Title

Early childhood predictors of early school-age academic skills and resilience among children living in poverty

Authors

Choe, Daniel Ewon
Barreda, Santiago
Galán, Chardée A
et al.

Publication Date

2023

DOI

10.1111/sode.12715

Received: 14 March 2023 | Revised: 19 September 2023 | Accepted: 20 September 2023

DOI: 10.1111/sode.12715

ORIGINAL ARTICLE

WILEY

Early childhood predictors of early school-age academic skills and resilience among children living in poverty

Daniel Ewon Choe[1] | Santiago Barreda[7] | Chardée A. Galán[2] | Frances Gardner[3] | Melvin N. Wilson[4] | Thomas J. Dishion[5] | Daniel S. Shaw[6]

[1]Department of Human Ecology, University of California, Davis, California, USA

[2]Department of Psychology, University of Southern California, Los Angeles, California, USA

[3]Department of Social Policy and Intervention, University of Oxford, UK, Oxford

[4]Department of Psychology, University of Virginia, Charlottesville, Virginia, USA

[5]Department of Psychology, Arizona State University, Tempe, Arizona, USA

[6]Department of Psychology, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

[7]Department of Linguistics, University of California, Davis, California, USA

Correspondence
Daniel Choe, University of California, 1312 Hart Hall, 1 Shields Ave., Davis, CA 95616, USA. Email: danchoe@ucdavis.edu

Funding information
National Institute on Drug Abuse, Grant/Award Number: 5R01DA022773-04

Abstract

This longitudinal study of low-income families tested neighborhood-, family-, and child-centered promotive factors in early childhood, responses to an early family intervention, and their interactions as predictors of school-entry levels of and early school-age gains in academic skills. Using a racially-diverse, low-income sample (n = 527) from a randomized controlled trial of the Family Check-Up (FCU) intervention and Bayesian multilevel regression modeling, we tested whether neighborhood cohesion, positive mother–child engagement, and child self-regulation in early childhood (ages 2–5 years) and their interactions with FCU group assignment predicted the intercept and slope of academic skills across child age 5, 7.5, and 8.5 years. Higher positive mother–child engagement and child self-regulation predicted higher academic skills at school entry. An interaction between the FCU intervention and positive mother–child engagement predicted gains in academic skills compared to national norms. The findings suggest the FCU intervention leveraged positive mother–child

engagement in early childhood to promote academic skills, offering a potential avenue from which to prevent income achievement gaps before school entry.

KEYWORDS
academic skills, early childhood, intervention, poverty, resilience

1 | INTRODUCTION

Academic skills at school entry predict achievement in middle childhood and adolescence (Duncan et al., 2007; Sabol & Pianta, 2012), as well as college attendance, earnings, and home ownership in adulthood (Chetty et al., 2011). Large income gaps in academic skills are present at school entry and persist into secondary school (Waldfogel, 2012), as children raised in poverty show elevated rates of grade retention, special education placement, and school dropout (Duncan et al., 2012; Reardon, 2013). Although directly reducing poverty is of paramount importance, such efforts cannot undo the harmful effects of poverty on child development that preventive interventions may be suited better in ameliorating. Interventions that support skill acquisition, however, have been less effective when initiated after, rather than before school entry (Cunha & Heckman, 2007). Thus, clarifying how early childhood interventions can promote the academic skills of children living in poverty offers the potential to help reduce income achievement gaps.

Most studies of childhood poverty focus on risk factors or negative outcomes, which can stigmatize children's reasonable adaptations to poverty as deficits. A strength-based approach recognizes that people living in poverty adapt to high-stress environments in idiosyncratic ways by cultivating skills that interventions can potentially leverage to promote socioemotional and academic competencies (Ellis et al., 2017; Frankenhuis & Nettle, 2020). Longitudinal studies of young children's academic skills have identified antecedents in the family and other contexts, but studies linking school-entry skills to school-age outcomes typically predict to a single grade rather than changes across grades (Burchinal et al., 2020, 2002). Building on studies of families in Head Start, national samples, and literature on resilience, this longitudinal study of children in poverty integrates the bioecological and investment models to test an early intervention targeting existing strengths in families and its interactions with early childhood (ages 2–5) predictors of school-entry levels of (age 5) and early school-age gains in academic skills (ages 5–8.5).

Families in Women, Infants, and Children Nutritional Supplement (WIC) programs were recruited to participate in a multisite randomized controlled trial (RCT) of the Family Check-Up (FCU) intervention to prevent early conduct problems and support school readiness. All children were deemed "high-risk" for early conduct problems based on living below or just above the poverty line and having additional family, child, and/or socioeconomic risk factors. We estimated the intercept and slope of children's standings on academic skills relative to national averages rather than their absolute growth, as children living in poverty are less likely to fall behind academically when they score similarly in academic skills at school entry as their average achieving peers not living in poverty (Sattler & Gershoff, 2019). We used Bayesian multilevel regression modeling to test main effects of the FCU intervention, early childhood predictors, and their interactions simultaneously to yield more efficient and conservative estimates while protecting against common problems in "frequentist" models with many parameters (e.g., biased estimates and type 1 errors from multiple comparisons; Bürkner, 2017; Gelman et al., 2012).

1.1 | Theoretical framework

Structural theories of the causes of poverty posit that demographic and economic contexts have downstream effects on behavior and its interactions with poverty-related stressors (Brady, 2019). Poverty reflects countless stressful

conditions across contexts that cumulatively affect skill acquisition (McLoyd et al., 2009; Yoshikawa et al., 2012). The bioecological model views development as nested within ecological systems and driven by *proximal processes* or children's increasingly more complex interactions with people and objects in their immediate contexts to acquire motivation, knowledge, and skills (Bronfenbrenner & Morris, 2006). The investment model posits that parents invest basic resources, such as time and money, and enriching materials and experiences to promote children's skill acquisition (Magnuson & Votruba-Drzal, 2009). We integrate these models' emphasis on extrafamilial and family contexts, particularly parents' key role in children's development, with a strength-based approach to identify malleable factors across poverty contexts in early childhood that interventions can target to foster academic skills.

Resilience is the process of achieving relatively positive adaptation despite experiencing significant adversity (Luthar et al., 2015). Children living in poverty who continually perform well academically, having similar or higher standings on academic skills than national averages, demonstrate academic resilience (Rudd et al., 2021; Sattler & Gershoff, 2019). Longitudinal studies show all children regardless of their risk status benefit from *promotive factors*, such as positive characteristics of children's families, broader social milieu, and their strengths that elicit positive interactions, whereas *protective factors* include interventions that only buffer children from the effects of their high-stress contexts (Sameroff, 2010; Werner, 2013). Low-income children experience investments and proximal processes that can be promoted by preventive interventions, but no study to our knowledge has tested whether early interventions moderate effects of promotive factors on change in such children's academic skills. Resilience studies inform our selection of the following predictors: neighborhood cohesion (Froiland et al., 2013; Luthar et al., 2015), mother–child engagement (Morris et al., 2017; Werner, 2013), and self-regulation (Buckner et al., 2009; Distefano et al., 2021).

1.2 | Neighborhood social cohesion and young children's academic skills

The intersection of racial and class segregation, housing policy, and housing choices concentrates poverty in certain neighborhoods (Brady, 2019), which can create barriers to young children's school readiness. Neighborhood mechanisms can be conceptualized as *structure*, the socioeconomic and demographic characteristics of the residents, or as *process*, the informal interactions among neighbors or formal links between residents and local institutions (Leventhal & Dupéré, 2019). Resilience studies show social organization processes buffer children from the effects of adversity including structural factors like neighborhood poverty (Luthar et al., 2015). Neighborhood cohesion reflects a sense of community, closeness with neighbors, and emotional attachment to the neighborhood (Perez-Smith et al., 2001) and is part of collective efficacy, the perception that neighbors work cooperatively toward shared goals (Leventhal & Dupéré, 2019).

Neighborhood processes also mediate effects of structural factors on family functioning, parenting, and child test scores, but few studies examine effects of neighborhood processes on young children's academic skills (Froiland et al., 2013). High neighborhood cohesion predicts young children's greater verbal skills but not when considering mothers' social support (Kohen et al., 2002), which suggests neighbors' material and emotional support, such as help with paying bills and childcare, benefits children's academic skills. Community interventions have improved neighborhood cohesion (Shen et al., 2017), but neighborhood poverty has been shown to moderate effects of the FCU on child conduct problems in our low-income sample (Shaw et al., 2016). Specifically, the FCU only predicted lower aggression in children living in moderate as opposed to extreme neighborhood poverty, whereas FCU-related improvements to positive mother–child engagement only predicted lower aggression in children living in extreme neighborhood poverty. No study has tested whether the interaction between the FCU and neighborhood cohesion promotes academic skills, but such neighborhood processes may support academic skills better for children receiving FCU services, which we test in the present study.

1.3 | Positive mother–child engagement in early childhood

Parents nurture cognitive, academic, and socioemotional skills by investing in children's physical care, emotional support, cognitively stimulating materials, and enriching experiences, especially during early childhood (Froiland et al., 2013; Waldfogel, 2012). Investments can be expressed as positive parenting behaviors that serve as proximal processes through which parents promote young children's school readiness. Meta-analyses show small effects of positive parenting (e.g., warmth, autonomy granting) on child achievement (Pinquart, 2016). Yet, some studies of positive parenting and young children's academic skills have found mixed evidence of their association (e.g., Burchinal et al., 2002; Gershoff et al., 2007; Yeung et al., 2002), but these studies did not consider children living in poverty or child-driven effects on parenting.

Considering children's active behavior in their mother–child interactions may identify proximal processes malleable to intervention to promote academic skills (Morris et al., 2017). *Dyadic mutuality*, a mother and child's shared affect and enjoyment during interactions, predicts cognitive skills in early childhood independently of cognitive and language stimulation at home for families in Early Head Start (Ayoub et al., 2009). Past studies of our sample found the FCU improved academic skills by increasing mothers' early positive behavior support or tendency to engage children in lengthy interactions and discussions with periodic positive behavior, reinforcement, and prompts for continued interaction (Brennan et al., 2013). The FCU also reduced problem behavior by improving *dyadic positive engagement* (Sitnick et al., 2015) or interactions in which mother and child show high positive or neutral engagement with one another, which is related to greater positive behavior support (Dishion et al., 2017). We tested the interaction between the FCU intervention and dyadic positive engagement, as we expected young children who experience greater dyadic positive engagement to be more likely to acquire greater academic skills, especially when the FCU increases positive mother–child interactions.

1.4 | Children's self-regulation, school readiness, and resilience

Viewed as a critical component of school readiness, self-regulation reflects the voluntary control of attention, emotion, and behavior in the pursuit of goals and in response to changing contextual demands (Blair & Raver, 2015; Liew, 2012). High self-regulation in early childhood and at school entry predicts better academic skills (Allan et al., 2014; Welsh et al., 2010), such as greater gains in vocabulary and reading comprehension across first grade (Skibbe et al., 2012) and later achievement almost as strongly as school-entry math and reading skills (Duncan et al., 2007). Self-regulation also supports resilience of school-age children living in poverty (Buckner et al., 2009), although they are less likely to encounter family and neighborhood contexts that nurture self-regulation (Blair & Raver, 2015). High self-regulation recently was shown to serve as a promotive factor for young children's early math and literacy skills (Distefano et al., 2021). Children's early skills can beget gains in other skill domains (Cunha & Heckman, 2007; Sattler & Gershoff, 2019), and the skill acquisition of children at highest risk benefits most from early intervention (Pelham et al., 2017). Self-regulatory skills in early childhood are malleable to intervention (Chang et al., 2017) and may foster greater gains in academic skills for children receiving FCU services. We therefore examined the interaction between the FCU intervention and child self-regulation.

1.5 | Race-ethnicity, gender, and socioeconomic status

Family income and maternal education are key indicators of socioeconomic status (SES) with distinct links to parent and child outcomes (Duncan & Magnuson, 2003; McLoyd et al., 2009). They serve as selection factors that influence who experiences poverty and whether parents can invest in children's academic skills (Cunha & Heckman, 2007;

Gershoff et al., 2007; Yoshikawa et al., 2012). Family income in early childhood predicts educational attainment and employment in adulthood better than family income in middle childhood or adolescence (Duncan et al., 2017; Wagmiller et al., 2006). Income boosts are also linked causally to gains in child achievement (Dahl & Lochner, 2012). Mothers with low educational attainment are at increased risk of facing chronic poverty, and maternal education is one of the strongest predictors of children's academic skills (Harding, 2015; Magnuson & Votruba-Drzal, 2009). Children's risks of poverty exposure and suboptimal academic skills differ by race and sex, such that children who are racial-ethnic minorities, particularly boys, are at increased risk of chronic poverty and academic difficulties (Duncan et al., 2017; Wagmiller et al., 2006). We accounted for early childhood levels of family income and maternal education as predictors of academic skills, and geographic location, race-ethnicity, and child sex as covariates to limit their confounding effects.

1.6 | The current study

This longitudinal study utilized Bayesian multilevel modeling to examine main effects of neighborhood cohesion, family income, maternal education, dyadic positive engagement, and child self-regulation, averaged from ages 2 to 5, the FCU intervention, and their interactions on the intercept and slope of academic skills across ages 5, 7.5, and 8.5. We compared children's skill standings to national averages to identify academic resilience using standard scores on the norm-referenced Woodcock–Johnson Tests of Achievement III (WJ-III; Schrank et al., 2001). We expected children's academic skills on average to start below and fall behind national norms, as center- and school-based early childhood interventions with high-risk samples yield initial boosts to academic skills that wane across childhood (Ayoub et al., 2009; Campbell et al., 2001). We hypothesized that higher neighborhood cohesion, dyadic positive engagement, and self-regulation in early childhood, as well as assignment to the FCU intervention and its interactions with these factors, would predict higher academic skills at school entry and their early school-age gains. We expected lower-SES children, racial-ethnic minorities, and boys to score below national averages, as these children tend to be at risk for chronic poverty and/or academic problems (Duncan et al., 2017; Magnuson & Votruba-Drzal, 2009; Wagmiller et al., 2006).

2 | METHOD

2.1 | Participants

Across three U.S. cities, 731 families participated in a RCT testing the efficacy of a family-based intervention for young children at high risk for early conduct problems (Dishion et al., 2008). Participants were recruited between 2002 and 2003 from WIC clinics in metropolitan areas of Pittsburgh, Pennsylvania, and Eugene, Oregon, and in and around Charlottesville, Virginia. Families with a child between the ages of 2 years, 0 months and 2 years, 11 months were invited to participate if they met criteria in at least two of three domains associated with increased risk for early-starting conduct problems (Shaw & Shelleby, 2014): child behavior (e.g., difficult temperament), family problems (e.g., maternal depression, parental substance abuse), and sociodemographic risk (e.g., low parent educational attainment). Families who scored over established clinical thresholds or 1 *SD* above mean scores on measures without clinical cut-points met recruitment criteria. Initially, 1666 families were contacted at WIC sites, 879 met eligibility requirements, and 731 (83.2%) provided consent and assent (Dishion et al., 2008).

We removed 204 families (27.9% of full sample) in which biological mothers did not serve consistently as primary caregivers throughout early childhood to avoid capturing caregiver changes when aggregating variables across ages 2 to 5. The final sample included 527 biological mothers (72.1%) and children (50.3% girls). Mothers identified

children as non-Hispanic White (45.5%), non-Hispanic Black or African American (27.5%), or other racial-ethnic groups (26.9%), such as Asian American, Native American, mixed, and biracial. Among the final sample, 25.0% were from Charlottesville, 38.1% from Eugene, 36.8% from Pittsburgh, and 260 families (49.3%) were assigned randomly to treatment. Age 2 assessments were completed prior to random assignment to intervention or control conditions, and research staff were blind to assignments. On average in early childhood, mothers were high school graduates or had a GED and reported $1250 to $2082 per month in gross household income. A smaller percentage of mothers were high school graduates (78.2% to 79.9%) than among US adult women (83.7%; U.S. Census Bureau, 2003), and their average annual household income ($15,000 to $24,984) was considerably less than the $42,409 median income in 2002 (DeNavas-Walt et al., 2003).

2.2 | Home visit procedure

Families were scheduled for 2.5- to 3-h home assessments when target children were ages 2, 3, 4, 5, 7.5, and 8.5. Home visits were identical for intervention and control participants and occurred before the intervention for intervention families each year. Each home assessment from ages 2 to 5 began by having the child engage in free play with age-appropriate toys while the mother completed a battery of questionnaires (e.g., on sociodemographic factors while child was completing free play), followed by structured and unstructured observational tasks for the target child and mother. All interactions were videotaped for later coding. Relevant to the current study are the clean-up (15 min), teaching (mother assisted the child assemble a puzzle, build two towers, and play a board game; 3 min each), and meal preparation/lunch tasks (mother prepared a meal for the child; 20 min). At the end of home assessments at ages 5, 7.5, and 8.5, the child was administered tests of academic skills (30 min). Institutional review board approval was received for all aspects of this research. Families were compensated for participating and written consent was obtained from all mothers.

Family Check-Up. The FCU is a brief (typically 3—4 sessions per year) family-centered intervention for preventing early conduct problems, incorporating motivational interviewing to promote improvements in parenting skills and address other domains that compromise parental functioning (e.g., maternal depression). The FCU has been established as a reliable method for preventing conduct problems (Dishion & Stormshak, 2007; Dishion et al., 2011) and promoting school readiness (Brennan et al., 2012, 2013) during early childhood (Dishion et al., 2014) and adolescence (Connell et al., 2007) by increasing positive parenting (Dishion et al., 2008) and addressing parent well-being (Shaw et al., 2009). The FCU capitalized on existing strengths within families by sharing video clips of their positive parent–child interactions and using both motivational interviewing and evidence-based family management practices to promote what they already did well (rather than focusing on weaknesses). Critically, the FCU did not target children's academic skills. Caregivers in the intervention had the opportunity to receive the FCU after each assessment. Participation rates in the FCU intervention for the intervention group ranged from 77% of families at age 2 to 52% of families at age 8.5 (Smith et al., 2018).

2.3 | Measures

Academic skills. Children completed three subtests of the WJ-III's Academic Skills cluster (McGrew & Woodcock, 2001) in home assessments at ages 5, 7.5, and 8.5. Letter–Word Identification (i.e., identification of letters, then written words), Calculation (i.e., ability to write single numbers and perform mathematical procedures), and Spelling (i.e., prewriting skills, letter writing) subtests included 76, 45, and 59 items, respectively, combined into an age-standardized score at each age. The WJ-III was normed on a nationally representative sample of 8818 individuals from over 100 geographically diverse US communities (McGrew & Woodcock, 2001). Separate norms were established for preschool-age (2–5 years) and school-age children (Schrank et al., 2001). Children's standard scores shared

moderately large to large correlations (.58 to .87, $p < .001$). Children's standard scores were close to national averages at ages 5 ($M = 98.37$, $SD = 14.93$, $n = 476$), 7.5 ($M = 100.83$, $SD = 14.33$, $n = 418$), and 8.5 ($M = 96.70$, $SD = 12.64$, $n = 403$), suggesting that they performed similarly to most American children their age.

Neighborhood cohesion. Mothers completed five items adapted from Buckner (1988) in the Me and My Neighborhood Questionnaire at each assessment in early childhood (Perez-Smith et al., 2001; Pitt Mother & Child Project, 2001). Mothers reported their agreement with five statements (e.g., "*The neighborhood I live in is a big part of who I am.*") on a 7-point scale [1 = "*Not at all true*", 7 = "*Very true*"]. Items were summed into total scores at each annual assessment from ages 2 to 5 (mean item $\alpha = .87$) and averaged into a neighborhood cohesion composite (scale $\alpha = .78$).

Dyadic positive engagement. This dyadic state reflected duration of time the mother or child engaged in positive or neutral behavior while the other also engaged in positive or neutral behavior. At ages 2, 3, 4, and 5, videotaped tasks of mother and child were coded using the Relationship Affect Coding System (Appendix S1; Peterson et al., 2008), a microsocial coding system that captures the topography of behaviors and affect within parent–child interactions. The total duration each dyad was observed in positive interaction was divided by the overall session time to calculate a duration proportion score. Reliability coefficients were sufficient with overall Kappa scores of .93 and average agreement of 94% between ages 2 and 5. Scores at each assessment were mean averaged into a dyadic positive engagement composite (scale $\alpha = .75$).

Self-regulation. Mothers completed the Children's Behavior Questionnaire's 13-item inhibitory control subscale at each assessment in early childhood (Rothbart et al., 2001). Mothers rated children's behavior (e.g., "*Can lower his/her voice when asked to do so.*") on a 7-point scale [1 = "*extremely untrue*", 7 = "*extremely true*"]. Items were summed into total scores from ages 2 to 5 (mean item $\alpha = .72$) and averaged into a self-regulation composite (scale $\alpha = .81$).

Covariates. Mothers completed a demographics survey at each assessment in early childhood. Family monthly income was coded 1 ("*$415 or less*") to 13 ("*$7,500 or more*") and the average monthly income was between $1250 and $1665. Educational attainment was coded 2 ("*7th grade or less*") to 9 ("*graduate degree*"). Mothers were on average high school graduates or GED certificate holders but ranged from 7th grade or less to professional training and graduate degrees. These coding schemes were designed to capture relatively low values for the current sample and differ from those used in national studies or with higher-SES samples. Data at each assessment in early childhood were averaged into multiyear family income (item $\alpha = .85$) and maternal education (item $\alpha = .97$) composites.

Geographic location was examined with two binary variables for "Charlottesville" and "Eugene" coded as −1 = "*sample*" and 1 = "*name of city*." Intervention status was coded as −1 = "*control group*" and 1 = "*intervention group*." Mothers reported their child's sex and race-ethnicity, which was tested with two binary variables for '*non-Hispanic White/European American*' and '*non-Hispanic Black/African American*' coded such that −1 = "*sample*" and 1 = "*name of racial-ethnic group.*" Child sex was coded as −1 = "*female*" and 1 = "*male.*"

2.4 | Data analysis plan

We conducted preliminary analyses of descriptive statistics, missing data, and differences between the intervention and control groups using SPSS 27 (IBM Corp., 2020). We tested hypotheses with Bayesian multilevel regression modeling to predict the intercept and age-related slope of WJ-III academic skills across ages 5, 7.5, and 8.5 using the brms package (Bürkner, 2017) in R (R Core Team, 2019). The model formula is presented below:

$$WJ - III \sim A * (NC + FI + ME + DPE + SR + L + IS + R + S) + (A|FAMILY) \quad (1)$$

The formula includes the following continuous predictors: age (A), neighborhood cohesion (NC), family income (FI), maternal education (ME), dyadic positive engagement (DPE), and self-regulation (SR). Age was included so the intercept is equal to age 5 and the slope captures age-related effects of the predictors (A|FAMILY). The remaining continuous predictors were standardized to have a mean of zero and a standard deviation of 1. The formula also

included these categorical predictors: geographic location (L), intervention status (IS), child race–ethnicity (R), and sex (S). Sum coding was used for all categorical predictors where these predictors express differences to the model intercept or grand mean. A final model expanded on the first by testing simultaneously all interactions between early childhood predictors and the intervention in relation to the intercept and slope. The residuals were assumed to come from a *t* distribution with scale and d.f. (i.e., ν) parameters estimated from the data. Bayesian analysis allowed us to use *t* distributed errors, making our models robust to outliers and other issues without excluding data.

Bayesian inference relies on consideration of the posterior distribution of parameter values based on the data and prior probabilities of the parameters. This procedure results in a sequence of samples from the posterior distribution of parameters that can be used to assess credible values based on the data and model structure. This overcomes assumptions and common problems associated with "frequentist" approaches when estimating large numbers of parameters. For example, Bayesian yields more robust yet conservative tools for imputing missing data with outliers and non-normal distributions than "frequentist" approaches (Gelman et al., 2012). We present each parameter's estimated mean effect size, estimated error, and 95% credible interval (CI). The 95% CI of the posterior distribution of a parameter is an interval enclosing 95% of likely values, such that every value inside of the interval is more likely than every value outside of it. Using the highest density interval of each coefficient, we can consider the most probable value for each parameter and the amount of uncertainty in each estimated effect size.

3 | RESULTS

3.1 | Preliminary analyses

Table 1 shows descriptive statistics and correlations of study variables. Of 731 families in the original sample, 659 participated at age 3, 629 at age 4, 621 at age 5, 567 at age 7.5, and 565 at age 8.5. Mothers in the final sample ($n = 527$) reported higher educational attainment at age 2 ($M = 5.25$, $SD = 1.13$) than primary caregivers (89.7% mothers, 6.9% fathers, 3.4% other) excluded from analyses ($M = 5.04$, $SD = 1.15$), $t(729) = -2.21$, $p = .027$. Among the final sample, WJ-III scores were missing for 51 children at age 5, 109 at age 7.5, and 124 at age 8.5. Children missing WJ-III scores at age 5 or 7.5 did not differ from the remaining sample in academic skills. Children missing WJ-III scores at age 8.5, however, had lower academic skills at age 7.5 ($M = 94.49$, $SD = 16.32$) than the remaining sample ($M = 101.51$, $SD = 13.84$), $t(503) = -3.58$, $p < .001$, but they did not differ in academic skills at age 5 from those with WJ-III scores, $p = .271$. Little's (1988) missing completely at random test indicated that data missingness was at random and associated with measured variables (e.g., parent education), $\chi^2(2{,}608) = 3148.15$, $p < .001$, which supported the inclusion of covariates in main analyses. The brms package (Bürkner, 2018) in R (R Core Team, 2019) imputed missing values for dependent variables in Bayesian models.

The FCU intervention group (age 3 $M = .37$, $SD = .14$; age 5 $M = .38$, $SD = .14$) showed greater dyadic positive engagement on average than the control group (age 3 $M = .34$, $SD = .14$; age 5 $M = .36$, $SD = .14$) at ages 3, $t(633) = 3.07$, $p = .002$, and 5 years, $t(570) = 2.04$, $p = .042$. The FCU intervention group also had lower average WJ-III scores at age 7.5 ($M = 99.33$, $SD = 14.40$) than the control group ($M = 101.97$, $SD = 14.13$), $t(503) = -2.08$, $p = .038$. The FCU intervention and control groups did not differ on any other study variable.

3.2 | Main results

Discussion of model results is divided by prediction of the intercept and age-related slope. Intercept effects model WJ-III standard scores at age 5 and slope effects model variation in standard scores as a function of age in years. A negative correlation between the intercept and age-related slope ($r = -.43$, $SD = .06$) suggests children with higher initial standard scores show a greater age-related drop after school entry. Coefficient estimates, estimated errors,

TABLE 1 Descriptive statistics and intercorrelations of main study variables.

Variables	1	2	3	4	5	6	7	8
1. Neighborhood Cohesion	—							
2. Family Income	.15**	—						
3. Maternal Education	.01	.26***	—					
4. Dyadic Positive Engagement	.06	.11*	.26***	—				
5. Child Self-Regulation	.10*	.10*	.08	.15**	—			
6. Age 5 Academic Skills	−.02	.08	.24***	.18***	.17***	—		
7. Age 7.5 Academic Skills	.08	.18***	.19***	.17***	.22***	.63***	—	
8. Age 8.5 Academic Skills	.01	.13*	.14**	.11*	.21***	.57***	.88***	—
Means	14.91	4.43	5.34	.33	4.35	98.37	100.83	96.70
Standard Deviations	6.00	1.89	1.12	.11	.65	14.93	14.33	12.64
Minimum Values	5.00	1.00	2.00	.05	2.50	29.00	48.00	28.00
Maximum Values	33.75	10.50	8.25	.69	6.49	154.00	132.00	126.00
Valid Cases	527	526	527	527	527	476	418	403

Note: Variables 1 through 5 are mean scores from ages 2, 3, 4, and 5. *$p < .05$; **$p < .01$; ***$p < .001$.

and 95% CIs are presented in Figure 1 and Table 2. As hypothesized, higher dyadic positive engagement and self-regulation, as well as maternal education in early childhood predicted higher academic skills at age 5, as their CIs did not cross the 0-line representing the overall mean standard score of 98.1. Predictors are standardized to facilitate interpretability of their effects. For example, a child whose mother's education is two *SD*s above the sample mean is expected to score 5.86 points higher than the overall mean standard score of academic skills (i.e., maternal education's estimated effect on the intercept = 2.93, 2.93*2 = 5.86), whereas a child whose mother's education is two *SD*s below the sample mean is expected to score 5.86 points below the overall mean. Students' academic skills at the higher and lower ends of maternal education differed by over 11 points (5.86*2 = 11.72). There were also reliable effects on standard scores at age 5 for geographic location and child sex, such that boys scored lower than girls on academic skills.

Figure 1 and Table 2 show all age-related slope effects of predictors of WJ-III standard scores are small but precise with mean values near zero and narrow CIs. Although there is a consistent age-related drop of −.40 points per year in standard scores for academic skills (see Age estimate under Slope Terms in the first row of Table 2), this decrease only amounted to 1.4 points over the 3.5-year span of middle childhood (i.e., −.40*3.5 = −1.4), indicating substantial within-individual stability in academic skills from ages 5 to 8.5. Maternal education and child race-ethnicity were the only predictors of the age-related slope with CIs that did not cross the 0-line. Having a more educated mother or being non-Hispanic Black predicted a greater drop in standard scores from ages 5 to 8.5, but the standard scores of children with more highly educated mothers were still above average in this sample because of maternal education's intercept effect.

Contrary to our hypothesis, there were no main effects of the FCU intervention on the intercept or age-related slope of academic skills. Our final model shown in Figure 2 and Table 3 tested interactions between intervention

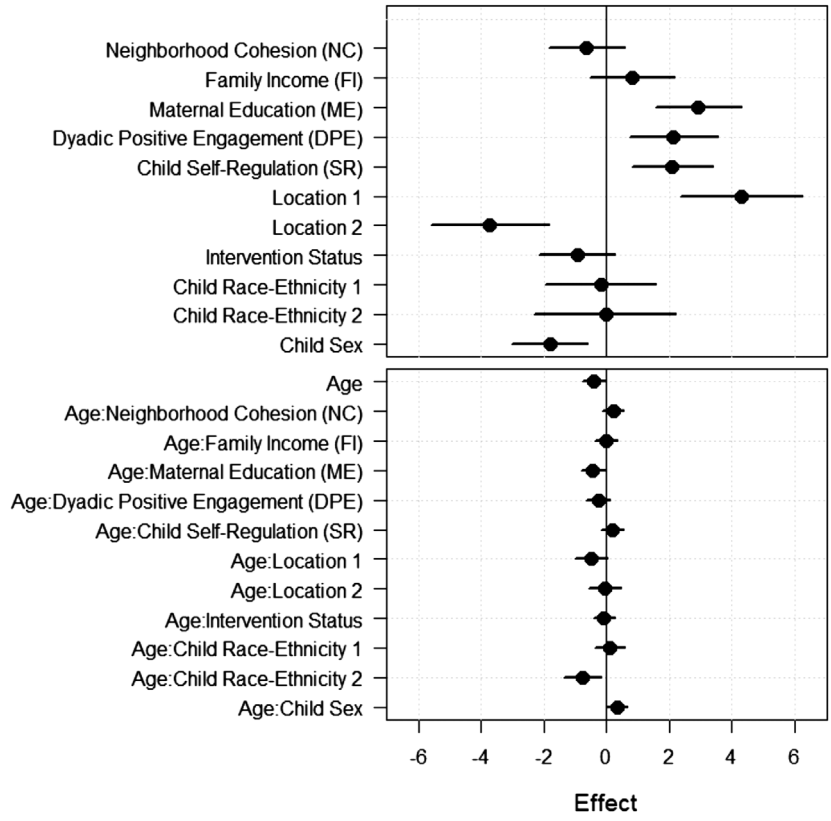

FIGURE 1 Credible intervals for estimated effects of predictors on the intercept (top) and age-related slope (bottom) for academic skills. Effects are represented as deviations from the overall mean standard score of 98.1 (i.e., the 0-line). Lines reflect 95% highest-density (credible) intervals, and points reflect means. Location 1 (Charlottesville). Location 2 (Eugene). Intervention status coded −1 = control, 1 = intervention. Race-ethnicity 1 coded −1 = sample, 1 = non-Hispanic White. Race-ethnicity 2 coded −1 = sample, 1 = non-Hispanic Black. Sex coded −1 = boys, 1 = girls.

status and all early childhood predictors simultaneously. The interaction between intervention status and dyadic positive engagement in relation to the age-related slope showed a reliable effect that did not cross the 0-line. Children who received the FCU intervention *and* experienced higher dyadic positive engagement in early childhood showed statistically reliable, albeit modest, increases in their academic skills from ages 5 to 8.5. All other findings were consistent with results of the first model reported in Figure 1 and Table 2.

4 | DISCUSSION

This longitudinal study of low-income families used Bayesian multilevel modeling to test multiple early childhood factors, the FCU intervention, and their interactions as predictors of school-entry levels of and early school-age gains in academic skills. As hypothesized, higher dyadic positive engagement and child self-regulation from ages 2 to 5 predicted higher academic skills at age 5, but we found almost no positive effects on early school-age gains in academic skills. No variables in early childhood predicted increased standings, with the notable exception that children in the intervention group with higher dyadic positive engagement rose in standings from ages 5 to 8.5. Findings suggest early

TABLE 2 Estimated intercept and age-related slope effects for early childhood predictors of academic skills.

Intercept terms					Slope terms				
	Estimate	Estimated error	Lower 95% CI	Upper 95% CI		Estimate	Estimated error	Lower 95% CI	Upper 95% CI
Intercept	**99.93**	**.65**	**98.67**	**101.20**	**Age**	**−.40**	**.18**	**−.75**	**−.05**
Neighborhood Cohesion (NC)	−.65	.62	−1.83	.59	Age:NC	.22	.17	−.11	.55
Family Income (FI)	.80	.68	−.52	2.17	Age:FI	−.01	.19	−.38	.36
Maternal Education (ME)	**2.93**	**.68**	**1.57**	**4.30**	**Age:ME**	**−.43**	**.19**	**−.80**	**−.07**
Dyadic Positive Engagement (DPE)	**2.12**	**.71**	**.76**	**3.53**	Age:DPE	−.26	.19	−.63	.12
Child Self-Regulation (SR)	**2.10**	**.65**	**.81**	**3.38**	Age:SR	.19	.18	−.17	.54
Location 1 (L1)	**4.31**	**1.00**	**2.34**	**6.23**	Age:L1	−.50	.27	−1.01	.04
Location 2 (L2)	**−3.72**	**.97**	**−5.60**	**−1.81**	Age:L2	−.06	.26	−.57	.45
Intervention Status (IS)	−.91	.61	−2.14	.26	Age:IS	−.07	.17	−.41	.26
Child Race-Ethnicity 1 (R1)	−.17	.91	−1.96	1.58	Age:R1	.11	.25	−.37	.60
Child Race-Ethnicity 2 (R2)	−.03	1.13	−2.30	2.20	**Age:R2**	**−.77**	**.31**	**−1.37**	**−.16**
Child Sex (S)	**−1.81**	**.61**	**−3.02**	**−.60**	Age:S	.34	.17	.00	.67

Note: Bold text marks predictors with estimated effects that do not overlap with the overall mean standard score of 98.1 (i.e., the 0-line in Figure 1). CI = credible interval. Location 1 (Charlottesville). Location 2 (Eugene). Intervention status coded −1 = control, 1 = intervention. Race-ethnicity 2 coded −1 = sample, 1 = non-Hispanic White. Race-ethnicity 2 coded −1 = sample, 1 = non-Hispanic Black. Sex coded −1 = boys, 1 = girls.

childhood interventions such as the FCU designed to improve mother–child engagement can promote low-income children's academic skills.

4.1 | Early childhood predictors of school-entry academic skills

Children in our low-income sample scored on average just below or at the means for the preschool- and school-age norming groups, so their academic skills were not far from national averages. Administering the WJ-III in children's homes may have yielded finer measurement of their capabilities, as lab- and school-based assessments can disadvantage children living in poverty by not assessing their performance in familiar high-stress environments to which they have adapted (Ellis et al., 2017). School-based measures of academic achievement, such as grades and test scores, are impacted by teachers' deficit-oriented biases toward students of color and students from disadvantaged backgrounds, such that low teacher expectations of students' skills create self-fulfilling prophecies that worsen student performance (Rogers et al., 2018; Ullucci & Howard, 2015). Our low-income sample's average WJ-III standard scores

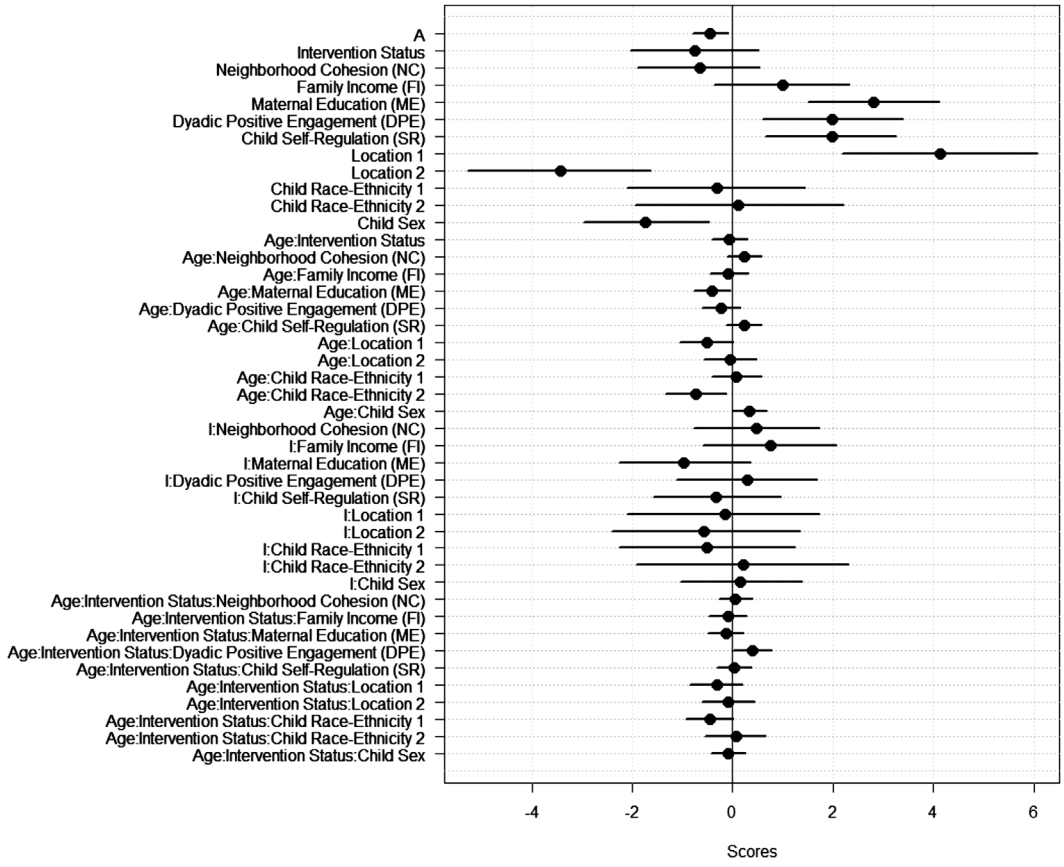

FIGURE 2 Effects of predictors and interactions with intervention status [i.e., I:Neighborhood Cohesion (NC) to Age:Intervention Status:Child Sex] on the intercept and age-related slope for academic skills. Location 1 (Charlottesville). Location 2 (Eugene). Race-ethnicity 1 coded −1 = sample, 1 = non-Hispanic White. Race-ethnicity 2 coded −1 = sample, 1 = non-Hispanic Black. Sex coded −1 = boys, 1 = girls.

suggest some children achieved academic resilience by reaching similar standings on academic skills as children in the norming groups, most of whom were not living in poverty (Schrank et al., 2001).

Guided by theory and the resilience literature, we examined factors across contexts in early childhood to identify malleable targets of intervention for low-income children's academic skills. Our observations of dyadic positive engagement captured key interactions as proximal processes by which mothers promoted children's skills. Consistent with prior research (Chang et al., 2017), dyadic positive engagement was correlated positively with family income, maternal education, child self-regulation, and academic skills. Past studies of our sample found the FCU intervention predicted higher academic skills at ages 5 and 7.5 indirectly through mothers' increases in positive behavior support from child ages 2 to 3 (Brennan et al., 2013). Furthermore, increases in dyadic positive engagement at age 3 attributed to the FCU predicted subsequent decreases in coercive parent–child exchanges (Sitnick et al., 2015) and improvements in observed self-regulation (Chang et al., 2017). As patterns of parent–child interactions stabilize over time (Dishion et al., 2017), it is key to engage parents in early childhood not only to promote positive parent–child engagement but also to prevent coercive interactions that exacerbate young children's problem behavior and school readiness.

Self-regulation is a critical component of school readiness (Blair & Raver, 2015). Overlapping self-regulatory skills increasingly become integrated in children's pursuit of classroom goals (Allan et al., 2014), such as refining academic

TABLE 3 Estimated intercept and age-related slope effects for early childhood predictors of academic skills and their interactions with intervention status.

	Estimate	Estimated error	Lower 95% CI	Upper 95% CI
Intercept	**100.01**	**.65**	**98.75**	**101.26**
Neighborhood Cohesion	−.65	.62	−1.90	.54
Family Income	1.01	.68	−.37	2.32
Maternal Education	**2.81**	**.67**	**1.49**	**4.11**
Dyadic Positive Engagement	**1.99**	**.71**	**.58**	**3.39**
Child Self-Regulation	**1.98**	**.66**	**.65**	**3.25**
Location 1	**4.14**	**.99**	**2.19**	**6.06**
Location 2	**−3.44**	**.94**	**−5.28**	**−1.64**
Intervention Status	−.75	.64	−2.04	.52
Child Race-Ethnicity 1	−.31	.90	−2.09	1.45
Child Race-Ethnicity 2	.11	1.08	−1.95	2.20
Child Sex	**−1.74**	**.64**	**−2.97**	**−.48**
Age	**−.44**	**.18**	**−.80**	**−.09**
Age: Neighborhood Cohesion	.23	.17	−.10	.58
Age: Family Income	−.09	.19	−.45	.30
Age: Maternal Education	**−.41**	**.18**	**−.77**	**−.05**
Age: Dyadic Positive Engagement	−.23	.20	−.61	.15
Age: Child Self-Regulation	.23	.18	−.14	.58
Age: Location 1	−.52	.27	−1.05	.02
Age: Location 2	−.06	.26	−.58	.47
Age: Intervention Status	−.07	.18	−.41	.28
Age: Child Race-Ethnicity 1	.07	.25	−.42	.57
Age: Child Race-Ethnicity 2	**−.73**	**.30**	**−1.33**	**−.13**
Age: Child Sex	.33	.18	−.02	.68
Intervention Status: Neighborhood Cohesion	.48	.64	−.77	1.73
Intervention Status: Family Income	.75	.67	−.59	2.06
Intervention Status: Maternal Education	−.98	.67	−2.27	.35
Intervention Status: Dyadic Positive Engagement	.30	.71	−1.11	1.67
Intervention Status: Child Self-Regulation	−.33	.66	−1.59	.96
Intervention Status: Location 1	−.15	.98	−2.10	1.73
Intervention Status: Location 2	−.58	.96	−2.41	1.34
Intervention Status: Child Race-Ethnicity 1	−.51	.90	−2.27	1.25
Intervention Status: Child Race-Ethnicity 2	.21	1.09	−1.92	2.31
Intervention Status: Child Sex	.16	.62	−1.04	1.38
Age: Intervention Status: Neighborhood Cohesion	.06	.17	−.28	.39
Age: Intervention Status: Family Income	−.09	.19	−.47	.27
Age: Intervention Status: Maternal Education	−.13	.19	−.50	.22

(Continues)

TABLE 3 (Continued)

	Estimate	Estimated error	Lower 95% CI	Upper 95% CI
Age: Intervention Status: Dyadic Positive Engagement	**.40**	**.20**	**.01**	**.78**
Age: Intervention Status: Child Self-Regulation	.03	.18	−.31	.38
Age: Intervention Status: Location 1	−.32	.27	−.86	.20
Age: Intervention Status: Location 2	−.08	.27	−.61	.43
Age: Intervention Status: Child Race-Ethnicity 1	−.45	.25	−.93	.01
Age: Intervention Status: Child Race-Ethnicity 2	.07	.31	−.54	.66
Age: Intervention Status: Child Sex	−.08	.17	−.43	.26

Note: Bold text marks predictors with estimated effects that do not overlap with the overall mean standard score of 98.1 (i.e., the 0-line in Figure 2). CI = credible interval. Location 1 (Charlottesville). Location 2 (Eugene). Intervention status coded −1 = control, 1 = intervention. Race-ethnicity 2 coded −1 = sample, 1 = non-Hispanic White. Race-ethnicity 2 coded −1 = sample, 1 = non-Hispanic Black. Sex coded −1 = boys, 1 = girls.

and social skills (Liew, 2012). Poverty-related stressors hinder development of self-regulatory skills, stifling their integration and generalization to other domains (Blair & Raver, 2015). Consistent with a meta-analysis (Allan et al., 2014), children's self-regulation, specifically inhibitory control, positively predicted their school-entry academic skills. Inhibitory control reflects the capacity to suppress socially inappropriate approach responses under conditions of novelty, uncertainty, or instruction (Rothbart et al., 2001). It also is a core executive function, a set of higher-order cognitive processes that support self-regulation and academic skills (Sabol & Pianta, 2012; Welsh et al., 2010). Past studies of our sample found parents' positive behavior support at age 2 predicted greater gains in self-regulation from ages 2 to 4 (Moilanen et al., 2010), and the FCU intervention predicted increases in dyadic positive engagement from ages 2 to an average score of 3, 4, and 5 years which, in turn, predicted higher self-regulation at age 5, and in turn greater peer acceptance from ages 7.5 to 10 (Chang et al., 2017). Our study further extends evidence of self-regulation in early childhood serving as a promotive factor for academic skills to children living in poverty (Buckner et al., 2009; Distefano et al., 2021; Sattler & Gershoff, 2019).

4.2 | Changes in low-income children's early school-age academic skills

Few variables in early childhood predicted change in academic skills, as children fell slightly behind national norms on average across the early school years. African American children and children of more educated mothers dropped in standings to a greater extent than others. Children of more educated mothers still had higher standings in the early school years from maternal education's initial boost to their school-entry skills, but these benefits waned over time. Ayoub et al. (2009) found Early Head Start children of mothers with a high school degree showed a less rapid decline in cognitive skills from 14 to 36 months than children of mothers without a high school diploma. Harding (2015) found increases in maternal education predicted greater conduct problems in Head Start children of mothers with up to or less than a high school education. Although these studies of Head Start children did not focus on academic skills, they demonstrated conditions under which higher maternal education ceases to benefit some children.

The high stability of children's standings and their modest drop with age may explain why we largely failed to predict gains in academic skills. The only exception was the interaction between the FCU intervention and dyadic positive engagement that predicted reliable gains in academic skills across the early school years, such that only children who experienced the FCU and high dyadic positive engagement in early childhood rose in standings over national averages. Although the predicted increase was small, it added to dyadic positive engagement's contribution to school-entry skills

that benefited all children. This result extends previous findings with our low-income sample that predicted academic skills at specific ages (Brennan et al., 2012, 2013) and suggests family interventions that target early mother–child engagement can promote academic resilience. This type of family support may be especially helpful for the most disadvantaged, as prior work with our low-income sample found the FCU intervention reduced child conduct problems in families with high rates of serious and/or chronic stressors (e.g., history of child maltreatment, maternal depression, parent criminal activity), but had null effects for families experiencing few other family or child risk factors (Pelham et al., 2017). Thus, the FCU may have only improved the academic skills of children who already experienced positive mother–child engagement regularly during early childhood. Intervention group families steadily decreased in participation with the FCU across time, which likely limited intervention effects.

4.3 | Study limitations and future directions

This study did not include fathers (or other parents), peers, school, classroom, or other skill variables because of its focus on early childhood predictors of academic skills. A meta-analysis of longitudinal studies of school-entry attention, cognitive, and socioemotional skills found that emergent academic skills best predicted later achievement (Duncan et al., 2007). Burchinal et al. (2020) found higher school-entry math and reading skills predicted their smaller gains over time, except in low-income children, and school-entry skills within domains were the best predictors of their early school-age levels. Income achievement gaps at school entry also do not appear to substantially widen or narrow over time because of classroom or school factors (Reardon, 2013). Future longitudinal studies that examine multiple skill domains across childhood can clarify their within- and cross-domain relations with classroom and school factors.

Families were recruited from WIC clinics and of mostly European or African ancestry, limiting our findings' generalizability across cultural, racial-ethnic, and socioeconomic groups. Despite families being recruited with the same risk criteria, location differences in academic skills likely reflect sociodemographic and related differences across sites that were beyond our control (e.g., local resource availability) and indicative of omitted variable bias. Data also were collected from 2002 to 2012, so our findings may not generalize to families currently in poverty.

4.4 | Policy and programmatic implications

Poverty in early childhood, especially chronic and deep poverty, is more detrimental to child achievement than poverty in middle childhood or adolescence (Duncan et al., 2012, 2017). The U.S. Department of Health and Human Services and the U.S. Department of Education (2016) released a joint policy statement urging family engagement in early childhood systems to promote healthy development, school readiness, and achievement. As parents are often children's first and most influential teachers, engaging families is key for early childhood programs offered by schools, community services, and agencies. Although few variables predicted improvements in academic skills after school entry, parent and child characteristics in early childhood reliably predicted school-entry standings, and the FCU intervention coupled with positive mother–child engagement predicted gains in academic skills. Early interventions targeting positive mother–child engagement and child self-regulation can promote school readiness and academic resilience (Blair & Raver, 2015; Morris et al., 2017). Clarifying strengths within families living in poverty that shape skill acquisition prior to school entry may then help reduce income achievement gaps.

ACKNOWLEDGMENTS

We are appreciative of the many families who participated and the many people who assisted in data collection and coding. This research was supported by a grant from the National Institute on Drug Abuse (5R01DA022773-04) to Daniel Shaw, Ph.D.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

Data can be made available upon request.

ETHICS STATEMENT

This study follows all ethical standards for human research.

ORCID

Daniel Ewon Choe https://orcid.org/0000-0002-3867-855X

REFERENCES

Allan, N. P., Hume, L. E., Allan, D. M., Farrington, A. L., & Lonigan, C. J. (2014). Relations between inhibitory control and the development of academic skills in preschool and kindergarten: A meta-analysis. *Developmental Psychology*, *50*(10), 2368–2379. https://doi.org/10.1037/a0037493

Ayoub, C., O'Connor, E., Rappolt-Schlictmann, G., Vallotton, C., Raikes, H., & Chazan-Cohen, R. (2009). Cognitive skill performance among young children living in poverty: Risk, change, and the promotive effects of Early Head Start. *Early Childhood Research Quarterly*, *24*(3), 289–305. https://doi.org/10.1016/j.ecresq.2009.04.001

Blair, C., & Raver, C. C. (2015). School readiness and self-regulation: A developmental psychobiological approach. *Annual Review of Psychology*, *66*(1), 711–731. https://doi.org/10.1146/annurev-psych-010814-015221

Brady, D. (2019). Theories of the causes of poverty. *Annual Review of Sociology*, *45*, 155–175. https://doi.org/10.1146/annurev-soc-073018-022550

Brennan, L. M., Shaw, D. S., Dishion, T. J., & Wilson, M. N. (2012). Longitudinal predictors of school- age academic achievement: Unique contributions of toddler-age aggression, oppositionality, inattention, and hyperactivity. *Journal of Abnormal Child Psychology*, *40*(8), 1289–1300. https://doi.org/10.1007/s10802-012-9639-2

Brennan, L. M., Shelleby, E. C., Shaw, D. S., Gardner, F., Dishion, T. J., & Wilson, M. (2013). Indirect effects of the family check-up on school-age academic achievement through improvements in parenting in early childhood. *Journal of Educational Psychology*, *105*(3), 762–773. https://doi.org/10.1037/a0032096

Bronfenbrenner, U., & Morris, P. A. (2006). The bioecological model of human development. In R. M. Lerner & W. Damon (Eds.), *Handbook of child psychology: Theoretical models of human development* (pp. 793–828). John Wiley & Sons Inc. https://doi.org/10.1002/9780470147658.chpsy0114

Buckner, J. C. (1988). The development of an instrument to measure neighborhood cohesion. *American Journal of Community Psychology*, *16*(6), 771–791. https://doi.org/10.1007/BF00930892

Buckner, J. C., Mezzacappa, E., & Beardslee, W. R. (2009). Self-regulation and its relations to adaptive functioning in low income youths. *American Journal of Orthopsychiatry*, *79*(1), 19–30. https://doi.org/10.1037/a0014796

Burchinal, M., Foster, T. J., Bezdek, K. G., Bratsch-Hines, M., Blair, C., Vernon-Feagans, L., & Family Life Project Investigators. (2020). School-entry skills predicting school-age academic and social–emotional trajectories. *Early Childhood Research Quarterly*, *51*, 67–80. https://doi.org/10.1016/j.ecresq.2019.08.004

Burchinal, M. R., Peisner-Feinberg, E., Pianta, R., & Howes, C. (2002). Development of academic skills from preschool through second grade: Family and classroom predictors of developmental trajectories. *Journal of School Psychology*, *40*(5), 415–436. https://doi.org/10.1016/S0022-4405(02)00107-3

Bürkner, P.-C. (2017). Brms: An R package for Bayesian multilevel models using Stan. *Journal of Statistical Software*, *80*(1), 1–28. https://doi.org/10.18637/jss.v080.i01

Bürkner, P.-C. (2018). Advanced Bayesian multilevel modeling with the R package brms. *The R Journal*, *10*(1), 395–411.

Campbell, F. A., Pungello, E. P., Miller-Johnson, S., Burchinal, M., & Ramey, C. T. (2001). The development of cognitive and academic abilities: Growth curves from an early childhood educational experiment. *Developmental Psychology*, *37*(2), 231–242. https://doi.org/10.1037/0012-1649.37.2.231

Chang, H., Shaw, D. S., Shelleby, E. C., Dishion, T. J., & Wilson, M. N. (2017). The long-term effectiveness of the family check-up on peer preference: Parent–child interaction and child effortful control as sequential mediators. *Journal of Abnormal Child Psychology*, *45*(4), 705–717. https://doi.org/10.1007/s10802-016-0198-9

Chetty, R., Friedman, J. N., Hilger, N., Saez, E., Schanzenbach, D. W., & Yagan, D. (2011). How does your kindergarten classroom affect your earnings? Evidence from Project Star. *Quarterly Journal of Economics*, *126*(4), 1593–1660. https://doi.org/10.1093/qje/qjr041

Connell, A. M., Dishion, T. J., Yasui, M., & Kavanagh, K. (2007). An adaptive approach to family intervention: Linking engagement in family-centered intervention to reductions in adolescent problem behavior. *Journal of Consulting and Clinical Psychology*, *75*(4), 568–579. https://doi.org/10.1037/0022-006X.75.4.568

Cunha, F., & Heckman, J. (2007). The technology of skill formation. *The American Economic Review*, *97*(2), 47–47. https://doi.org/10.1257/aer.97.2.31 http://www.nber.org/papers/w12840

Dahl, G. B., & Lochner, L. (2012). The impact of family income on child achievement: Evidence from the earned income tax credit. *American Economic Review*, *102*(5), 1927–1956.

DeNavas-Walt, C., Cleveland, R., & Webster Jr., B. H. (2003). U.S. Census Bureau, Current Population Reports, P60-221. *Income in the United States: 2002*. U.S. Government Printing Office. Retrieved from https://www2.census.gov/library/publications/2003/demo/p60-221.pdf

Dishion, T. J., Brennan, L. M., Shaw, D. S., McEachern, A. D., Wilson, M. N., & Jo, B. (2014). Prevention of problem behavior through annual Family Check-Ups in early childhood: Intervention effects from home to early elementary school. *Journal of Abnormal Child Psychology*, *42*(3), 343–354. https://doi.org/10.1007/s10802-013-9768-2

Dishion, T. J., Mun, C. J., Tein, J.-Y., Kim, H., Shaw, D. S., Gardner, F., Wilson, M. N., & Peterson, J. (2017). The validation of macro and micro observations of parent–child dynamics using the Relationship Affect Coding System in early childhood. *Prevention Science*, *18*(3), 268–280. https://doi.org/10.1007/s11121-016-0697-5

Dishion, T. J., Shaw, D. S., Connell, A. M., Gardner, F., Weaver, C., & Wilson, M. (2008). The Family Check-Up with high-risk indigent families: Preventing problem behavior by increasing parents' positive behavior support in early childhood. *Child Development*, *79*(5), 1395–1414. https://doi.org/10.1111/j.1467-8624.2008.01195.x

Dishion, T. J., & Stormshak, E. A. (2007). *Intervening in children's lives: An ecological, family-centered approach to mental health care*. American Psychological Association. https://doi.org/10.1037/11485-000

Dishion, T. J., Stormshak, E. A., & Kavanagh, K. A. (2011). *Everyday parenting: A professional's guide to building family management skills*. Research Press.

Distefano, R., Grenell, A., Palmer, A. R., Houlihan, K., Masten, A. S., & Carlson, S. M. (2021). Self-regulation as promotive for academic achievement in young children across risk contexts. *Cognitive Development*, *58*, 101050. https://doi.org/10.1016/j.cogdev.2021.101050

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, *43*(6), 1428–1446. https://doi.org/10.1037/0012-1649.43.6.1428

Duncan, G. J., & Magnuson, K. A. (2003). Off with Hollingshead: Socioeconomic resources, parenting, and child development. In M. H. Bornstein & R. H. Bradley (Eds.), *Socioeconomic status, parenting, and child development* (pp. 83–106). Lawrence Erlbaum Associates Publishers.

Duncan, G. J., Magnuson, K., Kalil, A., & Ziol-Guest, K. (2012). The importance of early childhood poverty. *Social Indictors Research*, *108*, 87–98. https://doi.org/10.1007/s11205-011-9867-9

Duncan, G. J., Magnuson, K., & Votruba-Drzal, E. (2017). Moving beyond correlations in assessing the consequences of poverty. *Annual Review of Psychology*, *68*(1), 413–434. https://doi.org/10.1146/annurev-psych-010416-044224

Ellis, B. J., Bianchi, J., Griskevicius, V., & Frankenhuis, W. E. (2017). Beyond risk and protective factors: An adaptation-based approach to resilience. *Perspectives on Psychological Science*, *12*(4), 561–587. https://doi.org/10.1177/1745691617693054

Frankenhuis, W. E., & Nettle, D. (2020). The strengths of people in poverty. *Current Directions in Psychological Science*, *29*(1), 16–21. https://doi.org/10.1177/0963721419881154

Froiland, J. M., Powell, D. R., Diamond, K. E., & Son, S. C. (2013). Neighborhood socioeconomic well-being, home literacy, and early literacy skills of at-risk preschoolers. *Psychology in the Schools*, *50*(8), 755–769. https://doi.org/10.1002/pits.21711

Gelman, A., Hill, J., & Yajima, M. (2012). Why we (usually) don't have to worry about multiple comparisons. *Journal of Research on Educational Effectiveness*, *5*(2), 189–211. https://doi.org/10.1080/19345747.2011.618213

Gershoff, E. T., Aber, J. L., Raver, C. C., & Lennon, M. C. (2007). Income is not enough: Incorporating material hardship into models of income associations with parenting and child development. *Child Development*, *78*(1), 70–95. https://doi.org/10.1111/j.1467-8624.2007.00986.x

Harding, J. F. (2015). Increases in maternal education and low-income children's cognitive and behavioral outcomes. *Developmental Psychology*, *51*(5), 583–599. https://doi.org/10.1037/a0038920

IBM Corp. (2020). *IBM SPSS Statistics for Macintosh, Version 27*. IBM Corp.

Kohen, D. E., Brooks-Gunn, J., Leventhal, T., & Hertzman, C. (2002). Neighborhood income and physical and social disorder in Canada: Associations with young children's competencies. *Child Development*, *73*(6), 1844–1860. https://doi.org/10.1111/1467-8624.t01-1-00510

Leventhal, T., & Dupéré, V. (2019). Neighborhood effects on children's development in experimental and nonexperimental research. *Annual Review of Developmental Psychology*, *1*(1), 149–176. https://doi.org/10.1146/annurev-devpsych-121318-085221

Liew, J. (2012). Effortful control, executive functions, and education: Bringing self-regulatory and social-emotional competencies to the table. *Child Development Perspectives*, *6*(2), 105–111. https://doi.org/10.1111/j.1750-8606.2011.00196.x

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, *83*(404), 1198–1202. https://doi.org/10.1080/01621459.1988.10478722

Luthar, S. S., Crossman, E. J., & Small, P. J. (2015). Resilience and adversity. In M. E. Lamb & R. M. Lerner (Eds.), *Handbook of child psychology and developmental science: Socioemotional processes* (pp. 247–286). John Wiley & Sons, Inc. https://doi.org/10.1002/9781118963418.childpsy307

Magnuson, K., & Votruba-Drzal, E. (2009). Enduring influences of childhood poverty. *Focus*, *26*(2), 32–37. https://www.irp.wisc.edu/publications/focus/pdfs/foc262f.pdf

McGrew, K. S., & Woodcock, R. W. (2001). Technical manual. *Woodcock-Johnson III*. Riverside Publishing.

McLoyd, V. C., Kaplan, R., Purtell, K. M., Bagley, E., Hardaway, C. R., & Smalls, C. (2009). Poverty and socioeconomic disadvantage in adolescence. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology: Contextual influences on adolescent development* (pp. 444–491). John Wiley & Sons, Inc. https://doi.org/10.1002/9780470479193.adlpsy002014

Moilanen, K. L., Shaw, D. S., Dishion, T. J., Gardner, F., & Wilson, M. (2010). Predictors of longitudinal growth in inhibitory control in early childhood. *Social Development*, *19*(2), 326–347. https://doi.org/10.1111/j.1467-9507.2009.00536.x

Morris, A. S., Robinson, L. R., Hays-Grudo, J., Claussen, A. H., Hartwig, S. A., & Treat, A. E. (2017). Targeting parenting in early childhood: A public health approach to improve outcomes for children living in poverty. *Child Development*, *88*(2), 388–397. https://doi.org/10.1111/cdev.12743

Perez-Smith, A., Albus, K., & Weist, M. (2001). Exposure to violence and neighborhood affiliation among inner-city youth. *Journal of Clinical Child and Adolescent Psychology*, *30*(4), 464–472. https://doi.org/10.1207/S15374424JCCP3004_03

Pelham, W. E., Dishion, T. J., Tein, J. Y., Shaw, D. S., & Wilson, M. N. (2017). What doesn't work for whom? Exploring heterogeneity in responsiveness to the family check-up in early childhood using a mixture model approach. *Prevention Science*, *18*, 911–922. https://doi.org/10.1007/s11121-017-0805-1

Peterson, J., Winter, C., Jabson, J. M., & Dishion, T. D. (2008). *Relationship affect coding system*. University of Oregon, Child and Family Center. Unpublished coding manual.

Pinquart, M. (2016). Associations of parenting styles and dimensions with academic achievement in children and adolescents: A meta-analysis. *Educational Psychology Review*, *28*, 475–493. https://doi.org/10.1007/s10648-015-9338-y

Pitt Mother & Child Project (2001). *Me and my neighborhood*. Unpublished measure.

R Core Team (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.r-project.org/

Reardon, S. F. (2013). The widening income achievement gap. *Educational Leadership: Faces of Poverty*, *70*, 10–16.

Rogers, K. R., Maxwell, D., & Robinson, S. R. (2018). Influences of academic success among low-income minority students: A qualitative interpretive meta-synthesis of student, educator, and parent experiences. *School Social Work Journal*, *43*(1), 38–59.

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at 3–7 years: The Children's Behavior Questionnaire. *Child Development*, *72*(5), 1394–1408. https://doi.org/10.1111/1467-8624.00355

Rudd, G., Meissel, K., & Meyer, F. (2021). Measuring academic resilience in quantitative research: A systematic review of the literature. *Educational Research Review*, *34*, 100402. https://doi.org/10.1016/j.edurev.2021.100402

Sabol, T. J., & Pianta, R. C. (2012). Patterns of school readiness forecast achievement and socioemotional development at the end of elementary school. *Child Development*, *83*(1), 282–299. https://doi.org/10.1111/j.1467-8624.2011.01678.x

Sameroff, A. (2010). A unified theory of development: A dialectic integration of nature and nurture. *Child Development*, *81*(1), 6–22. https://doi.org/10.1111/j.1467-8624.2009.01378.x

Sattler, K., & Gershoff, E. (2019). Thresholds of resilience and within- and cross-domain academic achievement among children in poverty. *Early Childhood Research Quarterly*, *46*(1), 87–96. https://doi.org/10.1016/j.ecresq.2018.04.003

Schrank, F. A., McGrew, K. S., & Woodcock, R. W. (2001). *Technical Abstract* (Woodcock-Johnson III Assessment Service Bulletin No., 2). Riverside Publishing.

Shaw, D. S., Connell, A., Dishion, T. J., Wilson, M. N., & Gardner, F. (2009). Improvements in maternal depression as a mediator of intervention effects on early childhood problem behavior. *Development and Psychopathology*, *21*(2), 417–439. https://doi.org/10.1017/S0954579409000236

Shaw, D. S., & Shelleby, E. C. (2014). Early-starting conduct problems: Intersection of conduct problems and poverty. *Annual Review of Clinical Psychology*, *10*, 503–528. https://doi.org/10.1146/annurev-clinpsy-032813-153650

Shaw, D. S., Sitnick, S. L., Brennan, L. M., Choe, D. E., Dishion, T. J., Gardner, F., & Wilson, M. N. (2016). The long-term effectiveness of the Family Check-Up on school-age conduct problems: Moderation by neighborhood deprivation. *Development and Psychopathology*, *28*(4.2), 1471–1486. https://doi.org/10.1017/S0954579415001212

Shen, C., Wan, A., Kwok, L. T., Pang, S., Wang, X., Stewart, S. M., Lam, T. H., & Chan, S. S. (2017). A community-based intervention program to enhance neighborhood cohesion: The Learning Families Project in Hong Kong. *PLoS ONE*, *12*(8), e0182722. https://doi.org/10.1371/journal.pone.0182722

Sitnick, S. L., Shaw, D. S., Gill, A., Dishion, T., Winter, C., Waller, R., Gardner, F., & Wilson, M. (2015). Parenting and the family check-up: Changes in observed parent-child interaction following early childhood intervention. *Journal of Clinical Child and Adolescent Psychology*, *44*(6), 970–984. https://doi.org/10.1080/15374416.2014.940623

Skibbe, L. E., Phillips, B. M., Day, S. L., Brophy-Herb, H. E., & Connor, C. M. (2012). Children's early literacy growth in relation to classmates' self-regulation. *Journal of Educational Psychology*, *104*(3), 541–553. https://doi.org/10.1037/a0029153

Smith, J. D., Berkel, C., Hails, K. A., Dishion, T. J., Shaw, D. S., & Wilson, M. N. (2018). Predictors of participation in the family check-up program: A randomized trial of yearly services from age 2 to 10 years. *Prevention Science*, *19*(5), 652–662. https://doi.org/10.1007/s11121-016-0679-7

Ullucci, K., & Howard, T. (2015). Pathologizing the poor: Implications for preparing teachers to work in high-poverty schools. *Urban Education*, *50*(2), 170–193. https://doi.org/10.1177/0042085914543117

U.S. Census Bureau (2003). *Annual tables on educational attainment from the Current Population Survey's March Annual Demographic File.* Retrieved from https://www.census.gov/data/tables/2002/demo/educational-attainment/cps-detailed-tables.html

U.S. Department of Health and Human Services & U.S. Department of Education (2016). *Policy statement on family engagement from the early years to the early grades.* Retrieved from https://www.acf.hhs.gov/sites/default/files/documents/ecd/16_0152reportclean_logos.pdf

Wagmiller, R. L., Lennon, M. C., Kuang, L., Alberti, P. M., & Aber, J. L. (2006). The dynamics of economic disadvantage and children's life chances. *American Sociological Review*, *71*(5), 847–866. https://doi.org/10.1177/000312240607100507

Waldfogel, J. (2012). The role of out-of-school factors in the literacy problem. *The Future of Children*, *22*(2), 39–54. https://doi.org/10.1353/foc.2012.0016

Welsh, J. A., Nix, R. L., Blair, C., Bierman, K. L., & Nelson, K. E. (2010). The development of cognitive skills and gains in academic school readiness for children from low-income families. *Journal of Educational Psychology*, *102*(1), 43–53. https://doi.apa.org/doi/10.1037/a0016738

Werner, E. E. (2013). What can we learn about resilience from large-scale longitudinal studies? In S. Goldstein & R. B. Brooks (Eds.), *Handbook of resilience in children* (pp. 87–102). Springer. https://doi.org/10.1007/978-1-4614-3661-4_6

Yeung, W. J., Linver, M. R., & Brooks-Gunn, J. (2002). How money matters for young children's development: Parental investment and family processes. *Child Development*, *73*(6), 1861–1879. https://doi.org/10.1111/1467-8624.t01-1-00511

Yoshikawa, H., Aber, J. L., & Beardslee, W. R. (2012). The effects of poverty on the mental, emotional, and behavioral health of children and youth: Implications for prevention. *American Psychologist*, *67*(4), 272–284. https://doi.org/10.1037/a0028015

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Choe, D. E., Barreda, S., Galán, C. A., Gardner, F., Wilson, M. N., Dishion, T. J., & Shaw, D. S. (2023). Early childhood predictors of early school-age academic skills and resilience among children living in poverty. *Social Development*, 1–19. https://doi.org/10.1111/sode.12715