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Preschool Center Quality and School Readiness: Quality Effects and Variation by Demographic and Child Characteristics

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This article examines associations between observed quality in preschool center classrooms for approximately 6,250 three- to five-year-olds and their school readiness skills at kindergarten entry. Secondary analyses were conducted using data from four large-scale studies to estimate the effects of preschool center quality and interactions between quality and demographic characteristics and child entry skills and behaviors. Findings were summarized across studies using meta-analytic methods. Results indicate small, but statistically significant associations for preschool center quality main effects on language and mathematics outcomes with little evidence of moderation by demographic characteristics or child entry skills and behaviors. Preschool center quality was not reliably related to socioemotional outcomes. The authors discuss possible explanations for the small effect sizes and lack of differential effects.

This article examines associations between the child-care center quality experienced by preschool-aged children (3–5 years old) and the school readiness skills of these children at kindergarten entry, and asks whether those associations are moderated by either demographic characteristics or the child's entry skills and behaviors. School readiness encompasses physical, cognitive, language, and behavioral aspects of development (Kagan, Moore, & Bredekamp, 1995). This study examines the following school readiness outcomes: language, mathematics, social skills, and externalizing problem behaviors using data from four large multisite child-care studies.

Children typically spend many hours in child-care settings during early childhood (Pianta, Burchinal, Barnett, & Thornburg, 2009) and the quality of those settings is thought to be an important factor in young children's development (Lamb & Ahnert, 2006). High-quality settings for 3- to 5-year-olds include frequent warm and stimulating interactions between caregivers and children and clear intentional instruction (Pianta et al., 2009). Several child-care quality assessment tools have been developed and are widely accepted. As measured by these instruments, child-care quality is often positively associated with child outcomes, but estimated effects range from very small to moderate depending on the study (Burchinal, Kainz, & Cai, 2011; Camilli, Vargas, Ryan, & Barnett, 2010; Pianta et al., 2009; Vandell, 2007).

Whether child-care quality is related to developmental outcomes differently for children with risk factors is an important policy question. Both federal and state governments invest heavily in providing (presumably high-quality) child care as a means to improve school readiness skills for children from economically disadvantaged families. However, there is mixed support in the literature for the notion that high-quality child care is more beneficial for particular subgroups of children.

The goals of this article are to examine the magnitude of preschool center quality main effects and the existence of moderators of these effects by providing integrated analyses across four large-scale

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child-care studies. Our two research questions are as follows: (a) to what extent are children's school readiness skills higher when they experience higher quality preschools, and (b) do the effects of preschool center quality on school readiness skills differ by child demographic background or child entry characteristics such as cognitive skills, attention skills, and problem behaviors? Our examination of child entry skill levels and behaviors as potential moderators of child-care quality effects may be of particular interest to the field due to the lack of prior research in this area.

Developmental Perspectives on Child-Care Quality

Our understanding of early childhood development is rooted in several complementary theoretical perspectives. A central proposition of bioecological (Bronfenbrenner & Morris, 2006) and life course theory (Elder, 1996) is that experiences provide the basis for development and early experiences can lay the foundation for later development. Prior studies highlight the importance of early childhood for brain development (Knudsen, Heckman, Cameron, & Shonkoff, 2006; Sapolsky, 2004) and subsequent academic and social development (Shonkoff & Phillips, 2000). Economic models of human capital development suggest the cumulative role of cognitive and socioemotional skills, as well as skill investments made by families, preschool programs, and schools in producing human capital (e.g., Cunha, Heckman, Lochner, & Masterov, 2006).

The literature on child-care quality and outcomes provides empirical evidence for these theories. The experimental literature suggests that higher quality care can have a lasting impact on development when that care begins during the early childhood years (Belfield, Nores, Barnett, & Schweinhart, 2005; Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001). The observational literature also suggests modest but relatively consistent evidence that higher quality child care is related to improved cognitive and social development (Burchinal et al., 2011; Peisner-Feinberg et al., 2001; Vandell, 2007; Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010). There is some, albeit mixed, evidence of "active range" thresholds in which gains in outcomes are larger at higher levels of quality (Burchinal, Vandergrift, Pianta, & Mashburn, 2009; Vandell et al., 2010). In recent analyses that combined results across five early child-care studies (Burchinal et al., 2011), children in lower quality care had lower outcomes than children in higher quality care, but the nonlinear association between quality and outcomes was only observed in higher quality care and with mostly instructional (rather than emotional) support quality measures.

Magnitude of Child-Care Quality Main Effects

The magnitude of associations between child-care quality and school readiness skills vary, depending on the study and the domain of development examined. Prior large-scale observational studies that did not involve random assignment to early child-care conditions (i.e., quasi-experiments) and that included larger and more representative samples than experimental studies, provide some evidence of associations between higher quality child care and positive, particularly cognitive, child outcomes (Burchinal & Cryer, 2003; Burchinal et al., 2011; Gormley, Gayer, Phillips, & Dawson, 2005; Howes et al., 2008; Mashburn et al., 2008; National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 2000, 2002, 2006; NICHD Early Child Care Research Network & Duncan, 2003; Peisner-Feinberg & Burchinal, 1997; Peisner-Feinberg et al., 2001; Reynolds, Temple, Robertson, & Mann, 2002; Vandell et al., 2010; Votruba-Drzal, Coley, & Chase-Lansdale, 2004).The effect sizes in these studies vary, with larger effects observed in studies with the greatest range in the quality of settings observed, as in the cost, quality, and child outcomes study (Peisner-Feinberg & Burchinal, 1997) and the NICHD SECCYD (NICHD Early Child Care Research Network, 2003, 2006).

Research on the effects of nonmaternal child care on children's socioemotional development has produced mixed results. On one hand, some research suggests that for some children, care outside the home can be disadvantageous to their social development (Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007; NICHD Early Child Care Research Network, 2002, 2003). On the other hand, some research suggests that child-care programs can benefit children's socioemotional development, especially when quality is high and among children from low-income families (Votruba-Drzal et al., 2004). There is research that suggests that nonmaternal child care may benefit low-income children's social development by compensating for the negative behavioral effects children receive from being raised in a low-quality home environment (Watamura, Phillips, Morrissey, McCartney, & Bub, 2011).

Of particular interest are prior findings regarding the links between child-care quality and school readiness outcomes that have resulted from analyses of the four studies analyzed in the current

study: the NICHD Study of Early Child Care and Youth Development (SECCYD), the Early Childhood Longitudinal Study–Birth Cohort (ECLS–B), the National Center for Early Development and Learning (NCEDL) 11-state prekindergarten evaluation, and the Early Head Start (EHS) study. Of the four, the NICHD SECCYD has been most often analyzed. The prevailing finding from these analyses is that the quality of care is consistently but modestly related to improved cognitive and language outcomes at 15, 24, 36, and 54 months, even after controlling for multiple child and family characteristics (NICHD Early Child Care Research Network, 2000, 2002, 2006; NICHD Early Child Care Research Network & Duncan, 2003). The NCEDL 11-state evaluation of prekindergarten programs also reported modest associations between quality and various child outcomes (Burchinal et al., 2008; Burchinal et al., 2009; Howes et al., 2008; Mashburn et al., 2008). Research using the ECLS-B and EHS studies has shown positive impacts on child outcomes of both non-maternal early childhood education program participation (Bassok, 2010) and higher quality child-care centers (Love et al., 2003; Love et al., 2005).

A recent meta-analysis of the published literature examining the association between child-care quality and child cognitive, academic, and socioemotional outcomes yielded a modest, albeit statistically significant, partial correlation of $r = .12$ (Burchinal et al., 2011). Burchinal et al. (2011) found stronger associations for language and academic outcomes than for socioemotional outcomes, and for outcome measures that were more closely aligned with the measures of child-care quality. Their reanalyses focused on the association between child-care quality and child outcomes among low-income children only, whereas this study includes all children in center-based care during the preschool period. Also, their study did not examine moderators. Along with examining demographic moderators, a contribution of our study to the child-care quality field is inclusion of *child entry skills and behaviors* as possible moderators of associations between observed child-care quality and child outcomes.

Existence of Child-Care Quality Moderators

Prior research yields little consensus on the existence of variables that moderate the effects of child-care quality on child outcomes. When moderators have been examined, the focus has been on demographic moderators such as race or ethnicity, gender, and socioeconomic status. Most studies of the NICHD SECCYD report main effects, but find few moderating effects (Vandell, 2007). Similarly, analyses of three large child-care studies not only found that child-care quality was related to development for all children but also found at best limited evidence that this effect was larger for at-risk children (Burchinal, Peisner-Feinberg, Bryant, & Clifford, 2000).

Researchers have postulated competing hypotheses regarding differential effects of child-care programs on child outcomes. Especially relevant to children's participation in high-quality early education programs is the *compensatory hypothesis* (Sameroff & Chandler, 1975), which predicts that children who are at risk because of their particular race or ethnicity or gender, or who are at risk because of economic disadvantage, low skills, or difficult temperaments are likely to derive greater benefits from high-quality early education programs relative to children who are not at risk. This hypothesis provides the rationale for the continued funding of programs such as Head Start. Alternatively, the *accumulated advantages* and *skill begets skill hypotheses* (also sometimes referred to as the Matthew effect—*the rich get richer*) posits that children who are more advantaged due to family or neighborhood circumstances or who have greater initial individual abilities will derive greater benefits from high-quality early education programs than their less advantaged peers because of their ability to build on these advantage or skills (Cunha et al., 2006). To examine these competing hypotheses, we test interactions between preschool center quality and three demographic characteristics (race or ethnicity, gender, maternal education) as well as between preschool center quality and three child entry characteristics (cognitive skills, attention skills, and externalizing problem behaviors).

Demographic Characteristics

We examined three demographic moderators: race or ethnicity, gender, and socioeconomic status (SES). Regarding race or ethnicity as a moderator, in line with the compensatory (vs. accumulated advantages) hypothesis, stronger child-care effects have been reported for African American and Hispanic children than for White children in an analysis of nationally representative data (Magnuson, Ruhm, & Waldfogel, 2007), an evaluation of a prekindergarten program (Gormley et al., 2005), and a study relating quality to outcomes across three early child-care studies (Burchinal et al., 2000). There is mixed evidence that the effects of early childhood pro-

grams are moderated by child gender. Two studies reported that boys appear to benefit more than girls from child-care experiences (Brooks-Gunn, Han, & Waldfogel, 2002; Votruba-Drzal et al., 2004), while reanalysis of the Abecedarian and Perry Preschool Projects found the opposite (Anderson, 2008). If the effect of high-quality child care is compensatory, boys will profit more than girls because boys tend to be less developmentally advanced than girls, putting them at greater risk for poor educational outcomes (Matthews, Ponitz, & Morrison, 2009). Finally, prior studies have found some support for moderation by maternal education and other measures of SES such as income level or poverty status. The cost, quality, and outcomes study found larger child-care quality effects for children whose mothers had low educational levels (Peisner-Feinberg & Burchinal, 1997; Peisner-Feinberg et al., 2001), and analyses of the NICHD SECCYD suggested that economically disadvantaged children seem to benefit more from better child-care quality (Dearing, McCartney, & Taylor, 2009).

Child Entry Skills and Behaviors

As mentioned earlier, the literature has posited a compensatory hypothesis (Sameroff & Chandler, 1975), in which children with low skills or difficult temperaments are likely to benefit the most from high-quality early education programs. But the opposite hypothesis is generated by the skill begets skill hypothesis, where the productivity of child-care investment is greatest for children with higher initial abilities (Cunha et al., 2006). We were not able to find prior empirical work that examined differential effects of child-care quality on children of varying *entry* skills and behaviors. In this study we test three child entry skills and behaviors as possible moderators of preschool center quality effects: cognitive skills, attention skills, and externalizing problem behaviors. For each of these, we test whether children who are low on the variable experience stronger effects of high-quality child care (compensatory effect) or whether children who are high on the variable experience stronger effects of high-quality child care (skill begets skill).

This Study

This study extends prior work in several ways. First, perhaps for the first time, we examine several child entry skills and behaviors as possible moderators of associations between observed child-care quality and child outcomes. Second, we formally estimate quality main effects and interactions across several of the largest child-care studies. As in a few prior childhood education studies (Burchinal et al., 2011; Duncan et al., 2007; Early et al., 2007), parallel analyses are conducted across multiple studies to ensure that the findings from each study do not differ simply because of modeling differences. Most importantly, we include a final statistical test that formally combines the findings across studies to test our hypotheses. Thus, as in Duncan et al. (2007), we apply meta-analytic techniques to summarize the results of our own secondary analyses of four large-scale studies, each of which had comparable regression models applied to it.

Research Hypotheses

Consistent with the main effects literature outlined earlier, we predicted small positive preschool center quality main effects for all school readiness outcomes. With regard to differential effects, we predicted that in accordance with the compensatory hypothesis, children will benefit more from high-quality preschool programs if they are African American or Hispanic, male children, if their mothers had low levels of education, or if they enter preschool with moderately low cognitive skills, low attention skills, or more externalizing behavior problems. We also examine the accumulated advantages and skill begets skill hypotheses that the opposite is true—that the effects of high-quality preschool programs are weakest for high-risk children and strongest for those children who begin the program with the most productive skills and behaviors.

Method

The four databases analyzed in the study were selected because they are large child-care studies containing the necessary preschool center quality and child outcome measures. Table 1 provides descriptions of these databases.

Sample and Procedure

NICHD Study of Early Child Care and Youth Development

Nonexperimental longitudinal data from the NICHD SECCYD are drawn from a multisite study

Table 1
Descriptions of the Four Studies

	NICHD SECCYD	ECLS-B[a]	NCEDL 11-state	EHS
Sample				
All children in center care	733	1,400[b]	2,995	1,140
Children with observed child-care quality scores	670	543	2,982	676
Number of classrooms	623	543	721	n/a
Year quality & posttest collected	1995–1996	2005–2006	2001 for Multistate study of pre-K and 2004 for SWEEP[c]	2001–2003 (three cohorts)
Population analysis sample represents	Children at the 10 locations across the United States who were in center-based care the year before pre-K	Children born in 2001 who were in center care at 4 years of age for at least 4 months and 10 hr/week	State funded pre-K classrooms and children in 11 participating states	Children who had been in EHS evaluation study as infants or toddlers (includes both treatment & control)
Percent Head Start classroom	9	24	15	45
Mean child (*SD*) age (mos) at pretest assessment	37.68 (0.75)	24.59 (1.41)	55.56[c] (3.84)	37.12 (1.42)
Mean child (*SD*) age (mos) at outcome assessment	56.86 (1.11)	54.37 (4.33)	60.60[c] (3.84)	59.00 (3.64)

Note. NICHD SECCYD = National Institute of Child Health and Human Development Study of Early Child Care and Youth Development; ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; NCEDL = National Center for Early Development and Learning; EHS = Early Head Start.
[a]All *N*s for the ECLS–B are rounded to the nearest 50 per NCES/IES reporting requirements. [b]A random subset of the ECLS–B sample had child-care settings evaluated, and our analyses subsample includes children who meet our $\geq$ 4 month criteria and were in care for at least 10 hr/month. [c]SWEEP = State-Wide Early Education Programs. As with many studies of child-care programs, the NCEDL project was not able to gain access to classrooms during the first month of the year so "fall" test scores were collected in the second and occasionally the third months of the program. The project needed to collect the "spring" assessments prior to the last month because so many special events and graduation events are scheduled for that time.

of births in 1991 (visit http://secc.rti.org/ for more information on NICHD SECCYD or see NICHD Early Child Care Research Network, 2006). Participants were recruited from hospitals located at 10 sites across the United States. Although not nationally representative, the study sample (n = 733, children in center-based child care only) closely matches national and census tract records with respect to demographic variables such as ethnicity and household income. Family, child care, and child characteristics were measured in home- and lab-based assessments when the children were 6, 15, 24, 36, and 54 months. Through observations, interviews, questionnaires, and child assessments, data include repeated assessments of demographic and parental characteristics; quality of parenting; type, amount, and quality of child care; and children's cognitive, academic, and social skills. The study's rich information collected on the child's demographic, home, and care environment allow researchers to control for a host of confounds related to children selecting into different child-care settings.

Early Childhood Longitudinal Study–Birth Cohort

The ECLS–B followed a large, nationally representative sample of children born in 2001 to kindergarten entry (for more information on ECLS–B, visit http://nces.ed.gov/ecls/birth.asp). This study provides detailed information on children's development, health, and learning experiences during the years leading up to school entry. Data were collected from sample children and their parents, as

well as child-care providers and teachers. Children's behavioral, cognitive, social, and physical abilities were directly assessed at 9, 24, and 48 months (preschool), and at kindergarten entry. The base year sample includes about 10,700 infants with data collected from birth certificate records and parent-provided information during the 9-month data collection wave. Data collection continued at 24 and 48 months and ended during the school year in which the child attended kindergarten, with an approximate completed sample size of 8,000. The primary child-care setting was observed for a randomly selected subset of the sample at 24 and 48 months. To address the concern that children in our ECLS–B sample may not have had adequate exposure to preschool to consider its influence, we restrict our ECLS–B analysis sample to children who were in 4 or more months in child-care settings for at least 10 hr/month (n = 1,400 approximately).

National Center for Early Development and Learning

The NCEDL followed nearly 3,000 (n = 2995) children enrolled in 721 pre-K classrooms randomly chosen within selected regions of 11 states with mature pre-K programs (for more information on NCEDL, visit http://fpg.unc.edu/projects/national-center-early-development-learning or see Early et al., 2005). These 11 states served approximately 80% of children in the United States, who attended state pre-K programs in the study years of 2001–2003. The design involved random sampling of 40 pre-K sites in six states during the 2001–2002 school year and 100 sites within an additional five states during 2003–2004. In both periods, within each pre-K site, one classroom was randomly selected to participate, and four children were randomly selected per classroom among children whose parents signed and returned the consent form, were scheduled to enter kindergarten the next year, spoke English or Spanish at home, and did not have an Individualized Education Plan. Children and their classroom experiences were assessed in the fall and spring of the pre-K year for all children and in the fall and spring of the kindergarten year for the first cohort of children.

Early Head Start

Our final study comes from the evaluation of the EHS program (visit http://www.acf.hhs.gov/programs/opre/research/topic/overview/early-head-start for more information). Although the EHS study is based on random assignment into early care, this study uses both treatment and control data on the child care that parents selected for their children between the ages 36 and 60 months (n = 1,140). The control group was a "services as usual group" and could attend whatever was available in the community, including child care that was not provided by the EHS program. In 1996, approximately 3,000 children under 1 year of age from low-income families from 17 sites were randomly assigned to receive EHS services, or to a control group. Treatment ended when the child was 3 years old and children in both groups were followed into kindergarten. Data on children, families, and child-care arrangements were collected when the children were 14, 24, and 36 months old, and in the spring just prior to kindergarten entry in the form of direct assessments of the children, maternal report interviews and questionnaires, and observations of the quality of the home and child-care environments.

Measures

Table 2 describes the key dependent and independent variables in our analyses along with information on when they were measured and their Cronbach's alpha (where available). Table 3 lists descriptive statistics of the key variables of interest in each of the studies. The measures of interest for each of the four studies are described next.

Child-Care Quality Measures

We include in the study the three child-care quality measures described next that assess practices thought to improve children's cognitive, achievement, and socioemotional skills; these include two global quality measures and a measure of instructional quality.

The Early Childhood Environment Rating Scale–Revised (ECERS–R; Harms, Clifford, & Cryer, 1998)—used in the ECLS–B, NCEDL, and EHS studies—is a widely used measure of global classroom quality, specifically designed for use in classrooms serving children between 2½ and 5 years of age. The ECERS–R has been used in numerous studies over the past 25 years and has been shown to correlate with child outcomes (e.g., Peisner-Feinberg et al., 2001). The ECERS–R includes 37 items with six subscales measuring the following: quality of space and furnishings, personal care routines, language and reasoning opportunities, activities, interactions, and program structure. Once in the fall

Table 2
Key Dependent and Independent Variables

	NICHD SECCYD	ECLS–B	NCEDL 11-state	EHS
Outcomes				
Language	Preschool Language Scale–3 (54 mos; α = .89–.92)	ECLS–B literacy (composite of PPVT & other measures; 48 mos; α = .91)	PPVT–III (spring pre-K; α = .92–.98)	PPVT–III (63 mos; α = .92–.98)
Mathematics	WJ–Revised applied problems (54 mos; α = .91)	ECLS–B math (math ECLS-K developed measures; 48 mos; α = .89)	WJ III applied problems (spring pre-K; α = .92–.94)	WJ III applied problems (63 mos; α = .92–.94)
Social skills	California Preschool Social Competency Scale (caregiver rating; 54 mos; α = .86)	ECLS–B social skills (composite created from several items of caregiver rating; 48 mos; 7 items, α = .98)	Teacher–Child Rating Scale—Social Skills (spring pre-K; α = .95)	n/a
Externalizing problem behaviors	CBCL–externalizing problem behaviors only (caregiver rating; 54 mos; α = n/a)	ECLS–B externalizing problem behaviors (composite created from several items; 48 mos; 10 items, α = .98)	Teacher–Child Rating Scale conduct problems subscale (spring pre-K; α = .92)	CBCL aggressive behaviors only (63 mos; α = n/a)
Preschool center quality	ORCE (36, 54 mos; α = .80–.90)	ECERS–R composite (48 mos; α = .92)	ECERS–R composite (α = .90) & CLASS emotional climate (α = .85–.86) & CLASS instructional climate (α = .85–.87; pre-K)	ECERS–R composite (48 mos; α = .92)
Child entry skills & behaviors				
Cognitive skills	Bayley (24 months; α = .83)	BSID–SF (a modified version of the Bayley; 24 mos; α = .80)	PPVT–III (Fall pre-K; α = .92–.98)	Bayley (36 mos; α = .83)
Attention skills	CBCL attention subscale (24 mos; α = n/a)	Bayley Infant Behavior Record (IBR) attention rating (24 mos; 4 items, α = .93)	Teacher–Child Rating Scale task orientation subscale (fall pre-K; α = .95)	Three-bag assessment of sustained attention to objects (36 mos; α = n/a)
Externalizing problem behaviors	CBCL–externalizing problem behaviors only (36 mos; α = .86)	n/a	Teacher–Child Rating Scale conduct problems subscale (fall pre-K; α = .91)	n/a

Note. NICHD SECCYD = National Institute of Child Health and Human Development Study of Early Child Care and Youth Development; ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; NCEDL = National Center for Early Development and Learning; EHS = Early Head Start; PPVT–III = Peabody Picture Vocabulary Test, 3rd edition; WJ = Woodcock–Johnson; CBCL = Child Behavior Checklist; ORCE = Observational Record of the Caregiving Environment; ECERS–R = Early Childhood Environment Rating Scale–Revised; CLASS = Classroom Assessment Scoring System; All reliability coefficients (alphas) are from the measure's authors except for the ECLS–B, in which the externalizing problem behaviors and social skills scales were created using confirmatory factor analysis.

and once in the spring, a trained observer spends several hours observing the classroom on a typical day, noting all aspects of the environment including materials, safety, health, language interactions, discipline, and relationships. Scores on the ECERS–R range from 1 to 7 with 1 = *inadequate*, 3 = *minimal*, 5 = *good*, and 7 = *excellent* quality.

The Observational Record of the Caregiving Environment (ORCE; NICHD Early Child Care Research Network, 2000) was designed specifically

Table 3
Descriptive Statistics

	NICHD SECCYD (Only center care)			ECLS–B[a] (Only center care for ≥4 months, & 10 + hr/month)			NCEDL 11-state (Study is all center care)			EHS (Only center care)		
	N	*M*	*SD*	N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Outcomes												
Preschool language scale	690	101.78	17.84									
Receptive vocabulary measure (i.e., PPVT)				1,300	8.85[c]	1.92	2,435	96.30	14.31	956	92.44	15.29
WJ applied problems	690	104.61	15.21				2,273	99.11	12.85	1,010	89.07	20.09
Math ECLS–K developed measures				1,250	24.29	7.00						
CBCL–externalizing problem behaviors	592	49.41	9.61							1,120	11.03	6.78
ECLS–B externalizing problem behaviors				1,350	.16	.96						
Hightower–conduct problems subscale							2,634	1.57	0.75			
CA preschool social competency scale	583	92.54	12.37									
ECLS–B social skills				1,250	−.06	1.02						
Hightower–social skills scale							2,644	3.64	0.77			
Child entry skills & behaviors												
Cognitive skills	708	93.60	14.38	1,250	127.11	11.10	2,298	94.00	15.02	1,037	91.22	12.62
Attention skills	710	2.99	0.66	1,250	13.62	3.74	2,566	3.52	0.94	1,053	4.89	0.97
Externalizing problem behaviors	402	26.65	18.83				2,571	1.51	0.53			
Observed process quality												
ORCE (36 months)	244	2.74	0.44									
ORCE (54 months)	670	3.04	0.55									
ECERS–R composite				550	4.51	1.10	2,967	3.84	0.81	676	5.25	1.14
CLASS instructional climate							2,927	2.07	0.84			
CLASS emotional climate							2,927	5.56	0.68			
Demographics												
Ethnicity total *N*	733			1,300			2,898			1,140		
White		0.80			0.52			0.41			0.37	
Black		0.11			0.18			0.18			0.33	
Hispanic		0.05			0.23			0.26			0.24	
Asian[b]					0.02							
Other (not Black, Hispanic, White)		0.04			0.05			0.14			0.06	
Gender total *N*	733			1,300			2,966			1,140		
Male		0.50			0.50			0.49			0.51	
Mother's education total *N*	733			1,400			2,885			1,140		
Mom ed: 12 years or less		0.24			0.42			0.59			0.74	
Mom ed: Some college		0.57			0.27			0.23			0.25	
Mom ed: BA plus		0.19			0.31			0.18			0.01	

Note. NICHD SECCYD = National Institute of Child Health and Human Development Study of Early Child Care and Youth Development; ECLS–B = Early Childhood Longitudinal Study– Birth Cohort; NCEDL = National Center for Early Development and Learning; EHS = Early Head Start; PPVT–III = Peabody Picture Vocabulary Test, 3rd edition; WJ = Woodcock–Johnson; CBCL = Child Behavior Checklist; ORCE = Observational Record of the Caregiving Environment; ECERS–R = Early Childhood Environment Rating Scale–Revised; CLASS = Classroom Assessment Scoring System; ECLS–B weight W31C0 was used for all ECLS–B variables except for the ECERS–R composite mean and standard deviation, which was weighted by W33P0. All *N*s for the ECLS–B are rounded to the nearest 50 per NCES/IES reporting requirements.

[a]All *N*s for the ECLS–B are rounded to the nearest 50 per NCES/IES reporting requirements. [b]Asian category only in ECLS–B (the other three studies include Asians in other category). [c]The mean for the ECLS–B receptive vocabulary test is the average number of correct items. From the manual, it "is based on 15 (of 16) PPVT items, which also tested receptive vocabulary (children were asked to select one of four pictures that represented the stimulus word). One PPVT item was removed from scoring due to the presence of differential item functioning."

for the NICHD SECCYD to assess the quality of caregiver–child interaction experienced by individual children. Observations of child-care quality are made during a minimum of four 44-min observation cycles spread over a 2-day period. At the end of each 44-min cycle, observers record ratings from

1 = *not at all characteristic* to 4 = *highly characteristic* to describe caregiver behavior. A positive caregiving composite score is created by obtaining a mean score across scales over all of the ORCE cycles at a given age period. Higher scores indicate that caregivers are more sensitive to children's behaviors, provide greater cognitive stimulation, have warmer and more positive demonstrations, foster greater explorations, and are less emotionally detached. Scores range from 1 (*unresponsive or harsh caregiving*) to 4 (*frequent responsive and stimulating caregiving*).

Finally, the NCEDL also used an early version of the Classroom Assessment Scoring System (CLASS; Pianta, La Paro, & Hamre, 2008), an observational assessment to rate teacher–child interactions on nine dimensions of the socioemotional and instructional climate of the classroom. During 2 observation days in each of the fall and spring, observers rated the pre-K classroom and teacher in repeated cycles of roughly 30 min. Observation days lasted from the time children arrived until they started nap in full-day programs or left for the day in half-day programs. Quality ratings of each dimension are on a scale of 1–7 with 1–2 indicating low levels, 3–5 medium levels, and 6–7 high levels. A score for each dimension was created by averaging across all cycles within a data collection period. Factor analysis of the CLASS yielded two factors—instructional climate and emotional climate (Early et al., 2005). Prior analyses of the NCEDL data (Burchinal et al., 2009; Burchinal et al., 2011) indicated that the CLASS Instructional Climate was significantly associated with academic outcomes and CLASS Emotional Climate was significantly associated with emotional outcomes; therefore, we used the CLASS Instructional Climate in the analyses with language and mathematics outcomes and CLASS Emotional Climate in the analyses with social skills and externalizing problem behaviors outcomes.

Outcome Measures

This study examined four outcome measures—language, mathematics, social skills, and externalizing problem behaviors.

Language. Several measures of receptive vocabulary were used across the studies. The Peabody Picture Vocabulary Test, 3rd edition (PPVT–III; Dunn & Dunn, 1997), used in the NCEDL and EHS studies, is an achievement test of receptive vocabulary that relates to other measures of language, literacy, and academic achievement. Children are shown a set of four pictures and asked to select the picture that best represents the meaning of a word spoken by the examiner. The Preschool Language Scale–3 (Zimmerman, Steiner, & Pond, 1992), used in the NICHD SECCYD, measures a range of language behaviors, including vocabulary, morphology, syntax, and integrative thinking, grouped into two subscales: auditory comprehension and expressive language. The ECLS–B research team created a new instrument based on item response theory analyses of items from language tests such the PPVT and literacy tests such as the Woodcock–Johnson (Snow et al., 2009).

Mathematics. The NCEDL and EHS studies administered the Woodcock–Johnson (WJ) III applied problems subtest (Woodcock, McGrew, & Mather, 2001) to measure early mathematics skills. Similar to the PPVT, the WJ subtests are standardized measures that are widely used and endorsed by early childhood practitioners to assess children's progress over time in basic skill areas. The WJ Applied Problems subtest examines the individual child's ability to analyze and solve math problems. The NICHD SECCYD study used the Woodcock–Johnson revised (Woodcock & Johnson, 1989) measure. The ECLS–B research team created a new math achievement test based on item response theory analyses of items from major math achievement tests including the WJ (Snow et al., 2009).

Social skills. For consistency across studies, even though some of the studies contained both maternal and nonmaternal caregiver reports, we included only the nonmaternal caregiver measures as all of the studies contained nonmaternal ratings, but not all contained maternal ratings. The California Preschool Social Competency scale (Levine, Elzey, & Lewis, 1969) was used in the NICHD SECCYD and is a 30-item questionnaire that assesses peer interaction skills as well as the child's ability to follow instructions and communicate effectively. We created a composite from seven items for the ECLS–B social skills outcome measure. The Teacher–Child Rating Scale (TCRS)–Social Skills (Hightower et al., 1986) was examined in the NCEDL. The EHS study did not contain a caregiver rating that was comparable to the other three outcomes measures; therefore, we did not include the social skills outcome for EHS.

Externalizing problem behaviors. Children who exhibit externalizing problem behaviors direct emotional problems outward into aggressive behaviors (Achenbach, 1991). Similar to the social skills outcomes, even though some of the studies contained both maternal and nonmaternal caregiver reports, we included only the nonmaternal caregiver

measures as all of the studies contained nonmaternal ratings but not all contained maternal ratings. The Child Behavior Checklist (CBCL; Achenbach, 1991) is a caregiver-report questionnaire on which the child is rated on various competencies and behavioral problems. The CBCL–externalizing problem behaviors subscale outcome measure was used in the NICHD SECCYD and EHS study and includes aggressive behaviors such as arguing, screaming, seeking attention, teasing others, behaving in a threatening manner, and displaying a temper. We created a composite from 10 items for the ECLS–B externalizing problem behaviors outcome measure. The TCRS conduct problems subscale (Hightower et al., 1986; with six items including child is "disruptive in class" and "overly aggressive") was examined in the NCEDL.

Child Entry Skills and Behaviors

This study examined three child entry skills and behaviors—cognitive skills, attention skills, and externalizing problem behaviors.

Cognitive skills. The Bayley Scales of Infant Development (in the NICHD SECCYD, EHS studies) or a modified version of the Bayley (in the ECLS–B study; Bayley, 1993) was administered at 24 months for the NICHD SECCYD and ECLS–B studies and 36 months for EHS to assess general cognitive development. The ECLS–B used a modified version of the Bayley—the BSID–Short Form (SF; Snow et al., 2009). It contained a subset of the items in the full Bayley, but the psychometric properties are similar and scores from the BSID–SF are compatible with the full Bayley. The PPVT–III (Dunn & Dunn, 1981) was administered at the beginning of preschool in the NCEDL study (see the previous section for a description of this measure).

Attention skills. The four studies administered a variety of measures of attention skills. CBCL (Achenbach, 1991) was used in the NICHD SECCYD study and includes an attention subscale measured at 24 months. The CBCL attention subscale assesses attention problems potentially indicative of concentration difficulties, problems sitting still, impulsivity, nervousness, and poor performance in school. The ECLS–B included attention ratings at 24 months from the Bayley Infant Behavior Record (IBR), reflecting the extent to which the infant is responsive to the examiner and to test materials (Snow et al., 2009). The TCRS (Hightower et al., 1986), used in the NCEDL study, is a behavioral rating scale that assesses children's social competence and problem behaviors. The task orientation subscale (with five items including child is "well organized" and "completes work") is used in this study. The Three-Bag Assessment measuring child's sustained attention to objects was measured at 36 months in the EHS.

Externalizing problem behaviors. Of the four studies, only the NICHD SECCYD and NCEDL had well-defined or readily available externalizing problem behavior measures at preschool entry to include in the analysis. For the NICHD SECCYD, the CBCL externalizing behavior subscale at 36 months was included in the analyses. The TCRS conduct problems subscale (Hightower et al., 1986) assessed in the fall of pre-K in the NCEDL is used in this study. Description of the child entry measures can be found in the externalizing problem behavior outcome measure section above.

Control Variables

Extensive covariates were included to minimize selection bias. Where available, our control variables include the following: pretest school readiness measures, child age, low birth weight, maternal characteristics (such as depression and sensitivity), parenting quality, household structure, and family income. Most control variables in the studies reflect demographic characteristics and social risk factors collected during interviews with the mother. Our pretest measures of the variables used as school readiness outcomes should be particularly effective at eliminating biases from selection into child-care quality.

Missing Data

In these studies, as in all longitudinal studies, information is missing on some of the variables. We dealt with this by using multiple imputations with Stata software to fill in missing variables based on regressions of the available variables, plus a randomly selected error term. Each database is then used to produce coefficient estimates, which are then combined into a single estimate with an appropriately estimated standard error. Under the assumption that data are missing at random, which can typically be met using the large number of controls available in these studies, this methodology has been shown to produce estimates with excellent statistical properties (Allison, 2002).

Analytic Approach

For each study, we at least partially accounted for selection bias by including the child's pretest skills

level as a covariate, along with a host of other covariates listed in Table 3 and in the online appendix. This amounts to estimating "residualized change models" (NICHD Early Child Care Research Network & Duncan, 2003) in which a particular child school readiness skill at the end of child care is regressed on the pretest skill, average child-care quality, plus a full set of demographic and child controls. Our school readiness outcomes are language, mathematics, social skills, and externalizing problem behaviors at kindergarten entry. Our predictors include observed child-care quality, interactions between child-care quality and demographic characteristics, and interactions between child-care quality and child entry cognitive skills, attention skills, and externalizing problem behaviors.

To be as comprehensive as possible in testing both the compensatory and accumulated advantages or skill begets skill hypotheses, we estimated models interacting child-care quality with the child entry skills and behaviors in models containing both continuous and categorical child entry skills and behaviors variables—Quality × Continuous Entry Skill or Behavior, Quality × Low Entry Dummy, and Quality × High Entry Dummy. Both approaches were used because the cross-product interactions between quality and child characteristics as continuous variables will always provide the most powerful approach to detecting interactions when the underlying assumptions are met (DeCoster, Iselin, & Gallucci, 2009). That is, this approach is always preferable when the interaction reflects a linear increase (or decrease) in the association between quality and child outcomes with an increase in child characteristics. In contrast, this approach will fail to detect interactions when the slope between quality and child outcomes is qualitatively different when child outcomes are initially either high or low. To examine this possibility, we also created categorical variables that reflected whether child characteristics were conceptually high or low in the pretest score. We chose this conceptual approach over a more traditional approach that depended on a quartile split to ensure that what constituted a high level or low level on the child characteristics was clinically meaningful and consistent across studies. Cut points for low and high dummy groups were created based on either 1 *SD* below and above the norm mean or sample mean (depending on whether measures were standardized), or using the meaningful categories set by the measure creators for the entry skills and behavior measures which contain ratings.

Because different variables were measured within each study, the estimated models also had to differ slightly across studies. Each analysis model predicted the child's school readiness skill using the following generic equation testing the quality main effect:

$$Y_{t+1} = \beta_0 + \beta_1 Y_t + \beta_2 \text{covariates}_t + \beta_3 \text{quality}_{t \to t+1} + e$$

Each potential moderator was examined in separate analyses. The following generic equation tests the potential moderators:

$$Y_{t+1} = \beta_0 + \beta_1 Y_t + \beta_2 \text{covariates}_t + \beta_3 \text{quality}_{t \to t+1} + \beta_4 \text{moderator}_t + \beta_5 \text{quality}_{t \to t+1} \times \text{moderator}_t + e$$

In these equations, Y is child school readiness skill at times t (pretest) or $t + 1$ (posttest), covariates_t are covariates from the pretest as described above, $\text{quality}_{t \to t+1}$ is child-care quality averaged over the interval between t and $t + 1$, and moderator_t is the pretest measure of one of the moderators listed above. We estimated several versions of these equations. We then averaged coefficients across the four studies, separately for quality main effects and interactions, in a meta-analysis using the Comprehensive Meta-Analysis software (Borenstein, Hedges, Higgins, & Rothstein, 2009).

Results

Tables 4 through 7 display the standardized regression coefficients and standard errors for the individual studies and the meta-analytic averages for preschool center quality main effects and interactions for the school readiness outcomes in our analyses. A complete listing of the regression results for each individual study can be found in our online appendix.

Results for Language Outcome

Quality Main Effects for Language Outcome

As described above, our analyses began with investigation of each of the four individual studies. These analyses indicated that the ECERS quality score was significantly related to the language outcome in the ECLS–B nationally representative study ($B = .09$, $p < .01$) and the CLASS Instructional Climate quality score was significantly related to the language outcome in the NCEDL 11-state pre-K study ($B = .04$, $p < .05$). The second stage of the analyses combined these quality coefficients from the individual analyses using the meta-analytic approach. As predicted, the meta-analysis revealed a statistically significant, although small, preschool

Table 4
Standardized Coefficients and Meta-Analytic Averages for Preschool Center Quality Main Effects and Interactions for Language Outcome

	NICHD SECCYD	ECLS–B	NCEDL		EHS	**Meta-analytic average**
	ORCE *B* (*SE*)	ECERS *B* (*SE*)	ECERS *B* (*SE*)	CLASS Instructional Climate *B* (*SE*)	ECERS *B* (*SE*)	*B* (*SE*)
M1: **Quality (Q) Main effect**	0.04 (0.03)	0.09** (0.03)	0.03 (0.02)	0.04* (0.02)	0.03 (0.04)	0.05*** (0.01)
Quality × Demographics						
M2: Q × Black	−0.14 (0.09)	−0.03 (0.08)	0.01 (0.03)	0.01 (0.04)	−0.01 (0.07)	−0.01 (0.03)
M2: Q × Hispanic	−0.11 (0.16)	0.05 (0.08)	−0.04 (0.04)	0.03 (0.04)	−0.04 (0.09)	0.00 (0.03)
M2: Q × Other Race or Ethnicity	0.01 (0.12)	–	0.04 (0.04)	0.01 (0.03)	−0.01 (0.16)	0.02 (0.03)
M3: Q × Male	0.01 (0.05)	0.11 (0.06)	0.03 (0.02)	0.02 (0.03)	0.03 (0.06)	0.03 (0.02)
M4: Q × Some College	0.08 (0.06)	−0.04 (0.07)	0.04 (0.03)	0.02 (0.03)	0.03 (0.06)	0.03 (0.02)
M4: Q × BA Plus	0.07 (0.08)	0.14* (0.07)	0.05 (0.03)	0.02 (0.03)	0.29 (0.39)	0.05* (0.03)
Quality × Child's Entry Skills & Behaviors						
M5: Q × Cognitive, Continuous	−0.03 (0.03)	0.02 (0.03)	0.01 (0.01)	0.00 (0.01)	0.02 (0.03)	0.00 (0.01)
M6: Q × Low Cognitive	0.08 (0.08)	−0.05 (0.08)	−0.02 (0.01)	−0.01 (0.01)	−0.11 (0.08)	−0.02 (0.01)
M7: Q × High Cognitive	0.00 (0.06)	0.07 (0.07)	0.00 (0.01)	−0.01 (0.01)	−0.04 (0.07)	0.00 (0.01)
M8: Q × Attention, Continuous	0.01 (0.03)	0.00 (0.03)	0.00 (0.01)	0.01 (0.02)	0.00 (0.03)	0.00 (0.01)
M9: Q × Low Attention	−0.07 (0.07)	−0.02 (0.07)	0.02 (0.01)	0.00 (0.02)	0.05 (0.11)	0.01 (0.01)
M10: Q × High Attention	−0.06 (0.07)	−0.02 (0.09)	−0.01 (0.01)	0.01 (0.01)	0.03 (0.06)	0.01 (0.01)
M11: Q × Problem Beh., Continuous	0.04 (0.02)	–	−0.02 (0.01)	0.00 (0.02)	–	0.01 (0.01)
M12: Q × Most Problem Behaviors	0.11 (0.05)	–	0.02 (0.01)	0.00 (0.01)	–	0.01 (0.01)
M13: Q × Least Problem Behaviors	−0.06 (0.11)	–	−0.01 (0.01)	0.00 (0.01)	–	−0.01 (0.01)

Note. NICHD SECCYD = National Institute of Child Health and Human Development Study of Early Child Care and Youth Development; ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; NCEDL = National Center for Early Development and Learning; EHS = Early Head Start; ORCE = Observational Record of the Caregiving Environment; ECERS–R = Early Childhood Environment Rating Scale–Revised; CLASS = Classroom Assessment Scoring System. Reference groups: race or ethnicity = White; gender = female; mother's education = 12 years or less. Models: M1 = quality main effect, pretest, covariates; M2–M13 = adds Quality × Moderator to M1. *$p < .05$. **$p < .01$. ***$p < .001$.

center quality main effects for the language outcome ($B = .05$, $p < .001$). A 1 *SD* increase in quality (roughly 1 point on the 7-point ECERS and CLASS scales and .5 point on the 4-point ORCE scale) was thus associated with a .05 *SD* increase in the language outcome.

Quality Interactions for Language Outcome

Whether observed preschool center quality was moderated was examined by adding the interactions involving the six demographic characteristics in one set of models and the three child entry characteristics in a second set of models (see Table 4 for results). Only one of the six demographic characteristics interacted significantly with quality in the meta-analysis. The Quality × Maternal Education interaction was statistically significant at the meta-analytic level for children's language skills. Preschool center quality was a stronger predictor of language skills for children of highly educated mothers (BA plus) than children whose mothers had 12 years or less of schooling ($B = .05$, $p < .05$), which does not support the compensatory hypothesis but does support the accumulated advantages hypothesis. When the results from each study were examined separately, this interaction attained statistical significance only within the ECLS–B study.

No evidence emerged indicating interactions between preschool center quality and entry skill or behavior levels of the children.

Results for Mathematics Outcome

As shown in Table 5, the meta-analysis also indicated statistically significant, albeit small, preschool center quality main effects for the mathematics outcome ($B = .03$, $p < .05$). A 1 *SD* increase in quality was thus associated with a .03 *SD* increase in the mathematics outcome. Examining the results from each study separately, significant associations involving quality was observed only for the CLASS Instructional Climate main effect in the analysis of the NCEDL data.

The meta-analysis did not yield significant interactions involving observed quality, but a few interactions attained statistical significance within analyses of each study. These are presented, but should not be interpreted in the absence of an overall meta-analytic finding. Regarding Quality × Race or Ethnicity, the CLASS Instructional Climate quality score was a stronger predictor of mathematics achievement for Hispanic and Other (vs. White) children in the NCEDL study. Regarding Quality × Maternal Education, only the ECERS child-care quality measure in the NCEDL was statistically significant—this variable was a stronger predictor for children whose mothers had some college education compared to children whose mothers had 12 or fewer years of education. Finally, an inconsistent scattering of very few statistically significant coefficients with the child entry skills and behaviors yielded nonsignificant findings in the meta-analysis of the mathematics outcome.

Table 5
Standardized Coefficients and Meta-Analytic Averages for Preschool Center Quality Main Effects and Interactions for Mathematics Outcome

	NICHD SECCYD	ECLS–B	NCEDL		EHS	**Meta-analytic average**
	ORCE *B* (*SE*)	ECERS *B* (*SE*)	ECERS *B* (*SE*)	CLASS Instructional Climate *B* (*SE*)	ECERS *B* (*SE*)	*B* (*SE*)
M1: **Quality (Q) Main effect**	0.05 (0.03)	0.02 (0.03)	−0.01 (0.02)	0.06*** (0.02)	0.06 (0.04)	0.03* (0.01)
Quality × Demographics						
M2: Q × Black	−0.12 (0.10)	0.01 (0.07)	0.02 (0.03)	0.04 (0.04)	0.01 (0.07)	0.01 (0.03)
M2: Q × Hispanic	−0.15 (0.19)	0.03 (0.09)	0.03 (0.04)	0.14*** (0.04)	−0.01 (0.09)	0.06 (0.03)
M2: Q × Other Race or Ethnicity	−0.17 (0.14)	–	−0.03 (0.04)	0.07* (0.04)	−0.10 (0.15)	0.00 (0.04)
M3: Q × Male	0.02 (0.06)	0.07 (0.06)	0.02 (0.03)	0.01 (0.03)	−0.01 (0.06)	0.02 (0.02)
M4: Q × Some College	0.10 (0.07)	−0.07 (0.07)	0.07* (0.03)	−0.01 (0.03)	0.03 (0.06)	0.03 (0.02)
M4: Q × BA Plus	0.04 (0.09)	0.05 (0.07)	−0.01 (0.04)	−0.07 (0.03)	−0.49 (0.40)	−0.02 (0.03)
Quality × Child's Entry Skills & Behaviors						
M5: Q × Cognitive, Continuous	−0.04 (0.03)	0.00 (0.02)	0.00 (0.02)	−0.01 (0.01)	0.04 (0.03)	0.00 (0.01)
M6: Q × Low Cognitive	0.21* (0.10)	−0.04 (0.07)	−0.01 (0.01)	0.00 (0.02)	−0.21* (0.08)	−0.01 (0.01)
M7: Q × High Cognitive	−0.02 (0.07)	0.00 (0.06)	−0.01 (0.02)	−0.01 (0.01)	−0.06 (0.07)	−0.01 (0.01)
M8: Q × Attention, Continuous	−0.01 (0.03)	0.00 (0.03)	−0.02 (0.02)	0.02 (0.02)	0.01 (0.03)	0.00 (0.01)
M9: Q × Low Attention	0.00 (0.08)	−0.05 (0.07)	0.01 (0.02)	−0.03 (0.02)	0.03 (0.11)	−0.01 (0.02)
M10: Q × High Attention	−0.03 (0.08)	−0.03 (0.09)	0.01 (0.01)	0.02 (0.01)	0.02 (0.06)	0.01 (0.01)
M11: Q × Problem Beh., continuous	0.02 (0.03)	–	0.00 (0.01)	0.04* (0.02)	–	0.02 (0.01)
M12: Q × Most Problem Behaviors	0.09 (0.06)	–	−0.01 (0.02)	−0.04* (0.02)	–	−0.01 (0.02)
M13: Q × Least Problem Behaviors	−0.02 (0.12)	–	−0.01 (0.01)	0.03 (0.02)	–	0.01 (0.02)

Note. NICHD SECCYD = National Institute of Child Health and Human Development Study of Early Child Care and Youth Development; ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; NCEDL = National Center for Early Development and Learning; EHS = Early Head Start; ORCE = Observational Record of the Caregiving Environment; ECERS–R = Early Childhood Environment Rating Scale–Revised; CLASS = Classroom Assessment Scoring System. Reference groups: race or ethnicity = White; gender = female; mother's education = 12 years or fewer. Models: M1 = quality main effect, pretest, covariates; M2–M13 = adds Quality × Moderator to M1.
*$p < .05$. ***$p < .001$.

Table 6
Standardized Coefficients and Meta-Analytic Averages for Preschool Center Quality Main Effects and Interactions for Social Skills Outcome

	NICHD-SECCYD	ECLS-B	NCEDL		EHS	**Meta-analytic average**
	ORCE *B* (*SE*)	ECERS *B* (*SE*)	ECERS *B* (*SE*)	CLASS Instructional Climate *B* (*SE*)	ECERS *B* (*SE*)	*B* (*SE*)
M1: **Quality (Q) Main effect**	0.07 (0.04)	0.02 (0.02)	0.00 (0.02)	0.03 (0.02)	n/a (n/a)	0.02 (0.01)
Quality × Demographics						
M2: Q × Black	−0.12 (0.14)	0.04 (0.06)	−0.01 (0.04)	0.00 (0.04)	n/a (n/a)	0.00 (0.03)
M2: Q × Hispanic	−0.09 (0.26)	−0.02 (0.07)	0.02 (0.04)	0.00 (0.04)	n/a (n/a)	0.00 (0.03)
M2: Q × Other Race or Ethnicity	0.09 (0.18)	–	−0.09 (0.05)	−0.02 (0.05)	n/a (n/a)	−0.04 (0.05)
M3: Q × Male	0.03 (0.08)	0.06 (0.04)	0.03 (0.03)	0.03 (0.03)	n/a (n/a)	0.04 (0.02)
M4: Q × Some College	0.05 (0.09)	−0.11* (0.05)	−0.09* (0.04)	−0.04 (0.04)	n/a (n/a)	−0.07* (0.03)
M4: Q × BA Plus	−0.10 (0.12)	0.02 (0.06)	−0.05** (0.04)	−0.07 (0.04)	n/a (n/a)	−0.04 (0.03)
Quality × Child's Entry Skills & Behaviors						
M5: Q × Cognitive, Continuous	−0.04 (0.05)	0.00 (0.02)	−0.05 (0.02)	−0.03 (0.01)	n/a (n/a)	−0.03* (0.01)
M6: Q × Low Cognitive	0.16 (0.12)	−0.02 (0.06)	0.03 (0.02)	0.02 (0.02)	n/a (n/a)	0.02 (0.02)
M7: Q × High Cognitive	0.04 (0.10)	0.02 (0.06)	−0.04* (0.02)	−0.01 (0.02)	n/a (n/a)	−0.02 (0.02)
M8: Q × Attention, Continuous	0.04 (0.04)	0.01 (0.03)	0.00 (0.01)	0.00 (0.02)	n/a (n/a)	0.01 (0.01)
M9: Q × Low Attention	−0.05 (0.10)	0.00 (0.06)	0.02 (0.02)	0.00 (0.02)	n/a (n/a)	0.01 (0.02)
M10: Q × High Attention	0.08 (0.11)	0.00 (0.07)	0.01 (0.01)	0.00 (0.01)	n/a (n/a)	0.01 (0.01)
M11: Q × Problem Beh., Continuous	0.05 (0.03)	–	0.00 (0.02)	−0.02 (0.02)	–	0.01 (0.02)
M12: Q × Most Problem Behaviors	0.08 (0.08)	–	0.00 (0.02)	0.01 (0.02)	–	0.01 (0.02)
M13: Q × Least Problem Behaviors	−0.20 (0.15)	–	0.00 (0.02)	−0.02 (0.02)	–	−0.01 (0.02)

Note. NICHD SECCYD = National Institute of Child Health and Human Development Study of Early Child Care and Youth Development; ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; NCEDL = National Center for Early Development and Learning; EHS = Early Head Start; ORCE = Observational Record of the Caregiving Environment; ECERS–R = Early Childhood Environment Rating Scale–Revised; CLASS = Classroom Assessment Scoring System. Reference groups: race or ethnicity = White; gender = female; mother's education = 12 years or fewer. Models: M1 = quality main effect, pretest, covariates; M2–M13 = adds Quality × Moderator to M1.
*$p < .05$. **$p < .01$.

Results for Social Skills Outcome

As shown in Table 6, the meta-analyses of the social skills outcome did not indicate that preschool center quality was related to gains in social skills in preschool-age center care, but did reveal significant interactions for one of six interactions between quality and demographic and one of three interactions between quality and child entry skills. The two statistically significant findings with social skills outcomes were with maternal education and the entry cognitive skill (as a continuous variable) moderators. First, our results suggest that preschool center quality was a stronger predictor of gains in social skills for children whose mothers had a high school degree or less than for children whose mothers had some college ($B = -0.07$, $p < .05$), which provides limited support for the compensatory hypothesis. Second, with regard to the Quality × Cognitive interaction, analyses that included entry-level cognitive skills as a continuous variable suggested that that child-care quality was a stronger predictor of gains in social skills among children who entered preschool-age center care with lower cognitive skills ($B = -.03$, $p < .05$). Failure to attain this interaction when it was tested using categorical measures of entry cognitive skills is not surprising given the very modest interaction term that was attained in the analyses involving the continuous measure of entry cognitive skills and the con-

Table 7
Standardized Coefficients and Meta-Analytic Averages for Preschool Center Quality Main Effects and Interactions for Problem Behaviors Outcome

	NICHD-SECCYD	ECLS–B	NCEDL		EHS	**Meta-analytic average**
	ORCE *B* (*SE*)	ECERS *B* (*SE*)	ECERS *B* (*SE*)	CLASS Instructional Climate *B* (*SE*)	ECERS *B* (*SE*)	*B* (*SE*)
M1: **Quality (Q) Main effect**	0.01 (0.04)	−0.03 (0.03)	0.01 (0.02)	0.05** (0.02)	0.00 (0.05)	0.01 (0.01)
Quality × Demographics						
M2: Q × Black	0.13 (0.14)	−0.01 (0.07)	0.03 (0.04)	0.02 (0.05)	0.03 (0.08)	0.02 (0.03)
M2: Q × Hispanic	0.28 (0.24)	0.02 (0.09)	0.00 (0.04)	0.01 (0.04)	0.11 (0.09)	0.03 (0.03)
M2: Q × Other Race or Ethnicity	−0.15 (0.17)	–	0.01 (0.05)	0.04 (0.06)	0.09 (0.19)	0.01 (0.05)
M3: Q × Male	0.01 (0.08)	−0.08 (0.05)	0.01 (0.03)	0.02 (0.03)	0.01 (0.06)	−0.01 (0.02)
M4: Q × Some College	0.01 (0.10)	0.12* (0.06)	0.01 (0.04)	0.06 (0.04)	−0.02 (0.07)	0.04 (0.03)
M4: Q × BA Plus	0.02 (0.12)	−0.02 (0.06)	−0.04 (0.04)	−0.10** (0.04)	0.40 (0.47)	−0.05 (0.03)
Quality × Child's Entry Skills & Behaviors						
M5: Q × Cognitive, Continuous	0.01 (0.04)	0.00 (0.02)	−0.02 (0.02)	−0.02 (0.02)	−0.05 (0.03)	−0.01 (0.01)
M6: Q × Low Cognitive	0.09 (0.12)	0.01 (0.07)	0.03 (0.02)	0.03 (0.02)	0.07 (0.10)	0.03 (0.02)
M7: Q × High Cognitive	0.04 (0.10)	−0.03 (0.07)	−0.02 (0.02)	0.00 (0.02)	−0.10 (0.07)	−0.02 (0.02)
M8: Q × Attention, Continuous	0.02 (0.04)	0.00 (0.03)	0.01 (0.02)	0.00 (0.02)	−0.05 (0.03)	−0.01 (0.01)
M9: Q × Low Attention	−0.09 (0.10)	−0.01 (0.06)	−0.01 (0.02)	−0.02 (0.02)	0.18 (0.13)	−0.01 (0.02)
M10: Q × High Attention	−0.01 (0.10)	0.02 (0.07)	0.01 (0.01)	−0.01 (0.01)	−0.04 (0.07)	0.00 (0.01)
M11: Q × Problem Beh., Continuous	−0.06 (0.03)	–	0.00 (0.02)	−0.03 (0.02)	–	−0.03 (0.02)
M12: Q × Most Problem Behaviors	−0.11 (0.08)	–	0.01 (0.02)	0.03 (0.03)	–	0.01 (0.02)
M13: Q × Least Problem Behaviors	0.29 (0.15)	–	0.01 (0.02)	−0.02 (0.02)	–	0.00 (0.02)

Note. NICHD SECCYD = National Institute of Child Health and Human Development Study of Early Child Care and Youth Development; ECLS–B = Early Childhood Longitudinal Study–Birth Cohort; NCEDL = National Center for Early Development and Learning; EHS = Early Head Start; ORCE = Observational Record of the Caregiving Environment; ECERS–R = Early Childhood Environment Rating Scale–Revised; CLASS = Classroom Assessment Scoring System. Reference groups: race or ethnicity = White; gender = female; mother's education = 12 years or less. Models; M1 = quality main effect, pretest, covariates; M2–M13 = adds Quality × Moderator to M1.
*$p < .05$. **$p < .01$.

sistency in the direction of effects for the analyses involving the categorical variables.

Results for Problem Behaviors Outcome

At the meta-analytic level, no evidence emerged indicating that preschool center quality was related to externalizing problem behaviors as a main or interaction effect involving either demographic characteristics or entry child skills or behaviors (see Table 7). Again, we examined the results from separate analyses of each study to see if there was any suggestion of associations. In the NCEDL data, higher quality was related to more problem behaviors ($B = .05$, $p < .01$), but the Quality × Maternal Education interaction suggested that this positive association was stronger for children whose mothers had a high school degree or less than among children whose mothers had a BA degree or more ($B = -.10$, $p < .01$). In contrast, in the ECLS–B data, higher quality was related to fewer problem behavior among children whose mothers had a high school or less than among children whose mothers had some college ($B = .12$, $p < .05$). Failure to attain significant quality effects in the meta-analysis and the small, somewhat contradictory findings in the individual studies provide little evidence that preschool center quality was related to change in problem behaviors in these studies.

Discussion

The purpose of this study was to examine associations between child-care quality in preschool center care and children's academic and socioemotional skills at kindergarten entry. Our study involved a comprehensive approach to ensure that the same analytic strategy was used across selected large child-care studies and then meta-analytically combining the findings across studies. Our focus is on child-care quality as a predictor of gains in language, mathematics, social skills, and externalizing problem behaviors during preschool; therefore, we

are looking at the impact of the quality of preschool center care for 1–2 years—not the quality of care for the entire early childhood period. Our effect sizes are like value-added estimates and do not address questions about the impact of prior quality of care or of quality of care that is not measured by these widely used quality measures.

Results from these analyses suggest that observed quality of the preschool center classroom is very modestly related to: acquisition of language and mathematics skills overall, language skills for children of highly educated mothers (BA plus), and social skills for children who entered preschool-age care with lower cognitive skills or had mothers with some college. The quality main effects in this study are similar to those reported in several recent secondary analyses of the child-care literature and the meta-analysis of published articles examining child-care quality in preschool center classrooms and child outcomes conducted by Burchinal et al. (2011).

The magnitudes of these associations are considerably smaller than those reported by advocates. Several factors contribute to these differences. This study examined effects of quality of preschool care over a 1-year period, controlling for prior functioning. In some cases, the amount of exposure is 4–5 months, a time period that is much smaller than those reported when child-care quality is measured across a longer span of the early childhood period and also much smaller than those attained from carefully controlled small experimental studies.

Also, it is possible that child-care quality may not be adequately measured in currently available studies (Burchinal et al., 2011; Farran & Hofer, 2011; Gormley, 2007; Zaslow et al., 2006). All of the present quality measures were developed on a conceptual basis by child development experts without detailed psychometric analysis. For example, the ORCE quality measure developed in the 1990s specifically for the NICHD SECCYD was originally designed to focus on quality of interactions and relationships with teachers rather than cognitive and achievement skills. The end of the 1990s saw a paradigm shift in this research area as child care began being viewed as a compensatory intervention for at-risk children rather than as a service primarily for middle-class children and families. As the focus shifted to child-care's ability to improve school entry academic skills for at-risk students, the focus on instructional practices increased, yet none of the quality measures included intentional instructional practices (such as verbal interactions, which include elaborated vocabulary and sentence structures) that are important for fostering children's cognitive, academic, and social development (Burchinal et al., 2011). Furthermore, none measured the quality of instruction in specific content areas (e.g., language). The experimental evaluations of successful curricula suggest that a combination of the behaviors measured by these quality scales (e.g., warmth and responsiveness) as well as those not measured by these scales (e.g., focus and depth of instruction within the content area) is needed to positively affect children's school readiness skills.

Indeed, in a recent psychometric analysis of the ECERS–R, researchers advise the child-care quality field to proceed cautiously in using the ECERS–R to assess child-care quality as they find little evidence of response process validity, structural validity, and criterion validity (Gordon, Fujimoto, Kaestner, Korenman, & Abner, 2012). Also, given that the ECERS emphasizes aspects of the environment (e.g., materials, health practices, safety, and discipline) as opposed to educational goals (e.g., language, literacy, and numeracy), the ECERS may not be well suited for school readiness studies (Zaslow et al., 2006). The CLASS Instructional Climate measure—the most recent and most instruction-focused of the three quality measures in our study—yielded the most quality main effects across the four outcomes we examined, which contributed to the statistically significant meta-analytic average for the language and mathematics outcomes. On the whole, however, our findings are consistent with other recent studies suggesting that currently available quality measures may not be adequate to the research tasks being undertaken (Burchinal et al., 2011; Gordon et al., 2012; Zaslow et al., 2006).

We are cautious about overinterpreting the evidence of compensatory or accumulated advantages and skill begets skill as there was very little evidence supporting either hypothesis. In our examination of six demographic characteristics and three child entry skills and behaviors, the language outcome indicated only one statistically significant interaction while the social skill outcome indicated only two statistically significant interactions, with no evidence of moderating effects for the mathematics or problem behavior outcomes at the meta-analytic level. Failure to observe convincing evidence for either hypothesis could reflect a lack of either a compensatory or Matthew effect in preschool-age child-care impacts on school readiness outcomes, or it could reflect lack of power to detect very modest differences. If the quality measures

provide relatively weak measurement of classroom quality, then it will be even more difficult to detect interactions using those measures than it would be to detect main effects due to the decreased power inherent in testing interactions (Cohen, 1988). Replication of the attained interactions in other work will increase confidence that the findings are robust.

These findings may have implications for recent policies attempting to improve quality of child care through greater focus on observed quality ratings. Head Start has used the ECERS–R as part of its evaluation study, FACES, and is switching to the CLASS in performance monitoring. Soon, programs with low scores on the CLASS will be given greater scrutiny in the reauthorization process. Over half the states are using quality rating scales, typically the ECERS, in the quality rating and improvement systems based on evidence linking observed quality to child outcomes (Tout et al., 2010).

Study Limitations

This study has several limitations. First, as discussed earlier, although we employed the most widely used child-care quality measures, they may not provide adequate assessment of all aspects of the preschool center classroom that impact children's school readiness skills.

Second, because covariates varied somewhat across the four studies, our regression models, while similar to one another, were not identical across studies. For example, an important difference is the variation in child's age at assessment and the length interval between pretest (i.e., lagged dependent variable) and outcome for the four studies. We attempted to account for this variation by including controls for *age at pretest assessment* and the *age at outcome–age at assessment* time interval, but differences across studies remain.

Third, we only examined preschool-aged children (3–5 years old) in center-based child-care settings so our results should not be generalized to children who did not select into this context. We would, however, point out that over 75% of children nationally and within almost all early child-care studies are in center-based care at 4–5 years of age (Barnett, Epstein, Friedman, Sansanelli, & Hustedt, 2009).

Fourth, only the nationally representative ECLS–B offers extensive diversity in terms of the selected demographic characteristics and child entry skills and behaviors used to test interactions between observed quality and child outcomes. The other three studies tended to be more homogeneous, with two studies that include primarily low-income families (NCEDL and EHS) and one study that includes primarily middle-class families (NICHD SECCYD). We acknowledge that there are confounds in the NICHD SECCYD study, particularly between race or ethnicity and poverty status.

Finally, the three process quality measures in this study are different from one another. The ECERS and CLASS scores tend to be moderately to strongly correlated (Pianta et al., 2008), but it is likely that differences in these measures could reduce the likelihood of consistent findings across studies. We nevertheless believe that there is value in including them in our analysis as they are well established and frequently used measures in the early child-care quality literature. The purpose of employing meta-analysis techniques is to combine estimates across studies that have examined the same issue and to ask about the strength of the evidence across a diverse set of studies that include some of the major child-care studies of the last 15 years. We felt it was better to address our important questions in a systematic way even though we acknowledge that the study has limitations.

Conclusion

Our article applies meta-analytic techniques to summarize results from parallel analyses of four recent child-care studies to estimate the following: (a) the magnitude of the association between preschool center quality and child outcomes, and (b) variation in quality impacts by demographic characteristics and child entry skills and behaviors. The consistency of our results and the precision with which they are estimated across the four studies, multiple outcomes, and multiple child-care quality measures suggest the following: (a) there are, at best, very small preschool center quality main effects on child language and mathematics outcomes, and (b) there is generally an absence of *differential* preschool center quality effects on school readiness for subgroups of children defined by demographic characteristics or child entry skills and behaviors.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Appendix S1. Dataset-Specific CONTROLS.

Appendix S2. Regression Tables for the Individual Datasets.