170 fathers (40%) were indicated as taking the child 75
on unstructured outings most often, 235 mothers (56%) and 117 fathers (28%) as playing with the child, 76
and 290 mothers (64%) but only 19 fathers (4%) as the primary caregiver. Three additional caregiving 77
activities—helping with schoolwork, bathing/showering the child, and general caregiving involvement—are 78

examined as supplementary modifiers ([Appendix C](#)).

2.6 Parenting style and household measures

Socioeconomic indicators (individual income, education, and occupation [PMET]) and child's sex were examined as non-caregiving modifiers. Father's involvement in household chores (LYDON, reported by mothers at Years 1–2) was measured by asking whether the father helps with housekeeping tasks. Parenting styles were measured using the Parenting Styles and Dimensions Questionnaire (PSDQ) for three styles (authoritative, authoritarian, and permissive; 1–5 scale) reported by the mother at Years 4, 8, and 10 for her and the father's parenting style.⁴⁰ Each style is dichotomized at its sample mean, and assigned to the nearest year as with the caregiving indicators (Years 0–5 from Year 4, Years 6–8 from Year 8, Years 9–10 from Year 10).

2.7 Covariates

Baseline covariates measured at recruitment include age at delivery, ethnicity, household income (< \$2000/month versus $\geq$ \$2000/month), maternal education (college-educated versus non-college), occupation, and housing type (public versus private). Child covariates included sex, precise age at socioemotional outcome assessment, birth order, and whether the family employed a domestic helper.^{33,41–46}

2.8 Statistical analyses

We estimated year-specific multivariable regressions to assess how parent-specific involvement modified the association between park access and two child outcomes: the child's ERI (age seven) and CD-RISC (age ten). Formally, for each child i in neighborhood a and year y , we estimated

$$y_{ia} = \beta_1^{(y)} \text{Parks}_i^{(y)} + \beta_2^{(y)} m_i^{(y)} + \gamma^{(y)} \left(\text{Parks}_i^{(y)} \times m_i^{(y)} \right) + \alpha_a + \mathbf{\Gamma} \mathbf{X}_i + \varepsilon_{ia}, \quad (1)$$

where y_{ia} is the outcome (ERI or CD-RISC), $\text{Parks}_i^{(y)}$ denotes park accessibility at age y ($y = 0, \dots, \bar{y}$; $\bar{y} = 7$ for ERI, $\bar{y} = 10$ for CD-RISC), $m_i^{(y)}$ is a parent-specific involvement measure at the corresponding age, α_a are neighborhood fixed effects, and $\mathbf{X}_i$ are baseline covariates. The assumption is that, conditional on the baseline family background and neighborhood effects (e.g., local built-environment quality, amenities, neighborhood affluence, safety), the remaining variation in park access is as-good-as-random with respect

to the child's outcome potential. Standard errors were clustered by planning area to account for spatial dependence among nearby families (Figure 1).^{6,11}

We report figures with the year- and parent-specific interaction coefficients ($\hat{\gamma}^{(y)}$). To interpret magnitudes, we report changes per one-SD increase in parks.

3 Results

The mean ERI score was 22.4 (SD 5.4, $n = 506$), measured at 7.4 years old (SD 0.2, Table 1). The mean CD-RISC score was 60.0 (SD 17.1, $n = 429$), measured at 10.9 years old (SD 0.1). In 2019, there were 1,425 parks citywide (Figure 1c), with parks often in close proximity to residential locations (Figures 2 and A.1). Children had on average 9.4 parks (SD 8.5) within 15 minutes of their residence. Cross-parent correlations for the caregiving indicators are weakly but systematically negative (e.g., outings: $\hat{r} = -0.12$ to -0.19 ; Table A.3).

3.1 Main association between socioemotional outcomes and parks

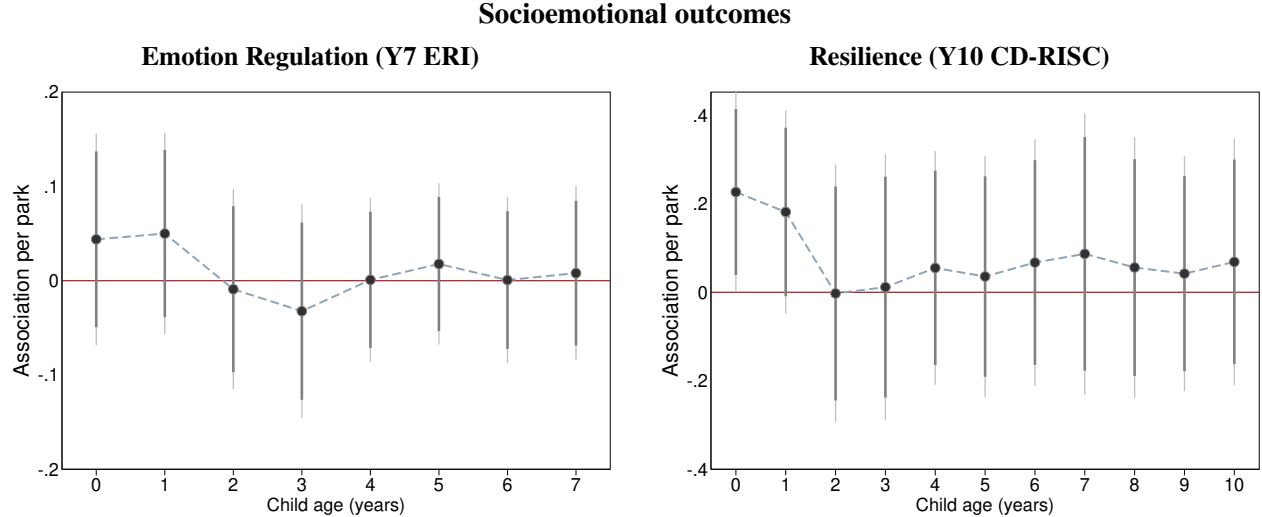


Figure 3|Association between park accessibility and child outcomes, by child age. Each panel shows year-specific estimates of the park–outcome association with 95% confidence intervals, without modifier interactions. ERI is reverse-coded.

For ERI, without conditioning on parental involvement, parks were not associated with ERI at any year (e.g., $\hat{\beta}_1^{(0)} = 0.04$, 95% CI: $[-0.07, 0.16]$, $p = .43$; Figure 3a). Park access was associated with CD-RISC at Year 0 ($\hat{\beta}_1^{(0)} = 0.23$, 95% CI: $[0.00, 0.45]$, $p = .05$; Figure 3b), implying a 2.0-point increase in resilience per one-SD increase in parks (12% of the CD-RISC SD).

3.2 Parent-specific involvement

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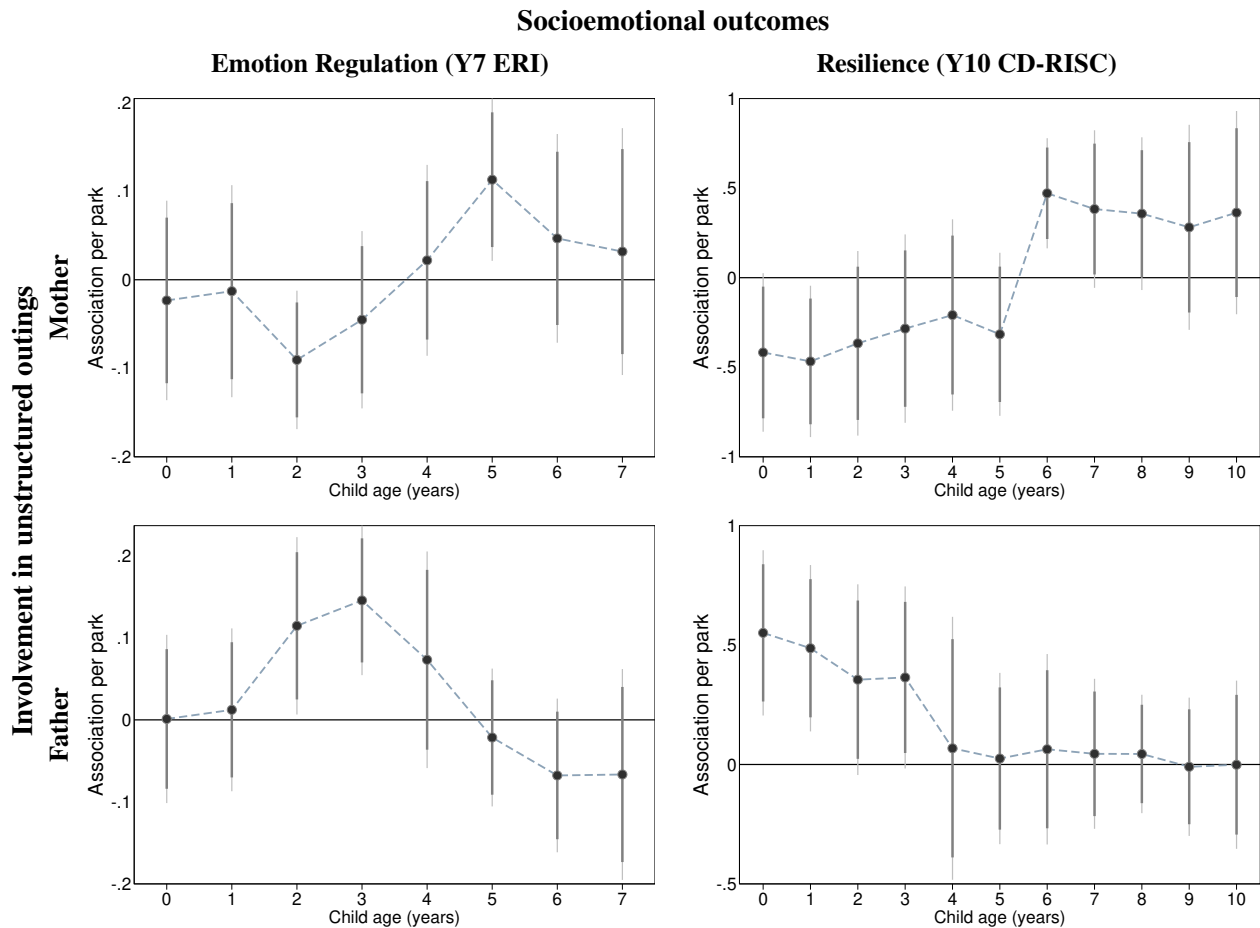


Figure 4|Unstructured outings as a modifier of the park–outcome association, by child age. Each panel shows how mother (top) or father (bottom) involvement in unstructured outings with the child modifies the association between park access and the outcome. ERI is reverse-coded. Markers are year-specific estimates with 95% confidence intervals.

Maternal involvement and primary caregiver status showed no significant main associations with either 120
 outcome. For fathers, outings at Years 6–10 were associated with higher resilience (e.g., Year 9: 5.53, 121
 $p < .01$, 32% of CD-RISC SD; [Table B.6](#)), and play at Year 5 with higher (better) ERI (1.41, $p = .02$, 26% 122
 of ERI SD; [Table B.9](#)). 123

Across the three parent-specific involvement indicators, maternal effects emerged later (from about age 124
 four onwards) while paternal effects appeared earlier (birth to age three). For ERI, mothers who took the child 125
 on outings ([Figure 4](#)) showed a negative (unfavorable) estimate at Year 2 (−0.09, 95% CI: [−0.17, −0.01], 126
 $p = .02$), followed by beneficial moderation at Year 5 (0.11, 95% CI: [0.02, 0.20], $p = .02$), corresponding 127
 to a 1.1-point higher (better) ERI score per one-SD increase in parks (21% of ERI SD). For CD-RISC, a 128
 similar reversal led to a beneficial moderation at Year 6 (0.47, 95% CI: [0.16, 0.78], $p < .01$), corresponding 129

to approximately 4.7 points higher resilience per one-SD increase in parks (27% of the CD-RISC SD). For ERI, paternal effects appeared at Year 3 (0.15, 95% CI: [0.05, 0.24], $p < .01$), corresponding to a 1.5-point higher (better) ERI score per one-SD increase in parks (27% of the ERI SD). For CD-RISC, paternal effects appeared at Years 0–1 (Year 0: 0.55, 95% CI: [0.21, 0.90], $p < .01$; Year 1: 0.49, 95% CI: [0.14, 0.84], $p = .01$), implying up to 4.6 points higher resilience per one-SD increase in parks at Year 0 (27% of the CD-RISC SD).

For *play* and *primary caregiver* (Figures 5 and B.3), the maternal-late/paternal-early pattern broadly replicated. Maternal play and maternal primary caregiver showed beneficial moderation at later ages for both outcomes. Paternal play showed beneficial moderation for CD-RISC in early years, consistent with the pattern for outings. Paternal play and paternal primary caregiver both deviated from the pattern for ERI at later years with unfavorable moderation, though the paternal primary caregiver finding rests on a small subgroup ($n \approx 19$).

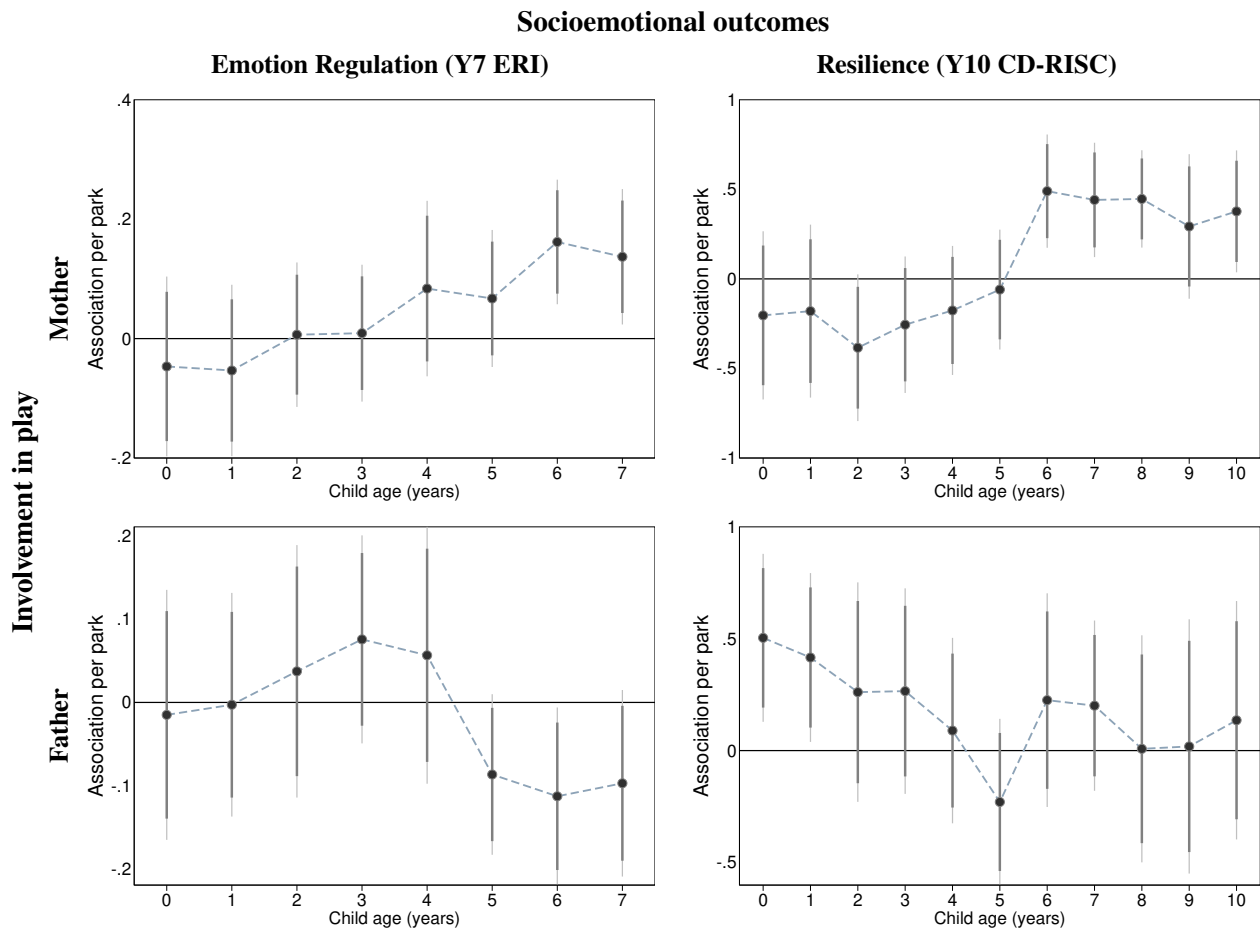


Figure 5|Play as a modifier of the park–outcome association, by child age. Each panel shows how mother (top) or father (bottom) involvement in play with the child modifies the association between park access and the outcome. ERI is reverse-coded. Markers are year-specific estimates with 95% confidence intervals.

3.3 Additional modifiers

We examined three additional caregiving activities as modifiers—helping with schoolwork, bathing the child, and general caregiving involvement—which broadly replicated the maternal-late/paternal-early pattern with comparable effect sizes, though maternal general caregiving showed unfavorable moderation at Year 9 for CD-RISC (Appendix C).

Girls benefitted more from park access for emotion regulation at later ages, while boys showed a stronger park–resilience association at earlier ages (Appendix D.1). Socioeconomic indicators (individual income, education, and occupation) moderated the park–outcome association for ERI (e.g., beneficial for paternal and maternal low income at Years 5–6, maternal PMET at Year 1) and CD-RISC (e.g., maternal PMET at Year 0–1, paternal college education at Year 10), but without the maternal-late/paternal-early temporal pattern for parental involvement (Appendix D.2).

Father’s early household involvement showed beneficial moderation for ERI at Year 2 but not for CD-RISC (Appendix D.3). Parenting styles moderated the park–CD-RISC association at Years 2–3 (authoritarian and permissive, both parents), but not the parent-specific temporal pattern (Appendices D.4 to D.6). Authoritative parenting—particularly paternal—showed main associations with better outcomes for both ERI and CD-RISC across nearly all years and was the only style correlated with parental involvement (Table D.4). Authoritarian and permissive styles (both parents) were associated with worse outcomes. Parenting styles had positive cross-parent correlations ($\hat{r} = 0.38\text{--}0.57$; Table D.3).

4 Discussion

Across unstructured outings, play, and primary caregiving, we observe a consistent timing pattern: maternal involvement strengthens the park–outcome association from about Year 4 onwards, while paternal involvement does so from birth to Year 3. Effect sizes (21–34% of the outcome SD) are comparable across modifiers, parents, and both outcomes. The BRIEF-2 ERI (parent-reported) and CD-RISC (self-reported) capture complementary dimensions of development—emotion regulation and broader psychological resilience, respectively.^{24,25,31,33} The regulatory capacities assessed by ERI underlie the resilience assessed by CD-RISC,⁴⁷ letting us trace the regulatory foundations of resilience in early childhood.

Child-relevant neighborhood spaces, such as parks, provide settings for outdoor unstructured play¹³ linked to children’s socioemotional development.¹⁷ Specifically, parks support forms of play relating to

physical and rough-and-tumble play, which build emotional balance, communication and negotiation skills, and emotional intelligence.^{16,17} As shared public spaces in the neighborhood community, parks also facilitate social play that requires turn-taking, negotiating implied social rules, and regulating behavior in group settings.¹⁷ Repeated opportunities for such play in the early years develop children's socioemotional capacity.^{17,24,25}

That said, young children of the age we considered depend on caregivers to access such spaces.²⁶ Moreover, parents are also playmates. Parent-child play allows parents to engage their child, lightly facilitating independent exploration while helping them navigate emotions. Through these, the child learns to manage strong emotions, progressing from parent- to self-regulated behavior.¹⁷ Without parent engagement, children have limited opportunities to benefit from such spaces.^{17,26} The modifiers capture the extent to which parents are present and engaged in their child's day-to-day, including the use of these spaces (e.g., taking the child on unstructured outings). Together, these may explain why the developmental benefits of parks are realized when parents are actively involved.

The parent-specific measures of caregiving also speak to the growing recognition that fathers (like mothers) contribute to child development.^{27,28,40,48–52} In particular, fathers have distinctive roles as playmates, tending to engage children in physical, rough-and-tumble play.^{27,28} Through positive physical play, fathers help children learn to manage intense emotions, navigate winning and losing, while encouraging risk-taking within safe play settings.^{17,27,50,53} That paternal involvement strengthens the beneficial association between parks and emotion regulation and resilience is consistent with this distinctive role.

The beneficial moderation is also timing-specific. The early paternal pattern (birth to Year 3) is consistent with evidence that early father involvement is foundational for later socioemotional outcomes, as studies found that father-child play quality at age 2 predicts emotional security at 10 and 16,¹⁸ low father involvement in infancy predicts mental health problems in middle childhood,¹⁹ disengaged father-infant interaction at 3 months predicts behavioral problems by age 1,²² and father absence at birth predicts developmental diagnoses by age 4.²³ A countervailing case is paternal primary caregiving, which has unfavorable moderation at later years, plausibly reflecting household adversity such as maternal absence, rather than an effect of paternal involvement per se.

A case study of play in a park setting offers an ecological clue for why the paternal beneficial modification window may be concentrated in the earliest years.²⁶ They observe that children below 3 predominantly play with their parent (or solo), with just 13% peer play. Peer play triples among children 3–6 at 31%, and those

above 6 are predominantly peer play at 91%.²⁶ This ecological observation aligns with our data: if fathers are the ones taking the child to parks, the early paternal effect may reflect a window when the father is the preferred playmate^{27,54} and channel through which they build their child's socioemotional capacities through play.¹⁷ As peer play increases with age,^{17,26} parents' role in play shifts,¹⁷ which could explain why maternal involvement becomes the operative modifier later—though parent-specific involvement was not observed in that case study, so this interpretation warrants future research attention.

The maternal-late/paternal-early timing pattern we observe is specific to parental involvement in the child's day-to-day activities. In sensitivity analyses, we find broad concordance of patterns from supplementary caregiving measures (e.g., helping with schoolwork/extra-curricular projects, bathing/showering, and general caregiving). We also observed beneficial modification from fathers' early involvement in household tasks. By contrast, non-caregiving characteristics do not exhibit comparable parent-differentiated timing. Lower income strengthens the beneficial association for ERI for both parents at later ages, which may capture the importance of amenity access for financially constrained families. Authoritarian and permissive parenting styles show beneficial moderation for CD-RISC at early years for both parents with similar timing. This may suggest a compensatory role, where children in less optimal households benefit more from park access, and the cross-parent similarity in timing is consistent with the cross-parent correlation in styles. As with paternal involvement, paternal authoritative parenting shows main associations with better outcomes, while authoritarian and permissive parenting are associated with worse outcomes, consistent with evidence linking authoritative parenting to better child well-being and authoritarian parenting to emotion dysregulation.^{55–57} In sum, what differentiates the park–outcome association across parents is not how they parent, but whether and when each parent is present in the child's daily activities.

Neighborhood fixed effects adjust for time-invariant attributes (e.g., neighborhood safety and affluence), but not within-area changes or all unmeasured correlates of park access.^{6,11} CD-RISC was originally validated in adults, and though established in pediatric populations, could not be administered any younger due to reading comprehension ([Appendix A.1](#)).³³ Park access was modeled via 15-minute multi-modal travel times^{10,11,34–36}, but lacks indicators of observed use or quality. Caregiving indicators are binary self-reports on involvement rather than the intensity or quality of engagement. Predominantly reported by mothers, they reflect the mother's perception of the father's caregiving, though low paternal cross-indicator concordance argues against mothers uniformly coding fathers as involved or uninvolved ([Figure A.8](#)).

Overall, our findings from the first decade of life are consistent with the notion of developmental

cascades²⁰—early positive experiences propagating into later-childhood outcomes—and extend the evidence by suggesting that one channel through which early parental involvement—as early as toddlerhood via fathers—operates is via access to neighborhood spaces facilitating outdoor unstructured play.

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Supporting Information

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A Data Descriptives

A.1 CD-RISC

The Connor-Davidson Resilience scale was initially developed in adult cohorts, but many studies use the scale given to children as young as ten³³, including GUSTO. Our study has no earlier measures of the same scale because of comprehensibility. The Flesch readability score for the CD-RISC scale is 75–77 (variation might depend on string pre-processing convention), a score widely accepted as “readable” (or comprehensible) to a child of the US 7th grade (12 years old). The related Flesch-Kincaid Grade score for the CD-RISC scale is 5.1, indicating suitability for US 5th graders³³. We also note that not all children took the scale at the same time. The CD-RISC instrument was administered over 17 months. In the analyses, we compute and adjust for the child's age at the CD-RISC administering date by taking the difference between the recorded date of the CD-RISC and their birthdates. [Table A.1](#) reports the item-level summary statistics and reliability measures; the overall Cronbach's alpha indicates good internal consistency.

Table A.1|CD-RISC 25-item scale data summary and reliability measures.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Summary					Reliability				
Connor-Davidson 25-Item Resilience Scale	n	Mean	S.D.	Min.	Max.	Sign	Item-test correlation	Corrected item-total correlation	Average Inter-item correlation	alpha
1. I am able to adapt when changes occur.	431	2.3	1.1	0	4	+	.625	.582	.33	.922
2. I have at least one close and secure relationship that helps me when I am stressed.	430	3.1	1.2	0	4	+	.476	.421	.338	.925
3. When there are no clear solutions to my problems, sometimes fate or God can help.	431	2.2	1.4	0	4	+	.323	.262	.346	.927
4. I can deal with whatever comes my way.	431	2.2	1.1	0	4	+	.626	.582	.33	.922
5. Past successes give me confidence in dealing with new challenges and difficulties.	430	2.5	1.2	0	4	+	.704	.667	.326	.921
6. I try to see the humorous side of things when I am faced with problems.	431	2.1	1.1	0	4	+	.519	.468	.336	.924
7. Having to cope with stress can make me stronger.	430	1.8	1.2	0	4	+	.566	.518	.333	.923
8. I tend to bounce back after illness, injury, or other hardships.	430	2.3	1.3	0	4	+	.537	.487	.335	.923
9. Good or bad, I believe that most things happen for a reason.	430	2.8	1.1	0	4	+	.545	.495	.334	.923
10. I give my best effort no matter what the outcome may be.	431	2.7	1	0	4	+	.676	.637	.327	.921
11. I believe I can achieve my goals, even if there are obstacles.	430	2.6	1	0	4	+	.753	.721	.323	.92
12. Even when things look hopeless, I don't give up.	431	2.4	1.1	0	4	+	.667	.627	.327	.921
13. During times of stress/crisis, I know where to turn for help.	430	2.7	1.2	0	4	+	.579	.532	.332	.923
14. Under pressure, I stay focused and think clearly.	431	2.2	1.1	0	4	+	.675	.636	.327	.921
15. I prefer to take the lead in solving problems rather than letting others make all the decisions.	430	2.2	1.2	0	4	+	.516	.465	.336	.924
16. I am not easily discouraged by failure.	431	2.3	1.1	0	4	+	.681	.643	.327	.921
17. I think of myself as a strong person when dealing with life's challenges and difficulties.	430	2.3	1.1	0	4	+	.701	.664	.326	.921
18. I can make unpopular or difficult decisions that affect other people, if it is necessary.	430	2	1.1	0	4	+	.434	.377	.34	.925
19. I am able to handle unpleasant or painful feelings like sadness, fear, and anger.	431	2.4	1.1	0	4	+	.536	.486	.335	.923
20. In dealing with life's problems, sometimes you have to act on a hunch without knowing why.	431	2.1	1.1	0	4	+	.531	.48	.335	.924
21. I have a strong sense of purpose in life.	431	2.5	1.2	0	4	+	.712	.676	.325	.92
22. I feel in control of my life.	430	2.4	1.3	0	4	+	.609	.564	.331	.922
23. I like challenges.	431	2.2	1.4	0	4	+	.588	.541	.332	.923
24. I work to attain my goals no matter what roadblocks I encounter along the way.	431	2.5	1.1	0	4	+	.734	.701	.324	.92
25. I take pride in my achievements.	430	2.9	1.1	0	4	+	.654	.613	.328	.921
Overall	429	60	17.1	5	100	—	—	—	.331	.925

Note: Tabulation of data summary and reliability measures of the 25-item Connor-Davidson Resilience Scale. All 25 items are on a 5-point Likert scale (0–4). Observations for items where the child refused to respond or caregiver accompanying the child requested to opt out are dropped. Item-test correlation is the correlation between the row item and the total score. Corrected item-total correlation is the correlation between the row item and the total score (excluding that row item). Column (10) reports the Cronbach's alpha. Last row reports the relevant overall scores for all 25 items.

A.2 Examples of neighborhood parks

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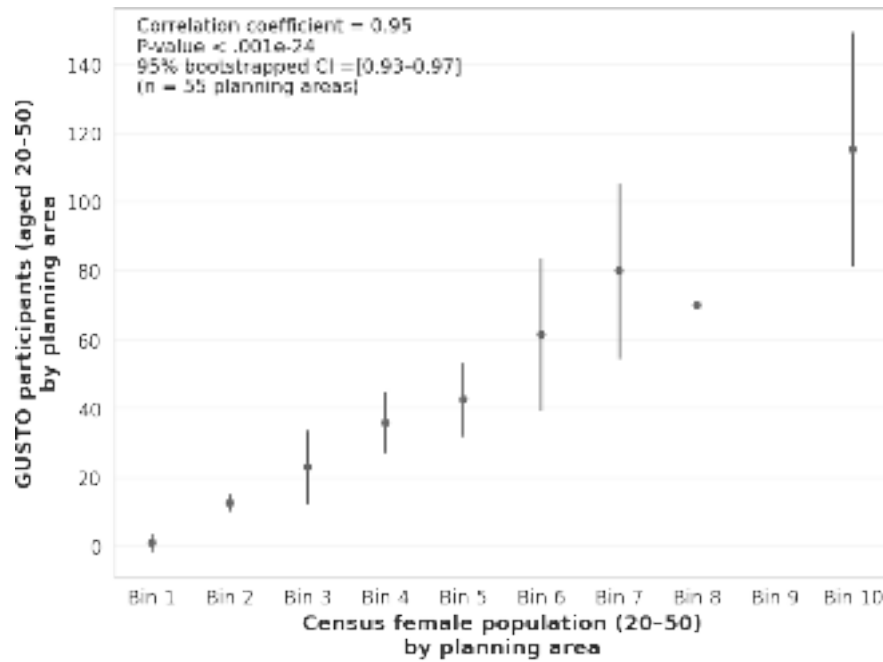
Figure A.1 Examples of neighborhood/community parks using street-level images.
Source: Google Photos.

A.3 Census and study population

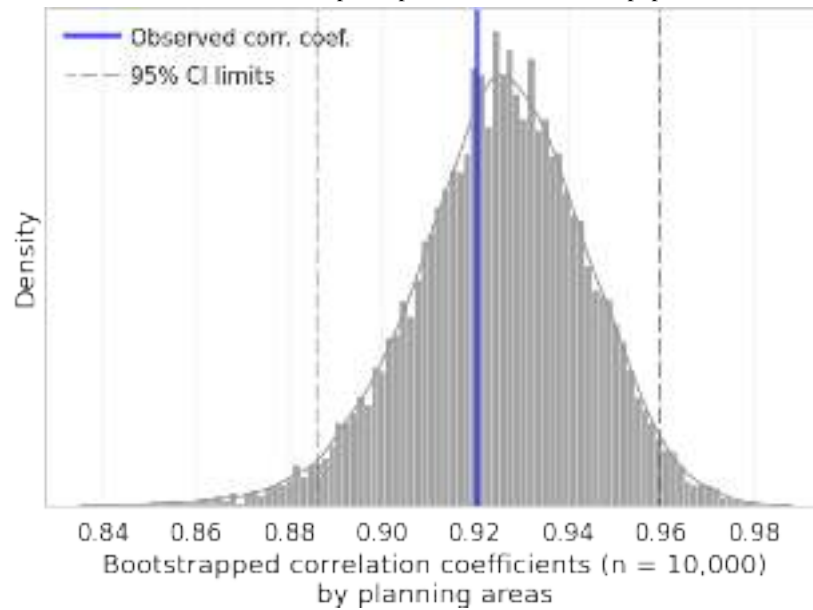
421

This appendix examines the spatial distribution of GUSTO participants across Singapore. GUSTO recruited pregnant women during their first-trimester antenatal visit at two major public birthing hospitals—KK Women’s and Children’s Hospital and the National University Hospital—which together serve a broad cross-section of Singapore’s population. We compare the spatial distribution of GUSTO mothers’ residences at enrolment with the 2010 census distribution of women aged 20–50 at two levels of aggregation: planning areas (55 areas; Figure A.2) and subzones (323 subzones; Figure A.3). At the planning area level, the number of GUSTO participants per area is strongly correlated with the corresponding census female population count ($r = .95$, 95% bootstrapped CI [.93, .97], $n = 10,000$ replicates). At the finer subzone level, the correlation remains high ($r = .90$). In both cases, areas with more women of childbearing age contributed proportionally more cohort participants, indicating that the cohort’s residential locations track the broader population distribution across the city.

431

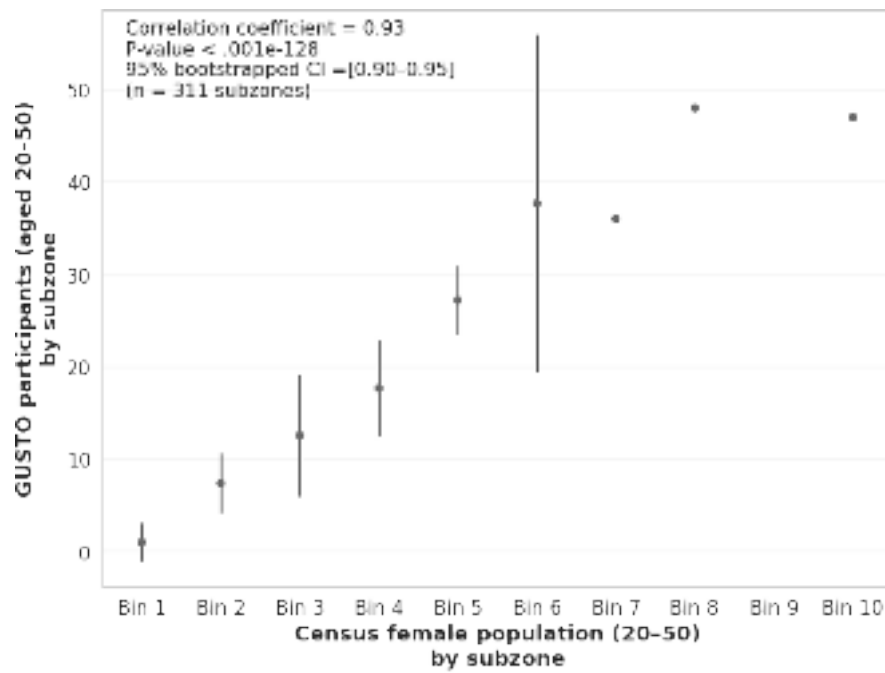


(a) Correlation between GUSTO participants and census-based population numbers

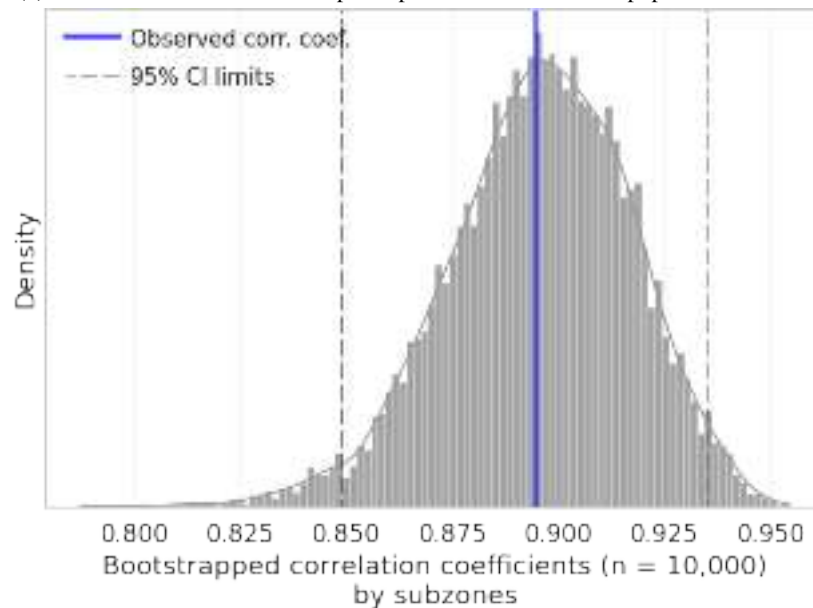


(b) Bootstrapped correlation coefficients

Figure A.2 Correlation between the number of GUSTO participants with the number of census-based women of the same age at the planning area level. Panel (a) also reports the bootstrapped (with replacement) confidence interval for the correlation coefficient (n = 10,000). Ten bins represent ten equal-interval bins of the planning areas by size of census female population aged 20–50. Solid vertical lines are standard deviations of the number of GUSTO participants in each bin. Panel (b) plots all bootstrapped correlation coefficients. Dashed vertical lines are the lower and upper limit of the bootstrapped confidence interval.



(a) Correlation between GUSTO participants and census-based population numbers



(b) Bootstrapped correlation coefficients

Figure A.3 Correlation between the number of GUSTO participants with the number of census-based women of the same age at the subzone (neighbourhood) level. Panel (a) also reports the bootstrapped (with replacement) confidence interval for the correlation coefficient (n = 10,000). Ten bins represent ten equal-interval bins of the subzones by size of census female population aged 20–50. Solid vertical lines are standard deviations of the number of GUSTO participants in each bin. Panel (b) plots all bootstrapped correlation coefficients. Dashed vertical lines are the lower and upper limit of the bootstrapped confidence interval.

A.4 Grids for commute time

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This appendix describes our measure of park accessibility based on travel times computed over a tessellation of hexagonal cells (H3 hexagonal hierarchical geospatial indexing system) across the island (Figure A.4). At resolution 9 (H3-9), each cell is approximately 0.11 km² with an average hexagonal side length of 200 metres. In total, there are around 9,000 H3-9 cells in Singapore. Most overlay with sea, water catchment, or nature reserves (Figure A.4). We retain only cells whose centroid falls within planning areas with at least 10,000 residents (unless central) and within subzones with at least 5,000 residents (unless central), yielding approximately 2,400 cells. From the resulting 2.87 million pairs of H3-9 cells, we queried HERE Technologies for walking and public transit commute times.

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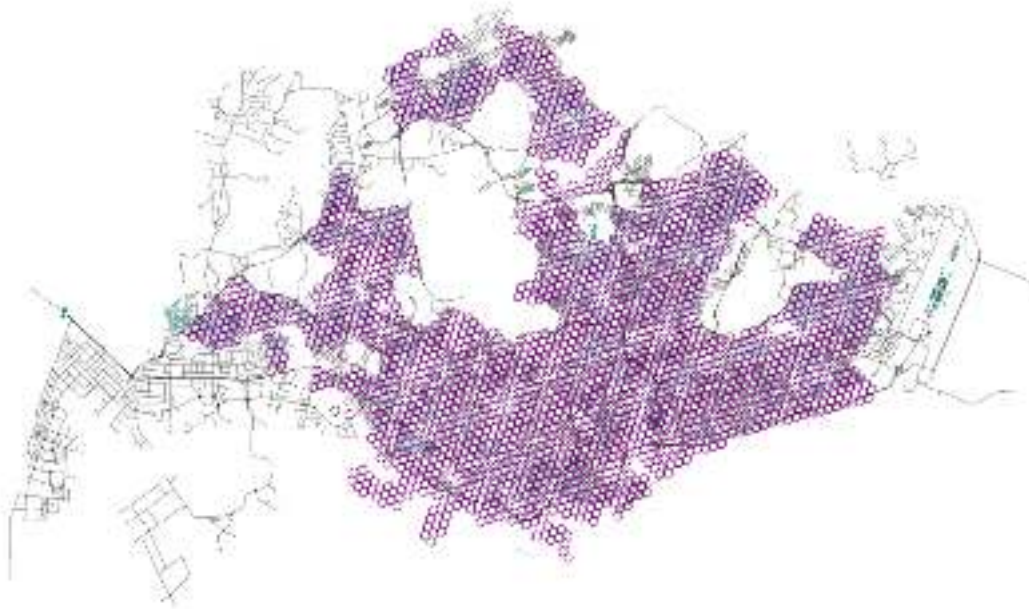
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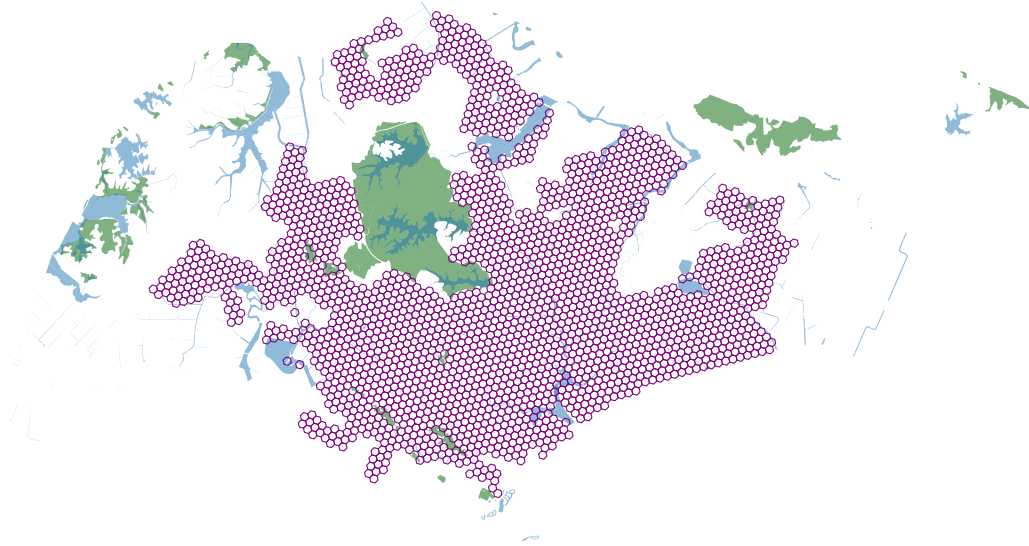
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(a) Grid of selected hexagons overlaid with buildings and roads



(b) Grid of selected hexagons overlaid with non-residential areas

Figure A.4 Grid of hexagon cells. Each cell is ~0.11 km². Subfigure (a) shows buildings and road networks as built environment. Subfigure (b) shows nature reserves, water bodies, and water catchment areas, with white areas mostly as non-residential spaces.

A.5 Age-based residential record assignment

Our measure of park access is based on the child’s residential address at each year of age (Years 0–10). Residential addresses in the cohort are updated at study visits, which may not coincide exactly with the child’s birthday. To assign each child’s neighborhood environment at a given age, we use the residential record closest in time to (but not later than) the child’s age at that year:

$$x_y = x_{t^*} \quad \text{s.t.} \quad t^* = \arg \min_{t: A_t \leq y} |y - A_t|, \quad (\text{A.1})$$

where x is the environment exposure measure based on year $y \in \{0, \dots, 10\}$, and A_t is the precise age of the child (in years) when the residential record was updated. Figure A.5 shows, for each year, the distribution of the child’s actual age when the matched residential record was last updated. The distributions clustered around the target age, indicating that the assigned address closely reflects where the child was living at that developmental period.

A.6 Age-based caregiving and involvement assignment

An analogous procedure to Appendix A.5 is used to assign caregiving and parental involvement measures to each developmental year. The Primary Caregiver Questionnaire (PCQ) was administered at select study waves: parental involvement items (e.g., who plays with the child, unstructured outings) were collected at waves corresponding approximately to Years 4–6, while primary caregiver status was collected at Years 4–10. Because children’s exact ages at survey administration vary, and the analysis requires year-specific modifier values for Years 0–10, we assign each child’s caregiving measure at year y from the PCQ wave closest in time:

$$m_y = m_{w^*} \quad \text{s.t.} \quad w^* = \arg \min_w |y - A_w|, \quad (\text{A.2})$$

where m is a caregiving modifier, $y \in \{0, \dots, 10\}$ is the developmental year, A_w is the precise age of the child (in years) when the PCQ was administered at wave w , and w ranges over the available waves for that modifier.

Figure A.6 shows, for each developmental year, the distribution of children’s ages at the matched PCQ record. At years that coincide with a directly collected wave (e.g., Years 4–10 for primary caregiver status), the distributions are tightly centred around the target age, confirming accurate matching. At years outside the collection range (e.g., Years 0–3), the distributions reflect the nearest available wave.

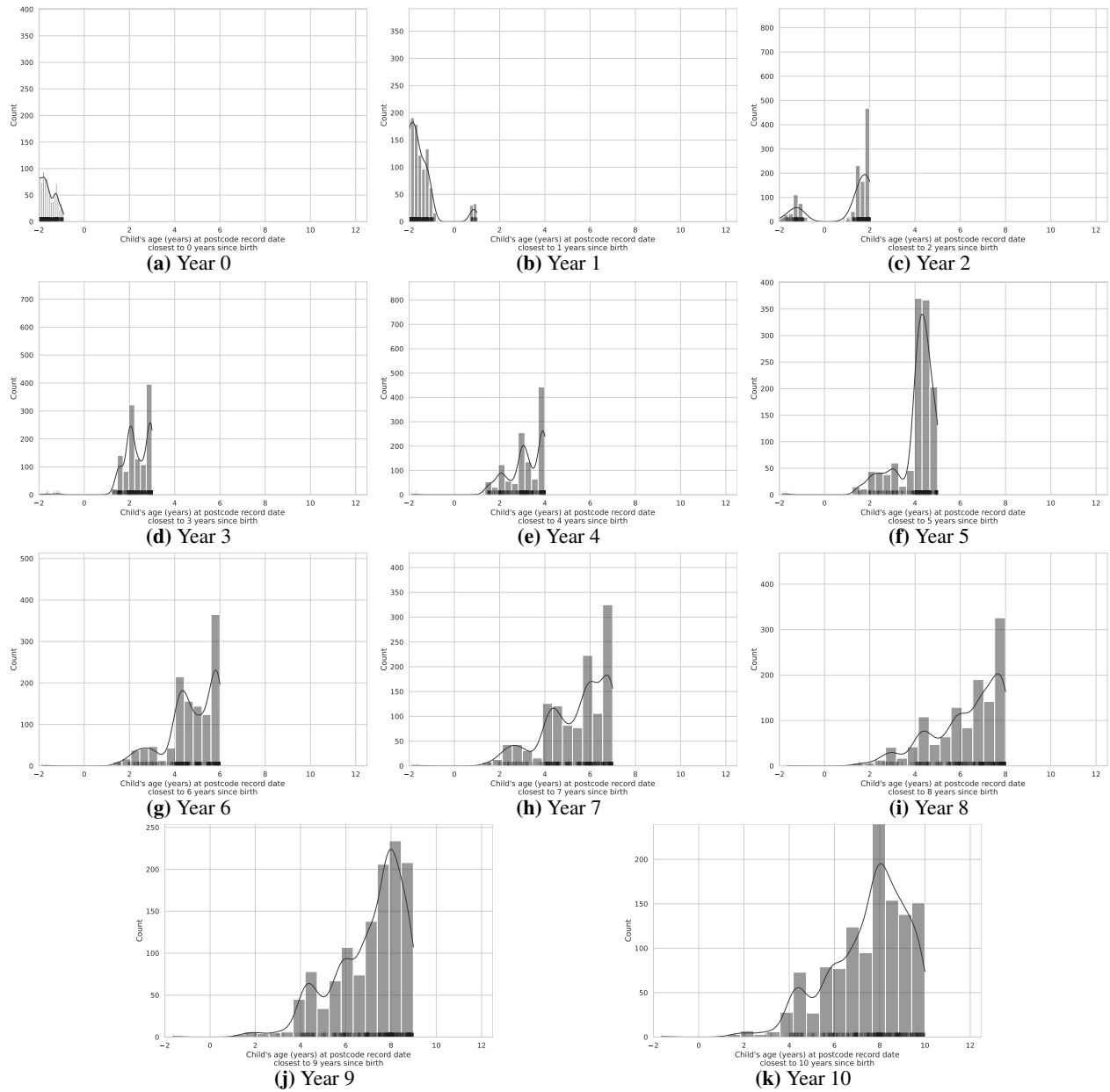


Figure A.5] Distribution of child's age at closest recorded residential update, by year. Each subfigure shows the distribution of the child's age when the nearest residential record was administratively recorded, for the year indicated. Subfigures have different y-axis scales.

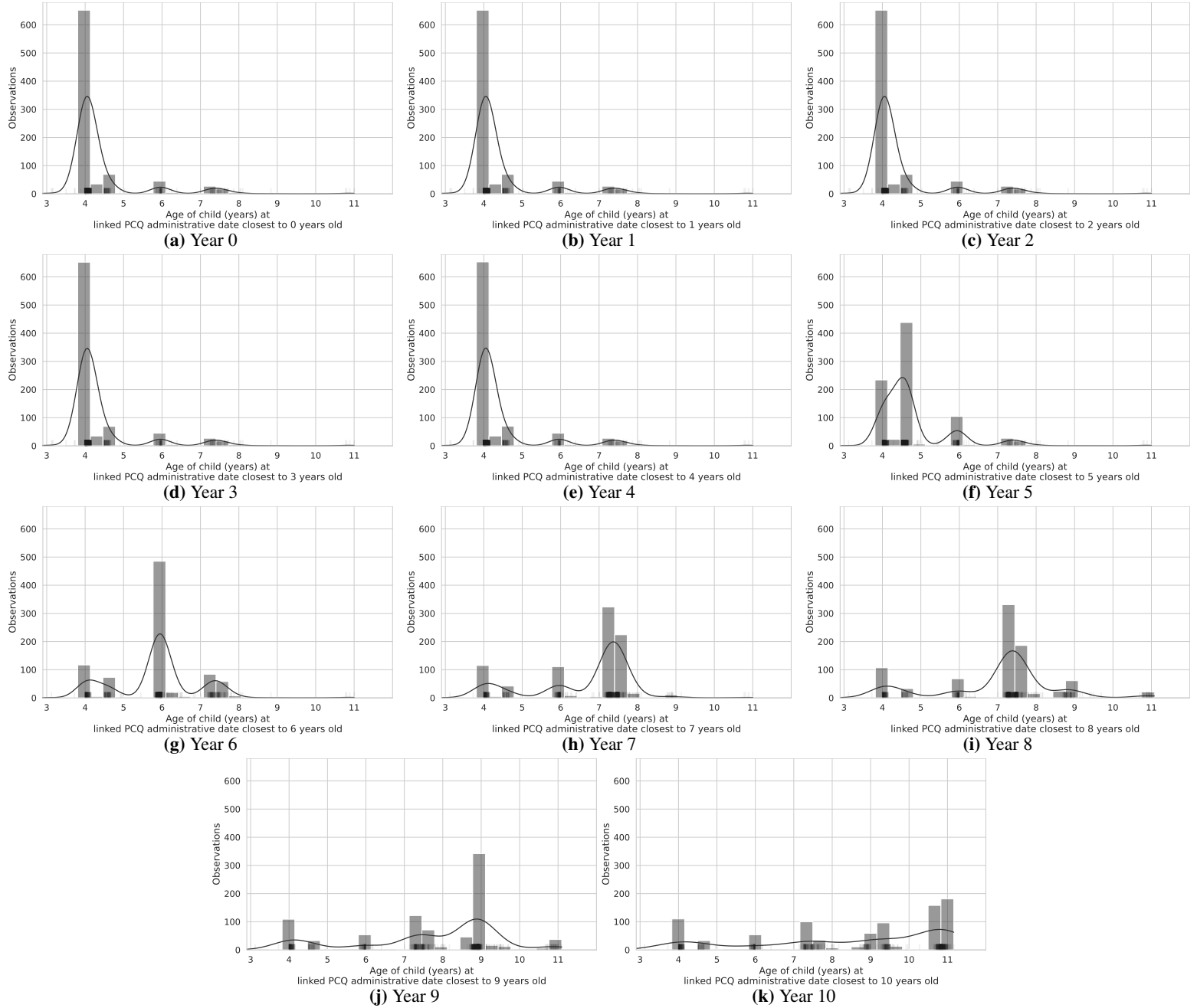


Figure A.6 Distribution of child's age at closest PCQ record with non-missing *caregiver* field (who is the primary caregiver?), by developmental year. Each subfigure links the child's age at the PCQ administration date closest to the target year using the matching equation above, where $w \in \{4, \dots, 10\}$. Common axis scales.

A.7 Concordance in parental involvement indicators

The caregiver questionnaires were predominantly completed by mothers (approximately 80% of respondents; Figure A.7). Table A.2 reports the distribution of primary caregiver designation across years. Mothers were designated as primary caregiver for 67–81% of children, increasing over time, while fathers were designated for only 2–5%.

Figure A.8 shows the concordance across the five paternal involvement indicators at Year 5. Unstructured outings is the most commonly reported paternal activity ($n = 168$), followed by play ($n = 117$), schoolwork ($n = 70$), bathing ($n = 53$), and primary caregiving ($n = 15$). The indicators exhibit low overlap. The largest single intersection ($n = 56$) consists of fathers reported as taking the child on unstructured outings but none of the other four activities; the next largest ($n = 40$) is play combined with outings only. Of the 225 fathers with at least one indicator, only 129 (31%) had at least two, 52 (13%) had at least three, and just 3 (0.7%) had all five (Panel b). This pattern suggests that the binary measures capture distinct dimensions of paternal involvement rather than a single “involved father” construct. In particular, the low concordance argues against the type of reporting bias where mothers uniformly code their partners “favorably” or “unfavorably” as involved or uninvolved across all activities: a father who takes the child on outings is not automatically reported as playing with the child or being the primary caregiver.

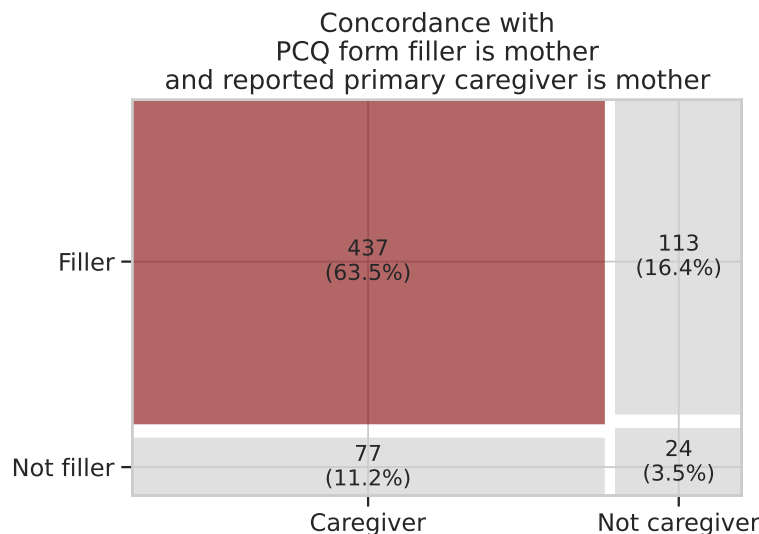
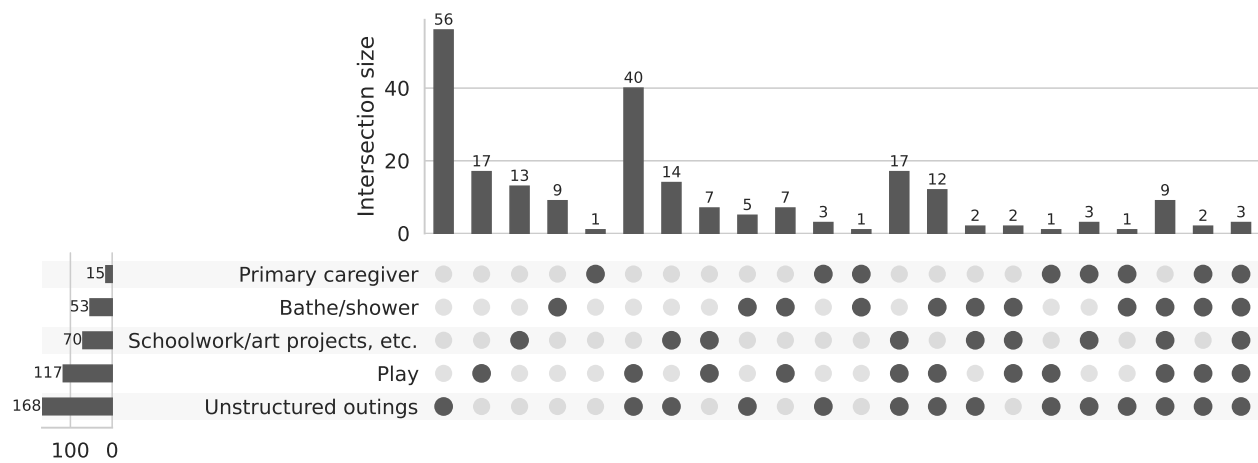


Figure A.7 Distribution of PCQ form respondents. Observations are at wave 10 of the GUSTO Primary Caregiver Questionnaire (PCQ) surveys.

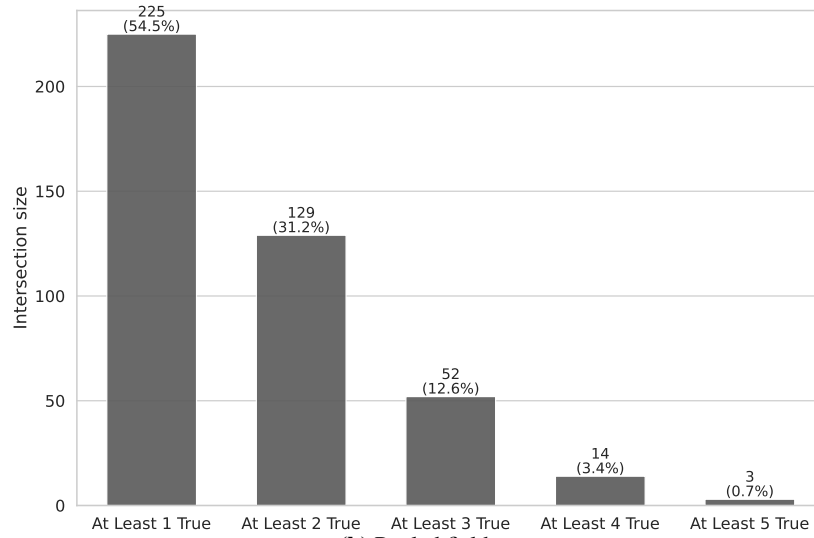
Table A.2 Coincidence in which parent is the primary caregiver to the child.

	(1)	(2)	(3)	(4)
Year	Both parents	Father only	Mother only	Neither parents
0	4 (0.93%)	21 (4.90%)	288 (67.13%)	123 (28.67%)
1	4 (0.93%)	21 (4.90%)	288 (67.13%)	123 (28.67%)
2	4 (0.93%)	21 (4.90%)	288 (67.13%)	123 (28.67%)
3	4 (0.93%)	21 (4.90%)	288 (67.13%)	123 (28.67%)
4	4 (0.93%)	21 (4.90%)	288 (67.13%)	123 (28.67%)
5	0 (0.00%)	15 (3.50%)	310 (72.26%)	103 (24.01%)
6	0 (0.00%)	9 (2.10%)	313 (72.96%)	106 (24.71%)
7	0 (0.00%)	9 (2.10%)	344 (80.19%)	75 (17.48%)
8	0 (0.00%)	9 (2.10%)	347 (80.89%)	72 (16.78%)
9	0 (0.00%)	14 (3.26%)	349 (81.35%)	65 (15.15%)
10	0 (0.00%)	21 (4.90%)	340 (79.25%)	67 (15.62%)

Notes: Table reports whether both parents (1), only the father (2), only the mother (3), or neither parents (4), are reported as the primary caregiver across the years in the sample ($N = 492$). Parentheses report the count as a percentage of the sample.



(a) Individual fields



(b) Pooled fields

Figure A.8 | Concordance in paternal involvement indicators at Year 5. Panel (a) reports concordance across the five parental involvement indicators for fathers. The lower panel indicates (i) the involvement indicators, (ii) the total number of fathers indicated, and (iii) various intersecting sets. Panel (b) reports the number of fathers with at least 1, 2, . . . , 5 of the involvement indicators. Percentages have $n = 413$ as the base (participants in the CD-RISC sample with at least one paternal involvement indicator).

Table A.3 | Cross-parent correlations for parental involvement indicators.

	Play	Unstructured outing	Primary caregiver
<i>Panel A: All respondents</i>			
Year 4 ($n = 815-819$)	-0.10**	-0.17***	-0.21***
Year 5 ($n = 815-819$)	-0.12***	-0.19***	-0.23***
Year 6 ($n = 815-819$)	-0.05	-0.12***	-0.23***
<i>Panel B: Estimation sample</i>			
Year 4 ($n = 546-586$)	-0.13**	-0.19***	-0.22***
Year 5 ($n = 546-586$)	-0.13**	-0.18***	-0.26***
Year 6 ($n = 546-586$)	-0.03	-0.10*	-0.24***

Note: Each cell reports the Pearson correlation between the maternal and paternal versions of the same indicator at the given year. Estimation sample conditions on at least one outcome (ERI or CD-RISC) being non-missing. * $p < .05$, ** $p < .01$, *** $p < .001$.

B Supplementary Tables & Figures to Main Results

This appendix provides the full regression tables and stratified coefficient plots underlying the main figures in the paper (Figures 3 to B.3). Tables B.1–B.2 report the baseline associations plotted in Figure 3. Figures B.1–B.4 show the year-specific associations separately by caregiving strata (complementing the interaction-term plots in Figures 4–B.3). The remaining tables (Tables B.3 to B.14) report the full regression output for each modifier–outcome combination. In all interaction models, parks is centered at its year-specific sample mean, so the modifier coefficient ($\hat{\delta}$) is interpretable as the direct association of the modifier at the average level of park access.

B.1 Supplementary Tables to Figure 3

Table B.1|Baseline association between Emotion Regulation Index (ERI) and Parks within 15-minute of residence.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable: Emotion Regulation Index (ERI) at Year 7								
Parks within 15-minute of residence based on residential record at year:								
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Parks within 15-min	0.04 (0.05) [−0.07–0.16] < p = 0.43 >	0.05 (0.05) [−0.06–0.16] < p = 0.35 >	−0.01 (0.05) [−0.12–0.10] < p = 0.86 >	−0.03 (0.06) [−0.15–0.08] < p = 0.56 >	0.00 (0.04) [−0.09–0.09] < p = 0.98 >	0.02 (0.04) [−0.07–0.10] < p = 0.67 >	0.00 (0.04) [−0.09–0.09] < p = 0.99 >	0.01 (0.05) [−0.08–0.10] < p = 0.86 >
R ²	0.300	0.286	0.294	0.290	0.319	0.281	0.290	0.279
Baseline (mother)	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X
Mean of outcome	25.5	25.5	25.5	25.5	25.5	25.6	25.5	25.5
Std. dev. X	8.9	8.9	9.1	9.6	9.8	10.2	10.3	10.2
Clusters	28	28	28	28	28	28	28	29
N	453	452	454	459	458	460	463	464

Note: Table reports baseline associations between ERI (always at Year 7) and Parks within 15-minute of residence based on residence at different age of the child. See Figure 3 for an alternate visualization of the estimated coefficients across years. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.2|Baseline association between CD-RISC and Parks within 15-minute of residence.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Outcome variable: Resilience (CD-RISC) at Year 10											
Parks within 15-minute of residence based on residential record at year:											
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Parks within 15-min	0.23 ^b (0.11) [0.00–0.45] < p = 0.05 >	0.18 (0.11) [−0.05–0.41] < p = 0.12 >	−0.00 (0.14) [−0.29–0.29] < p = 0.99 >	0.01 (0.15) [−0.29–0.31] < p = 0.94 >	0.06 (0.13) [−0.21–0.32] < p = 0.67 >	0.04 (0.13) [−0.24–0.31] < p = 0.79 >	0.07 (0.14) [−0.21–0.35] < p = 0.62 >	0.09 (0.16) [−0.23–0.41] < p = 0.58 >	0.06 (0.14) [−0.24–0.35] < p = 0.70 >	0.04 (0.13) [−0.22–0.31] < p = 0.75 >	0.07 (0.14) [−0.21–0.35] < p = 0.62 >
R ²	0.475	0.468	0.481	0.471	0.520	0.474	0.440	0.477	0.507	0.512	0.531
Baseline (mother)	X	X	X	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X	X	X	X
Mean of outcome	59.9	59.8	59.8	59.8	59.7	59.7	59.8	59.8	59.8	59.8	59.8
Std. dev. X	8.6	8.7	9.0	9.5	9.3	9.8	9.9	9.7	9.7	9.6	9.9
Clusters	29	29	28	28	28	28	28	29	30	30	30
N	380	379	380	382	381	382	384	386	385	383	383

Note: Table reports baseline associations between CD-RISC (always at Year 10) and Parks within 15-minute of residence based on residence at different age of the child. See Figure 3 for an alternate visualization of the estimated coefficients across years. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

B.2 Associations by Caregiving Strata

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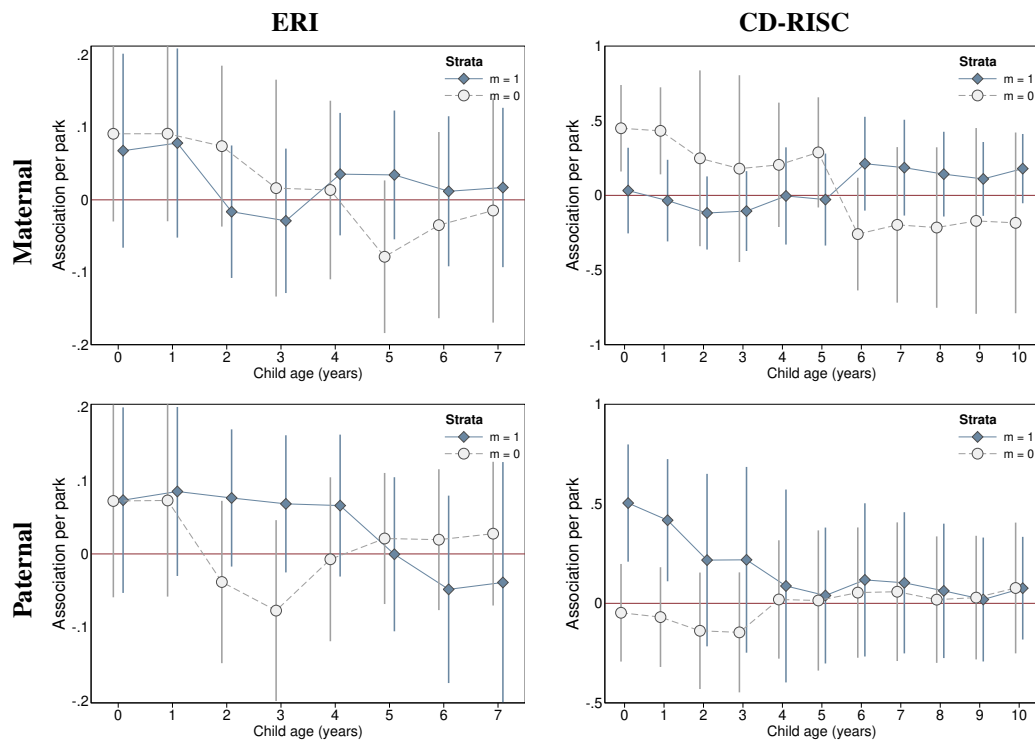


Figure B.1|Unstructured outing modifier ($m = 1$ if mother/father takes the child on unstructured outings most of the time, 0 if not). Each panel shows the year-specific association ($\hat{\beta}_1^{(y)}$) separately for children whose father/mother takes them on unstructured outings (solid) or does not (dashed), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor–Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom) unstructured outings. See [Figure 4](#) for the interaction terms and [Appendix B.3](#) for regression tables.

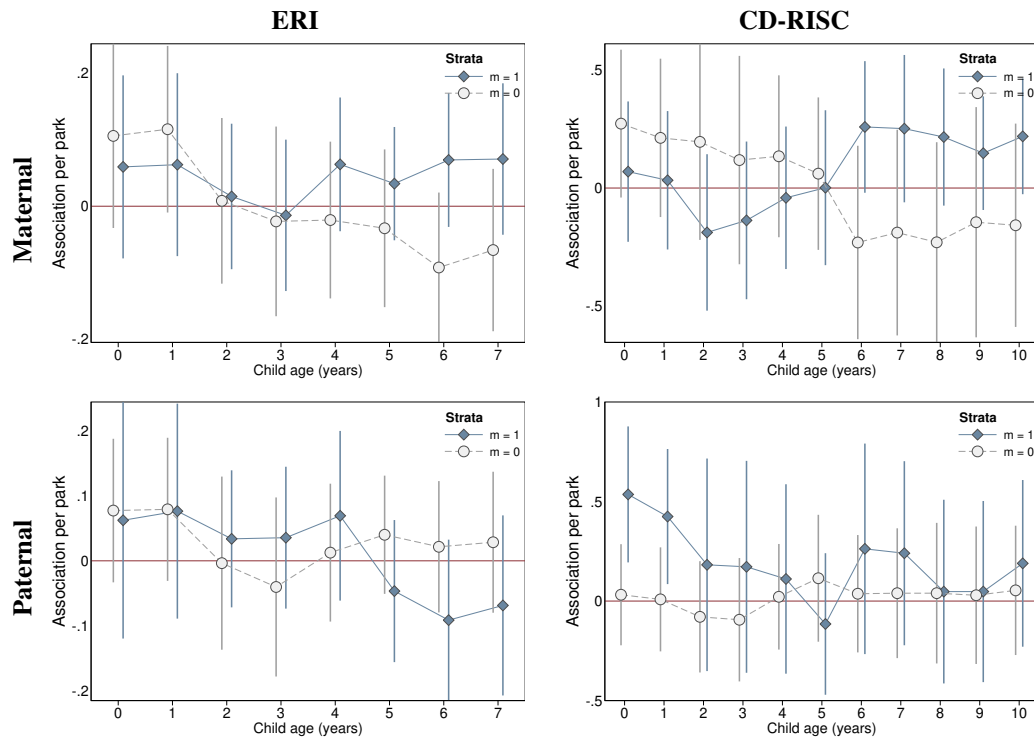


Figure B.2|Play modifier ($m = 1$ if mother/father plays with the child most of the time, 0 if not). Each panel shows the year-specific association ($\hat{\beta}_1^{(y)}$) separately for children whose father/mother plays with them (solid) or does not (dashed), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor–Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom) play. See [Figure 5](#) for the interaction terms and [Appendix B.4](#) for regression tables.

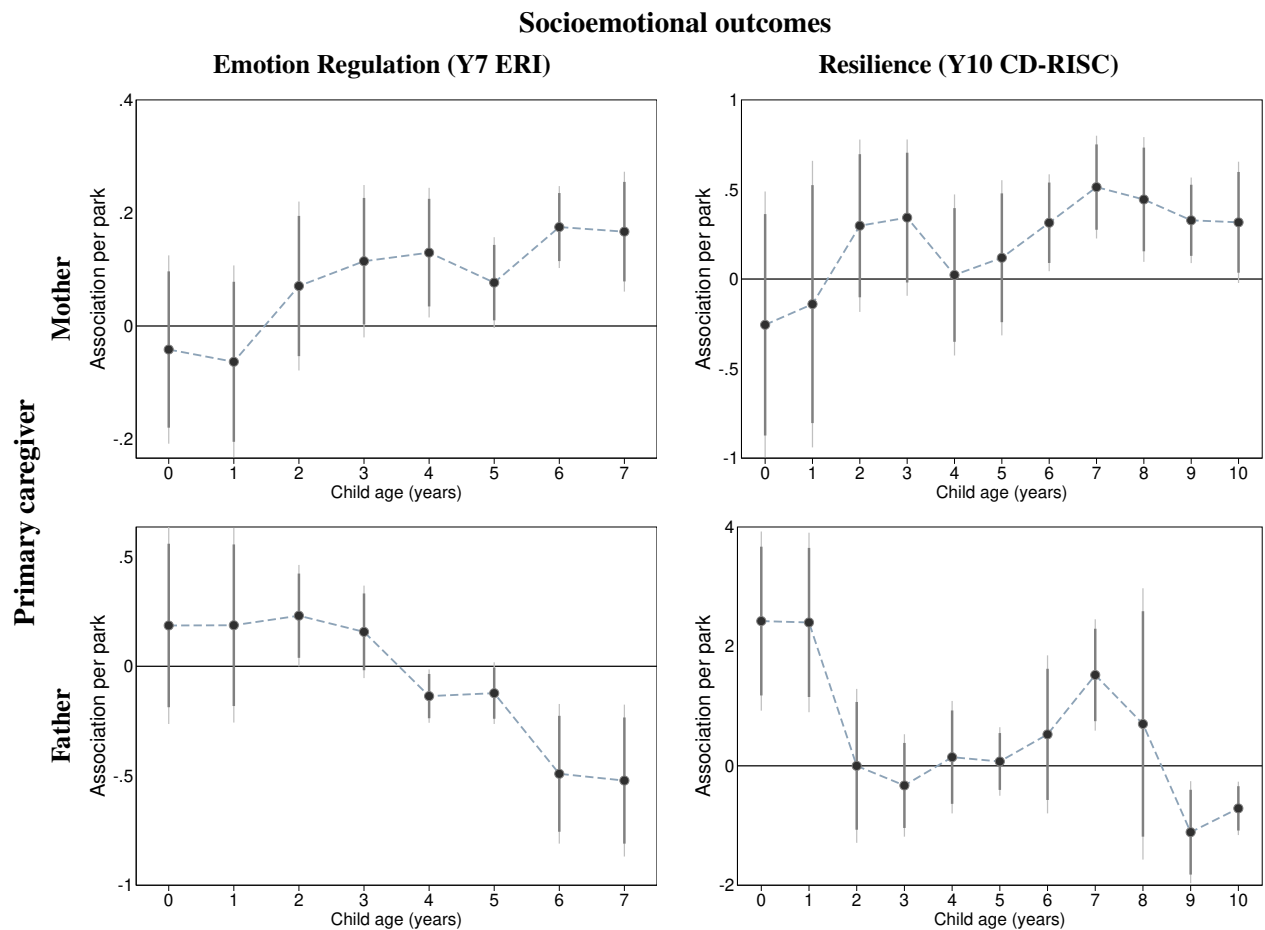


Figure B.3|Primary caregiver as a modifier of the park–outcome association, by child age. Each panel shows how the mother (top) or father (bottom) being the primary caregiver modifies the association between park access and the outcome. ERI is reverse-coded. Markers are year-specific estimates with 95% confidence intervals.

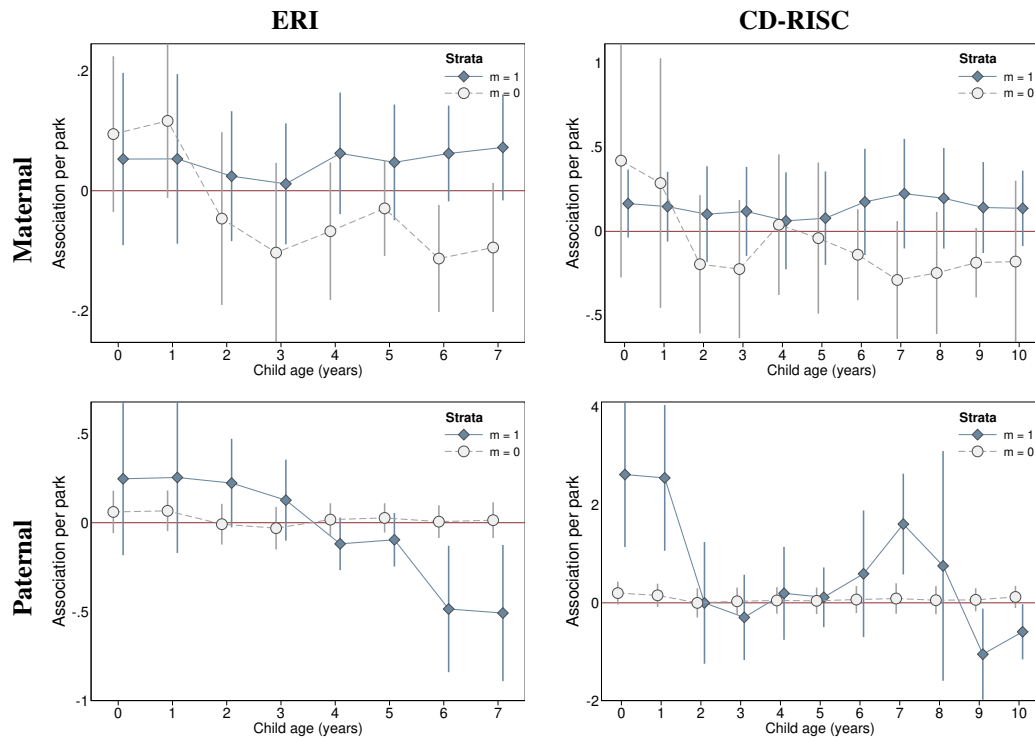


Figure B.4|Primary caregiver modifier ($m = 1$ if mother/father is primary caregiver, 0 if not). Each panel shows the year-specific association ($\hat{\beta}_1^{(y)}$) separately for children whose father/mother is (solid) or is not (dashed) the primary caregiver, with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor-Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom) primary caregiver. See [Figure B.3](#) for the interaction terms and [Appendix B.5](#) for regression tables.

B.3 Supplementary Tables to Figure 4

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Table B.3ERI and Parks: maternal unstructured outing modifier ($m = 1$ if mother takes child on unstructured outings most often, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable: Emotion Regulation Index (ERI) at Year 7								
Parks within 15-minute of residence based on residential record at year:								
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Parks within 15-min	0.09 (0.06) [−0.03–0.21] < $p = 0.13$ >	0.09 (0.06) [−0.03–0.21] < $p = 0.13$ >	0.07 (0.05) [−0.04–0.19] < $p = 0.18$ >	0.02 (0.07) [−0.13–0.17] < $p = 0.83$ >	0.01 (0.06) [−0.11–0.14] < $p = 0.82$ >	−0.08 (0.05) [−0.18–0.03] < $p = 0.14$ >	−0.03 (0.06) [−0.16–0.09] < $p = 0.58$ >	−0.01 (0.08) [−0.17–0.14] < $p = 0.85$ >
Caregiver modifier	−0.19 (0.67) [−1.57–1.19] < $p = 0.78$ >	−0.26 (0.67) [−1.64–1.12] < $p = 0.70$ >	−0.30 (0.58) [−1.50–0.90] < $p = 0.61$ >	−0.46 (0.65) [−1.80–0.88] < $p = 0.49$ >	−0.72 (0.66) [−2.07–0.62] < $p = 0.28$ >	−0.32 (0.69) [−1.73–1.10] < $p = 0.65$ >	0.22 (0.85) [−1.52–1.96] < $p = 0.80$ >	0.16 (0.81) [−1.51–1.82] < $p = 0.85$ >
(Parks within 15-min) × (Caregiver modifier)	−0.02 (0.05) [−0.14–0.09] < $p = 0.67$ >	−0.01 (0.06) [−0.13–0.11] < $p = 0.83$ >	−0.09 ^b (0.04) [−0.17– − 0.01] < $p = 0.02$ >	−0.05 (0.05) [−0.15–0.05] < $p = 0.36$ >	0.02 (0.05) [−0.09–0.13] < $p = 0.68$ >	0.11 ^b (0.04) [0.02–0.20] < $p = 0.02$ >	0.05 (0.06) [−0.07–0.16] < $p = 0.42$ >	0.03 (0.07) [−0.11–0.17] < $p = 0.64$ >
R ²	0.322	0.319	0.344	0.317	0.351	0.317	0.316	0.307
Baseline (mother)	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X
Mean of outcome	25.5	25.5	25.5	25.5	25.5	25.6	25.5	25.5
Std. dev. X	8.8	8.9	9.4	9.7	9.9	10.3	10.4	10.2
N(Modifier* = 1)	291	291	292	295	293	305	303	304
Clusters	28	28	28	28	28	28	28	29
N	415	415	416	420	419	421	424	425

Note: See Figure 4 for interaction terms and Figure B.1 for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.4|CD-RISC and Parks: maternal unstructured outing modifier ($m = 1$ if mother takes child on unstructured outings most often, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Outcome variable: Resilience (CD-RISC) at Year 10											
	Parks within 15-minute of residence based on residential record at year:										
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Parks within 15-min	0.45 ^a (0.14)	0.43 ^a (0.14)	0.25 (0.29)	0.18 (0.30)	0.20 (0.20)	0.29 (0.18)	-0.26 (0.18)	-0.20 (0.25)	-0.22 (0.26)	-0.17 (0.30)	-0.18 (0.30)
	[0.16-0.74]	[0.14-0.72]	[-0.34-0.84]	[-0.45-0.80]	[-0.21-0.62]	[-0.08-0.66]	[-0.64-0.12]	[-0.72-0.32]	[-0.75-0.32]	[-0.79-0.45]	[-0.79-0.42]
	< $p = 0.00$ >	< $p = 0.01$ >	< $p = 0.39$ >	< $p = 0.56$ >	< $p = 0.32$ >	< $p = 0.12$ >	< $p = 0.17$ >	< $p = 0.44$ >	< $p = 0.42$ >	< $p = 0.58$ >	< $p = 0.54$ >
Caregiver modifier	1.96 (2.62)	2.32 (2.55)	1.74 (2.35)	1.97 (2.24)	0.73 (2.72)	-2.01 (2.94)	0.77 (2.04)	0.36 (1.95)	-0.40 (1.96)	-0.06 (2.16)	-0.67 (2.41)
	[-3.41-7.32]	[-2.90-7.54]	[-3.09-6.56]	[-2.63-6.58]	[-4.85-6.31]	[-8.04-4.01]	[-3.41-4.95]	[-3.63-4.36]	[-4.41-3.60]	[-4.48-4.35]	[-5.59-4.26]
	< $p = 0.46$ >	< $p = 0.37$ >	< $p = 0.47$ >	< $p = 0.39$ >	< $p = 0.79$ >	< $p = 0.50$ >	< $p = 0.71$ >	< $p = 0.85$ >	< $p = 0.84$ >	< $p = 0.98$ >	< $p = 0.78$ >
(Parks within 15-min) × (Caregiver modifier)	-0.42 ^c (0.22)	-0.47 ^b (0.21)	-0.37 (0.25)	-0.28 (0.26)	-0.21 (0.26)	-0.32 (0.22)	0.47 ^a (0.15)	0.38 ^c (0.21)	0.36 ^c (0.21)	0.28 (0.28)	0.36 (0.28)
	[-0.86-0.03]	[-0.89--0.04]	[-0.88-0.15]	[-0.81-0.24]	[-0.74-0.33]	[-0.77-0.14]	[0.16-0.78]	[-0.06-0.82]	[-0.07-0.78]	[-0.29-0.85]	[-0.20-0.93]
	< $p = 0.06$ >	< $p = 0.03$ >	< $p = 0.16$ >	< $p = 0.28$ >	< $p = 0.43$ >	< $p = 0.17$ >	< $p = 0.00$ >	< $p = 0.09$ >	< $p = 0.10$ >	< $p = 0.32$ >	< $p = 0.20$ >
R ²	0.490	0.485	0.492	0.483	0.524	0.479	0.448	0.485	0.514	0.516	0.543
Baseline (mother)	X	X	X	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X	X	X	X
Mean of outcome	60.0	60.0	59.9	59.9	59.8	59.8	59.9	59.9	60.0	59.9	59.9
Std. dev. X	8.4	8.4	9.1	9.4	9.4	9.8	10.0	9.7	9.8	9.7	9.9
N(Modifier* = 1)	263	263	263	265	264	272	273	275	274	272	272
Clusters	29	29	28	28	28	28	28	29	30	30	30
N	368	368	368	370	369	370	372	374	373	371	371

Note: See Figure 4 for interaction terms and Figure B.1 for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.5|ERI and Parks: paternal unstructured outing modifier ($m = 1$ if father takes child on unstructured outings most often, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable: Emotion Regulation Index (ERI) at Year 7								
	Parks within 15-minute of residence based on residential record at year:							
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Parks within 15-min	0.07 (0.06)	0.07 (0.06)	-0.04 (0.05)	-0.08 (0.06)	-0.01 (0.05)	0.02 (0.04)	0.02 (0.05)	0.03 (0.05)
	[-0.06-0.20]	[-0.06-0.20]	[-0.15-0.07]	[-0.20-0.05]	[-0.12-0.10]	[-0.07-0.11]	[-0.08-0.12]	[-0.07-0.13]
	< $p = 0.27$ >	< $p = 0.26$ >	< $p = 0.48$ >	< $p = 0.21$ >	< $p = 0.89$ >	< $p = 0.63$ >	< $p = 0.68$ >	< $p = 0.57$ >
Caregiver modifier	0.96 (0.76)	0.97 (0.76)	0.97 (0.65)	0.50 (0.58)	0.45 (0.66)	0.17 (0.57)	-0.35 (0.74)	-0.31 (0.83)
	[-0.61-2.52]	[-0.58-2.53]	[-0.36-2.30]	[-0.70-1.70]	[-0.90-1.80]	[-1.00-1.34]	[-1.88-1.17]	[-2.01-1.40]
	< $p = 0.22$ >	< $p = 0.21$ >	< $p = 0.15$ >	< $p = 0.40$ >	< $p = 0.50$ >	< $p = 0.77$ >	< $p = 0.64$ >	< $p = 0.71$ >
(Parks within 15-min) × (Caregiver modifier)	0.00 (0.05)	0.01 (0.05)	0.11 ^b (0.05)	0.15 ^a (0.04)	0.07 (0.06)	-0.02 (0.04)	-0.07 (0.05)	-0.07 (0.06)
	[-0.10-0.10]	[-0.09-0.11]	[0.01-0.22]	[0.05-0.24]	[-0.06-0.21]	[-0.11-0.06]	[-0.16-0.03]	[-0.20-0.06]
	< $p = 0.98$ >	< $p = 0.80$ >	< $p = 0.04$ >	< $p = 0.00$ >	< $p = 0.26$ >	< $p = 0.60$ >	< $p = 0.15$ >	< $p = 0.30$ >
R ²	0.327	0.323	0.352	0.327	0.352	0.311	0.318	0.310
Baseline (mother)	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X
Mean of outcome	25.5	25.5	25.5	25.5	25.5	25.6	25.5	25.5
Std. dev. X	8.8	8.9	9.4	9.7	9.9	10.3	10.4	10.2
N(Modifier* = 1)	168	168	168	170	169	164	135	135
Clusters	28	28	28	28	28	28	28	29
N	415	415	416	420	419	421	424	425

Note: See Figure 4 for interaction terms and Figure B.1 for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.6|CD-RISC and Parks: paternal unstructured outing modifier ($m = 1$ if father takes child on unstructured outings most often, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Outcome variable: Resilience (CD-RISC) at Year 10										
	Parks within 15-minute of residence based on residential record at year:										
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Parks within 15-min	-0.05 (0.12) [-0.29-0.20]	-0.07 (0.12) [-0.32-0.18]	-0.14 (0.14) [-0.43-0.15]	-0.15 (0.15) [-0.45-0.16]	0.02 (0.14) [-0.28-0.32]	0.01 (0.17) [-0.34-0.37]	0.05 (0.16) [-0.27-0.38]	0.06 (0.17) [-0.29-0.41]	0.02 (0.16) [-0.30-0.34]	0.03 (0.15) [-0.28-0.34]	0.08 (0.16) [-0.25-0.41]
Caregiver modifier	< $p = 0.70$ > 1.24 (1.86)	< $p = 0.58$ > 1.35 (1.83)	< $p = 0.34$ > 1.89 (1.98)	< $p = 0.33$ > 1.45 (2.00)	< $p = 0.89$ > 2.95 (2.30)	< $p = 0.93$ > 1.96 (2.35)	< $p = 0.74$ > 4.31 ^b (1.78)	< $p = 0.73$ > 3.76 ^b (1.79)	< $p = 0.91$ > 4.39 ^a (1.40)	< $p = 0.85$ > 5.53 ^a (1.66)	< $p = 0.63$ > 4.71 ^b (1.99)
(Parks within 15-min) × (Caregiver modifier)	< $p = 0.51$ > 0.55 ^a (0.17)	< $p = 0.47$ > 0.49 ^a (0.17)	< $p = 0.35$ > 0.36 ^c (0.19)	< $p = 0.47$ > 0.36 ^c (0.19)	< $p = 0.21$ > 0.07 (0.27)	< $p = 0.41$ > 0.02 (0.17)	< $p = 0.02$ > 0.06 (0.19)	< $p = 0.04$ > 0.04 (0.15)	< $p = 0.00$ > 0.04 (0.12)	< $p = 0.00$ > -0.01 (0.14)	< $p = 0.03$ > -0.00 (0.17)
	[0.21-0.90] < $p = 0.00$ >	[0.14-0.84] < $p = 0.01$ >	[-0.04-0.75] < $p = 0.08$ >	[-0.02-0.75] < $p = 0.06$ >	[-0.48-0.62] < $p = 0.80$ >	[-0.33-0.38] < $p = 0.89$ >	[-0.33-0.46] < $p = 0.75$ >	[-0.27-0.36] < $p = 0.77$ >	[-0.20-0.29] < $p = 0.72$ >	[-0.30-0.28] < $p = 0.95$ >	[-0.35-0.35] < $p = 1.00$ >
R ²	0.493	0.483	0.493	0.484	0.526	0.476	0.449	0.486	0.518	0.527	0.548
Baseline (mother)	X	X	X	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X	X	X	X
Mean of outcome	60.0	60.0	59.9	59.9	59.8	59.8	59.9	59.9	60.0	59.9	59.9
Std. dev. X	8.4	8.4	9.1	9.4	9.4	9.8	10.0	9.7	9.8	9.7	9.9
N(Modifier* = 1)	146	146	145	146	145	153	123	124	124	123	123
Clusters	29	29	28	28	28	28	28	29	30	30	30
N	368	368	368	370	369	370	372	374	373	371	371

Note: See [Figure 4](#) for interaction terms and [Figure B.1](#) for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

B.4 Supplementary Tables to Figure 5

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Table B.7|ERI and Parks: maternal play modifier ($m = 1$ if mother plays with child most often, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable: Emotion Regulation Index (ERI) at Year 7								
Parks within 15-minute of residence based on residential record at year:								
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Parks within 15-min	0.11 (0.07) [−0.03–0.24] < $p = 0.13$ >	0.12 ^c (0.06) [−0.01–0.24] < $p = 0.07$ >	0.01 (0.06) [−0.12–0.13] < $p = 0.89$ >	−0.02 (0.07) [−0.17–0.12] < $p = 0.75$ >	−0.02 (0.06) [−0.14–0.10] < $p = 0.72$ >	−0.03 (0.06) [−0.15–0.09] < $p = 0.57$ >	−0.09 (0.05) [−0.20–0.02] < $p = 0.10$ >	−0.07 (0.06) [−0.19–0.06] < $p = 0.28$ >
Caregiver modifier	−0.43 (0.81) [−2.10–1.23] < $p = 0.60$ >	−0.50 (0.83) [−2.19–1.19] < $p = 0.55$ >	0.28 (0.72) [−1.19–1.75] < $p = 0.70$ >	−0.06 (0.79) [−1.67–1.55] < $p = 0.94$ >	−0.55 (0.80) [−2.20–1.09] < $p = 0.50$ >	0.44 (0.66) [−0.92–1.80] < $p = 0.51$ >	0.81 (0.56) [−0.33–1.95] < $p = 0.16$ >	0.75 (0.52) [−0.33–1.82] < $p = 0.17$ >
(Parks within 15-min) × (Caregiver modifier)	−0.05 (0.07) [−0.20–0.10] < $p = 0.53$ >	−0.05 (0.07) [−0.20–0.09] < $p = 0.45$ >	0.01 (0.06) [−0.11–0.13] < $p = 0.91$ >	0.01 (0.06) [−0.11–0.12] < $p = 0.87$ >	0.08 (0.07) [−0.06–0.23] < $p = 0.25$ >	0.07 (0.06) [−0.05–0.18] < $p = 0.24$ >	0.16 ^a (0.05) [0.06–0.27] < $p = 0.00$ >	0.14 ^b (0.06) [0.02–0.25] < $p = 0.02$ >
R ²	0.324	0.321	0.341	0.315	0.354	0.315	0.334	0.321
Baseline (mother)	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X
Mean of outcome	25.5	25.5	25.5	25.5	25.5	25.6	25.5	25.5
Std. dev. X	8.8	8.9	9.4	9.7	9.9	10.3	10.4	10.2
N(Modifier* = 1)	233	233	232	235	236	244	256	256
Clusters	28	28	28	28	28	28	28	29
N	415	415	416	420	419	421	424	425

Note: See Figure 5 for interaction terms and Figure B.2 for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.8|CD-RISC and Parks: maternal play modifier ($m = 1$ if mother plays with child most often, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Outcome variable: Resilience (CD-RISC) at Year 10										
	Parks within 15-minute of residence based on residential record at year:										
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Parks within 15-min	0.27 ^c (0.15) [-0.04-0.59]	0.21 (0.16) [-0.12-0.55]	0.20 (0.20) [-0.22-0.61]	0.12 (0.22) [-0.32-0.56]	0.13 (0.17) [-0.21-0.48]	0.06 (0.16) [-0.26-0.38]	-0.23 (0.20) [-0.64-0.18]	-0.19 (0.21) [-0.63-0.25]	-0.23 (0.21) [-0.65-0.19]	-0.14 (0.24) [-0.63-0.34]	-0.16 (0.21) [-0.59-0.27]
Caregiver modifier	< $p = 0.08$ > 2.61 (2.07)	< $p = 0.20$ > 2.81 (2.03)	< $p = 0.34$ > 2.73 (1.91)	< $p = 0.59$ > 1.47 (2.41)	< $p = 0.43$ > 1.98 (2.27)	< $p = 0.70$ > 1.24 (1.81)	< $p = 0.26$ > -0.87 (2.92)	< $p = 0.38$ > -0.46 (2.95)	< $p = 0.28$ > 0.90 (2.57)	< $p = 0.55$ > 1.38 (2.70)	< $p = 0.46$ > 1.34 (2.63)
(Parks within 15-min) × (Caregiver modifier)	< $p = 0.22$ > -0.20 (0.23) [-0.67-0.27]	< $p = 0.18$ > -0.18 (0.24) [-0.66-0.30]	< $p = 0.16$ > -0.38 ^c (0.20) [-0.79-0.03]	< $p = 0.55$ > -0.26 (0.19) [-0.64-0.13]	< $p = 0.39$ > -0.18 (0.18) [-0.54-0.18]	< $p = 0.50$ > -0.06 (0.16) [-0.39-0.28]	< $p = 0.77$ > 0.49 ^a (0.15) [0.17-0.81]	< $p = 0.88$ > 0.44 ^a (0.16) [0.12-0.76]	< $p = 0.73$ > 0.45 ^a (0.13) [0.17-0.72]	< $p = 0.61$ > 0.29 (0.20) [-0.11-0.70]	< $p = 0.61$ > 0.38 ^b (0.17) [0.04-0.72]
	< $p = 0.38$ >	< $p = 0.45$ >	< $p = 0.06$ >	< $p = 0.18$ >	< $p = 0.32$ >	< $p = 0.72$ >	< $p = 0.00$ >	< $p = 0.01$ >	< $p = 0.00$ >	< $p = 0.15$ >	< $p = 0.03$ >
R ²	0.487	0.480	0.496	0.482	0.525	0.475	0.452	0.489	0.519	0.518	0.546
Baseline (mother)	X	X	X	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X	X	X	X
Mean of outcome	60.0	60.0	59.9	59.9	59.8	59.8	59.9	59.9	60.0	59.9	59.9
Std. dev. X	8.4	8.4	9.1	9.4	9.4	9.8	10.0	9.7	9.8	9.7	9.9
N(Modifier* = 1)	207	207	208	209	211	226	233	234	234	233	233
Clusters	29	29	28	28	28	28	28	29	30	30	30
N	368	368	368	370	369	370	372	374	373	371	371

Note: See [Figure 5](#) for interaction terms and [Figure B.2](#) for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.9|ERI and Parks: paternal play modifier ($m = 1$ if father plays with child most often, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Outcome variable: Emotion Regulation Index (ERI) at Year 7							
	Parks within 15-minute of residence based on residential record at year:							
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Parks within 15-min	0.08 (0.05) [-0.03-0.19]	0.08 (0.05) [-0.03-0.19]	-0.00 (0.06) [-0.14-0.13]	-0.04 (0.07) [-0.18-0.10]	0.01 (0.05) [-0.09-0.12]	0.04 (0.04) [-0.05-0.13]	0.02 (0.05) [-0.08-0.12]	0.03 (0.05) [-0.08-0.14]
Caregiver modifier	< $p = 0.16$ > 1.19 (0.75)	< $p = 0.15$ > 1.25 ^c (0.71)	< $p = 0.96$ > 1.03 (0.66)	< $p = 0.55$ > 0.74 (0.70)	< $p = 0.81$ > 0.93 (0.58)	< $p = 0.37$ > 1.41 ^b (0.56)	< $p = 0.66$ > 0.41 (0.55)	< $p = 0.59$ > 0.42 (0.58)
(Parks within 15-min) × (Caregiver modifier)	< $p = 0.12$ > -0.01 (0.07) [-0.17-0.14]	< $p = 0.09$ > -0.00 (0.07) [-0.14-0.13]	< $p = 0.13$ > 0.04 (0.07) [-0.11-0.19]	< $p = 0.29$ > 0.08 (0.06) [-0.05-0.20]	< $p = 0.12$ > 0.06 (0.08) [-0.10-0.21]	< $p = 0.02$ > -0.09 ^c (0.05) [-0.18-0.01]	< $p = 0.46$ > -0.11 ^b (0.05) [-0.22- -0.01]	< $p = 0.48$ > -0.10 ^c (0.05) [-0.21-0.01]
	< $p = 0.84$ >	< $p = 0.97$ >	< $p = 0.62$ >	< $p = 0.22$ >	< $p = 0.46$ >	< $p = 0.08$ >	< $p = 0.04$ >	< $p = 0.09$ >
R ²	0.328	0.325	0.346	0.320	0.353	0.324	0.321	0.312
Baseline (mother)	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X
Mean of outcome	25.5	25.5	25.5	25.5	25.5	25.6	25.5	25.5
Std. dev. X	8.8	8.9	9.4	9.7	9.9	10.3	10.4	10.2
N(Modifier* = 1)	115	115	116	117	118	128	112	112
Clusters	28	28	28	28	28	28	28	29
N	415	415	416	420	419	421	424	425

Note: See [Figure 5](#) for interaction terms and [Figure B.2](#) for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.10CD-RISC and Parks: paternal play modifier ($m = 1$ if father plays with child most often, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Outcome variable: Resilience (CD-RISC) at Year 10										
	Parks within 15-minute of residence based on residential record at year:										
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Parks within 15-min	0.03 (0.12)	0.01 (0.13)	-0.08 (0.14)	-0.09 (0.15)	0.02 (0.13)	0.11 (0.16)	0.04 (0.14)	0.04 (0.16)	0.04 (0.17)	0.03 (0.17)	0.05 (0.16)
	[-0.22-0.29]	[-0.25-0.27]	[-0.36-0.20]	[-0.40-0.22]	[-0.24-0.29]	[-0.20-0.43]	[-0.26-0.33]	[-0.29-0.37]	[-0.31-0.39]	[-0.32-0.37]	[-0.27-0.38]
	< $p = 0.80$ >	< $p = 0.95$ >	< $p = 0.57$ >	< $p = 0.54$ >	< $p = 0.87$ >	< $p = 0.47$ >	< $p = 0.80$ >	< $p = 0.81$ >	< $p = 0.82$ >	< $p = 0.86$ >	< $p = 0.74$ >
Caregiver modifier	-2.04 (2.52)	-1.41 (2.51)	-0.84 (2.35)	-0.66 (2.56)	-0.52 (2.29)	1.04 (1.79)	1.55 (2.39)	1.12 (2.11)	2.01 (1.85)	2.02 (1.95)	1.71 (2.05)
	[-7.20-3.13]	[-6.56-3.74]	[-5.65-3.98]	[-5.90-4.59]	[-5.22-4.18]	[-2.64-4.71]	[-3.34-6.45]	[-3.21-5.45]	[-1.77-5.79]	[-1.96-6.00]	[-2.49-5.90]
	< $p = 0.43$ >	< $p = 0.58$ >	< $p = 0.72$ >	< $p = 0.80$ >	< $p = 0.82$ >	< $p = 0.57$ >	< $p = 0.52$ >	< $p = 0.60$ >	< $p = 0.29$ >	< $p = 0.31$ >	< $p = 0.41$ >
(Parks within 15-min) $\times$ (Caregiver modifier)	0.50 ^b (0.18)	0.42 ^b (0.18)	0.26 (0.24)	0.27 (0.22)	0.09 (0.20)	-0.23 (0.18)	0.23 (0.23)	0.20 (0.19)	0.01 (0.25)	0.02 (0.28)	0.14 (0.26)
	[0.13-0.88]	[0.04-0.79]	[-0.23-0.75]	[-0.19-0.73]	[-0.33-0.50]	[-0.60-0.14]	[-0.25-0.70]	[-0.18-0.58]	[-0.50-0.52]	[-0.55-0.59]	[-0.40-0.67]
	< $p = 0.01$ >	< $p = 0.03$ >	< $p = 0.28$ >	< $p = 0.25$ >	< $p = 0.66$ >	< $p = 0.22$ >	< $p = 0.34$ >	< $p = 0.29$ >	< $p = 0.97$ >	< $p = 0.95$ >	< $p = 0.61$ >
R ²	0.492	0.481	0.489	0.481	0.522	0.477	0.443	0.482	0.511	0.515	0.540
Baseline (mother)	X	X	X	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X	X	X	X
Mean of outcome	60.0	60.0	59.9	59.9	59.8	59.9	59.9	59.9	60.0	59.9	59.9
Std. dev. X	8.4	8.4	9.1	9.4	9.4	9.8	10.0	9.7	9.8	9.7	9.9
N(Modifier* = 1)	93	93	94	95	95	107	92	93	93	92	92
Clusters	29	29	28	28	28	28	28	29	30	30	30
N	368	368	368	370	369	370	372	374	373	371	371

Note: See [Figure 5](#) for interaction terms and [Figure B.2](#) for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

B.5 Supplementary Tables to Figure B.3

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Table B.11|ERI and Parks: maternal primary caregiver modifier ($m = 1$ if mother is primary caregiver, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable: Emotion Regulation Index (ERI) at Year 7								
Parks within 15-minute of residence based on residential record at year:								
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Parks within 15-min	0.09 (0.06) [−0.04–0.22] < $p = 0.15$ >	0.12 ^c (0.06) [−0.01–0.24] < $p = 0.07$ >	−0.05 (0.07) [−0.19–0.10] < $p = 0.51$ >	−0.10 (0.07) [−0.25–0.05] < $p = 0.17$ >	−0.07 (0.06) [−0.18–0.05] < $p = 0.24$ >	−0.03 (0.04) [−0.11–0.05] < $p = 0.45$ >	−0.11 ^b (0.04) [−0.20– − 0.02] < $p = 0.01$ >	−0.09 ^c (0.05) [−0.20–0.01] < $p = 0.08$ >
Caregiver modifier	−0.14 (0.71) [−1.59–1.32] < $p = 0.85$ >	−0.13 (0.72) [−1.61–1.35] < $p = 0.86$ >	0.22 (0.68) [−1.17–1.61] < $p = 0.75$ >	0.04 (0.69) [−1.37–1.44] < $p = 0.96$ >	0.09 (0.75) [−1.45–1.63] < $p = 0.91$ >	−0.09 (0.52) [−1.15–0.98] < $p = 0.87$ >	0.01 (0.54) [−1.10–1.13] < $p = 0.98$ >	0.39 (0.57) [−0.78–1.56] < $p = 0.50$ >
(Parks within 15-min) × (Caregiver modifier)	−0.04 (0.08) [−0.21–0.12] < $p = 0.61$ >	−0.06 (0.08) [−0.23–0.11] < $p = 0.45$ >	0.07 (0.07) [−0.08–0.22] < $p = 0.34$ >	0.11 ^c (0.07) [−0.02–0.25] < $p = 0.09$ >	0.13 ^b (0.06) [0.02–0.24] < $p = 0.03$ >	0.08 ^c (0.04) [−0.00–0.16] < $p = 0.06$ >	0.18 ^a (0.04) [0.10–0.25] < $p = 0.00$ >	0.17 ^a (0.05) [0.06–0.27] < $p = 0.00$ >
R ²	0.314	0.301	0.322	0.311	0.345	0.296	0.317	0.305
Baseline (mother)	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X
Mean of outcome	25.5	25.5	25.5	25.5	25.5	25.6	25.5	25.5
Std. dev. X	8.9	8.9	9.1	9.6	9.8	10.1	10.3	10.1
N(Modifier* = 1)	288	287	287	290	290	305	323	351
Clusters	28	28	28	28	28	28	28	29
N	446	445	447	452	451	453	456	457

Note: See Figure B.3 for interaction terms and Figure B.4 for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.12|CD-RISC and Parks: maternal primary caregiver modifier ($m = 1$ if mother is primary caregiver, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Outcome variable: Resilience (CD-RISC) at Year 10											
Parks within 15-minute of residence based on residential record at year:											
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Parks within 15-min	0.42 (0.34) [-0.27-1.12] < $p = 0.23$ >	0.29 (0.36) [-0.46-1.03] < $p = 0.43$ >	-0.20 (0.20) [-0.61-0.22] < $p = 0.34$ >	-0.22 (0.20) [-0.64-0.19] < $p = 0.27$ >	0.04 (0.20) [-0.38-0.46] < $p = 0.85$ >	-0.04 (0.22) [-0.49-0.41] < $p = 0.86$ >	-0.14 (0.13) [-0.41-0.13] < $p = 0.30$ >	-0.29 (0.17) [-0.64-0.06] < $p = 0.10$ >	-0.25 (0.18) [-0.61-0.12] < $p = 0.17$ >	-0.19 ^c (0.10) [-0.39-0.02] < $p = 0.08$ >	-0.18 (0.24) [-0.66-0.30] < $p = 0.45$ >
Caregiver modifier	-2.31 (3.14) [-8.74-4.11] < $p = 0.47$ >	-2.10 (3.21) [-8.67-4.46] < $p = 0.52$ >	-1.34 (3.01) [-7.51-4.84] < $p = 0.66$ >	-1.66 (2.92) [-7.66-4.33] < $p = 0.57$ >	-0.64 (2.85) [-6.49-5.22] < $p = 0.82$ >	1.14 (2.80) [-4.61-6.88] < $p = 0.69$ >	-0.03 (2.54) [-5.25-5.19] < $p = 0.99$ >	-2.51 (2.12) [-6.86-1.84] < $p = 0.25$ >	-0.20 (2.15) [-4.61-4.20] < $p = 0.92$ >	1.51 (2.65) [-3.90-6.93] < $p = 0.57$ >	-2.18 (2.28) [-6.84-2.49] < $p = 0.35$ >
(Parks within 15-min) × (Caregiver modifier)	-0.26 (0.36) [-1.00-0.49] < $p = 0.49$ >	-0.14 (0.39) [-0.94-0.66] < $p = 0.72$ >	0.30 (0.23) [-0.18-0.78] < $p = 0.22$ >	0.34 (0.21) [-0.09-0.78] < $p = 0.12$ >	0.02 (0.22) [-0.43-0.47] < $p = 0.92$ >	0.12 (0.21) [-0.31-0.55] < $p = 0.58$ >	0.31 ^b (0.13) [0.04-0.58] < $p = 0.02$ >	0.51 ^a (0.14) [0.23-0.80] < $p = 0.00$ >	0.44 ^b (0.17) [0.10-0.79] < $p = 0.01$ >	0.33 ^a (0.12) [0.09-0.57] < $p = 0.01$ >	0.32 ^c (0.17) [-0.02-0.66] < $p = 0.07$ >
R ²	0.478	0.470	0.485	0.478	0.520	0.475	0.445	0.490	0.517	0.518	0.536
Baseline (mother)	X	X	X	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X	X	X	X
Mean of outcome	59.9	59.8	59.8	59.8	59.7	59.7	59.8	59.8	59.8	59.8	59.8
Std. dev. X	8.6	8.7	9.0	9.5	9.3	9.8	9.9	9.7	9.7	9.6	9.9
N(Modifier* = 1)	256	255	256	258	258	273	281	307	311	313	305
Clusters	29	29	28	28	28	28	28	29	30	30	30
N	380	379	380	382	381	382	384	386	385	383	383

Note: See [Figure B.3](#) for interaction terms and [Figure B.4](#) for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.13|ERI and Parks: paternal primary caregiver modifier ($m = 1$ if father is primary caregiver, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable: Emotion Regulation Index (ERI) at Year 7								
Parks within 15-minute of residence based on residential record at year:								
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Parks within 15-min	0.06 (0.06) [-0.06-0.18] < $p = 0.31$ >	0.07 (0.06) [-0.05-0.18] < $p = 0.24$ >	-0.01 (0.06) [-0.12-0.11] < $p = 0.88$ >	-0.03 (0.06) [-0.15-0.09] < $p = 0.60$ >	0.02 (0.04) [-0.07-0.11] < $p = 0.70$ >	0.03 (0.04) [-0.06-0.11] < $p = 0.51$ >	0.01 (0.04) [-0.09-0.10] < $p = 0.90$ >	0.01 (0.05) [-0.09-0.11] < $p = 0.77$ >
Caregiver modifier	0.36 (1.14) [-1.98-2.70] < $p = 0.75$ >	0.39 (1.14) [-1.96-2.74] < $p = 0.74$ >	-0.09 (1.43) [-3.02-2.85] < $p = 0.95$ >	0.76 (1.30) [-1.92-3.43] < $p = 0.57$ >	0.76 (1.26) [-1.83-3.35] < $p = 0.55$ >	-1.88 ^c (1.01) [-3.95-0.19] < $p = 0.07$ >	-0.79 (2.27) [-5.45-3.88] < $p = 0.73$ >	-1.49 (1.18) [-3.91-0.93] < $p = 0.22$ >
(Parks within 15-min) × (Caregiver modifier)	0.19 (0.22) [-0.26-0.64] < $p = 0.40$ >	0.19 (0.22) [-0.26-0.63] < $p = 0.39$ >	0.23 ^c (0.11) [-0.00-0.46] < $p = 0.05$ >	0.16 (0.10) [-0.05-0.37] < $p = 0.14$ >	-0.14 ^b (0.06) [-0.26- -0.01] < $p = 0.03$ >	-0.12 ^c (0.07) [-0.26-0.02] < $p = 0.09$ >	-0.49 ^a (0.16) [-0.81- -0.17] < $p = 0.00$ >	-0.52 ^a (0.17) [-0.87- -0.18] < $p = 0.00$ >
R ²	0.315	0.301	0.326	0.309	0.339	0.298	0.309	0.301
Baseline (mother)	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X
Mean of outcome	25.5	25.5	25.5	25.5	25.5	25.6	25.5	25.5
Std. dev. X	8.9	8.9	9.1	9.6	9.8	10.1	10.3	10.1
N(Modifier* = 1)	19	19	19	19	19	17	11	10
Clusters	28	28	28	28	28	28	28	29
N	446	445	447	452	451	453	456	457

Note: See [Figure B.3](#) for interaction terms and [Figure B.4](#) for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table B.14|CD-RISC and Parks: paternal primary caregiver modifier ($m = 1$ if father is primary caregiver, 0 if not).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Outcome variable: Resilience (CD-RISC) at Year 10										
	Parks within 15-minute of residence based on residential record at year:										
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Parks within 15-min	0.20 ^c (0.11) [-0.03-0.43] < $p = 0.09$ >	0.15 (0.12) [-0.08-0.39] < $p = 0.20$ >	-0.00 (0.15) [-0.30-0.30] < $p = 0.99$ >	0.03 (0.14) [-0.25-0.31] < $p = 0.82$ >	0.05 (0.13) [-0.22-0.32] < $p = 0.72$ >	0.04 (0.13) [-0.23-0.31] < $p = 0.76$ >	0.07 (0.13) [-0.21-0.34] < $p = 0.62$ >	0.09 (0.15) [-0.22-0.40] < $p = 0.57$ >	0.05 (0.14) [-0.23-0.34] < $p = 0.71$ >	0.06 (0.12) [-0.18-0.30] < $p = 0.61$ >	0.12 (0.11) [-0.11-0.35] < $p = 0.29$ >
Caregiver modifier	3.24 (3.28) [-3.49-9.96] < $p = 0.33$ >	3.41 (3.35) [-3.45-10.27] < $p = 0.32$ >	-1.45 (5.23) [-12.19-9.28] < $p = 0.78$ >	-1.76 (3.94) [-9.84-6.32] < $p = 0.66$ >	3.64 (4.22) [-5.02-12.30] < $p = 0.40$ >	-6.55 (4.81) [-16.42-3.32] < $p = 0.18$ >	6.55 (5.30) [-4.32-17.42] < $p = 0.23$ >	-2.73 (5.74) [-14.48-9.02] < $p = 0.64$ >	5.17 (13.46) [-22.36-32.69] < $p = 0.70$ >	14.27 (9.03) [-4.20-32.75] < $p = 0.12$ >	1.81 (3.93) [-6.21-9.84] < $p = 0.65$ >
(Parks within 15-min) $\times$ (Caregiver modifier)	2.42 ^a (0.73) [0.92-3.92] < $p = 0.00$ >	2.40 ^a (0.73) [0.90-3.90] < $p = 0.00$ >	-0.00 (0.63) [-1.29-1.29] < $p = 1.00$ >	-0.33 (0.42) [-1.19-0.53] < $p = 0.44$ >	0.15 (0.46) [-0.80-1.09] < $p = 0.75$ >	0.07 (0.28) [-0.50-0.65] < $p = 0.80$ >	0.53 (0.64) [-0.80-1.85] < $p = 0.42$ >	1.52 ^a (0.46) [0.59-2.45] < $p = 0.00$ >	0.70 (1.11) [-1.57-2.97] < $p = 0.53$ >	-1.11 ^b (0.42) [-1.97- -0.26] < $p = 0.01$ >	-0.71 ^a (0.22) [-1.16- -0.27] < $p = 0.00$ >
R ²	0.487	0.479	0.481	0.473	0.521	0.478	0.443	0.483	0.512	0.519	0.539
Baseline (mother)	X	X	X	X	X	X	X	X	X	X	X
Baseline (child)	X	X	X	X	X	X	X	X	X	X	X
Areal effects: Neighborhood	X	X	X	X	X	X	X	X	X	X	X
Mean of outcome	59.9	59.8	59.8	59.8	59.7	59.7	59.8	59.8	59.8	59.8	59.8
Std. dev. X	8.6	8.7	9.0	9.5	9.3	9.8	9.9	9.7	9.7	9.6	9.9
N(Modifier* = 1)	18	18	18	18	18	14	9	9	8	13	19
Clusters	29	29	28	28	28	28	28	29	30	30	30
N	380	379	380	382	381	382	384	386	385	383	383

Note: See [Figure B.3](#) for interaction terms and [Figure B.4](#) for stratified coefficient plots. Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

C Additional Caregiving Modifiers

This appendix reports three supplementary caregiving activities—helping with schoolwork (Figure C.2), bathing or showering the child (Figure C.1), and general caregiving involvement (Figure C.3)—that exhibit the same maternal-late/paternal-early temporal pattern of beneficial moderation documented in Section 3.2. Schoolwork and general caregiving were collected at Years 4–6, while bathing/showering was collected at Years 4–7. For ERI, maternal moderation appeared at Year 6 (bathing $\hat{\gamma}^{(6)} = -0.10$, $p < .01$; general caregiving $\hat{\gamma}^{(6)} = -0.13$, $p = .04$), and for CD-RISC, also at later years (schoolwork $\hat{\gamma}^{(5)} = 0.44$, $p < .01$; bathing at Years 6 and 9, e.g., $\hat{\gamma}^{(9)} = 0.57$, $p = .03$; general caregiving $\hat{\gamma}^{(6)} = 0.60$, $p = .02$), though general caregiving at Year 9 showed an unfavorable moderation. For paternal moderation, for ERI, we observe beneficial association at Years 2–4 (e.g., general caregiving $\hat{\gamma}^{(2)} = -0.22$, $p < .01$; bathing $\hat{\gamma}^{(3)} = -0.16$, $p < .01$; schoolwork $\hat{\gamma}^{(4)} = -0.15$, $p = .04$). For CD-RISC, paternal schoolwork and bathing showed positive moderation at Years 0–3 (e.g., schoolwork $\hat{\gamma}^{(2)} = 0.88$, $p < .01$; bathing $\hat{\gamma}^{(2)} = 0.47$, $p = .01$).

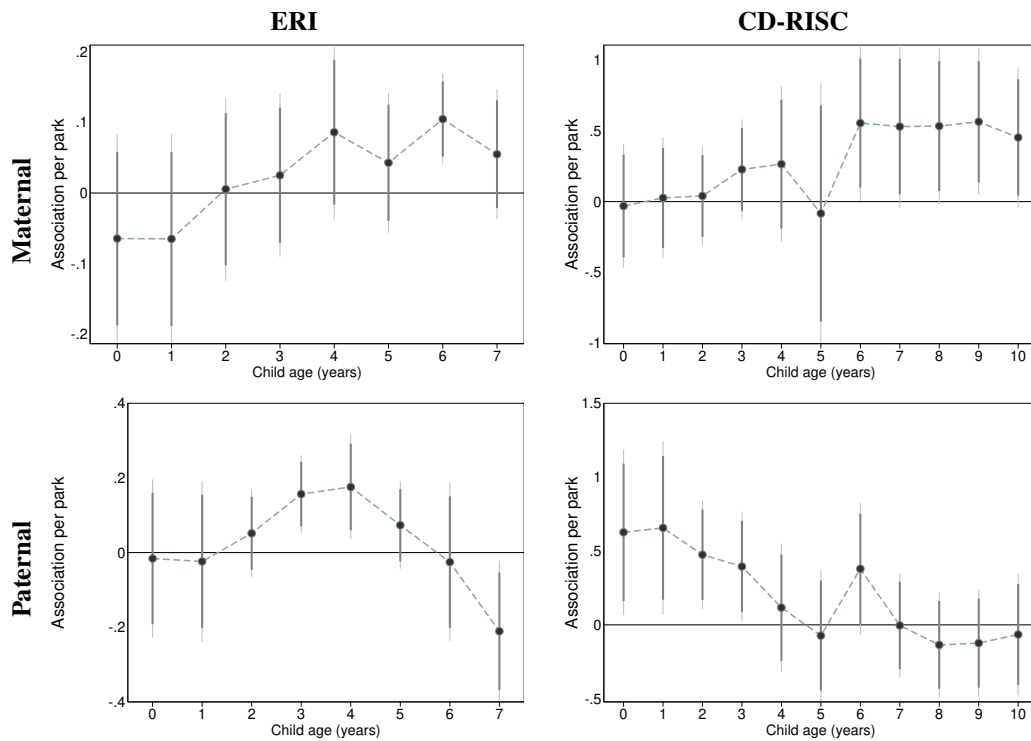


Figure C.1|Bathe/shower modifier ($m = 1$ if mother/father bathes or showers the child most often, 0 if not). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$) from Equation (1), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor–Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom).

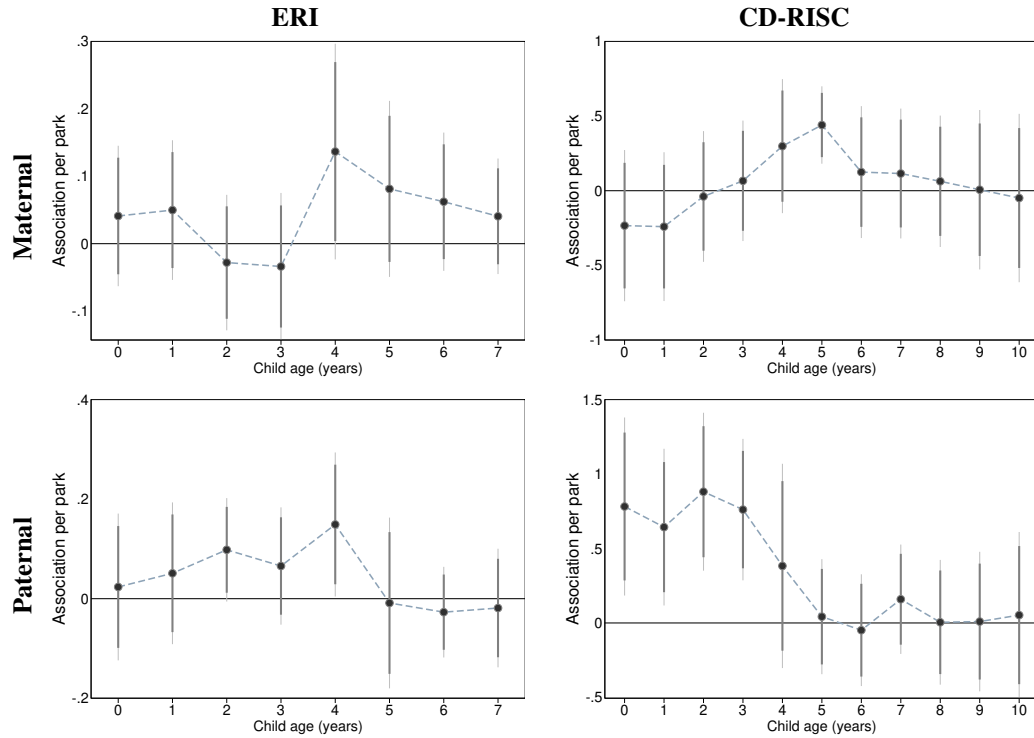


Figure C.2|Schoolwork modifier ($m = 1$ if mother/father helps the child with schoolwork, art projects, etc., 0 if not). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$) from Equation (1), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor–Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom).

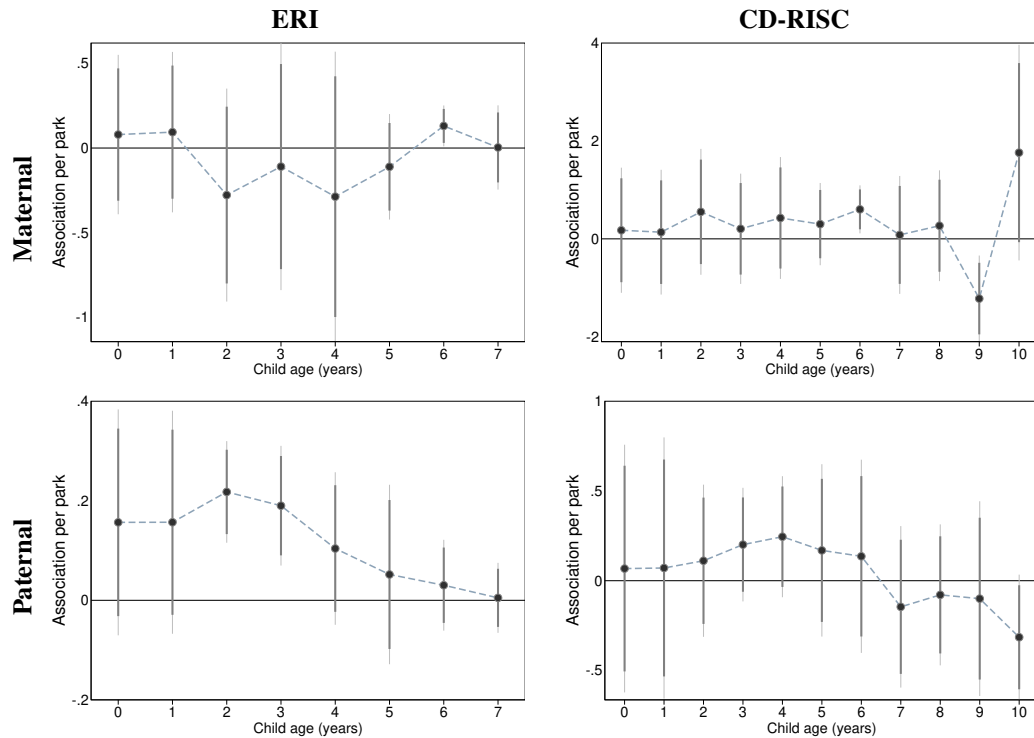


Figure C.3|Caregiver modifier ($m = 1$ if mother/father is a caregiver of the child, 0 if not). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$) from Equation (1), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor–Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom).

D Non-Caregiving Modifiers

This appendix examines whether non-caregiving factors moderate the park–outcome association: child sex (Appendix D.1), socioeconomic status (income, education, occupation; Appendix D.2), father’s involvement in household chores (Appendix D.3), and parenting styles (authoritative, authoritarian, permissive; Appendices D.4 to D.6).

We measure father’s involvement in household chores using the LYDON caregiver questionnaire, filled out by the mother at Years 1 and 2 only. The questionnaire asks whether anyone else helps with housekeeping tasks and chores (response options: “no,” “a bit,” “a lot”), with check-box sub-items for the partner, the respondent’s mother, and others. We code a binary indicator ($m = 1$ if the partner is reported as helping, 0 otherwise).

The Parenting Styles and Dimensions Questionnaire (PSDQ) yields pre-computed factor scores (on a 1–5 scale) for three parenting styles—authoritative, authoritarian, and permissive. The PSDQ is filled out by the mother at Years 4, 8, and 10. The mother reports on both her own parenting style and her perception of the father’s parenting style. To enable year-by-year comparison with the caregiving modifiers, we assign each year’s PSDQ from the nearest collected wave (Years 0–5 from Year 4, Years 6–8 from Year 8, Years 9–10 from Year 10; for ERI, Years 0–5 from Year 4 and Years 6–7 from Year 8). Each style is dichotomized at its sample mean (above-mean = 1, below-mean = 0), yielding a binary modifier comparable to the caregiving indicators. To facilitate interpretation when reporting the main associations for parenting styles, we center the parks measure, so the modifier coefficient ($\hat{\delta}$) is interpretable as the main association at average park access. Coefficient plots of the interaction term across all years are reported in Figures D.5 to D.7.

D.1 Child’s Sex

Figure D.1 reports differences in the parks and socio-emotional outcome by the child’s sex. For ERI, the girl interaction estimates trend negative (beneficial) from around Year 3 onward, and reach statistical significance at $p < .05$ at Year 4, suggesting girls may benefit slightly more from park access for emotion regulation, though estimates are imprecise. For CD-RISC, the girl interaction estimates are negative (unfavorable) in the early years (Years 0–1), suggesting boys benefit more from park access for self-reported resilience at age ten.

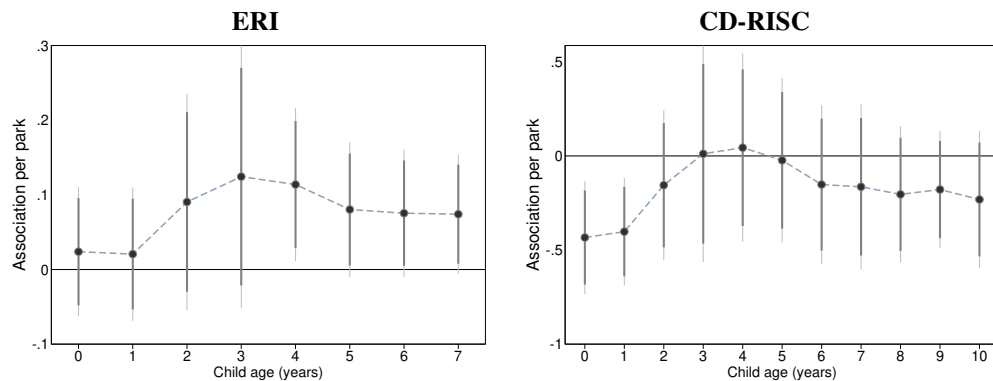


Figure D.1|Child sex modifier ($m = 1$ if child is a girl, 0 if boy). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$) from Equation (1), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor–Davidson Resilience Scale (CD-RISC; right).

D.2 Socioeconomic Status

Figures D.2 to D.4 examine whether income, education, and occupation moderate the park–outcome association. Unlike the caregiving modifiers, these SES indicators do not exhibit a consistent maternal-late/paternal-early temporal pattern. For ERI, maternal low income shows beneficial (negative) moderation at later years (around Years 5–7), and maternal professional/managerial occupation (PMET; Professionals, Managers, Executives, and Technicians) shows beneficial moderation at early years (around Years 0–1). For CD-RISC, paternal university education shows positive (beneficial) moderation that increases at later years, while paternal PMET shows a persistent negative (unfavorable) interaction across most years. Estimates are generally imprecise.

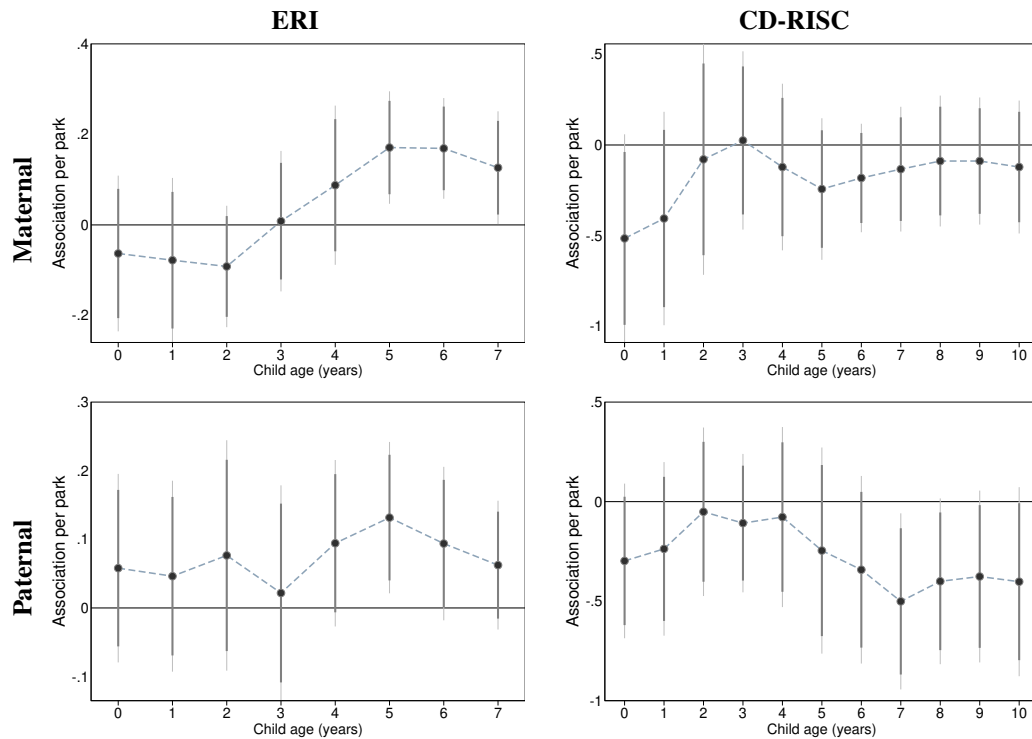


Figure D.2 [Low income modifier ($m = 1$ if father/mother reports low income, 0 if not). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$) from Equation (1), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor–Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom).

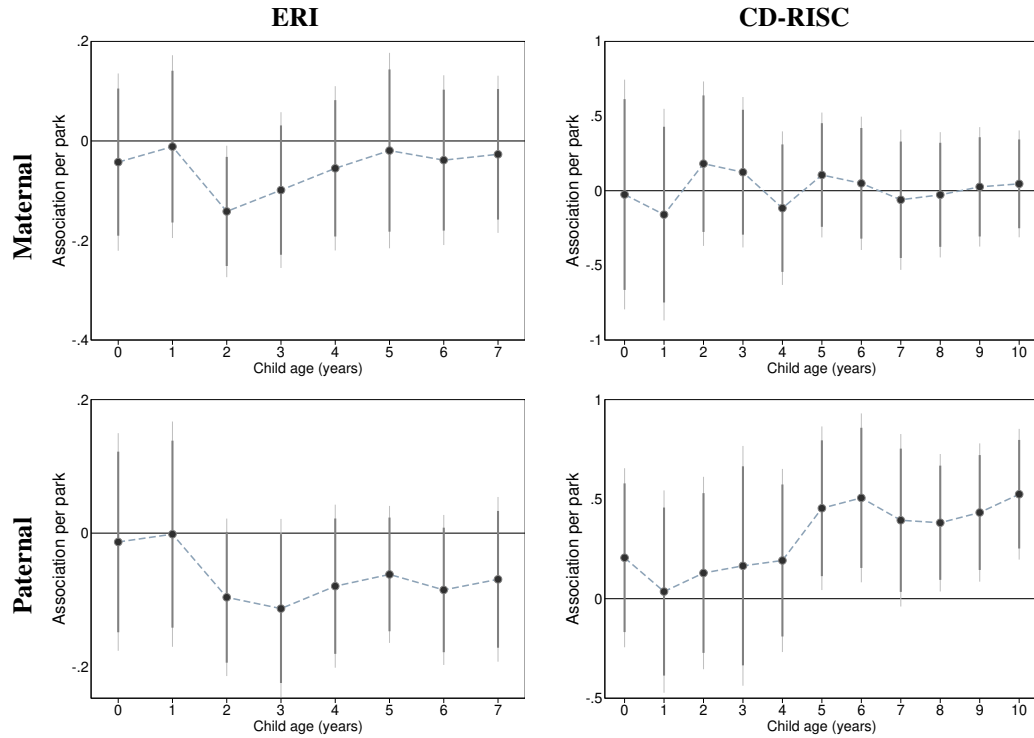


Figure D.3|University education modifier ($m = 1$ if father/mother has a university degree, 0 if not). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$) from Equation (1), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor-Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom).

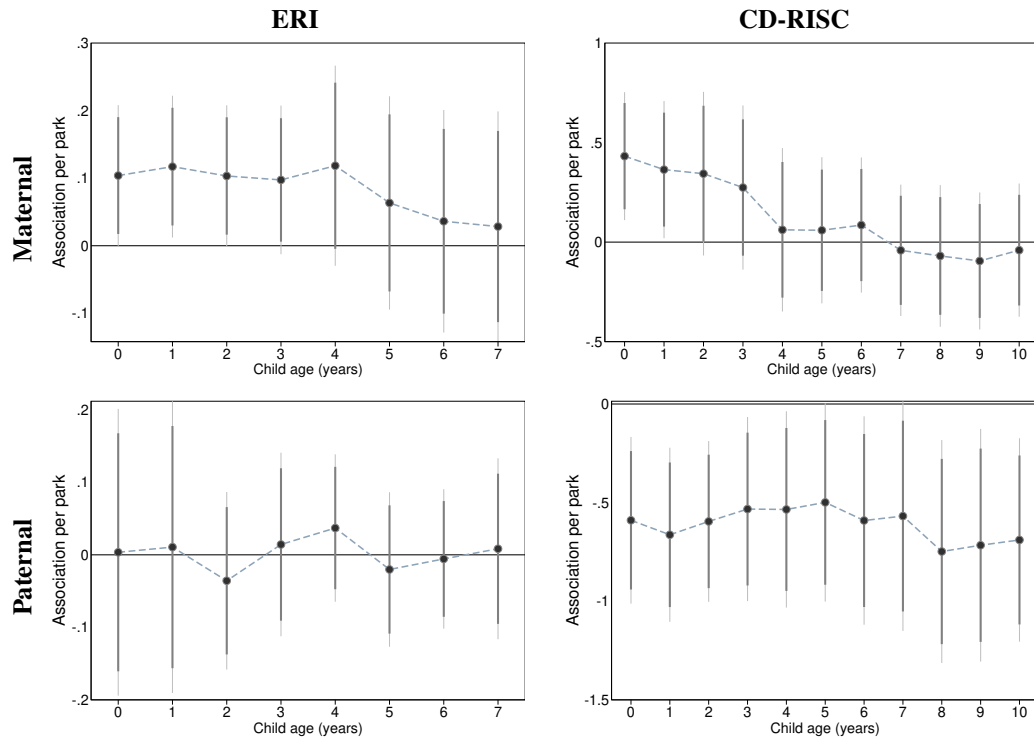


Figure D.4|Professional/managerial occupation modifier ($m = 1$ if father/mother is in a professional or managerial occupation, 0 if not). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$) from Equation (1), with 95% confidence intervals. Columns correspond to the Emotion Regulation Index (ERI; left) and the Connor-Davidson Resilience Scale (CD-RISC; right). Rows correspond to maternal (top) and paternal (bottom).

D.3 Father's Involvement in Household Chores

For ERI at Year 2, the direct association of father helping is positive (unfavorable; $\hat{\delta} = 2.95$, $p = .01$, or 0.5 SD of ERI; Table D.1). The interaction with parks is negative ($\hat{\gamma} = -0.238$, $p < .01$), implying that the park-ERI association is more favorable when fathers help, though the interaction (40% of SD in ERI per one-SD increase in parks) does not fully offset the direct effect. For CD-RISC, the interaction estimates are negative (unfavorable) at both years but not statistically significant (Table D.2).

Table D.1 ERI and Parks: father household involvement modifier ($m = 1$ if father helps with household tasks or chores, 0 if not). Available at Years 1 and 2 only.

	(1)	(2)
	Year 1	Year 2
Parks within 15-min	-0.078 (0.130) [-0.344-0.187] < $p = 0.550$ >	-0.139 (0.094) [-0.331-0.054] < $p = 0.150$ >
Father helps with household tasks/chores	-0.115 (0.769) [-1.693-1.462] < $p = 0.882$ >	-0.712 (0.982) [-2.727-1.302] < $p = 0.474$ >
(Parks within 15-min) $\times$ (Father helps with household tasks/chores)	0.191 (0.136) [-0.088-0.470] < $p = 0.172$ >	0.238 ^a (0.079) [0.076-0.399] < $p = 0.005$ >
R ²	0.409	0.440
Baseline (mother)	X	X
Baseline (child)	X	X
Areal effects: Neighborhood	X	X
Mean of outcome	25.6	25.6
Std. dev. X	8.9	9.1
N(Father helps with household tasks/chores = 1)	182	176
Clusters	28	28
N	309	309

Note: Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

Table D.2|CD-RISC and Parks: father household involvement modifier ($m = 1$ if father helps with household tasks or chores, 0 if not). Available at Years 1 and 2 only.

	(1)	(2)
	Year 1	Year 2
Parks within 15-min	0.267 (0.339) [−0.426–0.961] < $p = 0.436$ >	0.155 (0.277) [−0.414–0.723] < $p = 0.581$ >
Father helps with household tasks/chores	−0.420 (3.256) [−7.090–6.250] < $p = 0.898$ >	0.532 (2.571) [−4.743–5.806] < $p = 0.838$ >
(Parks within 15-min) × (Father helps with household tasks/chores)	−0.100 (0.360) [−0.837–0.636] < $p = 0.782$ >	−0.226 (0.253) [−0.745–0.294] < $p = 0.381$ >
R^2	0.579	0.600
Baseline (mother)	X	X
Baseline (child)	X	X
Areal effects: Neighborhood	X	X
Mean of outcome	59.9	59.9
Std. dev. X	8.4	8.6
N(Father helps with household tasks/chores = 1)	170	161
Clusters	29	28
N	282	281

Note: Other variables are not reported for brevity. Maternal baselines include (i) mother age at delivery (quadratic), (ii) ethnicity, (iii) mother university degree, (iv) household lower income (< 2000), (v) occupation, and (vi) public housing. Child baselines include child's sex, age at time of outcome collection (in years), birth order, and employment of domestic helper. Standard errors are clustered at planning areas. Parentheses: standard errors. Square brackets: 95% confidence intervals. Angle brackets: p-values. Significance levels: ^c 0.1 ^b 0.05 ^a 0.01.

D.4 Parenting Style: Authoritative

Above-mean paternal authoritative parenting shows strong main associations with better outcomes for almost all years. For ERI, paternal authoritative parenting is associated with approximately 1.9–2.4 points lower (better) ERI at all years ($-2.18, p < .01$ at Year 0; $p < .01$ at all Years 1–7), corresponding to 35–44% of the ERI SD. For CD-RISC, paternal authoritative parenting is associated with approximately 5.6–7.4 points higher resilience at Years 0–5 (6.31, $p = .01$ at Year 0) and Years 9–10 (7.61, $p < .01$ at Year 9), corresponding to 37–43% of the CD-RISC SD, though estimates at Years 6–8 are not significant. Maternal authoritative parenting shows weaker and mostly marginal main associations, though reaching significance for ERI at Years 3 ($-2.28, p = .01$) and 5 ($-2.21, p = .01$).

Figure D.5 shows the interaction between above-mean authoritative parenting and parks across all years. Maternal authoritative parenting showing marginal beneficial moderation at Years 6–7 for CD-RISC (0.36, 95% CI: $[-0.03, 0.75]$, $p = .07$ at Year 6; 0.34, 95% CI: $[-0.00, 0.69]$, $p = .05$ at Year 7). No significant interactions are observed for paternal authoritative parenting for both outcomes.

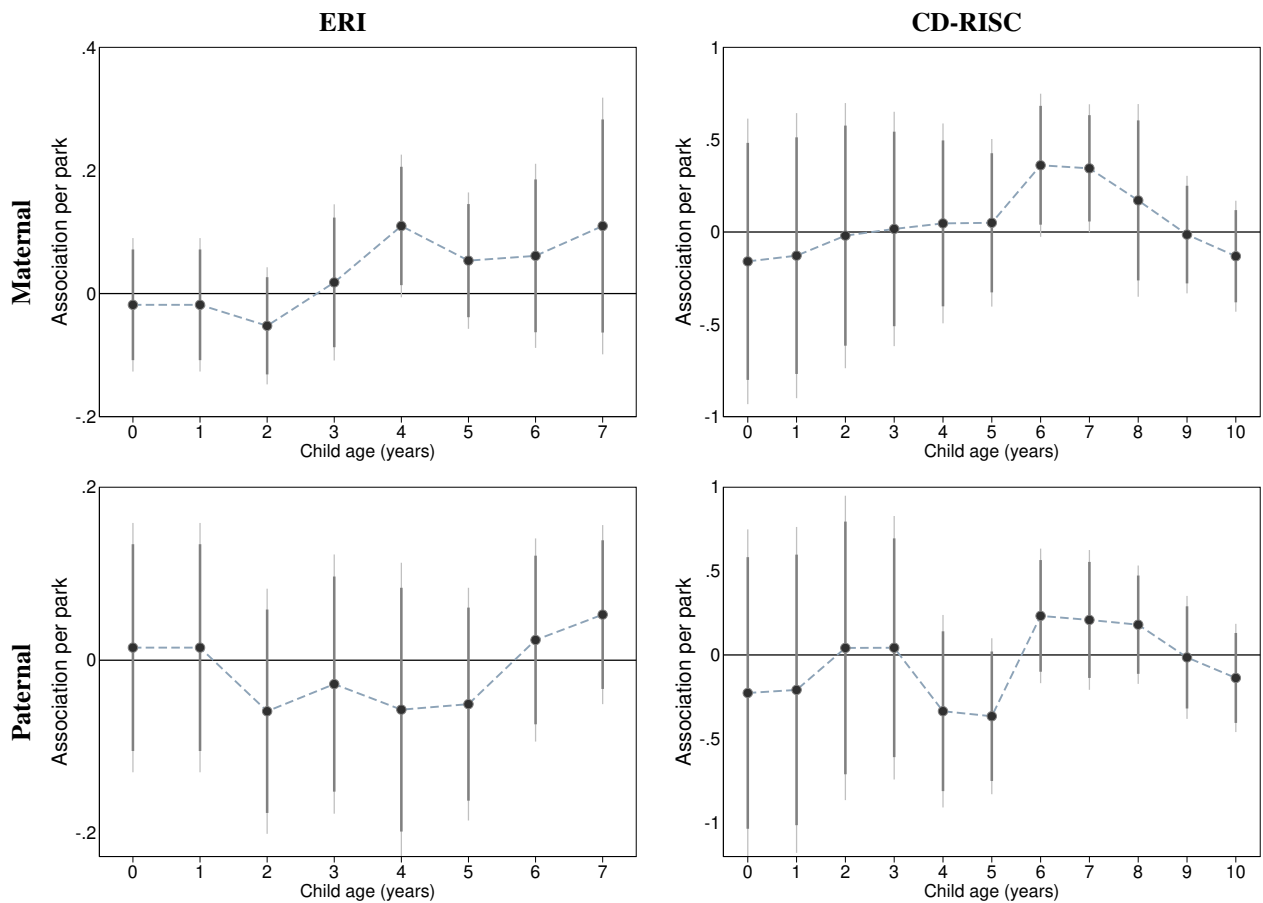


Figure D.5|Authoritative parenting style modifier (continuous, all years). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$), with 95% and 90% confidence intervals. PSDQ is propagated to all years via nearest collected wave (Y0–5 from Y4, Y6–8 from Y8, Y9–10 from Y10). Columns correspond to ERI (left) and CD-RISC (right). Rows correspond to maternal (top) and paternal (bottom) authoritative parenting.

D.5 Parenting Style: Authoritarian

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Above-mean paternal authoritarian parenting shows unfavorable main associations with ERI at Years 3–7 (2.47, $p = .02$ at Year 3; 1.73, $p = .01$ at Year 7), corresponding to approximately 1.7–2.5 points higher (worse) ERI (32–46% of ERI SD). Maternal authoritarian parenting shows a similar unfavorable direction for ERI at Years 3–7, reaching significance at Years 3 (2.01, $p = .01$) through 7 (1.63, $p = .04$). Neither parent shows significant main associations with CD-RISC.

Figure D.6 shows the interaction between above-mean authoritarian parenting and parks across all years. For CD-RISC, maternal authoritarian parenting shows positive (beneficial) interactions at Years 0–3 (0.68, 95% CI: [0.21, 1.15], $p = .01$ at Year 2). Paternal authoritarian parenting shows a positive interaction at Year 2 (0.81, 95% CI: [0.11, 1.52], $p = .03$) and negative reversals at Years 9–10 (–0.37, $p = .01$ at Year 9; –0.42, $p = .01$ at Year 10).

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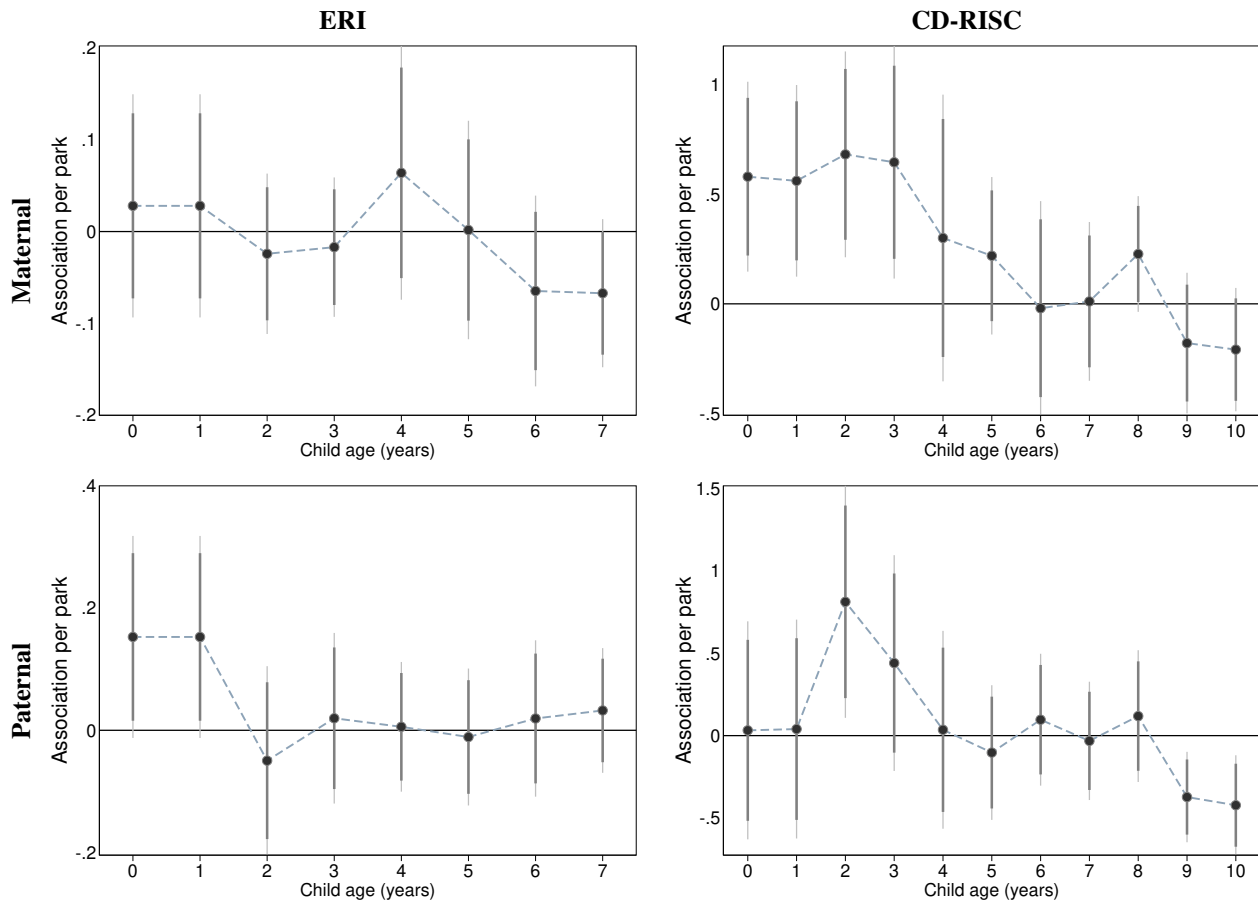


Figure D.6|Authoritarian parenting style modifier (continuous, all years). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$), with 95% and 90% confidence intervals. PSDQ is propagated to all years via nearest collected wave (Y0–5 from Y4, Y6–8 from Y8, Y9–10 from Y10). Columns correspond to ERI (left) and CD-RISC (right). Rows correspond to maternal (top) and paternal (bottom) authoritarian parenting.

D.6 Parenting Style: Permissive

Above-mean paternal permissive parenting shows unfavorable main associations with ERI at Years 2–6 (2.19, $p < .01$ at Year 3; 1.88, $p = .04$ at Year 4), corresponding to approximately 1.5–2.2 points higher (worse) ERI (28–41% of ERI SD). Maternal permissive parenting shows unfavorable main associations with ERI at Years 6–7 (2.31, $p < .01$ at Year 6; 1.95, $p < .01$ at Year 7). Neither parent shows significant main associations with CD-RISC.

Figure D.7 shows the interaction between above-mean permissive parenting and parks across all years. For CD-RISC, maternal permissive parenting shows positive (beneficial) interactions at Years 2–3 (0.88, 95% CI: [0.27, 1.48], $p = .01$ at Year 2; 0.94, 95% CI: [0.30, 1.58], $p = .01$ at Year 3). Paternal permissive parenting shows a similar positive interaction at Year 3 (0.61, 95% CI: [0.15, 1.06], $p = .01$), with a negative reversal at Year 10 (−0.26, 95% CI: [−0.52, −0.01], $p = .05$). For ERI, no significant interactions are observed for either parent.

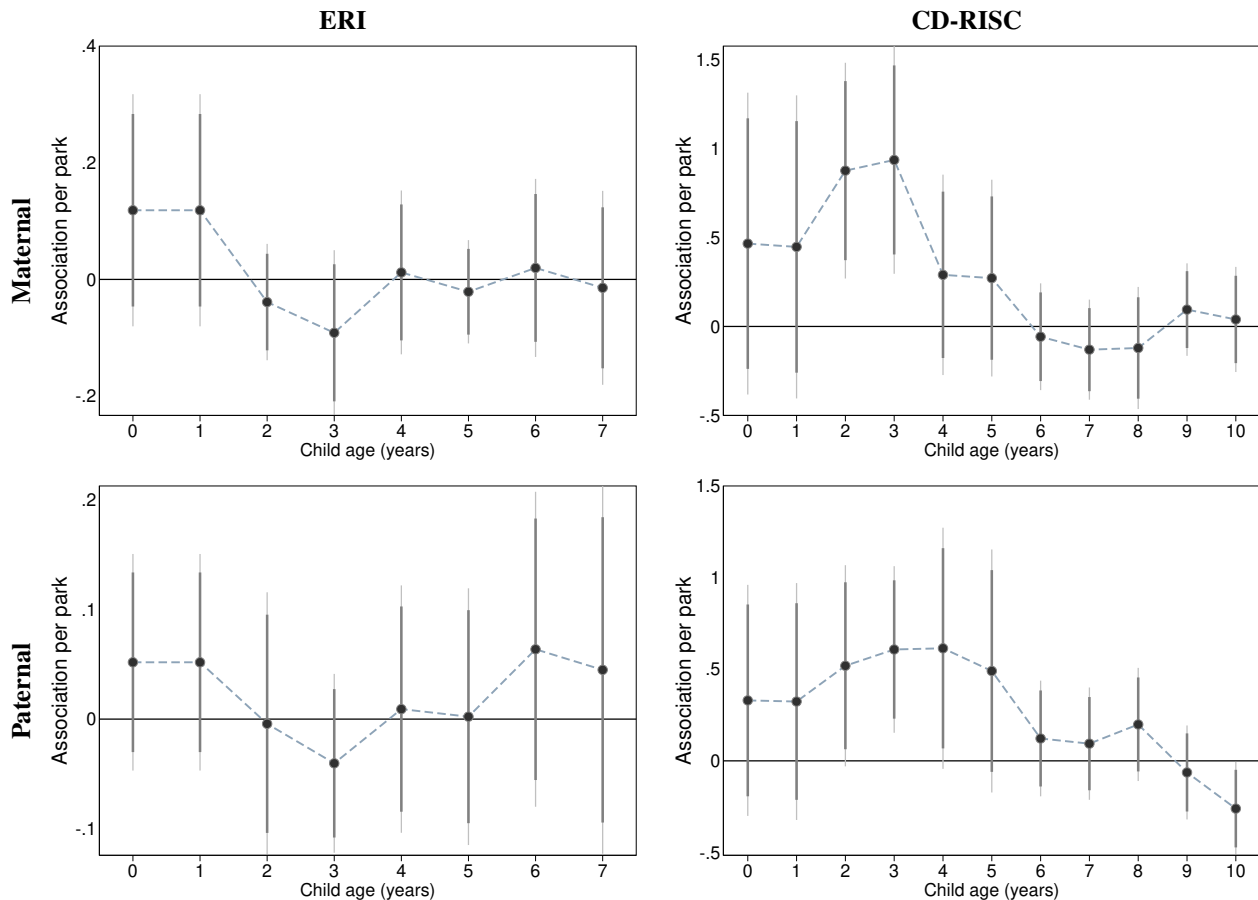


Figure D.7|Permissive parenting style modifier (continuous, all years). Each panel shows the year-specific interaction coefficient ($\hat{\gamma}^{(y)}$), with 95% and 90% confidence intervals. PSDQ is propagated to all years via nearest collected wave (Y0–5 from Y4, Y6–8 from Y8, Y9–10 from Y10). Columns correspond to ERI (left) and CD-RISC (right). Rows correspond to maternal (top) and paternal (bottom) permissive parenting.

D.7 Cross-parent correlations in parenting styles

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Table D.3 | Cross-parent correlations for parenting styles (PSDQ).

	Authoritative	Authoritarian	Permissive
<i>Panel A: All respondents</i>			
Year 4 (<i>n</i> = 497)	0.53***	0.50***	0.57***
Year 8 (<i>n</i> = 416)	0.53***	0.52***	0.55***
Year 10 (<i>n</i> = 406–408)	0.38***	0.41***	0.52***
<i>Panel B: Estimation sample</i>			
Year 4 (<i>n</i> = 368)	0.51***	0.45***	0.54***
Year 8 (<i>n</i> = 391)	0.53***	0.54***	0.58***
Year 10 (<i>n</i> = 406)	0.38***	0.41***	0.52***

Note: Each cell reports the Pearson correlation between the maternal and paternal scores for the same style at the given wave. Both maternal and paternal scores are reported by the mother. Estimation sample conditions on at least one outcome (ERI or CD-RISC) being non-missing. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table D.4 | Same-parent correlations between parenting styles (PSDQ) and involvement indicators (CG) at Year 4.

		Play	Unstructured outing	Primary caregiver
<i>Panel A: All respondents (<i>n</i> = 480–489)</i>				
Maternal	Authoritative	0.18***	0.10*	0.04
	Authoritarian	0.00	–0.02	0.03
	Permissive	0.03	0.02	–0.05
Paternal	Authoritative	0.11*	0.11*	0.07
	Authoritarian	–0.02	0.04	0.01
	Permissive	–0.01	0.02	–0.05
<i>Panel B: Estimation sample (<i>n</i> = 362–368)</i>				
Maternal	Authoritative	0.16**	0.06	0.05
	Authoritarian	0.06	–0.01	0.04
	Permissive	0.08	0.06	–0.04
Paternal	Authoritative	0.09	0.12*	0.07
	Authoritarian	–0.03	0.03	0.00
	Permissive	–0.01	0.02	–0.07

Note: Estimation sample conditions on at least one outcome (ERI or CD-RISC) being non-missing. * $p < .05$, ** $p < .01$, *** $p < .001$.