Annenberg Institute
BROWN UNIVERSITY

EdWorkingPaper No. 24-1099

Early Childhood Education and Maltreated Children's Behavioral and Cognitive Outcomes: Quasi-experimental Evidence from the National Survey of Childhood and Adolescent Well-Being II

Kevin A. Gee
University of California, Davis

Prior evidence shows that early childhood education (ECE) can serve as a protective factor that boosts maltreated children's school readiness outcomes. Yet, less is known about ECE's relationship to other developmental domains critical to their wellbeing including their adaptive behaviors and cognitive development. Focusing on a broader range of outcomes allows for a more holistic picture of the ways in which ECE influences maltreated children's developmental wellbeing. This study investigates ECE's relationship to maltreated children's adaptive behaviors (daily living and socialization skills) and cognitive development (attention and memory; perception and concepts) using data on a sample of 1,570 children (Mean age = 11.5 months at baseline) from the National Survey of Child and Adolescent Well-Being II. To estimate ECE's association with children's outcomes, this study uses the quasi-experimental method of propensity score weighting which accounts for observable selection bias between children in ECE versus not in ECE. In the short-term (Mean age = 22 months), ECE leads to lower daily living skills as well as higher perception and concept scores. These effects did not persist as children approached their formal schooling years (Mean age = 42 months). Effects were not detected on either their social skills or attention and memory. These findings demonstrate mixed evidence of ECE's relationship to maltreated children's outcomes and underscores the importance of identifying critical features of ECE that might need to be tailored to the specific needs of maltreated children.

VERSION: November 2024

Suggested citation: Gee, Kevin A.. (2024). Early Childhood Education and Maltreated Children's Behavioral and Cognitive Outcomes: Quasi-experimental Evidence from the National Survey of Childhood and Adolescent Well-Being II. (EdWorkingPaper: 24 -1099). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/dvdk-6c97

Early Childhood Education and Maltreated Children's Behavioral and Cognitive Outcomes: Quasi-experimental Evidence from the National Survey of Childhood and Adolescent Well-Being II

Kevin A. Gee[1]

[1]School of Education, University of California, Davis

Author Note

Kevin A. Gee https://orcid.org/0000-0002-5734-1688

Correspondence concerning this article should be addressed to Kevin A. Gee, University of California, Davis, School of Education, One Shields Avenue, Davis, CA, 95616. Email: kagee@ucdavis.edu

Abstract

Background: Prior evidence shows that early childhood education (ECE) can serve as a protective factor that boosts maltreated children's school readiness outcomes. Yet, less is known about ECE's relationship to other developmental domains critical to their wellbeing including their adaptive behaviors and cognitive development. Focusing on a broader range of outcomes allows for a more holistic picture of the ways in which ECE influences maltreated children's developmental wellbeing.

Objective: This study investigates ECE's relationship to maltreated children's adaptive behaviors (daily living and socialization skills) and cognitive development (attention and memory; perception and concepts).

Participants and Setting: This study leveraged data on sample of 1,570 children (M_{age} = 11.5 months) from the National Survey of Child and Adolescent Well-Being II.

Methods: To estimate ECE's association with children's outcomes, this study uses the quasi-experimental method of propensity score weighting which accounts for observable selection bias between children in ECE versus not in ECE.

Results: In the short-term (M_{age} = 22 months), ECE is associated with lower daily living skills as well as higher perception and concept scores. These associations did not persist as children approached their formal schooling years (M_{age} = 42 months). Associations were not detected between ECE and either their social skills or attention and memory.

Conclusions: These findings demonstrate mixed evidence of ECE's relationship to maltreated children's outcomes and underscores the importance of identifying critical features of ECE that might need to be tailored to the specific needs of maltreated children.

Keywords: early childhood education; child maltreatment; adaptive behaviors; cognitive development; propensity score weighting; national survey of adolescent and child well-being

1. Introduction

Children who are victims of maltreatment can experience a range of negative educational outcomes relative to their non-maltreated peers, from lowered math and reading achievement to higher rates of absenteeism and grade repetition (Romano et al., 2014; Stone, 2007; Veltman & Browne, 2001). Given the downstream educational consequences of childhood maltreatment, there is a critical need to identify interventions to promote wellbeing early in these children's lives, potentially protecting them from negative consequences later in life. One such intervention is early childhood education (ECE). An emergent evidence base demonstrates that ECE can serve as a protective factor that boosts children's school readiness outcomes, especially among the youngest maltreated infants and toddlers who experience the highest risk of maltreatment during one of their most critical formative developmental stages of life (U.S. Department of Health & Human Services & Administration on Children, 2022). Of the extant evidence base documenting ECE's effect on maltreated children (e.g., Lee, 2016; Lee, 2020; Lipscomb et al., 2013; Merritt & Klein, 2015), ECE has been associated with higher achievement-related outcomes, including their language abilities (Merritt & Klein, 2015) and overall cognitive performance (Lipscomb et al., 2013).

However, while the primary focus of these studies is on traditional achievement-based outcomes, less is known about ECE's relationship to other developmental domains critical to their wellbeing, including cognitive outcomes such as their as attention and memory well as non-cognitive abilities, like their socialization skills. Over 35 years ago, Aber and Cicchetti (1984) called for a more a more holistic view of maltreated children, including a more expansive understanding of their developmental contexts and domains (Wodarski et al., 1990) and, to date, there continues to be a need to more deeply understand the ECE contexts of maltreated children

as well as examine a broader range of outcomes that can be influenced by participating in ECE. In addition, methodologically, prior research has tended to be predominately correlational which creates newfound opportunities to leverage quasi-experimental methods that can generate more robust evidence to guide policy and practice. Finally, understanding the effectiveness of ECE for maltreated children is both timely and relevant given current policy debates over a nationwide expansion of early learning opportunities. While scaling up the reach of ECE holds promise for promoting positive trajectories for all children, how CWS-involved children experience the effects of ECE offers insights into ways that ECE may need to be adapted and tailored to the specific needs of CWS-involved children.

Accordingly, the aim of this present study is to investigate how ECE relates to the adaptive behaviors and cognitive development of maltreated children. This work makes two new contributions to the existing empirical evidence base addressing ECE's effects on maltreated children. First, this study examines two sets of behavioral and cognitive outcomes that have been previously unexamined in prior research on ECE and maltreated children's outcomes: their adaptive behaviors (daily living and socialization skills as measured by the Vineland Adaptive Behavior Scale Screener [VABS; Sparrow et al., 1993]), and their cognitive development (attention and memory; and perception and concepts as measured by the Battelle Development Inventory [BDI; Newborg, 2004]). Focusing on a broader range of outcomes allows for a more expansive and holistic picture of the ways in which ECE can shape children's developmental wellbeing. Second, this study leverages the quasi-experimental method of propensity score weighting that helps to reduce threats due to selection bias, thereby highlighting a new methodological way of estimating ECE's connection to the wellbeing of CWS-involved children. Methodologically, prior studies of ECE's association with CWS-involved children's outcomes

has been established through correlational designs (Merritt & Klein, 2015), matched sampling (Kovan et al., 2014) or smaller scale analyses on youth in non-parental care from the randomized Head Start Impact Study (e.g., Lipscomb et al., 2013).

2. Maltreated Children's Adaptive Behaviors and Cognitive Development

2.1. Adaptive Behaviors

Adaptive behaviors refer to the most fundamental types of skills needed to navigate everyday life. These skills have been shown to exist in three primary domains: practical (e.g., daily living skills like personal care), conceptual (e.g., numeracy), and social (e.g., interpersonal abilities) (Tassé et al., 2012). While research on adaptive behaviors in children has traditionally focused on children with disabilities, more recent attention has focused on the adaptive skills of CWS-involved children—not only is there overlap in these populations (Gee, 2020) but knowledge of maltreated children's adaptive behaviors, especially behaviors in which they experience delays, is important to guide the kinds of developmental supports and interventions needed to promote positive developmental trajectories (Viezel et al., 2014). Maltreatment can adversely impact adaptive behaviors via the broader behavioral and physical effects of abuse and neglect—for instance, daily living skills requires fine motor (e.g., grasping) and gross motor development (e.g., manipulating objects, reflexes), both of which can be delayed due to abuse (Wade et al., 2018). In fact, the daily living skills of CWS-involved children (as captured by the VABS) is lower by approximately half a standard deviation versus in the normed reference population (Casanueva et al., 2011).

Prior research on the adaptive behaviors in maltreated youth has focused primarily on older children (5 and above) and has demonstrated how maltreatment type (i.e., abuse or neglect) can lead to difference in their daily living and socialization skills. For instance, one small-scale

study (N = 160) of maltreated children (aged 5-18) in New York found that compared to children who have been abused, those experiencing neglect had significantly lower daily living skills (a mean score of 84.69 vs. 94.69) as well as socialization skills (a mean score of 83.29 vs. 90.69) (Viezel et al., 2014). Further, the type and frequency of neglect may matter as well. Dubowitz and colleagues (2005) found that maltreated children (aged 4 to 8) participating in the Longitudinal Studies of Child Abuse and Neglect (LONGSCAN) who experienced more frequent incidents of medical neglect had significantly lower daily living skills (B = -3.27; p < .05) as well as socialization skills (B = -2.25; p < .01) while those experiencing higher incidents of hygiene neglect had lower socialization skills (-2.71; p < .05).

2.2. Attention and Memory; Perception and Concepts

In addition to children's adaptive behaviors, two cognitive developmental domains—their attention and memory alongside their perception and concepts—represent the earliest and most foundational aspects of children's development in their first 2 years of life that can have later effects on their school readiness (Institute of Medicine and National Research Council, 2000). Based upon the BDI, attention and memory capture the extent to which children can retrieve information as well as focus on visual and auditory stimuli over a period of time (Michalec, 2011). Perception and concepts capture children's sensorimotor interactions (i.e., use of senses alongside their physical motor skills). As with their adaptive behaviors, delays in these early developmental stage domains can inform the specific types of supports and interventions that children may need to support positive trajectories throughout childhood. As with children's adaptive behaviors, prior research on CWS-involved children from the NSCAW II (0 to 47 months old) shows lower scores on attention and memory as well as perception and concepts relative to the mean in the normative sample of children (Casanueva et al., 2011). Further, close

to a third (29.4%) of children had perception and concepts scores that were 2 or more standard deviations below the mean, indicating very low sensorimotor abilities that could require developmental interventions (Casanueva et al., 2011).

3. How ECE Influences the Outcomes of CWS-Involved Children: Theory and Evidence

Theoretically, ECE can influence the adaptive behaviors and cognitive development of CWS-involved children through several interrelated pathways (Dinehart et al., 2013; Klein, 2016). The first, and most direct, is via the developmental experiences and activities that ECE, especially when high-quality, can provide to promote children's positive development. Beyond this direct link, a second and equally critical indirect pathway is through parents or caregivers and the family microsystem (Dinehart et al., 2013). For instance, ECE can offer parents or caregivers respite care, which eases the stress and anxiety related to caregiving responsibilities, and subsequently enhances child wellbeing via more positive caregiving interactions (Meloy & Phillips, 2012). ECE can also offer parents and caregivers direct training in how to manage care of CWS-involved children (Meloy & Phillips 2012), leading to enhanced outcomes. Finally, ECE can influence the resources of the family microsystem as it can allow parents and caregivers to pursue work opportunities thereby boosting familial resources—both material and emotional—that can be vital inputs that promote children's development (Meloy & Phillips, 2012).

Although prior investigations have yet to explicitly examine how ECE relates maltreated children's adaptive behaviors or their cognitive development, especially in terms of their attention and memory or perception and concepts, the extant empirical literature shows that ECE can promote positive outcomes of CWS-involved children. As summarized in Table 1, results of four recent studies of ECE and CWS-involved children (Merritt & Klein, 2015) or those in foster

care (Lee, 2016; Lee, 2020; Lipscomb et al., 2013), show that ECE is typically associated with higher cognitive performance, with a few notable exceptions. Among the studies showing positive associations, Merritt and Klein's (2015) analysis of CWS-involved children (aged 0-59 months at baseline) from the second National Survey of Child and Adolescent Well-Being (NCSAW II) found that children in ECE had significantly higher language scores (effect size [ES] = .09) with larger effects among children who experienced supervisory neglect (ES = .11). Similarly, analyses based on the Head Start Impact Study (HSIS; Lipscomb et al., 2013) which relied on random assignment of children to Head Start services, show that 3- to 4-year-olds in non-parental care who were exposed to one-year of Head Start had higher Woodcock-Johnson III composite scores (a combination of letter word identification, spelling and applied problems) relative to children not in Head Start (ES = .16). Similar associations were found in the longer term. For instance, Lee's (2020) analysis of HSIS children in non-parental care demonstrated that by age 8 to 9, children's word-identification scores were higher (ES = .20) for those who participated in Head Start. Conversely, Lee (2016) also found that after exposure to 2 years of Head Start, foster youth in the HSIS did not have significantly higher math reasoning or oral comprehension abilities.

Regarding children's behavioral outcomes, Lipscomb et al., (2013) found no immediate connection between Head Start and the externalizing behaviors of children in non-parental care the year after children were assigned to Head Start. Yet, they also identified an indirect effect they considered as "modest" ($p < .10$)—children in Head Start had lower externalizing behaviors two years after exposure to Head Start, via two indirect pathways: enhanced positive teacher-student relationships as well as lower behavior problems after the first year of Head Start.

Finally, Lee (2020) detected a "marginally significant" ($p < .10$) effect on social skills and positive approaches to learning among 8 to 9 year olds who participated in Head Start.

Collectively, this emergent body of evidence shows that ECE—especially Head Start—can boost the cognitive outcomes of CWS-involved children; however, ECE's connection to their behavioral outcomes is less conclusive. What remains open to further empirical investigation is whether ECE is associated with improvements in a broader range of outcomes, both cognitive and non-cognitive, among children who have experienced maltreatment.

4. Methods

4.1. Data

This study leverages data from the second National Survey of Child and Adolescent Well-Being (NSCAW II), the only nationwide longitudinal study of children of abuse or neglect (U.S. Department of Health and Human Services, 2012). The analytic sample consists of 1570 children, 24 months and under (M_{age} = 11.5 months; range: 2 to 24 months old), who were not in ECE at baseline (wave 1); of those, 286 were in ECE by wave 2 while 1,286 remained out of ECE. Baseline descriptive statistics on this study's measures, disaggregated by ECE status, are summarized in Table 2.

4.2. Measures

4.2.1. Early Childhood Care and Education

The main predictor of interest is ECE participation. Caregivers were asked whether (1 = *yes*; 0 = *no*) the child currently attends a day care program, such as Head Start, nursery school or an early childhood development program. The item explicitly pertained to "any center-based program" and excluded home-based baby sitting or home day care. This measure has been used previously to capture ECE participation among CWS-involved children (Merritt & Klein, 2015).

4.2.2. Adaptive Behaviors (Daily Living Skills and Socialization Skills)

Children's daily living skills and socialization skills were captured using the Vineland Adaptive Behavior Scale (VABS) Screener (Sparrow et al., 1993). Caregivers responded to 15 items about how their child accomplished daily living tasks (e.g., how much help they need putting on shoes or when dressing themselves) and 15 items about their child's social skills (e.g., the extent to which their child shows interest in other children). Raw scores for each domain were converted to standard scores (M = 100; SD = 15) and adjusted for a child's age. Prior research using these items have noted high interrater reliability (.98) and strong correlation between the screener and the full instrument (correlations were .95 and .98, respectively) (Horowitz et al., 2018).

4.2.3. Cognitive Development

Scores on two subscales of the Battelle Developmental Inventory, 2nd Edition (BDI-2; Newborg, 2005) were used: Attention and Memory; and Perception and Concepts. Both are part of the Cognitive Domain of the BDI. Attention and Memory captures attention to visual and auditory stimuli like the recall of songs and rhymes while Perception and Concepts captures how children process concepts such as time and weight (Hilton-Mounger, 2011). Raw scores on each domain were standardized (M = 100; SD = 15). Internal consistency on the Cognitive Domain has been shown to be good (≥.80) (Alfonso et al., 2010).

4.2.4. Child Characteristics

4.2.4.1. Demographics. Children's demographic information included their: (a) age in months, (b) race and ethnicity in four categories: Black non-Hispanic, White non-Hispanic, Hispanic and all other races and ethnicities; and (c) gender in two categories and coded as female = 1, male = 0.

4.2.4.2. Health. A child's health as rated by their caregivers was included and coded into three categories: excellent; very good or good; fair or poor.

4.2.4.3. Learning Disability. A measure capturing whether a child had a learning problem or disability was included. Caregivers were asked whether (1 = yes; 0 = no) an educator or professional told them that their children had learning problems, special needs or a developmental disability.

4.2.4.4. Maltreatment Type. Maltreatment type was captured using a modified version of the Maltreatment Classification System (MCS; Barnett, et al., 1993). Investigative caseworkers were asked through an in-person interview to identify the types of maltreatment that the child experienced based on their case report. Types of abuse and neglect were coded into six categories: physical maltreatment, sexual maltreatment, emotional maltreatment, substance exposure, domestic violence and other forms of abuse or neglect (i.e., educational maltreatment). Other includes categories such as: abandonment, moral/legal maltreatment, educational maltreatment and exploitation.

4.2.4.5. Substantiation Status. A measure of whether a child's maltreatment case was substantiated (= 1) or not (= 0) was included. Substantiated means that the abuse or neglect could be proven and backed by credible evidence (Casanueva et al., 2012).

4.2.4.6. Foster Care. A measure of whether a child was in foster care (=1) or not (=0) was included.

4.2.5. Caregiver Characteristics

Caregiver characteristics included their marital status (married = 1 or not married, separated or divorced = 0); the number of children in the household in five categories (1 through 5 or more); their poverty level in four categories based on the 2010 federal poverty guidelines (< 50%; 50%

to <100%; 100% to 200%; > 200%); and whether they were depressed based on the Composite International Diagnostic Interview Short Form (CIDI-SF). Additional measures included whether caregivers received support via the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and Temporary Assistance for Needy Families (TANF) programs. Other characteristics included: their employment status, coded in three categories (full time, part time or unemployed); indicators for whether they resided in and urban area or non-urban area; and, finally, whether they were born in the US or not.

4.3. Data Analytic Plan

To estimate the association between ECE and maltreated children's developmental outcomes, this study used propensity score weighting, an analytic approach that helps reduce observable bias between treated (e.g., children in ECE) and comparison (e.g., children not in ECE) groups in observational studies (Austin & Stuart, 2015; Dugoff et al., 2014). In this study, children in ECE and non-ECE groups differ in systematic ways and simply comparing their outcomes without accounting for these observed differences would lead to biased estimates because many of these systematic differences drive both their placement into ECE as well as their developmental outcomes.

Through this method, a *propensity score* is estimated for each child which predicts the probability (ranging from 0 to 1) that each child received ECE, conditional on their observed characteristics prior to their receipt of ECE. If modeled accurately, this propensity score summarizes all the information we know about what drives selection into ECE into a singular score (Murnane & Willett, 2010). Children with lower propensity scores (closer to zero) have a lower probability of ECE based on their set of observables whereas those with higher propensity scores (closer to one) have a higher probability.

The propensity score is then used in a weighting scheme that when applied to the sample generates a pseudo-population in which ECE and non-ECE groups have similar distributions of observed background characteristics. Two different sets of weights are estimated: one, that when applied to the data, is used to estimate the average treatment effect (ATE) and the other, the average treatment effect on the treated (ATT). In this study, the ATE captures the effect if all children (both ECE and non-ECE groups) received ECE versus not while the ATT estimates the effect of ECE among the subgroup of children who were exposed to ECE versus if they had not. Both effects are of interest and relevant to policy and practice—the ATE is relevant given recent interest in scaling up and universalizing access to ECE and helps address what outcomes would look like if CWS-children were all exposed to ECE, while the ATT continues to be relevant given that under current practices, caregivers still selective place their children into ECE.

More specifically, the analytic plan for this study was as follows:

Modeling Selection into ECE. First, using a theoretically and empirically informed set of predictors of ECE measured at baseline (wave 1), logistic regression was used to model the probability that a child received ECE in wave 2 to generate propensity scores of each child.[1] The model fit to data for child *i* was as follows:

$$\text{logit}(p_i) = \alpha + \beta \boldsymbol{x}_i \qquad (1)$$

where $\text{logit}(p_i)$ is the log-odds of placement into ECE and $\boldsymbol{x}_i$ represents the vector of selection predictors whose effects are captured in the coefficient vector β. $\boldsymbol{x}_i$ also includes relevant interactions and higher order terms for selected predictors.

Propensity Score Estimation. From the fitted model (1), a propensity score was estimated for each child:

[1] See the Supplemental Appendix for a detailed description of the selection modeling process.

$$\hat{p}_i = \frac{1}{1+e^{-[\hat{\alpha}+\hat{\beta}\mathbf{x}_i]}} \quad (2)$$

Propensity Score Weights. Using these propensity scores, two weights were generated for each child *i* that aligned with two different estimators of interest: the ATE or the ATT (Dugoff et al., 2014):

For the ATE, weights (*w*), known as *inverse probability weights*, for child *i* were calculated as: $w_i = \frac{Z_i}{\hat{p}_i} + \frac{(1-Z_i)}{1-\hat{p}_i}$, where Z denotes whether the child was in ECE (Z = 1) or not (Z = 0). For children in ECE (Z = 1), those with a higher probability of selecting into ECE conditional on their observables (a higher $\hat{p}_i$) are downweighted while individuals with a lower probability (a lower $\hat{p}_i$) are upweighted. Those in ECE with lower $\hat{p}_i$'s are more informative since their propensity to select into ECE is similar to their non-ECE counterparts, except that they received ECE. Thus, they approximate what the non-ECE group would have looked like if treated. For children not in ECE (Z = 0), those whose probability of selecting into ECE based on their observables was lower are downweighted while individuals whose selection was higher are upweighted. Children in the non-ECE group with higher $\hat{p}_i$'s are more informative since their propensity to select into ECE is more similar to their ECE counterparts, except that they did not receive ECE. Thus, they help us better understand what the ECE group would have looked like if not treated. Extreme weights were handled by trimming the weights at the 99th percentile (Austin, 2015).

For the ATT, weights were calculated as: $w_i = Z_i + (1 - Z_i)\left(\frac{\hat{p}_i}{1-\hat{p}_i}\right)$ and when applied to the data is referred to as *weighting by the odds* (Dugoff et al., 2014). Children in ECE (Z = 1) are all assigned a weight of one while children not in ECE (Z = 0) are weighted to resemble the treated group that received ECE. Those not in ECE and with higher $\hat{p}_i$'s are upweighted given

that their probability of selection into ECE conditional on their observables is high (and thus, more observationally similar to ECE recipients, except that they did not receive ECE). Those not in ECE with lower $\hat{p}_i$'s are downweighted.

Covariate Balance. Covariate balance was then assessed by examining the standardized differences in the set of baseline characteristics between ECE and non-ECE groups, before and after applying the propensity score weights. For continuous measures, the standardized difference was calculated by taking the mean differences in the ECE and non-ECE groups and dividing it by the standard deviation across both groups. For dichotomous measures, standardized differences were based on differences in proportions between each group divided by their prevalence in both groups (Austin & Stuart, 2015). Balance was considerable reasonable if standardized mean differences were < |0.25| on the propensity score weighted data (Stuart, 2010).

Treatment Effect Estimation. Finally, to estimate the relationship between ECE and children's outcomes, OLS regression models were fit to the propensity score weighted data where each outcome was regressed on an indicator for ECE participation alongside agency fixed effects and controls to account for residual imbalance (i.e., standardized differences between |0.05| and |0.25|) in observed baseline characteristics between ECE and non-ECE groups. A threshold of 0.25 was adopted based on review standards established by the Institute of Education Sciences (IES) What Works Clearinghouse (WCC) for quasi-experimental studies that rely on propensity scores (What Works Clearinghouse, 2020). Controls that were measured on a continuous scale (e.g., age) were centered on the grand mean for the ATE and the treatment mean for ATT.

Missing data was handled using multiple imputation by chained equations through which 40 imputed datasets were constructed. Selection models that predicted the probability of ECE were fit to each imputed dataset yielding propensity scores that were then averaged across the imputed datasets. The ATE and ATT were estimated within each of those imputed datasets and the results were pooled together. Based on recommendations by for analyzing survey data using propensity score methods, survey design information (strata, primary sampling unit and survey weights) was incorporated at both the selection modeling and treatment effect estimation stages of the analyses to account for stratified sampling design of the NSCAW II as well as non-response. Standard errors were estimated using Taylor linearization, the prescribed method for variance estimation for the NSCAW II data. R software, version 4.0.2 (R Core Team, 2020) was used in imputation and selection modeling stages of the analysis while Stata 15.1 (StataCorp, 2017) was used in estimating the treatment effects.

5. Results

5.1. Sample Characteristics at Baseline

As shown in Table 2, children in the overall sample (ECE and non-ECE children pooled together) were, on average, approximately 12 months old (11.5 months) and included slightly more males (54%) versus females (46%). By race and ethnicity, 27% were Black non-Hispanic, 29% Hispanic, 38% White non-Hispanic and the remaining 6% consisted of children from all other racial and ethnic backgrounds. By maltreatment type, the most common was emotional (35%), followed by sexual (20%) and physical (12%). About a third (31%) of caregivers were below 50% of the federal poverty line and a majority (84%) participated in the WIC program.

Relative to children not in ECE, those in ECE were, on average, younger (9 months versus 12 months), White (50% versus 36%), male (69% versus 52%), and from households with

only one child (64% versus 36%). Further, caregivers of children in ECE were from lower poverty backgrounds (22% versus 12% had incomes >200% of the federal poverty line), currently married (40% versus 22%) and worked fulltime (30% versus 17%).

5.2. Selection Modeling of ECE

When modeling the probability of ECE using logistic regression, predictors were included that could plausibly influence both selection into ECE as well as children's cognitive and behavioral outcomes. To identify such predictors, this study relied upon prior empirical work by Klein et al., (2016) who estimated the probability of ECE placement using the NSCAW II data, the same dataset used in this study. Relevant predictors that Klein et al. (2016) identified include: maltreatment type (physical abuse or not); a child's age; family socioeconomic status based on the federal poverty line; caregiver employment status; number of children in the home; and a child's race and ethnicity. Additional predictors were also selected based upon the accommodations framework of childcare selection established by Meyers and Jordan which conceptualizes the ECE decision not as a choice, per se, but rather an adaptation to contextual factors such as familial needs, resources and cultural preferences (Coley, 2014). Family needs include: parental employment status, participation in social support programs (WIC or TANF), marital status and household size. Family resources include caregiver depression. Finally, cultural norms and preferences are captured via race and ethnicity as well as caregivers' immigrant background and geographic region of residence. The results of modeling selection into ECE (Table 3) using logistic regression shows that the odds of ECE were higher for Whites (relative to Blacks) and females (relative to males). Further, uptake of ECE was more probable among caregivers who cared for 3 or more children, were married and received TANF.

5.3. Estimation of Propensity Scores and Weights

Figure 1 displays the distribution of propensity scores by ECE and non-ECE groups based on this fitted selection model. As shown, propensity scores between both groups substantially overlap suggesting that the observations, when weighted, are not heavily influenced by extreme or zero weights which could lead to inflated standard errors especially when estimating the ATE (Leite, 2016). The ATE weights have a mean of 3.8 (SD = 10.12) with a minimum of 1 and maximum of 79.52 while the ATT weights have a mean of 0.45 (SD = 1.03) with a minimum of .0003 and maximum of 31.19.

5.4. Balance Before and After Weighting

Figures 2 and 3 display the balance in baseline characteristics (expressed as standardized differences between ECE and non-ECE groups) before and after applying propensity score weights. After inverse probability weighting, the standardized differences between ECE versus non-ECE groups for all predictors included in the selection model were reduced below .25 SDs, indicating acceptable balance (Stuart, 2010). After weighting by the odds, all standardized differences in predictors between ECE and non-ECE groups were also reduced below .25, with the exception of one predictor—foster care, which was just above the threshold at .26. Additional attempts at modifying the selection model (e.g., incorporating interaction terms and non-linear terms) to generate different sets of propensity scores and associated weights did not improve the balance on this one predictor; however, given that all other predictors were reasonably balanced between ECE and non-ECE groups and that the imbalance was close to .25, I preceded to use these weights and also ensured that all subsequent models to estimate the ATT effect included the predictor for foster care placement as a covariate.

5.5. Main Results: Association Between ECE and Outcomes

Table 4 displays the estimated associations between ECE for each outcome without propensity score weighting (row 1), followed by weighting to obtain the ATE (row 2) and ATT (row 3). For brevity, only the coefficient estimates on the indicator variable for ECE participation are presented. The full results are in Supplemental Tables A1 (adaptive behaviors) and A2 (cognitive development).

Results without propensity score weighting show that ECE is negatively related to children's daily living skills (B = -3.30; $p < .05$). After propensity score weighting, the relationship remains negative and significant for both the ATE and ATT (B = -6.05, $p < .001$ and B = -3.10, $p < .05$, respectively) and represent effects sizes of approximately 0.37 and 0.19, respectively. Notably, the magnitude of the ATE is roughly two times larger relative to the ATT. The ATE suggests that if all CWS-involved children in the sample were in ECE (and not just those selecting into ECE) their daily living skills would have been approximately two fifths of a standard deviation lower relative to if they all had not taken part in ECE. On the other hand, the ATT indicates that children who were in ECE had daily living scores that were approximately a fifth of a standard deviation lower relative to if they had not been in ECE. While the results show that ECE was also negatively related to children's socialization skills, zero effects could not be ruled out.

In terms of children's cognitive development, no relationship was detected between ECE and their attention and memory skills, both without and with propensity score weights. On the other hand, without accounting for imbalance in observables through propensity weighting, children in ECE had significantly higher perception and concepts skills (B = 1.63, $p < .05$), net of controls and agency fixed effects. This is an effect size of about 0.45 of a standard deviation. However, this association is attenuated once propensity score weights were applied. For the ATE

estimate, maltreated children are predicted to have perception and concept scores roughly 1.1 points higher ($p < .05$), an ES of approximately .30, if they all had been assigned to ECE. Unlike the ATE results, the ATT, though positive, was not significant at conventional levels of significance.

While these results pertain to children's outcomes when they were about 11.5 months old, on average, additional analyses using the final wave available in the NSCAW II when children were 49 months old, on average, show that ECE was not significantly related to either their adaptive behaviors or cognitive development (Table 4).

Taken together, these findings demonstrate mixed evidence of ECEs relationship to maltreated children's outcomes: ECE, in the short term, are positively related to increases in children's perception and concepts yet are negatively associated with lowered daily living skills. However, as children approach the transition to formal schooling (when they are 4 years old, on average), the associations between ECE and their adaptive behaviors and cognitive development is statistically indistinguishable from zero.

6. Discussion

While a handful of recent studies have determined that ECE is associated with common school readiness outcomes of CWS-involved youth, especially higher language abilities (Merritt & Klein, 2015), much less is known about whether ECE can also influence other outcomes critical to their wellbeing, such as their attention and memory and socialization skills. This study, the first to leverage the quasi-experimental method of propensity score weighting to estimate the effect of ECE among a nationally representative sample of CWS-involved children, yields several new insights into ECE's effectiveness. First, ECE leads to lower daily living skills for both children overall and for those receiving ECE. Second, ECE is linked with higher perception

and concept scores, on average, particularly if all children had been in ECE versus not. Finally, by the time children reach the final wave of the study, when they were on average, 4 years old, zero effects could not be ruled out, and thus the effects—both lower daily living skills and higher perception and concept scores—did not persist to the point in time when children were approaching their formal schooling years.

Due to limitations of the data, features of the ECE programs, like ECE educators' qualifications and curricular content, were unavailable and thus, this study is unable to pinpoint the exact mechanisms through which ECE led to these effects. Further, the propensity score weighting approach only accounts for observable biases between ECE and non-ECE groups—there still may be unobservable biases that were unaccounted for in these results. Nonetheless, this study, in conjunction with Merritt and Klein's (2015) study places into sharper focus the plausible effects that could result if ECE is scaled up. It also presents evidence of likely cognitive benefits relevant among those who select into ECE.

When considered in the context of prior studies that have investigated ECE's effect on CWS-involved children, this study is the first to demonstrate a plausible negative short-run effect of ECE on children's daily living skills. While this study is unable to empirical tease out why children experience lower skills due to the limited information about the actual experiences of children in these ECE settings, one potential explanation might be related to the quality of the developmental activities and routines that children were exposed to on a day-to-day basis. Evidence from a study examining accreditation status (a proxy for quality) of ECE programs in Miami-Dade County serving children in the child welfare system found that a lower proportion of CWS-involved children attended accredited centers (30%) versus children not involved in CWS (55%) (Dinehart et al., 2013). Further, those in accredited centers had stronger

developmental outcomes. Given the increased likelihood that children may have been in unaccredited centers in this study, they may also have been exposed to lower quality interactions and experiences related to their daily living skill versus their non-ECE counterparts. Moreover, we also do not know the frequency with which children are being cared for by different ECE providers, the level of engagement that children had with their ECE educators, or how they interacted with their peers in the ECE setting—together, these could introduce instability into children's ECE experiences that could diminish ECE's effectiveness especially if these situations disrupt patterns in their daily living skills.

Relatedly, the quality of children's ECE experiences may also be relevant given the positive effect of ECE on children's perception and concepts. The kinds of developmental experiences and activities, relative to those provided by caregivers or relatives in the home, may have more effectively emphasized experiences that were more beneficial to children's overall sensorimotor development. This possibility opens up further avenues for research on the kinds of quality experiences and interactions that CWS-involved children have in ECE centers and, in particular, given the known traumas and stressors that maltreated children face, whether and how ECE centers are implementing trauma informed approaches to better enhance children's outcomes. Recent efforts at integrating trauma informed care practices into ECE are promising (Bartlett & Smith, 2019), especially when the CWS and ECE sectors collaborate to build capacity so that CWS-involved children can access high quality ECE. For example, the U.S. Department of Health and Human Services Early Childhood-Child Welfare (ECCW) collaborative projects, carried out between 2011-2015, showed promising progress, including increasing in the number of children enrolled in high quality ECE programs and were subsequently screened for developmental supports.

Finally, these findings can be helpful when weighing the cost and benefits of taking up ECE. The take up rate of ECE is typically lower for CWS-involved children—in fact, among children under 5, close to 30% of CWS-involved children were in ECE versus 48% in the broader population while nearly 90% are not enrolled in Head Start despite being eligible (Klein et al., 2018). A contributing factor to this lower take up rate is that within CWS system itself and relatedly, the court system, the benefits of ECE remain less clear which reduces the likelihood of ECE referrals (James Bell Associates, 2015). Evidence that ECE—at least in the short term—can boost children's cognitive development may help stakeholders better assess the potential benefits of utilizing early care and education. At the same time, knowing that ECE may have short run negative effects on their daily living skills should certainly not dissuade referrals; rather, it is important to provide information to caregivers and CWS staff so they can determine whether and how ECE programs are providing high quality experiences that foster developmentally appropriate skills that enable children to navigate their daily experiences.

In closing, these findings are just a start to deeper conversations between stakeholders—from a range of sectors, including child welfare, education and public health—about ways to promote the early care and educational needs of CWS-involved children. Ensuring the wellbeing of CWS-involved children will require a more expansive examination that further unpacks not only just the impacts of ECE, but the features of the ECE system, including its workforce and curriculum, that might need to be adapted to help boost CWS-involved youth outcomes so that they may all thrive.

References

Aber, J. L., & Cicchetti, D. (1984). The socio-emotional development of maltreated children. In H. E. Fitzgerald, B. M. Lester, & M. W. Yogman (Eds.), *Theory and research in behavioral pediatrics: Volume 2* (pp. 147-205). Springer. https://doi.org/https://doi.org/10.1007/978-1-4899-1660-0

Alfonso, V. C., Rentz, E. A., & Chung, S. (2010). Review of the battelle developmental inventory, second edition. *Journal of Early Childhood and Infant Psychology, 6,* 21-40.

Austin, P. C., & Stuart, E. A. (2015). Moving towards best practice when using inverse probability of treatment weighting (iptw) using the propensity score to estimate causal treatment effects in observational studies. *Statistics in Medicine*, *34*(28), 3661-3679. https://doi.org/https://doi.org/10.1002/sim.6607

Bartlett, J. D., & Smith, S. (2019). The role of early care and education in addressing early childhood trauma. *American Journal of Community Psychology*, *64*(3-4), 359-372. https://doi.org/https://doi.org/10.1002/ajcp.12380

Casanueva, C., Dolan, M., Smith, K., & Ringeisen, H. (2012). NSCAW child well-being spotlight: Children with substantiated and unsubstantiated reports of child maltreatment are at similar risk for poor outcomes. https://www.acf.hhs.gov/sites/default/files/documents/opre/nscaw2_child_mal.pdf

Casanueva, C., Ringeisen, H., Wilson, E., Smith, K., & Dolan, M. (2011). *NSCAW II baseline report: Child well-being. OPRE report #2011-27b.* https://www.acf.hhs.gov/opre/report/nscaw-ii-baseline-report-child-well-being-final-report

Dinehart, L. H., Katz, L. F., Manfra, L., & Ullery, M. A. (2013). Providing quality early care and education to young children who experience maltreatment: A review of the literature. *Early Childhood Education Journal*, *41*(4), 283-290. https://doi.org/10.1007/s10643-012-0553-6

Dubowitz, H., Pitts, S. C., Litrownik, A. J., Cox, C. E., Runyan, D., & Black, M. M. (2005). Defining child neglect based on child protective services data. *Child Abuse and Neglect, 29*(5), 493-511. https://doi.org/https://doi.org/10.1016/j.chiabu.2003.09.024

Dugoff, E. H., Schuler, M., & Stuart, E. A. (2014). Generalizing observational study results: Applying propensity score methods to complex surveys. *Health Services Research, 49*(1), 284-303. https://doi.org/10.1111/1475-6773.12090

Gee, K. A. (2020). Maltreatment profiles of child welfare–involved children in special education: Classification and behavioral consequences. *Exceptional Children, 86*(3), 237-254. https://doi.org/10.1177/0014402919870830

Hilton-Mounger, A. (2011). Battelle developmental inventory. In *Encyclopedia of child behavior and development* (pp. 210–212). Springer.

Horowitz, L. M., Thurm, A., Farmer, C., Mazefsky, C., Lanzillo, E., Bridge, J. A., Greenbaum, R., Pao, M., Siegel, M., Autism, & Developmental Disorders Inpatient Research, C. (2018). Talking about death or suicide: Prevalence and clinical correlates in youth with autism spectrum disorder in the psychiatric inpatient setting. *Journal of Autism and Developmental Disorders, 48*(11), 3702-3710. https://doi.org/10.1007/s10803-017-3180-7

Institute of Medicine and National Research Council. (2000). *From neurons to neighborhoods: The science of early childhood development*. https://doi.org/10.17226/9824

James Bell Associates. (2015). Synthesis of findings from the 2011 child welfare-early education partnerships to expand protective factors for children with child welfare involvement. https://www.jbassoc.com/wp-content/uploads/2018/03/Findings-2011-Child-Welfare-Early-Education-Partnerships.pdf

Klein, S. (2016). Benefits of early care and education for children in the child welfare system. A research-to-practice brief. OPRE report 2016-68. *US Department of Health and Human Services*. https://eric.ed.gov/?id=ED606722

Klein, S., Mihalec-Adkins, B., Benson, S., & Lee, S.-Y. (2018). The benefits of early care and education for child welfare-involved children: Perspectives from the field. *Child Abuse and Neglect, 79*, 454-464. https://doi.org/https://doi.org/10.1016/j.chiabu.2018.02.015

Kovan, N., Mishra, S., Susman-Stillman, A., Piescher, K. N., & LaLiberte, T. (2014). Differences in the early care and education needs of young children involved in child protection. *Children and Youth Services Review, 46*, 139-145. https://doi.org/10.1016/j.childyouth.2014.07.017

Lee, K. (2016). Head start's impact on cognitive outcomes for children in foster care. *Child Abuse Review, 25*(2), 128-141. https://doi.org/https://doi.org/10.1002/car.2413

Lee, K. (2020). Long-term head start impact on developmental outcomes for children in foster care. *Child Abuse and Neglect, 101*, 104329. https://doi.org/10.1016/j.chiabu.2019.104329

Leite, W. (2016). Practical propensity score methods using R. Sage Publications.

Lipscomb, S. T., Pratt, M. E., Schmitt, S. A., Pears, K. C., & Kim, H. K. (2013). School readiness in children living in non-parental care: Impacts of head start. *Journal of Applied Developmental Psychology, 34*(1), 28-37. https://doi.org/10.1016/j.appdev.2012.09.001

Meloy, M. E., & Phillips, D. A. (2012). Rethinking the role of early care and education in foster care. *Children and Youth Services Review, 34*(5), 882-890. https://doi.org/https://doi.org/10.1016/j.childyouth.2012.01.012

Merritt, D. H., & Klein, S. (2015). Do early care and education services improve language development for maltreated children? Evidence from a national child welfare sample. *Child Abuse and Neglect, 39*, 185-196. https://doi.org/10.1016/j.chiabu.2014.10.011

Michalec, D. (2011). Bayley scales of infant development: Third edition. In S. Goldstein & J. A. Naglieri (Eds.), *Encyclopedia of child behavior and development*. Springer.

Murnane, R. J., & Willett, J. B. (2010). Methods matter: Improving causal inference in educational and social science research. Oxford University Press.

Battelle development inventory—2nd edition (BDI-2), (2004).

R Core Team. (2020). *R: A language and environment for statistical computing*. https://www.R-project.org/

Ridgeway, G., Kovalchik, S. A., Griffin, B. A., & Kabeto, M. U. (2015). Propensity score analysis with survey weighted data. *Journal of Causal Inference, 3*(2), 237-249. https://doi.org/doi:10.1515/jci-2014-0039

Romano, E., Babchishin, L., Marquis, R., & Fréchette, S. (2014). Childhood maltreatment and educational outcomes. *Trauma, Violence, & Abuse*, *16*(4), 418–437. https://doi.org/https://doi.org/10.1177/1524838014537908

Sparrow, S. S., Carter, A. S., & Cicchetti, D. V. (1993). Vineland screener: Overview, reliability, validity, administration and scoring.

StataCorp. (2017). Stata statistical software: Release 15.

Stone, S. (2007). Child maltreatment, out-of-home placement and academic vulnerability: A fifteen-year review of evidence and future directions. *Children and Youth Services Review*, *29*(2), 139-161. https://doi.org/10.1016/j.childyouth.2006.05.001

Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical science : a review journal of the Institute of Mathematical Statistics*, *25*(1), 1-21. https://doi.org/10.1214/09-STS313

Tassé, M. J., Schalock, R. L., Balboni, G., Bersani, H., Jr, Borthwick-Duffy, S. A., Spreat, S., Thissen, D., Widaman, K. F., & Zhang, D. (2012). The construct of adaptive behavior: Its conceptualization, measurement, and use in the field of intellectual disability. *American Journal on Intellectual and Developmental Disabilities*, *117*(4), 291-303. https://doi.org/10.1352/1944-7558-117.4.291

U.S. Department of Health & Human Services, Administration for Children and Families,,, & Administration on Children, Youth and Families,, Children's Bureau,. (2022). *Child maltreatment 2020*. https://www.acf.hhs.gov/cb/data-research/child-maltreatment.

U.S. Department of Health and Human Services. (2012). The national survey on child and adolescent well-being II (NSCAW II) restricted release, waves 1-3.

Veltman, M. W., & Browne, K. D. (2001). Three decades of child maltreatment research implications for the school years. *Trauma, Violence, & Abuse*, *2*(3), 215-239. https://doi.org/http://www.jstor.org/stable/26636335

Viezel, K. D., Lowell, A., Davis, A. S., & Castillo, J. (2014). Differential profiles of adaptive behavior of maltreated children. *Psychological Trauma: Theory, Research, Practice, and Policy*, *6*(5), 574-579. https://doi.org/10.1037/a0036718

Wade, T. J., Bowden, J., & Jane Sites, H. (2018). Child maltreatment and motor coordination deficits among preschool children. *Journal of Child & Adolescent Trauma*, *11*(2), 159-162. https://doi.org/10.1007/s40653-017-0186-4

What Works Clearinghouse. (2020). *What works clearinghouse standards handbook,, version 4.1*. https://ies.ed.gov/ncee/wwc/handbooks

Wodarski, J. S., Kurtz, P. D., Gaudin, J. M., Jr., & Howing, P. T. (1990). Maltreatment and the school-age child: Major academic, socioemotional, and adaptive outcomes. *Social Work, 35*(6), 506-513. https://doi.org/10.1093/sw/35.6.506

Tables and Figures

Table 1

Summary of Studies that Examine the Association Between Early Childhood Education (ECE) and Maltreated Children's Outcomes

Study	Site(s)/Data sources	Sample	Age	ECE Characteristics	Study Design	Outcome(s)	Findings and Effect sizes
Merritt & Klein (2015)	Nationwide (NSCAW II)	3,504 (869 in ECE; 2,632 not in ECE)	0-59 months at baseline	Any type of day care such as Head Start, nursery school or early childhood development program	Correlational; Multiple regression analysis	Preschool Language Scales-3 (PLS - 3)	ECE was associated with higher PLS-3 scores [ES = .09] The magnitude of the relationship was larger for children who experienced supervisory neglect [ES = .11]
Lipscomb et al. (2013)	Nationwide (Head Start Impact Study)	253 children in non-parental care	3-4 years old at baseline	Head Start	Random assignment	Woodcock-Johnson III composite (letter-word identification, spelling and applied problems) Student-Teacher Relationship Scale Adjustment Scales for	After one year of Head Start, children had higher WJ III scores [ES =.16] and stronger relationships with teachers [ES = .30]. No effect on externalizing behavior problems. "Modest" effects on T-S relationships and problem

						Preschool Intervention (child behavior problems)	behaviors after two years. Effects persisted an additional year beyond Head Start participation [WJ-II: ES = .65; T-S Relationships: ES = .16]
Lee (2016)	Nationwide (Head Start Impact Study)	162 children in non-parental care (97 in Head Start; 65 in other forms of care)	3-4 years old at baseline	Head Start	Random assignment	Woodcock-Johnson III (math reasoning, oral comprehension)	At 5-6 years old, there was no effect on math or oral comprehension. Girls in Head Start had higher math [ES = .26] and comprehension [ES = .32], while boys had lower performance in math [ES = .49] and reading [ES = .22]
Lee (2020)	Nationwide (Head Start Impact Study)	187 children in non-parental care (103 in Head start; 84 in other	3-4 years old at baseline	Head Start	Random assignment	Woodcock-Johnson III (applied problems, word identification)	At 8-9 years old, children had higher word-identification scores [ES ≈ .20; note ES was not provided but approximated by

	forms of childcare)	Social skills and positive learning approaches	SD of outcome in Lipscomb et al., study]
		Behavior Problems	"Marginally significant" ($p < .10$) effect on social skills and positive approaches to learning.

Table 2

Weighted Descriptive Statistics on a Sample of CWS-involved children (National Survey of Childhood Wellbeing [NSCAW] II; n = 1,570)

	Full Sample		ECE		Non-ECE		Standardized difference
	Mean or Proportion	SD	Mean or Proportion	SD	Mean or Proportion	SD	(ECE vs. Non-ECE)
Outcomes at baseline							
Daily living skills	103.02	18.42	109.95	15.49	101.85	18.62	0.44
Social skills	105.22	20.25	113.85	18.66	103.76	20.15	0.50
Attention and memory	11.24	3.90	12.47	4.01	11.03	3.84	0.37
Perception and concepts	9.39	2.92	10.15	2.83	9.26	2.91	0.31
Child characteristics							
Age (in months)	11.47	5.78	8.93	4.79	11.90	5.83	0.51
Race and ethnicity							
All other races/ethnicities	0.06	0.24	0.02	0.13	0.07	0.25	0.20
Hispanic	0.29	0.45	0.20	0.40	0.31	0.46	0.23
White non-Hispanic	0.38	0.49	0.50	0.50	0.36	0.48	0.29
Black non-Hispanic	0.27	0.44	0.27	0.45	0.26	0.44	0.02
Female	0.46	0.50	0.31	0.46	0.48	0.50	0.34
Male	0.54	0.50	0.69	0.46	0.52	0.50	0.34
Health							
Excellent	0.58	0.49	0.62	0.49	0.57	0.49	0.08
Very good or good	0.36	0.48	0.37	0.48	0.36	0.48	0.02
Fair or poor	0.06	0.24	0.02	0.12	0.07	0.25	0.22
Non-learning disabled	0.94	0.24	0.96	0.20	0.94	0.25	0.10
Has learning disability	0.06	0.24	0.04	0.20	0.06	0.25	0.10
Maltreatment type							
Physical maltreatment	0.12	0.32	0.14	0.35	0.12	0.32	0.09
Sexual maltreatment	0.21	0.41	0.10	0.30	0.23	0.42	0.30
Emotional maltreatment	0.35	0.48	0.37	0.48	0.34	0.47	0.06
Other forms of abuse or neglect	0.01	0.09	0.01	0.08	0.01	0.09	0.01
Substance exposure	0.13	0.34	0.06	0.23	0.15	0.35	0.26

Domestic violence	0.08	0.27	0.07	0.25	0.08	0.27	0.04
Unsubstantiated	0.68	0.47	0.68	0.47	0.68	0.47	0.00
Substantiated	0.32	0.47	0.32	0.47	0.32	0.47	0.00
Not in foster care	0.94	0.23	0.89	0.31	0.95	0.22	0.25
In foster care	0.06	0.23	0.11	0.31	0.05	0.22	0.25
Caregiver characteristics							
Not married, separated or divorced	0.76	0.43	0.60	0.49	0.78	0.41	0.44
Married	0.24	0.43	0.40	0.49	0.22	0.41	0.44
Household size							
1	0.40	0.49	0.64	0.48	0.36	0.48	0.57
2	0.24	0.43	0.15	0.35	0.26	0.44	0.27
3	0.17	0.37	0.10	0.30	0.18	0.38	0.22
4	0.07	0.25	0.08	0.26	0.06	0.25	0.04
5 or more	0.12	0.32	0.04	0.20	0.13	0.34	0.28
Poverty level							
< 50%	0.30	0.46	0.23	0.42	0.32	0.47	0.20
50% to <100%	0.34	0.47	0.31	0.46	0.34	0.47	0.07
100% to 200%	0.22	0.42	0.24	0.43	0.22	0.42	0.04
> 200%	0.13	0.34	0.23	0.42	0.12	0.32	0.32
Depressed (dysphoric)	0.16	0.37	0.13	0.34	0.17	0.37	0.11
Receives WIC	0.81	0.39	0.86	0.34	0.80	0.40	0.15
Receives TANF	0.13	0.34	0.06	0.23	0.15	0.35	0.26
Work status							
Full time	0.19	0.39	0.30	0.46	0.17	0.37	0.35
Part time	0.10	0.31	0.16	0.36	0.10	0.29	0.20
Unemployed	0.71	0.45	0.54	0.50	0.74	0.44	0.44
Non urban	0.22	0.42	0.28	0.45	0.21	0.41	0.16
Urban	0.78	0.42	0.72	0.45	0.79	0.41	0.16
Immigrant	0.06	0.24	0.04	0.20	0.07	0.25	0.09
Non immigrant	0.94	0.24	0.96	0.20	0.93	0.25	0.09

Table 3

Selection Model Predicting the Odds of Center Based Care Use Among a Sample of CWS-involved children (National Survey of Childhood Wellbeing [NSCAW] II; n = 1,570)

	OR	*SE*	*p*-value
Outcomes at baseline			
Daily living skills	1.00	(0.01)	.74
Social skills	1.03	(0.01)	.01
Attention and memory	1.06	(0.05)	.22
Perception and concepts	0.90	(0.06)	.12
Child characteristics			
Age (in months)	0.86	(0.12)	.30
Race and ethnicity (Reference: Black non-Hispanic)			
All other races and ethnicities	0.41	(0.19)	.06
Hispanic	0.46	(0.30)	.23
White non-Hispanic	0.08	(0.09)	.02
Female	1.98	(0.65)	.04
Health			
Very good or good	1.24	(0.41)	.52
Fair or poor	0.30	(0.34)	.29
Has learning disability	3.39	(2.30)	.07
Maltreatment type (Reference: Physical maltreatment)			
Sexual maltreatment	0.99	(0.78)	.99
Emotional maltreatment	2.12	(1.41)	.26
Other forms of abuse or neglect	0.44	(0.30)	.23
Substance exposure	1.43	(1.23)	.68
Domestic violence	4.00	(2.85)	.05
Substantiated	0.99	(0.78)	.99
In foster care	1.50	(1.01)	.54
Caregiver characteristics			
Marital status (Reference: Not married, separated or divorced)			
Married	2.31	(0.74)	.01
Household size (Reference: 1)			
2	0.31	(0.23)	.12
3	0.10	(0.07)	.00
4	0.02	(0.03)	.00
5 or more	0.06	(0.06)	.01
Poverty level (Reference: < 50%)			
50% to <100%	0.64	(0.41)	.49
100% to 200%	0.31	(0.19)	.05
> 200%	0.33	(0.25)	.14
Depressed (dysphoric)	1.15	(0.53)	.77
Receives WIC	0.66	(0.31)	.37
Receives TANF	0.42	(0.18)	.04
Employment status (Reference: Full time)			
Part time	1.28	(0.77)	.68
Unemployed	0.54	(0.20)	.10

Urban	0.77	(0.43)	.64
Immigrant	1.97	(2.36)	.57
Substantiated x Age	1.13	(0.06)	.04
Substantiated x Immigrant	0.46	(0.59)	.54
Substantiated x HHSize (2)	1.99	(1.53)	.37
Substantiated x HHSize (3)	18.06	(16.16)	.00
Substantiated x HHSize (4)	87.62	(114.64)	.00
Substantiated x HHSize (5)	6.60	(7.22)	.09
Foster care x White	5.04	(4.18)	.05
Foster care x Hispanic	2.50	(2.50)	.36
Foster care x All other races/ethnicities	9.29	(12.21)	.09
Foster care x Learning disability	0.35	(0.40)	.36

Note. Model incorporates survey weights and design information (strata and primary sampling unit information). Missing data handled through multiple imputation by chained equations. The model was fit to 40 imputed datasets and the results were pooled together using Rubin's rules.

Table 4

Results Describing the Relationship Between Early Care and Education and CWS-Involved Children's Developmental Outcomes at Wave 2

Effect of ECE	Adaptive Behaviors		Cognitive Development	
	Daily living skills	Socialization skills	Attention and memory	Perception and concepts
Without propensity score weights	-3.30* (1.52)	-1.62 (3.32)	-0.27 (0.50)	1.63* (0.66)
ATE	-6.05*** (1.61)	-2.46 (2.74)	-0.32 (0.37)	0.66 (0.41)
ATT	-3.10* (1.47)	-1.78 (2.34)	-0.23 (0.43)	1.10* (0.47)
Observations (unweighted)	1570	1570	1570	1570

Note. Models include relevant controls, agency fixed effects, survey weights and design information. Missing data handled through multiple imputation. Taylor linearized standard errors in parentheses.

* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 1

Distribution of Propensity Scores by ECE Participation Groups

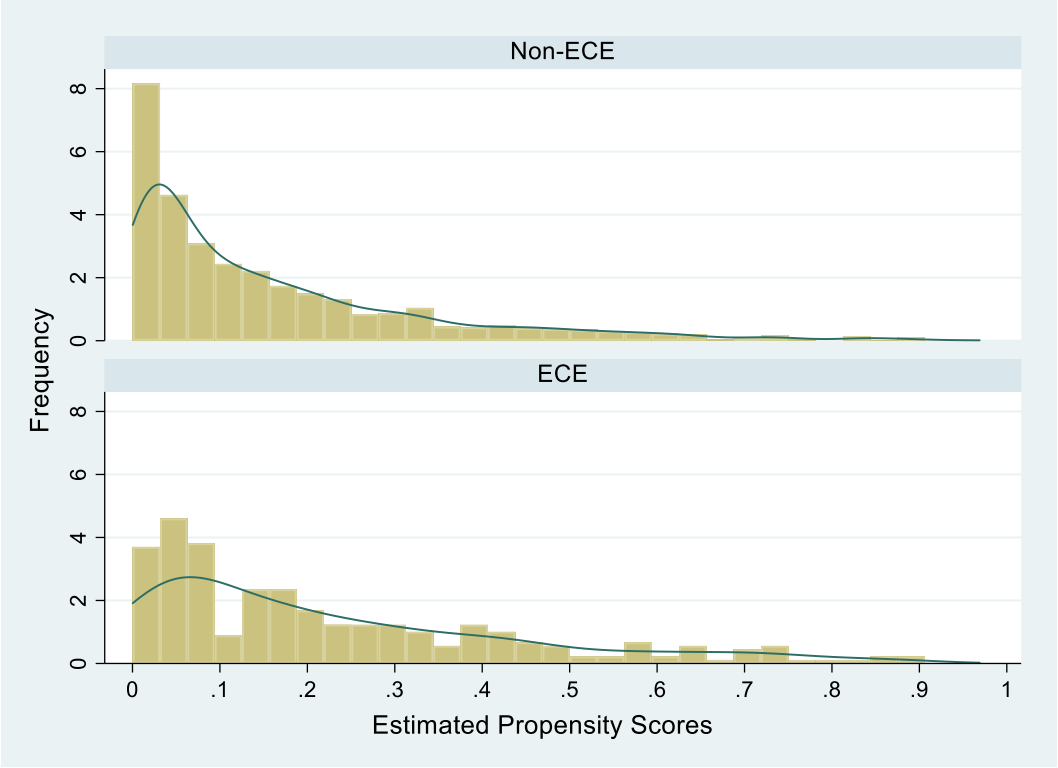


Figure 2

Standardized Differences in Baseline Characteristics of ECE and non-ECE Participants Before and After Inverse Probability Weighting

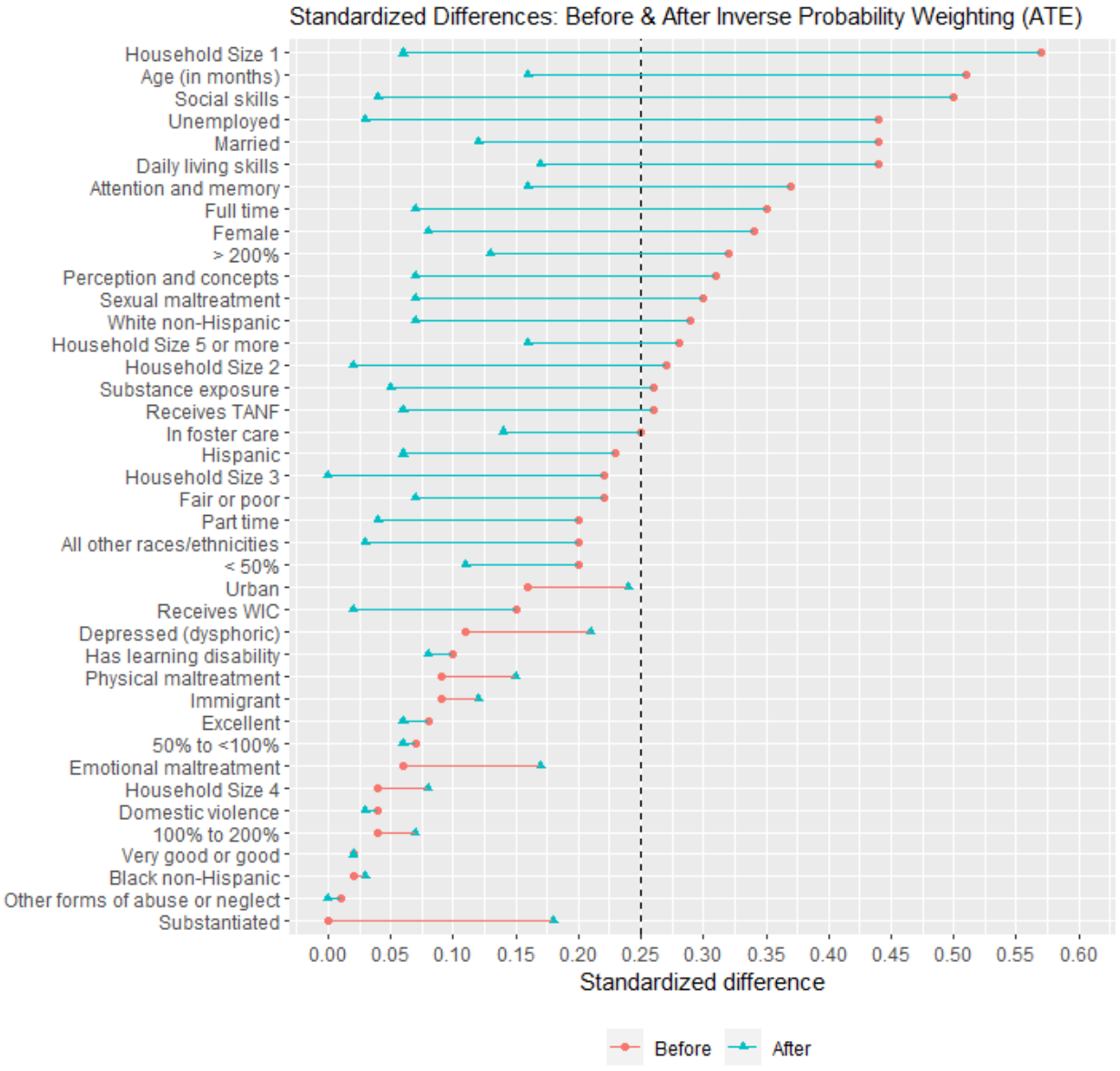
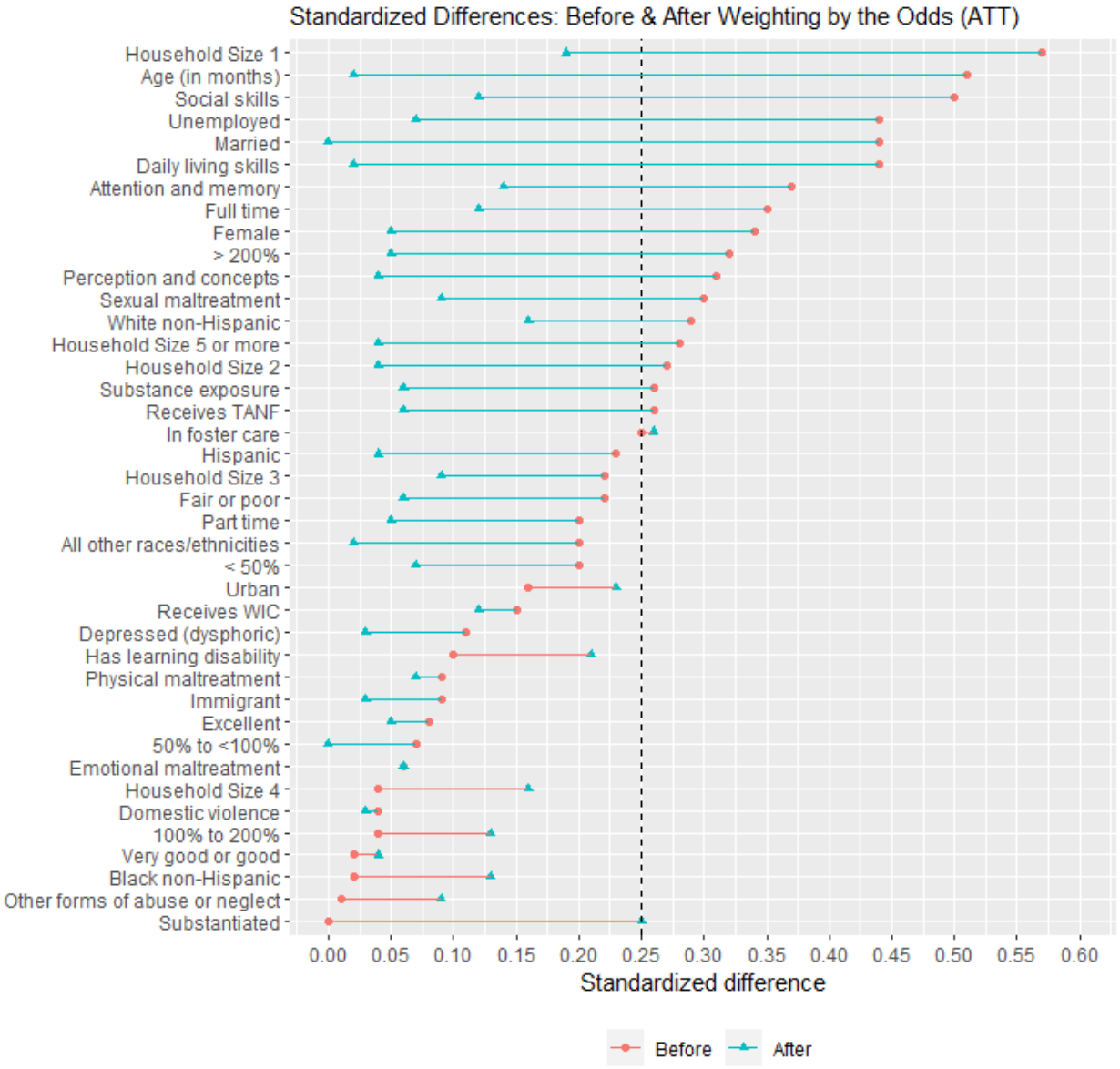


Figure 3

Standardized Differences in Baseline Characteristics of ECE and non-ECE Participants Before and After Weighting by the Odds



Supplemental Appendix

Selection Modeling of ECE

When modeling the probability of ECE using logistic regression, predictors were included that could plausibly influence both selection into ECE as well as children's cognitive and behavioral outcomes. To identify such predictors, this study relied upon prior empirical work by Klein et al., (2016) who estimated the probability of ECE placement using the NSCAW II data, the same dataset used in this study. Relevant predictors that Klein et al. (2016) identified include: maltreatment type (physical abuse or not); a child's age; family socioeconomic status based on the federal poverty line; caregiver employment status; number of children in the home; and a child's race and ethnicity. Additional predictors were also selected based upon the accommodations framework of childcare selection established by Meyers and Jordan which conceptualizes the ECE decision not as a choice, per se, but rather an adaptation to contextual factors such as familial needs, resources and cultural preferences (Coley, 2014). Family needs include: parental employment status, participation in social support programs (WIC or TANF), marital status and household size. Family resources include caregiver depression. Finally, cultural norms and preferences are captured via race and ethnicity as well as caregivers' immigrant background and geographic region of residence.

The results of modeling selection into ECE using logistic regression (see table below) shows that the odds of ECE were higher for Whites (relative to Blacks) and females (relative to males). Further, uptake of ECE was more probable among caregivers who cared for 3 or more children, were married and received TANF.

Selection Model Predicting the Odds of Center Based Care Use Among a Sample of CWS-involved children (National Survey of Childhood Wellbeing [NSCAW] II; n = 1,570)

	OR	*SE*	*p*-value
Outcomes at baseline			
Daily living skills	1.00	(0.01)	.74
Social skills	1.03	(0.01)	.01
Attention and memory	1.06	(0.05)	.22
Perception and concepts	0.90	(0.06)	.12
Child characteristics			
Age (in months)	0.86	(0.12)	.30
Race and ethnicity (Reference: Black non-Hispanic)			
All other races and ethnicities	0.41	(0.19)	.06
Hispanic	0.46	(0.30)	.23
White non-Hispanic	0.08	(0.09)	.02
Female	1.98	(0.65)	.04
Health			
Very good or good	1.24	(0.41)	.52
Fair or poor	0.30	(0.34)	.29
Has learning disability	3.39	(2.30)	.07
Maltreatment type (Reference: Physical maltreatment)			

Sexual maltreatment	0.99	(0.78)	.99
Emotional maltreatment	2.12	(1.41)	.26
Other forms of abuse or neglect	0.44	(0.30)	.23
Substance exposure	1.43	(1.23)	.68
Domestic violence	4.00	(2.85)	.05
Substantiated	0.99	(0.78)	.99
In foster care	1.50	(1.01)	.54
Caregiver characteristics			
Marital status (Reference: Not married, separated or divorced)			
Married	2.31	(0.74)	.01
Household size (Reference: 1)			
2	0.31	(0.23)	.12
3	0.10	(0.07)	.00
4	0.02	(0.03)	.00
5 or more	0.06	(0.06)	.01
Poverty level (Reference: < 50%)			
50% to <100%	0.64	(0.41)	.49
100% to 200%	0.31	(0.19)	.05
> 200%	0.33	(0.25)	.14
Depressed (dysphoric)	1.15	(0.53)	.77
Receives WIC	0.66	(0.31)	.37
Receives TANF	0.42	(0.18)	.04
Employment status (Reference: Full time)			
Part time	1.28	(0.77)	.68
Unemployed	0.54	(0.20)	.10
Urban	0.77	(0.43)	.64
Immigrant	1.97	(2.36)	.57
Substantiated x Age	1.13	(0.06)	.04
Substantiated x Immigrant	0.46	(0.59)	.54
Substantiated x HHSize (2)	1.99	(1.53)	.37
Substantiated x HHSize (3)	18.06	(16.16)	.00
Substantiated x HHSize (4)	87.62	(114.64)	.00
Substantiated x HHSize (5)	6.60	(7.22)	.09
Foster care x White	5.04	(4.18)	.05
Foster care x Hispanic	2.50	(2.50)	.36
Foster care x All other races/ethnicities	9.29	(12.21)	.09
Foster care x Learning disability	0.35	(0.40)	.36

Note. Model incorporates survey weights and design information (strata and primary sampling unit information). Missing data handled through multiple imputation by chained equations. The model was fit to 40 imputed datasets and the results were pooled together using Rubin's rules.

Supplemental Table A1. Full Results: Adaptive Behaviors (VABS)

	Daily living skills						Socialization skills					
	Without propensity score weights		ATE		ATT		Without propensity score weights		ATE		ATT	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Early childhood education	**-3.30***	**(1.52)**	**-6.05*****	**(1.61)**	**-3.10***	**(1.47)**	**-1.62**	**(3.32)**	**-2.46**	**(2.74)**	**-1.78**	**(2.34)**
Race and ethnicity (Reference: All other races and ethnicities)												
Black non-Hispanic	10.36*	(4.26)			5.35	(4.61)	8.65	(5.49)			1.40	(4.55)
Hispanic	5.47	(3.75)	-2.44	(1.67)	0.25	(4.74)	4.15	(3.63)	-0.14	(3.85)	-3.96	(4.54)
White non-Hispanic	5.90	(3.96)	-2.13	(2.19)	2.18	(4.57)	6.61	(4.47)	-1.21	(2.98)	-2.15	(4.10)
Female	7.58***	(1.73)	8.19***	(1.88)	7.89***	(2.07)	2.89	(2.84)	2.57	(2.41)	0.75	(2.34)
Age (in months)	0.96**	(0.29)					0.12	(0.24)				
Health status (Reference: Fair or poor)												
Excellent	2.03	(3.23)	-2.55	(1.59)			11.36***	(2.64)	-0.12	(2.70)		
Very good or good	1.67	(3.17)					7.97**	(2.86)				
Has learning disability	0.02	(4.59)	-4.68	(3.50)	-4.63	(3.47)	1.10	(5.82)	-4.30	(4.54)	-2.04	(3.53)
Maltreatment type (Reference: Other types)												
Physical maltreatment	1.21	(3.69)	-0.37	(3.76)	3.71	(3.16)	1.00	(7.24)	1.83	(4.92)	-0.82	(6.23)
Sexual maltreatment	2.89	(2.85)	2.49	(2.33)			0.38	(4.57)	1.18	(3.28)		
Emotional maltreatment	-3.75	(3.57)	-3.87	(2.51)	-0.33	(3.08)	-4.14	(4.04)	-3.65	(2.94)	-2.57	(3.89)
Substance exposure	-0.69	(2.78)					2.60	(4.01)				
Domestic violence	-1.68	(3.02)					-2.39	(4.43)				
Substantiated	2.31	(1.90)	2.05	(1.98)	0.89	(2.31)	1.98	(2.29)	2.49	(1.85)	2.67	(2.50)
In foster care	-4.77	(3.19)	1.04	(3.46)	-2.87	(3.28)	1.98	(2.27)	6.62*	(3.12)	0.23	(2.69)
Married	-0.07	(1.78)	-1.82	(2.16)	0.42	(2.10)	-1.41	(2.28)	-3.42	(2.84)	-0.16	(2.55)
Household size (Reference: 5 or more)												
1	-3.69	(3.67)	-1.67	(2.50)	-2.38	(2.11)	-0.72	(3.10)	-1.66	(3.07)	-3.90	(3.88)
2	1.66	(2.75)					5.88*	(2.69)				
3	-1.08	(2.84)			-0.90	(2.52)	-0.06	(2.47)			-2.92	(3.32)
4	-0.68	(3.49)	2.18	(2.57)	1.55	(3.11)	0.06	(2.81)	-3.02	(3.07)	-6.72*	(2.95)
Federal poverty level												

(Reference: > 200%)												
100% to 200%	-2.10	(2.31)	-0.13	(2.79)	-5.16	(3.47)	-1.12	(2.94)	6.61	(3.47)	0.57	(4.03)
50% to <100%	-0.25	(2.93)					-2.53	(2.86)				
< 50%	0.39	(2.80)	0.09	(2.83)	-2.98	(2.62)	-2.27	(3.53)	2.25	(3.43)	-0.75	(3.46)
Receives WIC	-3.55	(2.14)			-1.16	(1.63)	-8.08***	(2.32)			-4.27	(2.90)
Receives TANF	-1.18	(2.15)	-2.51	(2.24)			0.79	(2.05)	0.07	(2.17)		
Depressed (dysphoric)	-2.29	(2.47)	-2.45	(2.28)	-6.41	(3.61)	-4.64	(4.15)	-3.17	(3.47)	-7.91	(5.68)
Employment status												
Full time	4.24	(2.39)	2.06	(3.25)	6.85	(4.05)	5.55*	(2.48)	2.68	(6.08)	11.12*	(5.46)
Part time	-5.08**	(1.68)					-9.47	(5.63)				
Urban	-6.31	(5.52)	-8.28	(4.56)	-10.27	(4.94)	-4.63	(6.58)	0.54	(7.21)	-2.49	(6.94)
Immigrant	-1.07	(2.39)	-1.17	(2.90)	2.53	(3.39)	-6.60*	(3.13)	-4.95	(4.81)	-2.87	(4.61)
Developmental outcomes at baseline												
Daily living skills	0.14**	(0.05)					-0.06	(0.07)				
Social skills	0.10	(0.07)					0.21**	(0.08)				
Attention and memory	-0.34	(0.26)					-0.01	(0.30)				
Perception and concepts	1.09*	(0.48)					0.49	(0.41)				
Health: Fair or poor			-6.14*	(2.93)					-9.09	(4.77)		
HH Size: 5			-2.26	(2.57)					-2.72	(4.27)		
Poverty level: > 200%			1.66	(3.00)	-1.62	(2.72)			8.55*	(3.62)	6.63*	(3.03)
Unemployed			2.04	(2.31)	5.07	(3.40)			5.39	(4.34)	8.45	(4.91)
Centered baseline outcomes (ATE)												
Age			0.82***	(0.21)					0.20	(0.27)		
Daily living skills			0.15**	(0.05)					0.06	(0.07)		
Attention and memory			0.03	(0.23)					0.17	(0.23)		
Perception and concepts			1.01*	(0.44)					0.84	(0.54)		
Other forms of abuse or neglect					0.02	(4.28)					-4.58	(7.48)
Centered baseline outcomes (ATT)												
Social skills					0.15*	(0.07)					0.16*	(0.07)
Attention and memory					-0.32	(0.27)					-0.25	(0.23)
Perception and concepts					0.73*	(0.34)					0.50	(0.40)
Constant	42.94***	(11.88)	89.13***	(4.16)	85.67***	(4.58)	71.38***	(12.67)	89.83***	(7.28)	102.54***	(7.58)

Observations (unweighted)	1570	1570	1570	1570	1570	1570

Note. Models include survey weights, design information and agency fixed effects. Missing data handled through multiple imputation. Taylor linearized standard errors in parentheses. Covariates included in the ATE and ATT models had standardized differences between ECE and non-ECE groups at baseline that were between |0.05| and |0.25|.
* $p < .05$, ** $p < .01$, *** $p < .001$

Supplemental Table A2. Full Results: Cognitive Development (BDI)

	Attention & memory						Perception & concepts					
	Without propensity score weights		ATE		ATT		Without propensity score weights		ATE		ATT	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Early childhood education	**-0.27**	**(0.50)**	**-0.32**	**(0.37)**	**-0.23**	**(0.43)**	**1.63***	**(0.66)**	**0.66**	**(0.41)**	**1.10***	**(0.47)**
Race and ethnicity (Reference: All other races and ethnicities)												
Black non-Hispanic	1.06	(1.02)			1.45	(1.00)	0.28	(1.00)			1.17	(1.36)
Hispanic	0.20	(1.18)	-0.66	(0.62)	0.32	(0.93)	-0.24	(0.88)	-0.56	(0.51)	-0.19	(1.04)
White non-Hispanic	0.39	(1.08)	-1.00	(0.59)	0.62	(1.05)	0.13	(0.98)	-0.30	(0.44)	0.50	(1.22)
Female	0.75*	(0.37)	1.13**	(0.41)	1.32**	(0.47)	1.03**	(0.33)	0.63	(0.34)	1.03**	(0.38)
Age (in months)	-0.07	(0.05)					-0.03	(0.04)				
Health status (Reference: Fair or poor)												
Excellent	1.70	(1.20)	0.41	(0.40)			-0.90	(0.95)	0.16	(0.35)		
Very good or good	0.59	(1.14)					-0.94	(1.00)				
Has learning disability	-1.82	(0.95)	-1.26	(0.92)	-1.11	(0.74)	-2.29**	(0.83)	-1.40	(0.80)	-1.57*	(0.64)
Maltreatment type (Reference: Other types)												
Physical maltreatment	1.80	(1.01)	-0.02	(0.74)	0.52	(1.05)	0.27	(1.07)	-0.48	(0.61)	-0.76	(0.89)
Sexual maltreatment	0.44	(0.78)	-0.55	(0.67)			0.67	(0.72)	0.25	(0.53)		
Emotional maltreatment	1.11	(0.73)	-0.12	(0.57)	0.38	(0.84)	0.19	(0.78)	-0.37	(0.52)	0.10	(0.58)
Substance exposure	1.37	(0.70)					0.61	(0.81)				
Domestic violence	1.59*	(0.74)					0.19	(0.85)				
Substantiated	-0.56	(0.38)	-0.18	(0.45)	0.15	(0.49)	-0.56	(0.55)	-0.02	(0.48)	-0.49	(0.60)
In foster care	1.54**	(0.50)	1.20	(0.71)	1.25*	(0.59)	1.16**	(0.40)	1.25*	(0.62)	1.44*	(0.59)
Married	0.08	(0.36)	0.52	(0.39)	0.04	(0.47)	0.60	(0.48)	0.58	(0.41)	0.57	(0.54)
Household size (Reference: 5 or more)												
1	0.15	(0.69)	0.28	(0.44)	-0.04	(0.57)	0.91	(0.87)	0.75	(0.38)	0.09	(0.44)
2	0.62	(0.79)					0.43	(0.81)				
3	0.13	(0.70)			-0.16	(0.59)	0.28	(0.84)			-0.74	(0.62)
4	0.77	(0.85)	0.16	(0.77)	-0.49	(0.82)	-0.21	(1.05)	0.34	(0.69)	0.14	(0.82)
Federal poverty level (Reference: > 200%)												

100% to 200%	-0.79	(0.55)	-0.60	(0.47)	-0.77	(0.67)	-0.32	(0.61)	-0.09	(0.60)	0.02	(0.77)
50% to <100%	-0.36	(0.50)					-0.36	(0.69)				
< 50%	-0.60	(0.63)	-0.19	(0.50)	-1.00	(0.51)	-0.00	(0.59)	0.29	(0.46)	0.07	(0.65)
Receives WIC	0.61	(0.65)			-0.11	(0.76)	-0.97	(0.70)			0.35	(0.56)
Receives TANF	0.30	(0.31)	-0.09	(0.41)			-0.60	(0.49)	-0.98*	(0.44)		
Depressed (dysphoric)	0.15	(0.40)	0.53	(0.48)	0.67	(0.54)	0.52	(0.38)	0.65	(0.41)	0.62	(0.46)
Employment status	-0.54	(0.35)	0.82	(0.62)	-0.04	(0.78)	0.45	(0.42)	0.50	(0.57)	-0.64	(0.67)
Full time	-1.67**	(0.60)					-0.11	(0.56)				
Part time	1.34	(0.70)	0.69	(1.13)	-1.85*	(0.80)	-0.60	(0.81)	-0.84	(0.91)	-2.32**	(0.84)
Urban	0.62	(0.76)	0.24	(0.73)	0.20	(0.90)	0.26	(0.73)	0.71	(0.66)	0.40	(0.77)
Immigrant												
Developmental outcomes at baseline	-0.03*	(0.01)					-0.00	(0.01)				
Daily living skills	-0.00	(0.01)					-0.00	(0.01)				
Social skills	0.13*	(0.05)					0.06	(0.05)				
Attention and memory	0.15	(0.09)					0.19	(0.10)				
Perception and concepts			-1.12	(1.10)					0.40	(1.05)		
Health: Fair or poor			0.46	(0.62)					-0.70	(0.60)		
HH Size: 5			-0.03	(0.43)	-0.14	(0.54)			0.31	(0.56)	0.33	(0.74)
Poverty level: > 200%			0.78	(0.61)	-0.01	(0.68)			-0.23	(0.54)	-0.24	(0.47)
Unemployed												
Centered baseline outcomes (ATE)			-0.11*	(0.05)					0.01	(0.04)		
Age			-0.02	(0.01)					0.00	(0.01)		
Daily living skills			0.09	(0.06)					-0.00	(0.04)		
Attention and memory			0.03	(0.09)					0.20*	(0.09)		
Perception and concepts					-1.26	(1.79)					0.31	(1.57)
Other forms of abuse or neglect												
Centered baseline outcomes (ATT)					-0.01	(0.02)					0.01	(0.01)
Social skills					0.02	(0.08)					-0.02	(0.07)
Attention and memory					0.19	(0.11)					0.12	(0.07)
Constant	5.11	(2.53)	6.63***	(1.10)	7.54***	(1.48)	5.04	(2.62)	6.04***	(0.97)	7.77***	(1.55)
Observations (unweighted)	1570		1570		1570		1570		1570		1570	

Note. Models include survey weights, design information and agency fixed effects. Missing data handled through multiple imputation. Taylor linearized standard errors in parentheses. Covariates included in the ATE and ATT models had standardized differences between ECE and non-ECE groups at baseline that were between |0.05| and |0.25|.

* $p < .05$, ** $p < .01$, *** $p < .001$