Within- and Between-Sector Quality Differences in

Early Childhood Education and Care

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High-quality early childhood experiences shape children's readiness for school as well as their later life outcomes (Campbell et al., 2012; Schweinhart et al., 2005). At the same time, the early childhood education and care (ECEC) landscape is marked by low and inconsistent quality (Barnett et al., 2010)—a reality that may have costly private and public ramifications. For this reason, the past two decades have seen heightened investment in strategies to improve access to affordable, *high-quality* early learning opportunities, including substantial increases in state and federal funding, the introduction of more stringent regulations for licensed care settings and the emergence of Quality Rating and Improvement Systems (QRIS), which incentivize quality improvement through increased accountability (Bassok & Loeb, 2015).

Recent early childhood quality improvement efforts also emphasize the need to build cohesion across the fragmented early childhood landscape, which ranges from full-day pre-kindergarten programs to neighbors watching children in home-based settings. Nevertheless, formal and informal ECEC arrangements still face starkly different requirements and funding streams and are characterized by large differences in quality (National Association for Regulatory Administration, 2008; Pianta, Barnett, Burchinal, & Thornburg, 2009; Wrigley & Dreby, 2005). Relatedly, children's cognitive outcomes at school entry differ substantially across sectors, with children who attend formal programs, including childcare centers, Head Start, and pre-kindergarten, consistently outperforming peers in the informal sector on academic outcomes (Bradley & Vandell, 2007; Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007).

One plausible explanation for the differences in outcomes across sectors is differences in quality. Given the extensive research base demonstrating the importance of ECEC quality

(Yoshikawa et al., 2013), this hypothesis is compelling. Surprisingly, however, there has been little empirical investigation of this relationship. Few studies have examined (1) how much ECEC sectors vary with respect to quality or (2) to what extent variation in these environmental factors mediates the relationship between ECEC sector and child development.

In this paper we document the magnitude of quality differences between and within sectors using the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), a nationally representative study conducted by the National Center for Education Statistics (NCES) that tracks 14,000 children from infancy in 2001 through kindergarten entry. We explore a wide range of characteristics ranging from safety measures to caregiver credentials, time spent on learning activities and externally conducted observations of process quality. We contrast the formal and informal sectors first, looking separately at programs serving toddlers and those serving four-year-olds. We then probe variation within the formal sector, comparing childcare centers, Head Start, and pre-kindergarten. Finally, we assess the extent to which systematic differences in quality predict differences in child outcomes across sectors.

Although the dataset we leverage in the current analysis is now a decade old, and the early childhood landscape has changed in important ways over that period, it is the largest and most current dataset available with detailed measures of quality for both preschoolers and toddlers. It thus allows us to address several limitations inherent in earlier studies and provide new evidence on the link between ECEC sectors and child outcomes.

Background

Differences in outcomes between and within sectors

Children who attend formal ECEC settings score higher on cognitive and academic assessments relative to both children who had *no* exposure to ECEC and those in informal

settings (Ansari & Winsler, 2011; Bradley & Vandell, 2007; NICHD Early Child Care Research Network, 2004; Vandell, 2004). This formal care advantage with respect to cognitive outcomes has been documented widely, though formal care is also associated with higher levels of stress and externalizing relative to parental care, a pattern not observed for informal settings (Belsky, 2002; Coley, Votruba-Drzal, Miller, & Koury, 2013; Vermeer & van IJzendoorn, 2006).

Studies have also examined differences in child outcomes *within* the formal care sector, comparing children enrolled in Head Start, pre-kindergarten, and other center-based care. These studies suggest that Head Start and pre-kindergarten, which face more stringent regulations and receive more resources, yield greater benefits than other formal settings, though results are mixed depending on the comparisons and outcomes considered (Gormley, Phillips, Adelstein, & Shaw, 2010; Henry, Gordon, & Rickman, 2006; Zhai, Waldfogel, & Brooks-Gunn, 2013).

Differences in quality between and within sectors

A closely related literature has documented differences in *quality* both between formal and informal ECEC settings, and within formal settings between Head Start, pre-kindergarten, and other center care (Rigby, Ryan, & Brooks-Gunn, 2007; Zellman & Karoly, 2015). Patterns are nuanced and differ depending on the measure considered and the age of the children served. Dowsett et al. (2008) demonstrated that children in formal settings experience more sensitive care, more cognitive stimulation, and more planned learning activities but are exposed to larger group sizes than children in home-based settings. That study also showed that among 4.5-year-old children, centers receive higher ratings on global quality compared to informal arrangements. Among toddlers, however, relative care is rated higher than formal care. Comparisons within the formal sector yield mixed results. Johnson and colleagues (2012) show that among subsidy-eligible children, pre-kindergarten programs offered the highest levels of global quality. In

contrast, Dowsett et al. (2008) found that Head Start programs were more organized and cognitively stimulating than other arrangements serving low-income children.

These differences in observed quality are likely explained, at least in part, by differences in regulations, which are the most widely used form of quality control in ECEC and vary substantially across sectors. Informal arrangements and those serving toddlers tend to have more stringent maximum group sizes and child:teacher ratios, but formal arrangements and those serving preschoolers require more staff training and frequent inspections. As an example, thirty-seven states have no formal education regulation for individuals running family childcare homes (National Association for Regulatory Administration, 2008). In contrast, about 60 percent of state pre-kindergarten programs require teachers hold a four year degree or more (Barnett, Carolan, Squires, Clarke Brown, & Horowitz, 2015). Within the formal sector, Head Start and pre-kindergarten programs generally face stricter quality guidelines than do other centers.

The impact of these regulations on true program quality depends on their implementation, subsequent monitoring, and the link between regulatory requirements and child development. Still, the systematic differences in quality requirements across sectors likely lead to differences both in actual quality experienced and in parents' perceptions of quality.

Do differences in quality across sectors explain differences in child outcomes?

Although descriptive studies consistently demonstrate important differences across sectors in both quality and child outcomes, we lack evidence on the extent to which quality differences between sectors (or between arrangements within sectors), *cause* differences in child outcomes. A large body of research examined links between structural features of ECEC and either program quality or child outcomes, with inconsistent and minimal findings (e.g., Clarke-Stewart, Vandell, Burchinal, O'Brien, & McCartney, 2002; Early et al., 2006). Process-oriented

measures of quality, such as observational measures of teacher-child interactions, are more

strongly associated with children's learning (Mashburn et al., 2008). To date there is little

empirical support for the hypothesis that quality differences across sectors explain differences in

child outcomes. Abner, Gordon, Kaestner, and Korenman (2013) assessed whether two widely-

used observational measures of quality mediate the relationship between sector and child

outcomes. They found little evidence to support this hypothesis, which they partially attribute to

psychometric issues with the instruments (Colwell, Gordon, Fujimoto, Kaestner, & Korenman,

2013; Gordon, Fujimoto, Kaestner, Korenman, & Abner, 2013).

Differences in quality are not the *only* plausible explanation for differences in child

outcomes across sectors. "Selection," whereby child characteristics systematically differ across

sectors, is another. For example, if children who enroll in informal settings come from lower-

income households, it may be that difference *and not exposure to different sectors* that explains

disparities in outcomes. Several studies document systematic differences in care use by family

characteristics (Huston, Chang, & Gennetian, 2002; Meyers, Rosenbaum, Ruhm, & Waldfogel,

2004). Financial and employment constraints, language, cultural mores, access to information,

and children's developmental stage may all be associated with both care type and child outcomes

(Coley, Votruba-Drzal, Collins, & Miller, 2014; Miller, Votruba-Drzal, & Coley, 2013).

The current study

In the current study we leverage rich, nationally representative data to assess the extent of

within- and between-sector quality differences in ECEC and to explore whether these differences

explain differences in children's reading and math outcomes across sectors. We focus our

analysis on two research questions:

1. How much does quality differ *between* formal and informal sectors and *within* the

formal sector between centers, Head Start, and pre-kindergarten?

2. Are differences in children's learning outcomes across sectors related to differences in observable measures of quality?

The study provides the most comprehensive and current documentation of quality differences between and within sectors. It also provides some of the only evidence on whether quality differences explain differences across sectors in child outcomes.

Earlier studies of quality gaps across sectors are less generalizable than the current work due to their reliance on relatively small and dated samples (Coley, Li-Grining, & Chase-Lansdale, 2006; Fuller, Kagan, Loeb, & Chang, 2004). Research leveraging the NICHD Study of Early Child Care and Youth Development (SECCYD) provides the richest evidence to date (Dowsett et al., 2008; NICHD Early Child Care Research Network, 2004). Quality measures in that study are a unique strength. However, SECCYD tracked children entering preschool roughly two decades ago, sampled from just nine states, and under-represented low-income children.

Several studies leveraging the more recent Child Care Supplement to the Fragile Families and Child Wellbeing Study have uncovered important quality differences across sectors (Rigby et al., 2007; Ryan, Johnson, Rigby, & Brooks-Gunn, 2011). However, generalizability concerns are still relevant as data were drawn from 14 cities, oversampled children born to unmarried mothers, and focused solely on three-year-olds.

We improve upon the existing literature by using the ECLS-B, which provides the most recent data available on quality measures for a nationally representative sample. Although other studies have already leveraged this data to examine ECEC quality, they focus either on a subset of the children in the dataset (e.g., Johnson, Martin, & Brooks-Gunn, 2013) or on a subset of the quality measures available (e.g., Abner et al., 2013). We examine the extent to which a far more

extensive set of quality measures mediates the relationship between sectors and child outcomes.

Methods

Participants

The ECLS-B tracks 14,000 children from infancy through kindergarten entry, and is representative of all children in the United States born in 2001 except those born to mothers less than 15 years of age or those who either died or were adopted prior to the nine-month assessment. We consider approximately 3,000 arrangements serving toddlers and 6,000 serving four-year-olds, although sample sizes vary across models and measures of quality.

The bulk of the quality measures examined in our study come from interviews with ECEC providers during wave 2, when children were approximately age two, and wave 3, when the children were about four. All children with a complete parent interview who were enrolled in one or more non-parental care arrangements were eligible for the provider interview. Of the approximately 4,800 children in non-parental care during the two-year-old wave, roughly 3,200 have complete provider interviews. During the four-year-old wave there were about 7,300 children in non-parental care and 6,000 complete provider interviews. If a child had multiple providers, data collectors interviewed the provider with whom the child spent most time.

We supplement quality measures from the provider interview with direct observational measures collected in a restricted subsample of classrooms included in the provider survey (~1,500 children in each wave). Sampling procedures for these observational measures differed somewhat between the two- and four-year-old waves. The target population for observations involved all cases with complete provider interviews except: (1) cases in Alaska and Hawaii, (2) cases in the American Indian supplement, (3) cases of children in care less than ten hours per week, (4) cases where the language of care was not English or Spanish, and (5) cases in which

children were not typically in care and awake for 2.5 hours at a time. In the two-year-old wave, all cases where the child's primary care was center-based care and where the child was classified as "in poverty" were included in the sample. Other groups of children were sampled at fixed rates. In the four-year-old wave, all children who had their ECEC arrangements observed during the two-year-old wave were automatically selected for observation as long as they remained in care for ten or more hours per week. Cases that met the basic eligibility criteria but had not been previously observed were selected at fixed rates stratified by poverty and care type.

The most consequential sources of nonresponse include lack of provider contact permission and non-completion of the childcare observation. To account for design-based oversampling and sample attrition, we use sample weights created for analysis of provider interview data (W33JO) and for use with direct observations (W33P0). Given low response rates on several survey instruments, NCES sampling reports for the two- and four-year-old waves of the ECLS-B include two "nonresponse bias analyses." The first analysis compared the two- and four-year-old samples to the sampling frame, while the second compared these samples to nine-month benchmarks for all eligible children. Both analyses found very few significant differences between responders and non-responders, and those that were significant were small (Snow et al., 2007). Nevertheless, to address missing data concerns, we conducted multiple imputation using chained equations and created 20 imputed datasets (Von Hippel, 2007). Our imputation model included all variables used in our analysis. We impute independent but not dependent variables.

Measures

NCES collected data in five waves between birth and kindergarten entry. At each wave, parents completed an interview, yielding detailed information about their families and children, including their ECEC experiences. In addition, ECEC providers and, when applicable, center

directors, completed detailed surveys during the second and third waves of the ECLS-B, when children were approximately age two and age four.

Defining sectors and arrangements. Although children may experience a number of care arrangements within a given week, we focus on primary care settings, defined as the settings in which children spent the most time. NCES determines each child's primary setting based on responses from the parental survey and then administers a questionnaire to the child's primary caregiver and (when applicable) the caregiver's program director. When possible we rely on responses from the ECEC provider to inform our assignment of each study child's primary care arrangement. For example, if a director identifies a setting as Head Start, we classify it as such even if the parent did not identify the program as Head Start. For children whose provider did not complete the program type item (approximately 33 percent in the two-year-old wave and 18 percent in the four-year-old wave), we rely on parent reports.

We classify ECEC into two main sectors: formal and informal. For two-year-olds, we define formal care as center-based ECEC, including early learning centers, nursery schools, and preschools. For four-year-olds, we disaggregate formal care into three arrangement types:

- *Childcare centers*: center-based care defined by the program director as a "child care center," "preschool/nursery school," or "some other center-based program."

- *Head Start*: center-based care defined by the program director as Head Start.

- *Pre-kindergarten*: center-based care defined by the program director as pre-kindergarten.

Within the informal sector, we define two distinct arrangements:

- *Family childcare homes*: home-based care provided outside the child's home for which providers collect a fee. Providers may be relatives or non-relatives.

- *Other care*: home-based care provided in the child's home (regardless of fee) or outside

  the child's home for no fee. Providers may be relatives or non-relatives. These homes are

  unlikely to be licensed and may include nannies, babysitters, or unpaid family members.

We classify children not attending formal or informal sectors as receiving parental care.

ECEC quality and experiences. We divide our measures of quality and ECEC

experiences into five categories: (1) ratios, (2) safety, (3) caregiver characteristics, (4) activities

and curriculum, and (5) observational measures of quality. We describe each of these below.

Ratios Child-to-teacher ratios are of particular interest given their prominence in

licensing rules and QRIS. A large existing literature examines both the effects of ratio

regulations on program quality and, more broadly, the effects of ratios on children's learning.

Ratios show an inconsistent association with process quality and child outcomes (Burchinal &

Cryer, 2003; Hotz & Xiao, 2011; Phillips, Mekos, Scarr, McCartney, & Abbott–Shim, 2000).

Safety. We examine three measures of safety that are arguably necessary to ensure a safe

environment: the availability of smoke detectors, first aid kits, and electrical outlet coverings.

Caregiver characteristics. We use several measures of professional preparation including

formal education (in years), possession of a Child Development Associate Credential (CDA),

possession of a post-secondary degree in early childhood education, completion of pre-service

coursework related to early learning, and participation in ongoing training. We also consider

caregiver age and experience. Each of these indicators has shown positive, though often modest,

associations with process quality and children's skills (Burchinal & Cryer, 2003; Burchinal,

Cryer, Clifford, & Howes, 2002; Early et al., 2006).

We also construct "high" and "low" caregiver quality composites. In the two-year-old

wave, the high quality composite is set to one if a caregiver has a CDA, ECE degree, or some

pre-service ECE coursework and participates in ongoing training. In the four-year-old wave, the composite is set to one if a caregiver has a BA or higher in early childhood education and participates in ongoing training. In both waves, the low quality composite indicates a caregiver who does not have a CDA, other ECE degree, or pre-service ECE coursework; has 12 or fewer years of formal education; and does not participate in any ongoing training. Although our measures do not provide direct measures of teaching quality, they provide proxies motivated by existing policy recommendations (Barnett et al., 2015).

Finally, we examine annual rates of caregiver turnover, which are negatively associated with cognitive, social-emotional, and linguistic outcomes (Tran & Winsler, 2011). Directors reported the number of caregivers who left in the last year which we divide by the total number of caregivers currently employed at the program. Caregivers are defined as individuals who work directly with children (i.e., bus drivers and cooks are excluded).

Activities and curriculum. The ECLS-B offers an array of provider-reported information about activities. In the two-year-old wave, we include reading activities, hours of television watched, outdoor play, and visits to zoos and libraries—each of which has been associated with children's outcomes (Frost, Wortham, & Reifel, 2012). From the four-year-old wave, we include frequency of reading and math activities, hours of television watched, use of games and puzzles, availability of computers, adherence to a written curriculum, and time spent on whole class and child-selected activities (Connor, Morrison, & Slominski, 2006; Duncan et al., 2007). While the literature linking several of these measures to later outcomes is underdeveloped, we include them to provide a holistic picture of the ECEC environment.

Observational measures of quality. Finally, we assess more direct aspects of process quality using two common observational tools: (1) the environment rating scale (ERS) overall

mean scores from the Infant/Toddler Environment Rating Scale (ITERS), Early Childhood

Environment Rating Scale (ECERS), or Family Day Care Rating Scale (FDCRS), as appropriate,

and (2) the Lead Caregiver Total Score from the Arnett Caregiver Observation Scale. The ERS

are the most widely used measures of ECEC quality and are included in 21 of 25 state QRISs

(National Center on Child Care Quality Improvement, 2013). These tools were not specifically

designed for quality comparisons across sectors, so we make comparisons with caution, noting

that earlier studies used these measures as we do here (Abner et al., 2013; Rigby et al., 2007).

Cognitive outcomes. Direct assessments of reading and math skills were developed

specifically for the ECLS-B and were administered during the fourth wave of data collection

when children were, on average, five years old. The reading assessment measures early literacy

skills such as letter recognition, conventions of print, and word recognition. The math assessment

examines number sense, counting, operations, geometric shapes, and estimation. Tests were

adaptive and Item Response Theory was used to estimate children's performance across the

assessment. We use t-scores, standardized to have a mean of 50 and a standard deviation of 10.

Our analysis also accounts for month of assessment and child's age at assessment.

Child and family characteristics. All models predicting child outcomes at age five also

control for the child's cognitive score from Wave 2 (approximately age two), as measured by the

Bayley Scales of Infant Development, 2nd Edition (BSID-II). The BSID-II captures children's

babbling, vocabulary, active exploration, understanding of repetitive actions, and problem

solving skills. Given that rates of non-relative care increase substantially after age two, this

cognitive score is the most appropriate measure of a pre-score.

Our multivariate analyses include a rich battery of child and family characteristics,

including demographic characteristics and family practices. We select an extensive list of

covariates hypothesized to confound the relationship between sector type and observed program quality or child outcomes. In all models, we use covariates reported by parents in the same wave that care quality was measured. Child-level characteristics include race, gender, birth weight, and current height and weight.

We construct two socio-economic status indicators: one for low-income families who are defined as those living at or below the poverty line and another for high income families, defined as those that earn $75,000 per year or more. Middle-income families are those in between and serve as our excluded category. Other family-level covariates include: total number of children in the home; mother's employment status, defined as working part-time, working full-time, looking for work, or out of the workforce; highest parental education level, defined as less than high school degree, high school degree, some college, and BA or above; a variable indicating whether English is the primary home language; WIC receipt; a binary indicator of whether a parent reads books to the child every day; television viewing at home (hours per day); occurrence of a family evening meal (days per week); and a binary variable documenting whether a parent hits or spanks the child for disciplinary purposes. We also account for census region and categorize children as living in urban, suburban, or rural areas, as reported during the four-year-old wave. (No similar measure at age two is available.)

Analysis

Sector and quality. To assess the relationship between care type and quality, we estimate ordinary least squares (OLS) and logistic regression models to predict each quality measure as a function of ECEC arrangement. OLS models are used with continuous measures of quality (e.g., hours of television watched per day), while logistic models are employed with binary measures of quality (e.g., whether a caregiver reads books every day).

Because the focus of this study is on variation in quality across ECEC, we exclude children solely in parental care. In models examining care quality in programs serving two-year-olds, children in childcare centers serve as the base category, to which family childcare homes and other care settings are compared. Among four-year-olds, we fit two sets of models. The first includes all children in formal and informal care. Here, again, children in formal sector arrangements serve as the base category. We then run models that restrict our sample to children in formal arrangements. In this case, children in childcare centers serve as the reference group, and we compare their program quality to the quality experienced by children in Head Start and pre-kindergarten. For each outcome, we fit two models. The first regresses a quality measure on ECEC arrangements to provide unadjusted mean differences. Model 2 adds a full battery of child and family characteristics to examine whether differences across sectors in quality are associated with differential patterns of selection into settings.

Sector and child outcomes. To estimate the association between sector and children's developmental outcomes, we run models similar to those described above but replace the program quality measures with children's reading and math test scores at age 5. We present results from four models per outcome and, to preserve sample size, exclude the observational measures of quality, which are only available for a relatively small subset of observations. The first model aims to capture the raw difference in child outcomes across sectors and includes only an indicator for care type (e.g. informal care), the child's pre-score (at age two), age at assessment, and the month of assessment. In a second model we add to these an extensive list of child and family covariates. In a third model, we remove the child and family covariates and add the full set of quality measures. Finally, Model 4 includes both the child and family covariates and the full set of quality measures.

Existing research, discussed above, demonstrates differences across families, based on socioeconomic status, race, and other factors, in their participation in particular types of ECEC. By including the extensive set of covariates available in the ECLS-B, as well as the child's cognitive assessment from age two, we account for many of these selection differences. However, despite the rich data, our models may not account for *all* child or family characteristics associated with the type of care a child experienced and with their reading and math outcomes at age 5. As a result, our models may give biased estimates of the causal relationship between ECEC type and child outcomes. Throughout the manuscript we describe our results as associational and remind readers of this descriptive rather than causal interpretation.

After presenting our main results, we consider a series of specification checks to unpack the relationship between ECEC type, observed quality, and child outcomes. First, we examine whether our results are substantively similar when restricting our sample to the subset of children that do have observational measures of quality. Second, we assess whether our findings are robust to the inclusion of indicator variables for children who experience more than one care arrangement. Finally, we present results from models where, rather than entering all quality measures simultaneously, we introduce each of four quality categories (i.e. ratios, safety, caregiver characteristics, activities and curriculum) into the model one at a time to explore whether particular quality indicators were more predictive of child development than others.

Note that due to data limitations, we are unable to determine how long a child has been at the setting where quality measures are collected. We use quality measures from the fall of the preschool year to predict outcomes at age five, keeping in mind that some children may have entered their arrangements before age four and others may have stayed with their surveyed providers for less than a year. Relatedly, we are unable to examine the association between

sector quality differences in toddler care and children's outcomes because the ECLS-B collected

outcomes only concurrently with measures of toddler care quality, when children may have had

only brief exposure to the setting, or roughly two years later, by which time many children

experienced other arrangements in addition to their reported primary care setting from age two.

Results

We present the results in two sections. In the first, we compare quality metrics across

formal and informal sectors. We disaggregate results across types of care within the formal

sector and highlight differences in the experiences of toddlers and preschoolers. In the second

section, we present associations between ECEC sector and children's reading and math outcomes

at age five and examine the extent to which ECEC quality differences explain these associations.

Differences in quality across sectors

Table 1 gives means and standard deviations of each quality measure in classrooms

serving four-year-olds. We disaggregate the descriptive statistics first by sector and then within

sectors by arrangement. The first two columns provide evidence of statistically significant and

meaningful differences between the formal and informal sectors across all but one measure.

Child-teacher ratios are higher in formal settings where there are, on average, seven children per

adult compared to three children per adult in informal settings. On the other hand, differences in

caregiver characteristics are large and always favor formal settings. While 56 percent of

caregivers in the formal sector have a degree in early childhood education or a related field, only

nine percent do so in the informal sector. Similarly, 80 percent of caregivers in the formal sector

report participating in ongoing training compared to only 16 percent in the informal sector.

Caregivers in the formal sector are far more likely to meet our composite measure of high quality

(37 percent compared to two percent).

In formal arrangements, 93 percent of caregivers reported doing both reading and math activities on a daily basis. By contrast, 68 percent of informal sector caregivers reported daily reading, and 60 percent reported daily math. While formal sector caregivers reported children spending about six minutes per day watching television, informal sector caregivers reported nearly two hours of daily television exposure. Finally, on both observational measures, formal programs substantially outperformed informal ones.

The overall sector differences may mask important within-sector variation. When we disaggregate the formal sector by type, we find that Head Start and pre-kindergarten programs tend to have more favorable characteristics than other centers, though within-sector differences are far smaller than differences between sectors. Head Start and pre-kindergarten programs have lower levels of caregiver turnover and higher percentages of caregivers with degrees in early childhood. They report reading books more frequently and are more likely to indicate they do reading and mathematics activities every day, follow a written curriculum, and have a computer.

Head Start and pre-kindergarten do differ from each other on several measures. For instance, while 30 percent of Head Start caregivers meet our high quality composite, 46 percent meet this threshold in pre-kindergarten programs. Pre-kindergarten caregivers have an additional year of formal education and are five percentage points more likely to have degrees in ECEC or a related field. Conversely, Head Start caregivers participate in more pre-service coursework and ongoing training, are more likely to have a CDA, and have an additional year and a half of professional experience compared with their pre-kindergarten peers. Head Start classrooms receive the highest scores on the ECERS and are more likely to follow a written curriculum.

In the last two columns of Table 1 we turn to the informal sector, separating "family childcare homes," in which children receive care in a home other than their own for a fee, from

"other care," which encompasses a range of arrangements including babysitters, nannies, and unpaid relatives. While both differ substantially from the formal sector, family childcare homes, which are more likely to face regulations, are closer to the formal sector on all measures.

Taken together, these results show that children enrolled in formal care experience higher quality by nearly all measures considered. While between-sector differences are larger than within, within sector quality is highest in arrangements subject to the most stringent regulations.

Differences in quality across age groups. Table 2 shows similarly structured results for settings serving toddlers. Recall that the ECLS-B does not disaggregate formal arrangements at Wave 2, when children are approximately age two, so we only make comparisons between centers, family childcare homes, and other care. Again, we find between-sector differences on nearly all quality measures. The most pronounced differences are in measures of caregiver quality. Half of children attending formal toddler care have "high quality" caregivers, compared to just one-fifth of their peers in family childcare homes. Recall that our composite measure of high quality is less stringent for providers serving toddlers than those serving preschoolers. Specifically, we designate two-year-olds' caregivers as "high quality" if they hold a CDA, other ECE degree, or have pre-service ECEC coursework and participate in ongoing training.

Formal arrangements are also significantly more likely than informal ones to meet basic safety standards and to report instructional activities. Over 90 percent of children in centers have caregivers who read books with them every day. That proportion falls to 60 percent for children in family childcare homes and just 51 percent of children in other informal care. Two-year-olds in childcare centers watch 12 minutes of television per day. Their peers in family childcare homes watch 82 minutes of television and two-year-olds attending other care watch two hours of television each day. Moreover, formal sector arrangements score nearly three-quarters of a

standard deviation higher than informal sector arrangements on environment rating scales.

The one exception to this overarching pattern is that children enrolled in informal care, and particularly those in other care, had significantly more exposure than their peers in formal care to engaging outings (e.g. zoos, aquariums, libraries, etc.). On the other hand, children in formal settings were more likely to go for a walk or play outside daily.

Our results show that the overall patterns of between-sector differences in ECEC quality are similar across age groups; however, programs serving four-year-olds tend to have more favorable characteristics than do those serving younger children, particularly with respect to caregivers. Relative to the caregivers of two-year-olds, the caregivers of four-year-olds turnover at lower rates, have about two more years of education, and are 35 percentage points more likely to hold a degree in early childhood education.

Accounting for child and family characteristics. One plausible hypothesis is that the quality differences described above are driven by between-sector differences in the populations of children served. To explore this possibility, we regress each of the quality measures discussed above on a rich set of child and family covariates and compare the sector coefficients to those from models with no covariates. Table 3 presents these results for five indicators of quality. Accounting for child and family characteristics does very little to explain quality differences across sectors, either for four-year-olds (top panel) or for toddlers (bottom panel). Similarly, differences in quality *within* the formal sector are largely unchanged when accounting for the rich set of factors (Table 4). Results for our other quality measures (available upon request) follow the same pattern. In short, quality differences across sectors are pronounced even when comparing children who are similar on many dimensions.

Differences in child outcomes across sectors

Next we turn to the question of whether these differences in quality explain variation in children's learning outcomes. Table 5 shows results from models examining the relationship between care type at age four and children's reading and math scores at age five. Outcome variables are standardized with a standard deviation of ten, so multiplying coefficients by 0.1 converts them into effect sizes. In the top panel, we compare the outcomes of children who attended informal care to those in formal care and find substantial differences across settings. Column 1 shows results from a model that only accounts for children's cognitive scores at age two, their age at assessment, and the month of assessment. This model shows that, on average, children in informal care arrangements score nearly 0.3 standard deviations lower than their peers on reading assessments at kindergarten entry. Accounting for our detailed set of covariates reduces that gap somewhat, but we still observe children in informal care scoring one-fifth of standard deviation lower than their peers in formal care on reading.

We next assess the role of measured quality in the sector differences. Column 3 shows results from models that exclude the child and family covariates and instead include an extensive set of quality measures (i.e. all items presented in Tables 1 except the observational measures, which are omitted to preserve sample size). Accounting for quality substantially reduces the difference in reading outcomes between formal and informal ECEC attendees. The coefficient on informal care participation is no longer statistically significant and the magnitude of the coefficient drops to less than half the size in Model 2 (-0.86 compared to -2.00). Including both the child and family covariates *and* the quality measures (Column 4) does not meaningfully change the coefficient relative to Model 3. These findings suggest that our measures of quality serve as mediators in the relationship between sector and children. The same patterns hold in Columns 5 through 8 of Table 5, where we replicate this analysis for math outcomes.

The bottom panel of Table 5 shows similar models limited to children enrolled in formal ECEC programs, which compare the reading and math outcomes of children in Head Start and pre-kindergarten to children in center-based care, the omitted group. The "raw" differences, shown in Column 1, show that children in Head Start score almost two-fifths of a standard deviation lower than their peers in center-based care, whereas children in pre-kindergarten score about a tenth of a standard deviation higher than children in center-based care. Including child and family covariates (Column 2) helps account for the non-random sorting of low-income children into Head Start, such that the Head Start coefficient is no longer statistically significant.

The final model, which includes both child and family covariates and quality measures, shows no statistically significant differences among formal care arrangements. While quality differences explain most of the outcome gaps between formal and informal participants, children's background characteristics explain most of the differences across types within formal care, particularly when comparing Head Start and centers. The models for math follow the same pattern, though a positive and statistically significant association between pre-kindergarten and math scores is still evident in the full model. Results are stable across a number of specification checks (e.g., controlling for multiple care arrangements, using propensity score matching).

In Table 6 we present a final set of models that examine whether specific sets of quality measures are particularly influential in driving results. Overall, it does not appear that one set of quality measures dominates. Each group partially mediates the association between sector and child outcomes. For reference, Columns 1 and 6 in Table 6 simply replicate Columns 2 and 4 from Table 5. In Columns 2 through 5, we add one set of quality covariates at a time. When we exclude all measures of quality, the association between informal care and child outcomes is -0.2 standard deviations. While including each set of quality covariates reduces the coefficient on

informal care somewhat, in all four cases, that coefficient is still statistically significant and ranges in magnitude from -0.13 standard deviations (when accounting for caregiver characteristics) to -0.18 (when accounting for safety). In contrast, when we include the full set of quality measures, the coefficient drops to -0.07 and is not statistically significant. For brevity, we present results only for reading, but math results are similar (and available upon request).

Tables 5 and 6 do not include observational measures of quality, which are only available for a subsample of the ECLS-B. When we included these measures in specification checks, results indicated that observational measures did not make a substantive difference and that these measures alone did little to mediate the relationship between sector and child outcomes.

Discussion

Differences in quality by sector

Existing research provides evidence that the type of non-parental care children experience matters for their developmental outcomes. This study replicates this finding and assesses the role of quality differences across sectors in these differences. We find, as have earlier studies, that ECEC quality – whether basic safety conditions, structural measures of quality such as caregiver education levels, caregiver-reported measures of classroom practices, or directly observed classroom quality – is systematically higher in formal settings. These quality differences further predict the developmental disparities across children in different sectors.

Our analysis leverages a large, nationally representative dataset with multiple measures of quality and thus provides a more comprehensive examination than has been previously possible. Notably, our sample size allows us to disaggregate patterns both by child age and by arrangement types within sectors. Across both toddler and preschool programs, formal programs rate higher on almost all quality measures. Moreover, we find significant differences between the

formal programs serving two-year-olds and those serving four-year-old children. For instance, caregivers of two-year-olds turn over at higher rates and are 35 percentage points less likely to hold a degree in early childhood education. We also show that within the formal sector, Head Start and pre-kindergarten provide higher quality care than childcare centers, though differences in quality within the formal sector are dwarfed by much larger between-sector differences.

None of our key findings about quality differences are explained by differences across sectors in the demographic characteristics of enrolled children. Although there are substantial differences by race and SES in care utilization patterns, accounting for these factors, as well as an extensive set of other covariates, has nearly no impact on the quality disparities.

Sector quality differences as mediators

While the quality differences we document are striking, their importance depends on the extent to which they affect children's development. Using a set of models predicting children's reading and math outcomes at age five based on age four ECEC sector and an extensive set of child and family covariates, we find that children who participated in formal ECEC scored higher on assessments relative to peers in informal care – by about a fifth of a standard deviation in reading and 0.14 standard deviations in math – even after accounting for an extensive set of covariates. These gaps are sizable and *larger* than gaps between children in center-based care and those cared for solely by their parents (Loeb et al., 2007).

This relationship between sector and children's early academic outcomes is mediated by quality. After accounting for quality measures, the "informal care" coefficient is reduced to less than half its initial magnitude and is no longer statistically significant. No single set of quality measures is responsible for this mediating role. Including all quality measures reduces the magnitude of the sector coefficient far more than including any individual set independently.

This finding, that provider-reported measures of quality explain a substantial portion of the difference in child outcomes, is intriguing, especially in light of a number of recent studies that have raised concerns about the lack of association between measures of ECEC quality and children's development (Burchinal, Kainz, & Cai, 2011; Mashburn et al., 2008; Sabol, Hong, Pianta, & Burchinal, 2013; Sabol & Pianta, 2014). One likely explanation for the difference between our results and those of earlier studies is that most existing studies analyze data *within* one sector or even within one arrangement type within a sector. Sabol and colleagues (2013) examine the link between various quality indices and child outcomes within a sample of children enrolled in state pre-kindergarten programs. Similarly, Colwell and colleagues (2013), who investigate associations between the Arnett Caregiver Interaction Scale and child outcomes, limit their samples to toddlers in home-based care and to preschoolers in center-based care. In such contexts, variation in quality is not nearly as pronounced as when comparing experiences *between* the formal and informal sectors. In the current analysis, the inclusion of quality measures in models limited to the formal sector care yielded much smaller changes. In other words, our results are consistent with earlier findings that *within the formal sector* quality indices fail to account for differences in outcomes across types.

This study is most similar to Abner and colleagues (2013), which also used the ECLS-B to explore the mediating role of quality in explaining the association between care sector and child outcomes. While our analysis uses an extensive set of quality measures, Abner and colleagues focus specifically on the mediating role of widely used observational measures. That study, like ours, finds little evidence of a mediating role for these particular observational measures. The discrepancy between our study and theirs is *not* driven by differences in sample, as our results continue to hold when limited to the sub-sample of children with observational

measures. In one specification check we replicate their finding that observational measures *alone* do little to mediate the relationship between sector and child outcomes. It is worth noting that correlations between observational quality and the other measures of quality used in this study are very low and never exceed 0.4, suggesting that the quality measures examined in the current study may be tapping other aspects of quality not measured through the observational tools.

Study limitations

The ECLS-B data and our analyses are not without limitations. First, the data include extensive but imperfect quality measures. Most of the measures are self-reported and may suffer from self-report bias. The observational measures available, while used extensively, have been criticized for their low associations with child outcomes and for limitations in capturing quality, particularly in kith and kin settings (Colwell et al., 2013; Sabol & Pianta, 2014). Non-response in quality measures, explained primarily by parents not granting data collectors permission or by providers failing to complete interviews, is another concern. Although we use survey weights, our results may not fully account for differences between respondents and non-respondents.

Our study also did not address several natural extensions. For instance, we only considered academic outcomes, but informal programs may hold the comparative advantage with respect to other important outcomes. Further, due to data limitations, we could not account for "combinations of quality" experienced through multiple care settings or intensity of exposure (e.g., age at entry or hours per week), and we could not assess the role of quality as mediator among toddlers. Existing research highlights the importance of multiple arrangements and care intensity and also suggests that the relative benefits of formal settings over informal settings may depend on children's age (Coley et al., 2013; Gordon, Colaner, Usdansky, & Melgar, 2013). Expanding the current analysis to address these issues would therefore be illuminating.

Finally, although this study leverages the most current, nationally representative data available, the children included in the ECLS-B were in toddler care more than a decade ago. Over this decade, the ECEC landscape has changed substantially, with heightened federal, state, and local interest both in expanded access to early childhood opportunities and in improved quality. Replicating the current analysis with more recent data to examine how the patterns we document have changed over time would be beneficial. Unfortunately, such rich and comprehensive data are not available for more recent years.

Newly released findings from the National Survey of Early Care and Education, a set of nationally representative surveys conducted in 2012 to describe the entire ECEC landscape including both formal and informal providers, suggest that today's ECCE landscape is similar to the landscape described through the ECLS-B, at least with respect to caregiver characteristics (National Survey of Early Care and Education Project Team, 2013). As an example, our study highlights substantial between and within sector variation in teacher education. Although the NSECE considers somewhat different measures than those considered here, it suggests similar gaps. In 2012, 53 percent of teachers working in the formal sector held some college degree (though not necessarily focused on early childhood) compared to 30 percent of home-based providers. Similar to the current study, educational attainment in the NSECE varied by program types *within* the formal sector, with school-sponsored centers and Head Start programs employing more highly educated teachers than other centers. Finally, in the current study we noted substantial differences between the teachers in toddler classes and those in preschool classrooms. The NSECE data echoes these results showing that in 2012, 62 percent of teachers serving three-to-five year old children held a college degree, compared to 36 percent of teachers working with younger children. Although both overall ECEC quality and disparities in quality

between and within sectors may have changed over the past decade, findings from the NSECE suggest that, at least with respect to labor force characteristics, large gaps remain.

Policy Implications and Conclusion

In 2012, 47 percent of three- to five-year-old children not yet in kindergarten experienced regular home-based care from relatives or non-relatives (Mamedova & Redford, 2013). Among infants and toddlers (age one or two), 80 percent received such informal care. A growing body of research finds that children enrolled in informal ECEC programs underperform their peers enrolled in formal settings. Our study corroborates these findings and documents that the formal sector offers higher quality care across a wide variety of program and caregiver measures. Given the widespread use of informal care, policy efforts to ensure their quality may have benefits.

Several concrete policy implications emerge from this study. First, because quality differences mirror cross-sector differences in regulation stringency, government intervention in the form of more highly regulated infant, toddler, and home-based care may meaningfully impact the quality of care available to young children. Federal Early Head Start-Child Care Partnerships offer a promising avenue for indirectly regulating the quality of infant and toddler care.

Second, because many families select informal, home-based settings due to the lack of availability, cost or timing (not aligning with job hours) of formal care, programs that ameliorate these issues by expanding access to flexible, affordable, formal arrangements may yield important benefits. Furthermore, policies aimed at building cohesion across sectors by coordinating services and funding streams through centralized eligibility determination may provide families with higher quality while still meeting parents' need for flexible care. Finally, our results highlight a potential role for informational interventions. Existing research shows that although most parents wish to enroll their child in safe, warm, and engaging ECEC,

they tend to be ill-equipped atdiscerning quality. For instance, Raikes, Torquati, Wang, and

Shjegstad (2012) show that 74 percent of parents give their child's provider an overall rating of

either "perfect" or "excellent." Mocan (2007) maintains that parents, particularly those with

lower levels of education, systematically over-estimate care quality and suggests the provision of

information as a potential policy solution for addressing this "information asymmetry." The K-

12 literature shows that providing parents with simple information about school quality leads to

changes in school choice and improvements in child outcomes (Hastings & Weinstein, 2008).

Our findings point to the potential power of providing parents with quality indices, combining

information from multiple measures, *specifically in contexts where there is substantial variation*

across settings in quality as there is between formal and informal care.

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Table 1. Characteristics of Programs Serving Four-Year-Olds, by Arrangement

	Non-Parental Care		Formal Arrangements			Informal Arrangements	
Variable	Formal Sector	Informal Sector	Centers	Head Start	Pre-K	FCC Homes	Other Care
Child:Teacher Ratio	7.14	3.00 ***	6.73	7.24 **	7.54 ***	4.32 ***	2.02 ***
	(3.63)	(2.33)	(3.59)	(2.87)	(3.88)	(2.82)	(1.16)
Caregiver characteristics							
Turnover	16%		17%	15% *	15% **		
	(0.19)		(0.20)	(0.19)	(0.19)		
Caregiver Age	40.67	47.54 ***	40.60	41.30	40.50	44.37 ***	49.86 ***
	(11.16)	(14.88)	(11.43)	(10.74)	(11.02)	(12.74)	(15.88)
Caregiver Education (Years)	15.03	11.68 ***	14.70	14.62	15.57 ***	12.05 ***	11.40 ***
	(2.06)	(3.15)	(2.05)	(1.80)	(2.06)	(3.19)	(3.09)
Caregiver has ECE Degree	56%	9% ***	50%	57% *	62% ***	13% ***	6% ***
Caregiver Pre-Service ECE Courses (Number)	1.85	0.58 ***	1.77	2.40 **	1.72	0.97 ***	0.30 ***
	(3.66)	(1.91)	(3.51)	(4.17)	(3.58)	(2.46)	(1.29)
Caregiver Participates in Ongoing Training	80%	16% ***	78%	88% ***	78%	32% ***	4% ***
Caregiver has CDA	31%	5% ***	26%	58% ***	25%	9% ***	3% ***
Caregiver Experience (Years)	13.29	10.38 ***	13.26	14.37 *	12.90	11.45 **	9.59 ***
	(8.71)	(9.99)	(8.80)	(9.11)	(8.42)	(9.63)	(10.19)
High teacher composite	37%	2% ***	32%	30%	46% ***	3% ***	1% ***
Low teacher composite	2%	51% ***	3%	0% ***	1% **	39% ***	60% ***
Safety							
One Working Smoke Detector Always Available	93%	95%	94%	95%	91% **	96%	94%
One First Aid Kit Always Available	99%	89% ***	100%	100%	97% ***	94% ***	85% ***
All Open Electrical Outlets Always Covered	88%	61% ***	91%	97% ***	81% ***	79% ***	48% ***
Activities & Curriculum							
Caregiver Reads Books (Times/Week)	7.16	3.99 ***	6.44	7.98 ***	7.63 ***	4.40 ***	3.69 ***
	(4.93)	(3.28)	(4.74)	(4.77)	(5.11)	(3.64)	(2.96)
Television (Hours/Day)	0.11	1.84 ***	0.14	0.07 *	0.10	1.56 ***	2.04 ***

	(0.55)	(1.50)	(0.48)	(0.54)	(0.61)	(1.57)	(1.41)
Conduct Reading Activities Every Day	93%	68% ***	89%	97% ***	96% ***	75% ***	64% ***
Conduct Math Activities Every Day	93%	60% ***	89%	96% ***	95% ***	65% ***	57% ***
Computer Available	66%	47% ***	56%	88% ***	69% ***	43% ***	50% *
Number of Times Games or Puzzles are Played per Week	4.59	3.61 ***	4.17	5.22 ***	4.82 ***	3.80 +	3.46 ***
Follow a Written Curriculum	87%		83%	96% ***	88% **		
More than One Hour/Day Spent on Whole Class Activities	28%		30%	23% **	28%		
More than One Hour/Day Spent on Child Selected Activities	33%		34%	37%	31%		
Observational measures							
ECERS/FDCRS Overall Mean Score	4.53	3.36 ***	4.43	4.85 ***	4.50	3.37 ***	3.35 ***
	(1.07)	(1.07)	(1.14)	(0.83)	(1.06)	(1.04)	(1.09)
Arnett Lead Caregiver Total Score	64.73	59.58 ***	64.40	65.09	64.90	59.21 **	59.85 **
	(11.56)	(12.41)	(12.08)	(10.86)	(11.31)	(11.79)	(12.89)
N (Minimum)	1400	350	550	400	500	150	200

*Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Caregivers serving four year olds are designated as "High" on the teacher characteristic composite if s/he holds a BA or higher in ECEC and participates in ongoing training. They are designated as "Low" on the teacher characteristic composite if s/he does not hold a CDA, ECEC degree, or pre-service ECEC coursework; has education of 12 years or less; and does not participate in ongoing training. Turnover is defined as the number of caregivers who left in the past 12 months divided by the sum of full-time and part-time caregivers working in the program. This measure relies on responses from center directors and thus is only available for formal sector arrangements. All estimates are weighted by the appropriate ECLS-B sample weights. Sample sizes are rounded to the nearest 50 in accordance with NCES requirements.*

Table 2. Characteristics of Programs Serving Two-Year-Olds, by Arrangement

	Variable	Centers	FCC Homes	Other Care
	Child:Teacher Ratio	4.07	4.36 *	2.00 ***
		(2.28)	(2.48)	(1.37)
Caregiver characteristics				
	Turnover	21%		
	Caregiver Age	35.27	43.73 ***	47.94 ***
		(11.39)	(12.14)	(15.70)
	Caregiver Education (Years)	13.00	12.03 ***	11.58 ***
		(1.72)	(2.78)	(3.00)
	Caregiver has ECE Degree (%)	21%	11% ***	10% ***
	Caregiver has Completed	25%	16% ***	7% ***
	Pre-Service ECE Courses (%)	(0.43)	(0.37)	(0.25)
	Caregiver Participates in Ongoing Training (%)	86%	43% ***	12% ***
	Caregiver has CDA (%)	21%	5% ***	2% ***
	Caregiver Experience (Years)	8.80	11.06 ***	9.16
		(7.32)	(9.79)	(10.08)
	High teacher characteristic composite	51%	21% ***	7% ***
	Low teacher characteristic composite	3%	34% ***	56% ***
Safety				
	One working smoke detector always available (%)	96%	96%	91% ***
	One first aid kit always available (%)	99%	91% ***	84% ***
	All open electrical outlets always covered	98%	80% ***	68% ***
Activities & Curriculum				
	Caregiver Reads Books (Every Day) (%)	91%	60% ***	51% ***
	Television (Hours/Day)	0.20	1.36 ***	1.95 ***
		(0.51)	(1.22)	(1.65)
	Go for a Walk or Play Outside Every Day (%)	84%	66% ***	62% ***
	Visited a Zoo, Aquarium, or Petting Farm in the Last Month (%)	4%	9% **	18% ***
	Visited a Library in the Last Month (%)	8%	15% ***	16% ***
Observational measures				
	ITERS/FDCRS Overall Mean Score	4.25	3.54 ***	3.38 ***
		(0.99)	(0.99)	(1.04)
	Arnett Lead Caregiver Total Score	61.91	61.16	61.22
		(9.88)	(10.89)	(10.54)
	N (Minimum)	600	350	400

*Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Caregivers serving two year olds are designated as "High" on the teacher characteristic composite if s/he holds a CDA, other ECE degree, or has pre-service ECEC coursework and who participates in ongoing training. They are designated as "Low" on the teacher characteristic composite if s/he does not hold a CDA, ECEC degree, or pre-service ECEC coursework; has education of 12 years or less; and does not participate in ongoing training. Turnover is defined as the number of caregivers who left in the past 12 months divided by the sum of full-time and part-time caregivers working in the program. This measure relies on responses from center directors and thus is only available for formal sector arrangements. All estimates are weighted by the appropriate ECLS-B sample weights. Sample sizes are rounded to the nearest 50 in accordance with NCES requirements.*

Table 3. Associations between Sector and Quality; Comparing Formal Care to FCC Homes and other Informal Care Arrangements

	Caregiver Reads Books (Every Day) OLS Specification				Child:Teacher Ratio OLS Specification				High Quality Teacher Logit Specification				Television (Hours/Day) OLS Specification				ECERS/ITERS/FDCRS Overall Mean Score OLS Specification			
	(1)		(2)		(1)		(2)		(1)		(2)		(1)		(2)		(1)		(2)	
Age 4																				
FCC Homes	-2.76	***	-2.98	***	-2.81	***	-2.66	***	0.06	***	0.07	***	1.45	***	1.42	***	-1.16	***	-1.03	
	(0.23)		(0.23)		(0.17)		(0.17)		(0.02)		(0.02)		(0.09)		(0.09)		(0.12)		(0.12)	
Other Care	-3.46	***	-3.58	***	-5.11	***	-5.02	***	0.02	***	0.02	***	1.93	***	1.88	***	-1.18	***	-1.07	
	(0.18)		(0.19)		(0.09)		(0.10)		(0.01)		(0.01)		(0.07)		(0.07)		(0.12)		(0.12)	
N	5800		5800		5800		5800		6000		6000		5750		5750		1750		1750	
Child & Family Covariates			X				X				X				X				X	
	Logit specification				OLS Specification				OLS Specification				OLS Specification				OLS Specification			
Age 2	(1)		(2)		(1)		(2)		(1)		(2)		(1)		(2)		(1)		(2)	
FCC Homes	0.15	***	0.16	***	0.29	*	0.35	*	0.26	***	0.28	***	1.16	***	1.03	***	-0.7	***	-0.68	***
	(0.03)		(0.03)		(0.15)		(0.15)		(0.04)		(0.04)		(0.06)		(0.06)		(0.08)		(0.08)	
Other Care	0.11	***	0.12	***	-2.07	***	-1.94	***	0.07	***	0.07	***	1.75	***	1.6	***	-0.86	***	-0.74	***
	(0.02)		(0.02)		(0.12)		(0.13)		(0.01)		(0.01)		(0.07)		(0.07)		(0.08)		(0.08)	
N	3150		3150		3200		3200		3250		3250		3150		3150		1400		1400	
Child & Family Covariates			X				X				X				X				X	

*Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Formal care is the excluded reference category. In the 4-year-old wave, a "High Quality Teacher" has a BA or higher in ECEC and participates in ongoing training. In the 2-year-old wave, a "High Quality Teacher" is defined as one with a CDA, other ECE degree, or some pre-service ECEC coursework who participates in ongoing training. All regressions include controls for the child's age at assessment and month of assessment, gender, race, income, birth weight, current weight and height, number of children in the home, maternal employment status, highest level of parents' education, primary language spoken in the home, WIC receipt, a set of home practices including daily reading, television exposure, frequency of joint family meals, and parent discipline practices), as well as urbanicity and census region. All estimates are weighted by the appropriate ECLS-B sample weights. Sample sizes are rounded to the nearest 50 in accordance with NCES requirements.*

Table 4. Associations between Formal Care Types and Quality; Comparing Center-based Care to Head Start and Pre-K

	Caregiver Reads Books (Every Day) OLS Specification		Child:Teacher Ratio OLS Specification		High Quality Teacher Logit Specification		Television (Hours/Day) OLS Specification		ECERS/FDCRS Overall Mean Score OLS Specification	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Age 4										
Head Start	1.53 ***	0.91 **	0.52 **	0.47 *	0.91	0.83	-0.06 *	-0.11 **	0.42 ***	0.6 ***
	(0.30)	(0.33)	(0.18)	(0.21)	(0.12)	(0.12)	(0.03)	(0.04)	(0.10)	(0.10)
Pre-K	1.19 ***	1.1 ***	0.82 ***	0.77 ***	1.79 ***	1.8 ***	-0.03	-0.04	0.07	0.08
	(0.22)	(0.22)	(0.17)	(0.17)	(0.17)	(0.18)	(0.03)	(0.04)	(0.12)	(0.10)
N	4400	4400	4400	4400	4600	4600	4400	4400	1400	1400
Child & Family Covariates		X		X		X		X		X

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Center-based care options are the excluded reference category. In the 4-year-old wave, a "High Quality Teacher" has a BA or higher in ECEC and participates in ongoing training. All regressions include controls for the child's age at assessment and month of assessment, gender, race, income, birth weight, current weight and height, number of children in the home, maternal employment status, highest level of parents' education, primary language spoken in the home, WIC receipt, a set of home practices including daily reading, television exposure, frequency of joint family meals, and parent discipline practices), as well as urbanicity and census region. All estimates are weighted by the appropriate ECLS-B sample weights. Sample sizes are rounded to the nearest 50 in accordance with NCES requirements.

Table 5. Associations between Age 4 ECEC Type, Quality Measures and Age 5 Outcomes (Excludes Observational Measures)

Panel A. Comparing the Informal and Formal ECEC Sectors
(Formal sector is reference category)

	Reading				Math			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Informal Care	-2.72 ***	-2.00 ***	-0.86	-0.72	-2.01 ***	-1.35 ***	-0.72	-0.67
	(0.44)	(0.41)	(0.75)	(0.70)	(0.42)	(0.40)	(0.76)	(0.70)
Observations	3800	3800	3800	3800	3800	3800	3800	3800
Age 2 Pre-Score/Age at Assessment	X	X	X	X	X	X	X	X
Child & Family Covariates		X		X		X		X
Quality Measures			X	X			X	X

Panel B. Comparing within Formal ECEC Arrangements
(Center care is reference category)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Head Start	-3.81 ***	-0.60	-3.79 ***	-0.78	-3.29 ***	0.35	-2.94 ***	0.33
	(0.60)	(0.61)	(0.63)	(0.64)	(0.59)	(0.61)	(0.60)	(0.62)
Pre-Kindergarten	0.93 *	0.88 *	0.79	0.72	0.73	0.86 *	0.81 +	0.87 +
	(0.47)	(0.43)	(0.50)	(0.47)	(0.45)	(0.41)	(0.48)	(0.44)
Observations	2750	2750	2750	2750	2750	2750	2750	2750
Age 2 Pre-Score/Age at Assessment	X	X	X	X	X	X	X	X
Child & Family Covariates		X		X		X		X
Quality Measures			X	X			X	X

*Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. In models shown in panel A, the sample includes all children in non-parental care and children in any form of formal care are the reference category. For all models shown in panel B, the sample includes all children in formal ECEC and children in center-based care are the reference category. All regressions include controls for children's cognitive score at age 2 as well as their age at assessment and month of assessment during the Wave 4 data collection. Models also include gender, race, income, birth weight, current weight and height, number of children in the home, maternal employment status, highest level of parents' education, primary language spoken in the home, WIC receipt, a set of home practices including daily reading, television exposure, frequency of joint family meals, and parent discipline practices), as well as urbanicity and census region. Models that include quality measures add in all measures of observed quality as presented in Table 2 (excluding the teacher quality composites due to multicollinearity and the observational measures of quality to maintain sample size). All estimates are weighted by the appropriate ECLS-B sample weights. Sample sizes are rounded to the nearest 50 in accordance with NCES requirements.*

Table 6. Associations between Age 4 ECEC Type, Sets of Quality Measures, and Age 5 Reading Outcomes (Excludes Observational Measures)

	Panel A. Comparing the Informal and Formal ECEC Sectors					
	(Formal sector is reference category)					
	(1)	(2)	(3)	(4)	(5)	(6)
Informal Care	-2.00 ***	-1.57 ***	-1.26 *	-1.84 ***	-1.64 **	-0.72
	-0.41	(0.46)	(0.59)	(0.44)	(0.57)	-0.7
Observations	3800	3800	3800	3800	3800	3800
Age 2 Pre-Score/Age at Assessment	X	X	X	X	X	X
Child:Teacher Ratio		X				
Caregiver Characteristics			X			
Safety				X		
Activities and Curriculum					X	
All Quality Measures						X
Child & Family Covariates	X	X	X	X	X	X

	Panel B. Comparing within Formal ECEC Arrangements					
	(Center care is reference category)					
	(1)	(2)	(3)	(4)	(5)	(6)
Head Start	-0.60	-0.68	-0.77	-0.64	-0.49	-0.78
	(0.61)	(0.61)	(0.62)	(0.61)	(0.64)	(0.64)
Pre-Kindergarten	0.88 *	0.79 +	0.75 +	0.92 *	0.92 *	0.72
	(0.43)	(0.43)	(0.45)	(0.44)	(0.45)	(0.47)
Observations	2750	2750	2750	2750	2750	2750
Age 2 Pre-Score/Age at Assessment	X	X	X	X	X	X
Child:Teacher Ratio		X				
Caregiver Characteristics			X			
Safety				X		
Activities and Curriculum					X	
All Quality Measures						X
Child & Family Covariates	X	X	X	X	X	X

Notes: + $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$. In models shown in panel A, the sample includes all children in non-parental care and children in any form of formal care are the reference category. For all models shown in panel B, the sample includes all children in formal ECEC and children in center-based care are the reference category. All regressions include controls for children's cognitive score at age 2 as well as their age at assessment and month of assessment during the Wave 4(age 5) data collection. Models also include gender, race, income, birth weight, current weight and height, number of children in the home, maternal employment status, highest level of parents' education, primary language spoken in the home, WIC receipt, a set of home practices including daily reading, television exposure, frequency of joint family meals, and parent discipline practices), as well as urbanicity and census region. Models that include quality measures add in all measures of quality as presented in Table 2 (excluding the teacher quality composites due to multicollinearity and the observational measures of quality to maintain sample size). All estimates are weighted by the appropriate ECLS-B sample weights. Sample sizes are rounded to the nearest 50 in accordance with NCES requirements.