

RUNNING HEAD: Early Child Care

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Early Child Care and Children's Development in the Primary Grades:
Follow-Up Results from the NICHD Study of Early Child Care

NICHD Early Child Care Research Network¹

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Abstract

Effects of early child care on children's functioning from 4½ years through the end of third grade (*M* age = 9.0 years) were examined in the NICHD (National Institute of Child Health and Human Development) Study of Early Child Care. Some effects of early child care that had been detected prior to school entry were maintained through the end of third grade. Higher quality child care continued to be linked with higher scores on standardized tests of math and reading achievement and of memory through third grade. More time periods of center care were associated with better memory, but also with more conflictual relationships with teachers and mothers. Some new effects were detected: More hours of child care were associated with poorer work habits and poorer social skills through third grade. Other effects, such as relations between amount of care and externalizing behaviors and teacher-child conflict, decreased during the primary grades and were not significant in Grade 3. These findings support the relative independence of quality, quantity, and type of child care in relation to child developmental outcomes.

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Questions about possible long-term effects of early child care on school-aged children's functioning are of great interest to parents, educators, and policy makers. These questions have been raised, in part, because of the large numbers of children who are in child care on a routine basis--9.8 million children under the age of 5 years were in child care for 40 or more hours a week in 1999 (Committee on Family and Work Policies, 2003)--and, in part, because there is a lack of agreement about the impact of this experience. Some scholars have argued that effects of early child care are no longer evident in the primary grades (ages 6 to 9 years), whereas others have contended that effects of early child care extend into the primary grades (and perhaps beyond). There also is disagreement/debate about the nature of the effects. Some have reported early child care to be associated with better functioning in the primary grades, whereas others have found it to relate to poorer functioning. Understanding the conditions under which early child care is associated with variations in children's functioning has been a primary goal of the NICHD Study of Early Child Care since its inception in the early 1990s.

The determination of possible linkages between early child care and children's development at the end of third grade is particularly needed because levels of achievement and social adjustment that form by third grade are highly stable thereafter (Entwisle & Alexander, 1999; Rutter & Maughan, 2002). At the same time, large-scale assessments of children's achievement outcomes typically start at third grade in the USA (National Center for Education Statistics [NCES], 2003), reflecting an assumption that prior to third grade children's performance is quite malleable. This assumption is supported by findings demonstrating fairly

low stability of achievement and social performance from pre-k through Grade 2 (La Paro & Pianta, 2001), with an average stability coefficient for achievement in the range of .30 and for social/behavioral adjustment of .20. Stability coefficients generally rise through the middle elementary school years, indicating that individual differences in scores remain fairly consistent after 3rd/4^Pth grade (e.g., Alexander & Entwisle, 1988; Entwisle & Alexander, 1999; NCES, 2003). This body of evidence underscores the importance of identifying those early experiences that help to prepare children for success in the primary grades versus place them at risk.

In an earlier paper published in this journal (NICHD Early Child Care Research Network [ECCRN], 2002), we reported that three aspects of early child care—quality, quantity, and type—were related to children’s school readiness measured at age 4½ years just prior to kindergarten. Higher quality child care was associated with higher pre-academic skills and language performance, whereas more hours in care and increasing hours in care predicted higher levels of behavior problems according to caregivers. More experience in center-type care predicted better language skills and performance on a memory task, but also more problem behaviors.

The purpose of the current report is to extend our ongoing study of the effects of early child care to the primary grades. We ask if the earlier detected effects associated with quality, quantity, and type of care are maintained through Grade 3, if these effects decline over time, or if previously undetected or unexamined effects emerge (i.e., sleeper effects). More specifically, we seek to determine whether effects of early child care are evident on child developmental outcomes during the primary grades, controlling for early family background and for children’s concurrent experiences at home, at school, and after school.

The NICHD Study of Early Child Care is well suited to address these questions.

Information about amount and type of child care was collected every 3 to 4 months from 1 month until school entry. Quality of the children's primary child-care setting (e.g., center, family day care home, nanny in own home) was assessed using observational methods when children were 6, 15, 24, 36, and 54 months of age. Measures of cognitive and social functioning were collected longitudinally at 4½ years, first grade, and third grade (and, for some measures, also in kindergarten and second grade). With these longitudinal measures of child functioning, we are able to ask if the relations we found at age 4½ years are maintained, increase, or decrease during the primary grades in a relatively large and diverse sample. We also consider the possibility that previously undetected or unexamined effects might emerge. Previous studies, which are reviewed in the sections that follow, are consistent with all four possibilities.

Is Child-Care Quality Related to Child Functioning During the Primary Grades?

Other investigators also have considered longer term effects of early child-care quality. One of the largest studies to date is the Cost, Quality, and Outcomes (CQO) Study, a study of children who attended child-care centers of varying quality in four states (Peisner-Feinberg et al., 2001). Quality was measured by observations of classroom practices and by teacher reports of the closeness of the teacher-child relationship at age 4 years. Children's developmental outcomes were then measured at 5, 6, and 8 years ($n = 345$ in Grade 2). Closer teacher-child relationships in child care predicted higher standardized test scores in language and math, and higher cognitive and attention skills as rated by teachers, in child care, kindergarten, and Grade 2. Notably, these effects did not decline over time. Closer teacher-child relationships in preschool also predicted fewer behavior problems and higher sociability in school, but the sizes of those effects did decline over time. These findings, then, suggest some enduring effects (at least through the primary grades) associated with the quality of teacher-child relationships and some decreasing

effects. Because the CQO Study did not include amount of time spent in child care when the quality assessments were made and only considered center-type care, it cannot address issues pertaining to quantity or type of care.

A second longitudinal study (Broberg, Wessel, Lamb & Hwang, 1997) followed 146 Swedish children beginning when they were 16 months to age 8 years. Some children entered center care shortly after the study was initiated, others entered child-care homes, and others never entered care. A cumulative measure of the structural quality of child care (number of children and caregivers in the group) obtained over three time periods (infancy, preschool, primary grades) was used to predict children's verbal and math abilities at age 8 years. Higher structural quality forecast higher math ability at age 8 years, an effect not evident in analyses conducted at 40 months. This work suggests the intriguing possibility of "sleeper" effects.

Other investigations involving small samples also reported relations between child-care quality and child social competencies in the primary grades (Howes, 1988; Vandell, Henderson, & Wilson, 1988). Howes (1988), for example, found relations between structural/caregiver characteristics (i.e., teacher training, child-adult ratio, group size, a planned curriculum, and space) at age 3 years and child functioning in first grade. Children whose early care met more structural/caregiver guidelines had fewer behavior problems and better work habits in comparison to children whose early care met fewer guidelines, controlling for family factors.

At the same time, as noted earlier, some longitudinal studies have not found relations between child-care quality and child developmental outcomes in the primary grades (Blau, 1999; Chin-Quee & Scarr, 1994; Deater-Deckard, Pinkerton, & Scarr, 1996). Several factors may account for these differential findings, including the particular measures used to assess quality and the fact that quality was assessed at a single point in time instead of longitudinally.

In the current investigation, we ask if relations between child-care quality and children's reading and math performance previously detected at age 4½ years in the NICHD Study (NICHD ECCRN, 2002) continue to be evident in the primary grades or if these effects dissipate or disappear. We further ask if early child-care quality is related to social functioning in the primary grades, following up on our earlier finding that higher quality child care was linked to fewer behavior problems at age 3 years but not at age 4½ years (NICHD ECCRN, 1998). Finally, attention focuses for the first time on children's work habits in school, as rated by their first- and third-grade teachers.

Is Quantity or Amount of Early Child Care Related to Child Functioning in the Primary Grades?

A number of investigations have considered relations between amount of child care and children's social and cognitive outcomes in the primary grades (Bates, Marvinney, Kelly, Dodge, Bennett, & Pettit, 1994; Belsky, 2001; Borge & Melhuish, 1995; Vandell & Corasaniti, 1990). In a study of middle-class third grade children (M age = 8 years), Vandell and Corasanti (1990) found that children with more extensive early child care (more than 30 hours a week since infancy) were rated by teachers and parents as having poorer peer relationships, work habits, and emotional health and as being more difficult to discipline. Extensive child care since infancy also was associated with more negative nominations from classmates, poorer academic and conduct grades, and lower standardized test scores. Similar findings were obtained by Bates et al. (1994), who reported more negative adjustment and less positive adjustment in kindergarten in a diverse sample of children who had experienced more hours in early child care across the infant, toddler and preschool years, controlling for SES, maternal stress, and child gender. Finally, in a Norwegian study (Borge & Melhuish, 1995), higher levels of maternal employment in the first 4 years (when child care was typically provided by kith and kin) were associated with higher levels

of behavior problems as reported by teachers at age 10 years. Although suggestive, these studies were limited in that they typically failed to take into consideration the quality of child care that children experienced.

These studies collectively indicate that relations between early child-care hours and problem behaviors may persist in the primary grades. What they do not reveal, however, is whether any such effects might be explained by the quality and type of care that children have experienced, because multiple features of the child-care experience were not subject to examination in a single inquiry. Mitigating against this possibility, somewhat, are our previous reports linking more time in child care with more caregiver-reported problem behavior at age 4½ years (NICHD ECCRN, 2002) and with more teacher- and mother-reported problem behavior in kindergarten (NICHD ECCRN, 2003b) even after controlling for quality and type of care (and a host of family background factors).

Other research raises the prospect that the seemingly adverse effects of amount of time in child care may decrease over time. In a sample of 267 children who were part of a high-risk sample, Egeland and Hiester (1995) found early and extensive child care was associated with more teacher-reported aggression and externalizing behaviors in kindergarten, but these differences were no longer apparent in Grades 3 and 6. In other reports from the NICHD Study of Early Child Care (NICHD ECCRN, 1998, 2003b), we have found higher child hours to be linked to more externalizing problems at several ages (2 years, 4.5 years, and kindergarten), but not at others (3 years).

In the current study, we consider amount of care and increasing and decreasing hours in relation to cognitive and social functioning in the primary grades, controlling for quality and type of care.

Is Type of Early Care Related to Child Functioning in the Primary Grades?

Our third research question asks whether children who experienced different types of early care settings also have different social and cognitive developmental outcomes. Some well-known experimental and quasi-experimental studies have tested the effects of high-quality early education programs on children who were at risk because of family poverty or low birth weight. Beneficial program effects were found for cognitive outcomes during the primary grades, including IQ scores, reading achievement, and math achievement (Campbell & Ramey, 1994; Hill, Brooks-Gunn, & Waldfogel, 2003; Reynolds, 2000; Schweinhart, Weikart, & Lerner, 1986). It was not possible in these studies, however, to ascertain if the program effects were explained by the quality of the setting or the type of setting because quality and type were confounded. In addition, the interventions often included the provision of services beyond high-quality, center-based care. Finally, because only at-risk children were studied, we do not know if similar effects would be obtained in children who are not at risk.

A few nonexperimental studies reveal positive relations between participation in high-quality centers and child developmental outcomes in elementary school (Andersson, 1989; Borge & Melhuish, 1995; Field, 1991). Field considered relations between duration of attendance in a stable high-quality program and grade school behavior and performance in a small, middle-class sample. Children who had attended a university child-care center for more months (beginning in infancy) were reported by their grade school teachers to have more friends and by their mothers to be more assertive and less aggressive than children who had attended the center for fewer months. In a study conducted in Sweden where quality of child care is known to be, on average, higher than in the USA, Andersson (1989) found experience in center care beginning in infancy to be associated with higher verbal skills at age 8 years, controlling for maternal education and

reported parenting. In the aforementioned Norwegian study, amount of experience in centers between 4 and 7 years forecast fewer behavior problems as reported by mothers at age 7 that carried over to age 10 years (Borge & Melhuish, 1995). What cannot be ascertained from these studies is whether effects associated with centers in societies offering rather high-quality care (with highly trained and reasonably paid caregivers) generalize to centers providing care of varying quality in a society in which training and compensation are both limited.

Indeed, not all data on centers point to seemingly positive outcomes, even when care is of high quality. The high-risk children who participated in the high-quality center-based care as part of the Abecedarian intervention study displayed higher cognitive scores (Campbell & Ramey, 1994) but also more aggression in first grade in comparison to children in the control group (Haskins, 1985). In our earlier reports through kindergarten, we also have found center-type care to be associated with higher problem behaviors on the one hand and higher cognitive-linguistic development on the other hand (NICHD ECCRN, 2004b). One thing we seek to determine in this inquiry is whether these seemingly positive and negative effects of center-based care endure—or change—over time.

Alternative Explanations

In all nonexperimental studies of child care, selection bias is an issue because family and child background is related to the type, amount, and quality of care in which children are placed (Committee on Family and Work Policies, 2003). Consequently, in the current study, effects associated with early child care are tested in growth curve analyses in which the child acts as his or her own control and after controlling for an extensive array of family factors. A related concern is that effects may be explained by unmeasured or omitted variables. In the case of school-aged children, concurrent experiences at home, school, or after school may account for

developmental trajectories during the primary grades, rather than the children's earlier child-care histories. For example, quality of classroom instruction in the primary grades may wash out earlier effects associated with child-care quality. Additionally, large amounts of out-of-school care during the primary grades may account for behavior problems in the primary grades rather than earlier child-care hours or experience of center-based care. Consequently, in the current study, measures of the quality of early and concurrent parenting, of the quality of classroom instruction in the primary grades, and of the amount of out-of-school care in the primary grades also were included as covariates.

Method

Participants

Families were recruited through hospital visits to mothers shortly after the birth of a child in 1991 in 10 locations in the U.S. During selected 24-hour intervals, all women giving birth ($n = 8,986$) were screened for eligibility. From that group, 1364 families completed a home interview when the infant was 1 month old and became the study participants. Details of the sampling plan can be found in our 2002 paper in this journal.

The analysis sample for the current study consisted of 872 children. Children were included in these analyses if they had outcome measures collected between 4½ years and Grade 3 and had child-care quality, hours, and type assessed. Data from children were excluded either because the child did not attend child care at any of the five times that quality was assessed ($n = 134$), or because the family had withdrawn from the study ($n = 358$). In the analysis sample, 26% of the mothers had no more than a high school education at time of enrollment; 21% had incomes no greater than 200% of the poverty level at third grade; and 22% were minority (i.e., not non-Hispanic European American). The participants differed from the 492 children who

were recruited but not included in this analysis sample (all differences, $p < .001$). Mothers of participants had more education ($M = 14$ years vs. 13 years) and were more likely to have a husband or partner in the household between birth and 54 months ($M = 0.85$ vs. 0.74). The children were less likely to be African American, non-Hispanic (21% vs. 34%). The families had higher family incomes as determined by their average income/needs ratio between birth and 54 months ($M = 3.72$ vs. 2.70).

Measures

In this subsection, measurements are described in terms of the roles they play in the analyses to be reported. Measures reflecting the child's experiences in child care prior to school entry are described first. Variables used to control for family factors (i.e., family covariates) are described second. Third, measures used to control for school and after-school experiences are described. Finally, child social and cognitive outcome measures are described. Information about this public data set can be found at <http://secc.rti.org/>.

Child-Care Characteristics

Nonmaternal child care was defined as regular care by anyone other than the mother—including care by fathers, relatives, and nannies (whether in home or out of home), family daycare providers, and centers—that was routinely scheduled each week. Three aspects of child care were measured from birth through 54 months: the quantity of care, the quality of care, and the type of care.

Child-care quantity. Parents reported the study children's hours of routine nonmaternal care during the phone and personal interviews conducted at 3-month intervals (called epochs) through 36 months and at 4-month intervals thereafter. The *hours* spent in all settings were summed for each of the 16 epochs and parameterized on an hours-per-week basis.

Child-care type. For each epoch, the child's primary care arrangement was classified as center, child-care home (any home-based care outside the child's own home except care by grandparents), in-home care (any caregiver in the child's own home except father or grandparent), grandparent care, or father care. If a child was in nonmaternal care for less than 10 hours/week, the epoch was coded as maternal care. The proportion of epochs in which the child received care in a center and the proportion of epochs in a child-care home were determined, and both were included as *type of care* predictors in analyses.

Child-care quality. *Quality* was defined by the caregiver-child interaction and stimulation. Observational assessments were conducted in the primary child-care arrangement at ages 6, 15, 24, 36, and 54 months. Quality was assessed during two half-day visits scheduled within a 2-week interval at 6-36 months and one half-day visit at 54 months. Observers completed four 44-min cycles of the Observational Record of the Caregiving Environment (ORCE) per child age through 36 months and two 44-min ORCE cycles at 54 months. Detailed descriptions of the ORCE assessments can be found in NICHD ECCRN (2002), including coding definitions, training procedures, and interobserver agreement. Reliability exceeded .90 at 6 months, .86 at 15 months, .81 at 24 months, .80 at 36 months, and .90 at 54 months.

Maternal, Child, and Family Controls

Early childhood covariates. Measures of maternal, child, and family characteristics during infancy and early childhood were collected and used as controls for possible selection bias: *maternal education* (in years); the study child's *race and ethnicity*; the proportion of epochs through 54 months in which the mother reported a *husband/partner* was present; family income through 54 months calculated as the mean *income-to-needs ratio*; and the intercept and slope of *maternal depressive symptoms* assessed by the Center for Epidemiological Studies Depression

Scales reported by the mother at 6, 15, 24, 36, and 54 months, determined by HLM analyses.

Composite *parenting quality* scores were created by first averaging standardized ratings of observed maternal sensitivity and of observed home environmental quality at 6, 15, 24, 36, and 54 months and then estimating their intercept and slope in HLM analyses. These control variables are described in detail in the earlier report in this journal (NICHD ECCRN, 2002).

Family covariates collected in the primary grades. Measures of family demographic and psychological characteristics also were obtained when children were in kindergarten and first, second, and third grades and included as time-varying covariates in the HLM analyses of child outcomes. These factors were *presence of a husband/partner* in the household, *income-to-needs ratio*, and *maternal depressive symptoms*.

In addition, measures of *parenting quality* when children were in first and third grades were included. Mother-child interactions were videotaped during 15-min semistructured tasks (NICHD ECCRN, 2003a). In first grade, the interaction activities included two tasks that were too difficult for the child to carry out independently and required the parent's instruction and assistance. A third activity was included that encouraged play between mother and child. These activities provided a context for observing the mother's support for the child in activities that could be frustrating but also an opportunity for fun together. Two activities were used to assess maternal sensitivity in third grade. The first was a discussion task of topics that were sources of disagreement between the mother and child, and the second activity was a planning task.

As was the case for the earlier observational assessments, tapes from all data collection sites were shipped to a central location for coding. Teams of five or six coders scored the videotapes from each time period, with some overlapping membership in the teams across the different ages. Coders were blind as to other information about the families. Coders received

intensive training and supervision and met periodically to recode tapes together as a group throughout the period of formal scoring. Complete operational and observation manuals can be found at <http://secc.rti.org/>.

The *Home Observation for Measurement of the Environment* (HOME; Caldwell & Bradley, 1984) was administered during home visits in first and third grades. The focus is on the child in the environment, child as a recipient of inputs from objects, events, and transactions occurring in connection with the family surroundings. Information is obtained during the course of a home visit by means of observation and semistructured interview. A centrally located system of training was used for data collectors at each age. Every four months, observers coded videotaped visits and the coding was compared with gold standard codes. All observers were required to maintain a criterion of scoring like the master coder on 90% of the items. Cronbach alphas for the total score at each age exceeded .77.

The HOME and maternal sensitivity ratings were standardized and averaged at each age to create a composite score. Together, these combined scores reflect parenting in two contexts: in the home and during semistructured play. We have found this composite parenting rating to be a strong and consistent predictor of children's cognitive and social competencies at earlier ages (ECCRN, 2002). Two indices of parenting quality (the intercept and slope) were created from the mean of the standardized scores at each age using HLM. The composite parenting scores from 54 months through third grade were entered as time-varying concurrent controls in the second set of analyses.

Classroom Quality in the Primary Grades

Children's classroom experiences were measured using the Classroom Observation System for First Grade (NICHD ECCRN, 2004a) and the Classroom Observation System for

Third Grade (NICHD ECCRN, in press). These observations focused on the classroom as well as the specific study child and his or her classroom experiences. In first grade, two 44-min observations were conducted during the morning. In third grade, classrooms were observed for eight 44-min cycles distributed across the school day. Seven-point global ratings of the classroom environment (over-control by teacher, teacher's emotional detachment, teacher's sensitivity to student needs) were made at the end of each observation cycle.

Observers from all 10 sites first trained on practice videotapes using a standardized detailed manual and attended a centralized training workshop. All observers passed a videotaped reliability test involving six cases. Average reliability for the teacher and classroom global ratings on the videotaped test was estimated at .63 using a correlation method and .75 using Winer's (1971) method. For more details on the derivation of these composites and the individual scales of which they are composed, see NICHD ECCRN (2004a; in press).

After-school Experience

Mothers were interviewed by telephone in the fall and spring of kindergarten and first, second, and third grades about the study children's out-of-school care. They were asked a series of questions about a number of possible out-of-school care arrangements. In the present study analyses, hours of nonparental out-of-school care arrangements (here named *after-school hours*) were obtained for each school year from the average across the spring and fall reports of the total hours mothers reported across all nonparental out-of-school care arrangements.

Child Outcomes

Cognitive and social outcomes were assessed longitudinally through the spring of third grade.

Academic achievement. With respect to cognitive-academic achievement, children were

administered four subtests from the Woodcock-Johnson Psycho-Educational Battery—Revised at age 54 months and in the spring of first and third grade: *Letter-Word Identification*, which assesses pre-reading skills in identifying isolated letters and words; *Applied Problems*, which measures skill in analyzing and solving practical problems in mathematics; *Memory for Sentences*, a short-term memory test; and *Picture Vocabulary*, which measures children’s ability to name objects depicted in a series of pictures. Items are presented in order of increasing difficulty and are scored 0 = incorrect or no response, or 1 = correct response, with basal and ceiling levels established. Typically, raw scores are converted to standard scores with a mean of 100 and a standard deviation of 15, but for this study we relied upon W ability scores so that change over time could be more easily documented. The W ability scores are transformations of the Rasch raw ability scores designed to eliminate the need for decimal fractions and negative values.

Social skills. The Social Skills Questionnaire from the Social Skills Rating System (SSRS; Gresham & Elliott, 1990) was completed by mothers at 54 months, kindergarten, first grade, and third grade and by teachers at kindergarten, first grade, and third grade. This instrument is composed of 38 items describing child behavior, each rated on a 3-point scale reflecting how often the child exhibited each behavior. Items are grouped into four areas: cooperation (e.g., “Keeps room neat and clean without being reminded”), assertion (e.g., “Makes friends easily”), responsibility (e.g., “Asks permission before using someone else's property”), and self-control (e.g., “Controls temper when arguing with other children”). The total score used in this report represents the sum of all 38 items, with higher scores reflecting higher levels of perceived *social skills* (alpha range from .86-.94).

Behavior problems. The Child Behavior Checklist was completed by mothers at 54

months, kindergarten, first, second, and third grades and by caregivers at 54 months and by teachers in kindergarten through third grade. The parent version lists 113 problem behaviors (Achenbach, 1991a) and the teacher version (Achenbach, 1991b) lists 100 problem behaviors. Both the parent and caregiver/teacher versions contain two subscales: Internalizing Problems (e.g., “Too fearful and anxious”) and Externalizing Problems (e.g., “Argues a lot”). Achenbach reports test-retest reliability of .89, interparent agreement of .70, and stability of .71 over 2 years. Raw scores were converted into standard T-scores, based on normative data for children of the same age.

Conflict with teacher and mother. The Student-Teacher Relationship Scale: Short Form (STRS; Pianta, 2001) was completed by caregivers at 54 months and by teachers in kindergarten, first grade, second grade, and third grade. The STRS is a widely used indicator of a teacher’s perceptions of the quality of his or her relationship with a specific child. In the current report, we focused on teacher-child conflict (e.g., “Dealing with this child drains my energy”), which was assessed by seven items that were rated using 5-point Likert scales. A parallel version of the STRS was completed by mothers at 54 months, kindergarten, first grade, and third grade. Coefficient alphas for the Conflict subscale ranged from .88 to .91 across grades.

Work habits. Teachers completed a 19-item mock report card in kindergarten and first, second, and third grades. This questionnaire includes six items addressing the child’s *work habits*. The items, each rated on a 5-point scale (1 = *very poor* to 5 = *very good*), were taken from Madison (Wisconsin) Metropolitan School District report cards. The six items include “Follows classroom procedures,” “Works well independently,” “Works neatly and carefully,” “Uses time wisely,” “Completes work promptly,” and “Keeps material organized.” Scores were based on the mean of the items at each age. Coefficient alphas were high, ranging from .94 to

.95.

Socio-emotional functioning. Teacher-reported social-emotional functioning was obtained from the mock report cards completed in kindergarten through third grades. The seven items addressing *social-emotional functioning* were from the Teacher Checklist of Peer Relations (Coie & Dodge, 1988) and rated on a 5-point scale (1 = *very poor* to 5 = *very good*). Items addressed the children's social skillfulness with peers and included items such as "Generates good quality solutions to interpersonal problems" and "Is aware of the effects of his/her behavior on others."

Results

Descriptive Analyses

The descriptive statistics for all child care and family measures from the early childhood period are shown in Table 1 and for all academic and social outcomes and concurrent school and family characteristics in Table 2. The correlations among the child-care variables, the family and school covariates, and the child outcomes are reported in Table 3. As shown in the top half of this table, children who were in child-care centers or child-care homes for more epochs tended to experience more hours of care per week. Children who experienced more hours of care during early childhood were more likely to spend more hours per week in after-school care. The bottom half of the table presents correlations between child-care/school experiences and family characteristics from both early childhood and the primary grades. The concurrent characteristics from Grade 1 only are presented to preserve space because very similar correlations were obtained when we examined concurrent characteristics from 54 months and Grade 3. The strongest positive correlations are between the child-care quality intercept and the quality of parenting. The strongest negative correlations were between mothers having a husband/partner in

the household and amount of nonparental after-school care.

Table 4 shows the correlations among the outcome measures. To conserve space, we present these only for outcomes collected in first grade, but similar correlations were obtained at all ages. High correlations were observed among the academic and cognitive scales from the Woodcock-Johnson scales, among maternal ratings of social-emotional outcomes, and among teacher ratings of social-emotional and classroom behavior outcomes.

The final table of correlations, Table 5, shows the correlations between child outcomes in first grade and all selected early child-care indices, school and after-school measures, and early childhood and concurrent school-age family characteristics. The hours/week of child care (intercept) correlated negatively with teacher ratings of social skills, emotional adjustment, and work habits. The quality of child care (intercept) correlated positively with the child's scores on the standardized achievement/cognitive test battery and with teacher ratings of social skills and work habits. Special caution is warranted before interpreting these simple correlations, as they do not take into account, as will the forthcoming primary analyses, known confounding between family background factors and child-care experiences.

Longitudinal Analyses of Early Child Care and Family Characteristics

Our primary data analyses tested the long-term associations between child-care experiences during the first 4.5 years and children's academic and social development from 4.5 years through the spring of the third grade. Longitudinal analyses reported in this paper were conducted using hierarchical linear models (HLM; Bryk & Raudenbush, 2002; Singer & Willett, 2003) that were fitted to estimate individual and group growth curves. Twelve longitudinal child developmental outcomes were considered: four cognitive/academic standardized test scores, three maternal ratings of social skills and behavior problems, and five teacher ratings of social

skills, behavior problems, and work habits. The HLM estimated linear and quadratic group growth curves for each outcome. Individual intercepts and linear slopes with respect to age were estimated as random effects for each child for each outcome. The individual intercepts and slopes were allowed to be correlated. The developmental outcome trajectories were centered at spring of first grade, that is, the main effect coefficient for the tested child-care parameters indicates the extent to which that variable related to the outcome in the spring of first grade. In addition, interactions with age were tested. The absence of any interaction between a child-care variable and child age indicates that the main effect of the child-care predictor on the outcome in question was comparable from 54 months to Grade 3 and thus does not simply reflect the effect of the predictor on the outcome measured in first grade. A significant age by child-care variable effect indicates that effects were not comparable at different ages. Age was centered at spring of first grade rather than spring of third grade because centering at the mean age maximizes power to detect main effects. When interactions with age were detected, we also tested whether the association between that child-care predictor and the child developmental outcome was significant at the endpoint, namely, at third grade.

The predictors of primary interest were the five child-care parameters used in the previous paper published in this journal (see p. 147 for details of the HLM analyses that yielded these estimates): the child-care quality intercept (estimated quality of child care at 27 months), the hours/week intercept (estimated hours in care at 27 months), the hours/week slope (estimated linear change over time in hours per week), proportion of epochs in center-based child care for at least 10 hours per week, and proportion of epochs in a child-care home for at least 10 hours per week. Missing predictor values were estimated by computing the mean of the surrounding values (e.g., income for second grade was estimated as the mean of income for first and third grade),

and all predictor variables and covariates were centered at the sample mean to enhance interpretation of main effects.

Three sets of analyses were conducted to address three related questions: (a) Do early child-care quality, quantity, and type predict child outcome trajectories from 4.5 years through third grade when early family factors are controlled? (b) Do child-care quality, quantity, and type predict child outcome trajectories when both early experiences and concurrent experiences are controlled? (c) Do child-care quality, quantity, and type interact with each other or with gender or with concurrent schooling quality in predicting child outcome trajectories?

In the first model, covariates that were used in the previous AERJ paper were used as controls: site, child ethnicity, child gender, maternal education, mean income/needs between 6 and 54 months, parenting intercept and slope between 6 and 54 months determined from prior HLM analyses, and maternal depressive symptoms intercept and slope between 6 and 54 months determined from prior HLM analyses. The second model added concurrent family, school, and after-school covariates collected in the primary grades to the covariates in the initial analyses. The time-varying concurrent covariates in first and third grades were family income/needs ratio, observed parenting, maternal depressive symptoms, observed classroom quality, and hours/week of after-school care. A third set of models tested the interaction terms.

Results regarding child-care experiences were so similar across the two models that only results from the analyses that included both early childhood and concurrent covariates are reported in Table 6. The results from analyses that included only the early childhood covariates are available from the authors on request. Listed in Table 6 are the coefficients for the main effects and interactions with age for child-care quality, child-care hours, the proportion of epochs of center care, and the proportion of epochs in child-care homes. Results involving the child-care

hours slope are not listed because none of the coefficients were significantly different from zero. Coefficients that were significant ($p < .05$) are bolded. The main effect coefficient represents the estimated association between that aspect of child care and children's outcomes in first grade. The age interaction coefficient simultaneously describes the extent to which the association between that aspect of child care and children's outcomes changed from 54 months through Grade 3 and the extent to which the linear change in the child's score is related to that predictor. When interactions with age were detected, we also tested whether the association between that child-care variable and the outcome was significant at the endpoint, third grade.

When variables of interest showed interactions with age, we plotted the estimated growth curve for a priori selected values for the child-care variables (Aiken & West, 1991). This approach allows for a visual representation of interactions between age and continuous variables in a way that illustrates findings from the analysis that produced those interactions. The a priori selected values corresponded to the values used in the previous AERJ paper: 10 and 30 hours per week for child-care hours; 0 and 33% of the time in that setting for proportion time in center care and in child-care homes; and bottom and top tercile (2.75 and 3.0) for child-care quality.

In addition, effect sizes were estimated to describe the association between each child-care parameter and child outcome at three ages (Gutman, Sameroff, & Cole, 2003). The effect sizes were computed as the product of the estimated child-care coefficient at each of the three ages and the standard deviation for the child-care index divided by the standard deviation for the outcome measure, and can be interpreted somewhat like a correlation. They represent the predicted change in standard deviation units of the outcome if that aspect of the child-care experience changed by one standard deviation. Note that effect sizes from the three ages should be regarded as reliably different only when the interaction between that child-care characteristic

and age was statistically significant.

Child-care quality. The first set of rows in Table 6 presents the child-care quality regression coefficients and effect sizes from the HLM analyses. The first row (labeled “CC Quality”) presents the estimated quality coefficient and standard error, and reflects the extent to which quality is associated with the outcome in first grade. The second row (labeled “CC Quality x Age”) lists the estimated quality x age coefficient and standard error, and reflects the extent to which the association between quality and outcomes changes linearly over time. The next three rows (labeled ES for effect size) present the age-specific effect sizes for the quality association.

As shown, children who had experienced higher quality care had significantly higher math (Applied Problems), vocabulary (Picture Vocabulary), and memory (Memory for Sentences) skills than children who had experienced lower quality care. These main effects of child-care quality appear to remain relatively consistent from 54 months through third grade; no significant age x child-care quality interactions were detected. The associations between child-care quality and later academic achievement were modest as the effect sizes (ranging from .07 to .09) demonstrate. Child-care quality was not related to mother or teacher reports of social functioning.

Child-care quantity. The next block of rows in Table 6 shows the regression coefficients and effect sizes associated with child-care hours. Teachers rated children with more hours of child care as having more externalizing behaviors, fewer social skills, more conflict with the teacher, and less adaptive work habits. Effect sizes tended to be modest (ranging from .01 to .12).

In analyses of two of these outcomes, externalizing behaviors and teacher-conflict, the magnitude of the association between the child-care hours intercept and child functioning

declined over time, as revealed by a significant interaction between age and child-care hours. At the last assessment age—third grade—child-care hours was no longer significantly related to teacher ratings of externalizing behaviors or conflict. Figures 1 and 2 illustrate these hours x age interactions by showing the estimated group growth curves for children who experienced child care for 10 hours/week and for 30 hours/week for externalizing behaviors and teacher-child conflict, respectively. (Ten and 30 hours were selected because they correspond to those featured in our previous AERJ paper and are cited in the literature as distinguishing low and high hours.)

As shown in Figures 1 and 2, children with more hours of care showed more externalizing behaviors and teacher conflict at entry to school. However, the children with fewer hours of child care showed a slightly larger increase in externalizing score between kindergarten and third grade than did children with more hours of care (see Figure 1). In contrast, as shown in Figure 2, children with more hours of child care showed a slightly larger decline in conflict with the teacher between kindergarten and third grade than did children with fewer hours of care.

Child-care type. As shown in the third block of rows in Table 6, children who spent more epochs in center-type care obtained higher scores on the memory test. In addition, children who experienced more epochs in center care were reported to have more conflicts with mothers and with teachers and to have more externalizing behavior problems according to the teacher. Again, this association appeared modest and consistent over time for three of these four outcomes, with effect sizes ranging from .01 to .13.

The association between time in center care and teacher report of conflict changed reliably over time, as evidenced in the significant center x age interaction. By third grade, proportion of time in center care was not statistically related to teacher ratings of conflict. Figure 3 shows predicted growth curves for children with no center care and for center care for 33% or

more of the epochs. As shown, children with more center care had significantly more conflict with caregivers/teachers at 54 months than did children without center care. However, children with more center care showed slightly more decline over time in conflict with teachers than did children with no center care.

The final set of rows show the coefficients and effect sizes associated with the proportion of time in child-care homes. Children who spent more time in child-care homes were reported as having more conflictual relationships with teachers than children who spent less time in child-care homes. This association did not change reliably over time. A significant child-care home by age interaction was obtained for teacher reported social-emotional skills. Teachers rated children who spent more time in child-care homes as showing increases in social-emotional skills over time relative to children who spent less time in child-care homes. Figure 4 shows predicted growth curves for children with no child-care home experience and those who were in child-care homes at least 33% of the epochs. As shown, children with more experience in child-care homes showed larger gains over time in their social-emotional skills than did children who had not attended a child-care home.

Interactions Between Child-Care Parameters

No significant interactions between child-care parameters were detected. Consequently, these results are not tabled or discussed.

Interactions between Child-Care Parameters and Child Gender

None of the reported associations changed when gender interactions were included, and none of the child-care variables showed interactions with gender.

Interactions between Child-Care Parameters and Current Classroom Quality

No significant interactions were detected.

Discussion

When the NICHD Early Child Care Research Network (2002) reported in this journal its prior findings linking early child-care experience with children's development at age 54 months, we concluded that "early child care is associated with both developmental risks and developmental benefits for children's functioning prior to school entry. The risk is that more hours in child care across the first 4½ years of life is related to elevated levels of problem behavior at 4 ½ years. The benefit is that higher quality child care, quality that improves over time, and more experience in centers predicts better performance on measures of cognitive and linguistic functioning." How do the results of the current follow up of children through third grade accord with these earlier conclusions?

Before addressing this question, readers should remain alert to the fact that that our findings are correlational in nature and do not allow us to infer causality. Correlational studies, however, can guide the generation of evidence-based hypotheses that can be tested with experimental designs and in domains in which experimental studies are either very difficult or unethical, such studies may guide practice. Readers also should remain alert to the fact that the effect sizes reported in the current paper (and in the earlier paper) are small but that this does not necessarily imply that they are without scientific and practical significance. After all, small effects that are pertinent to many may be of greater consequence to schools, communities and society than large effects that apply to few (see McCartney & Rosenthal, 2000). With so many children being in child care, often beginning at an early age and for long hours, and with about 60% of this care not characterized by sensitive and responsive caregiving (NICHD ECCRN, 2000), we believe that the detected effects of child care presented in this report (and our previous ones) merit scientific and public attention.

Consistent with the our findings prior to school entry (NICHD ECCRN, 2002), we found that relations between child-care quality and cognitive development were maintained through grade three as revealed by the Woodcock-Johnson subtests of applied problems (mathematics), picture vocabulary (reading) and memory for sentences (cognitive processes). Indeed, no quality-by-age interactions emerged during the primary grades, indicating that the positive effects of good quality child care neither dissipated nor intensified over this time period. Thus, it appeared that children who experience better (rather than poorer) quality of child care in their first 4 ½ years of life continued to manifest somewhat greater (rather than poorer) academic achievement across the primary grades than other children. That these cognitive and academic advantages are sustained through third grade is notable because reading and math competencies at the end of third grade are highly predictive of future academic performance (Alexander & Entwisle, 1988; Entwisle & Alexander, 1999; NCES 2003). It will be important to determine if these cognitive advantages are caused by child care and if they set the stage for further success in the later grades.

As in our earlier report dealing with children's functioning at age 4 ½ years (NICHD ECCRN, 2002), we did not find higher quality of care to be associated with enhanced social competence or with fewer behavior problems in the primary grades, after we controlled for quantity and type of child care. Although it is possible that lack of associations in the primary grades might be a function of the fact that especially poor quality child care was under-represented in the NICHD SECC, due to the non-random refusals of some child-care arrangements to let us observe them, this interpretation is at odds with the fact that positive associations between quality of care and children's social-emotional development were detected at age 24 and 36 months (NICHD Early Child Care Research Network, 1998). Moreover,

refusals to observe in the children's child-care arrangements became relatively rare as the children matured. That the NICHD Study of Early Child Care has previously found effects detected at one age, which disappeared at a later age to re-emerge at still a later age, cautions against drawing null conclusions regarding quality of child care and its potential long-term effects on children's social-emotional development.

Turning now to center-based care, the findings presented in this report indicate that the previously detected links between being in center care and cognitive and academic outcomes were maintained to some extent. Children who participated in center-care during more epochs tended to score higher on a standardized short-term memory test during the primary grades as they had prior to school entry. This effect, like the associations between quality and children's memory skills, did not decline during the primary grades. Children appeared to be carrying forward this early advantage.

In other respects, however, the current findings stand in contrast to our findings prior to school entry. In our earlier reports (2002, 2003), more time spent in child care predicted higher levels of problem behavior according to caregivers at 54 months and according to mothers and teachers at kindergarten. These earlier-detected relations appeared to dissipate during the primary grades. By the time children were evaluated in third grade, the effects of time in child care on teacher-reported externalizing problems and on teacher-child conflict were no longer statistically significant, nor was that of center-care experience on teacher-child conflict.

We again counsel caution in drawing firm conclusions with regard to the disappearance of an earlier-detected child-care effect. As noted above, in this longitudinal study effects associated with early child care have seemingly disappeared only to reappear at later periods. Because development is dynamic, we should not be surprised that effects are more in evidence at

some periods than others. Differences in child functioning are often more in evidence during developmental transitions, such as the start of school, than in periods of relative stability (Caspi, 1998).

In other related domains, relations with child-care hours and type continued to be in evidence. In particular, more hours in child care was related to lower levels of social skills as reported by teachers through Grade 3 and more center-care experience predicted higher mother-child conflict and more teacher-reported externalizing behaviors through Grade 3. Importantly, these main effects of amount and type of care were not moderated by age, suggesting no significant change in effect sizes over time.

Finally, the current analyses revealed relations between child-care hours and children's work habits, a domain that we had not assessed prior to school entry. Consistent with Vandell and Corasaniti's results in the primary grades (1990), we found that children who spent more hours in early child care were reported by their teachers to have poorer work habits as measured by items such as "works well independently", "uses time wisely", and "completes work promptly". These associations are notable because children's work habits by the end of the primary grades are building blocks for later success at school.

The dissipating—indeed, disappearing—effect of amount of care on teacher-reported externalizing problems and teacher-child conflict seems worthy of some additional consideration. These decreases could be the result of three distinct statistical patterns. First, those children with and without the treatment (i.e. high hours in child care) could regress towards the mean over time. Second, those who showed higher levels of problem behavior at an earlier measurement occasion, in this case those who have spent more hours in child care, could decline in their level of problem behavior over time, mirroring in some sense those with less extensive

child-care histories who previously showed lower levels of problem behavior, perhaps because of time spent together in school. Third, those who experienced lower levels of child care and of problem behavior could come to resemble those with the opposite profiles, increasing in problem behavior over time to more or less catch up with those with more extensive histories of child care.

With respect to teachers' reports of teacher-child conflict, evidence pertaining to dissipating adverse effects of child care were consistent with the second possible pattern, namely that, by third grade, children with higher hours and more center care came to resemble children with fewer hours and less center-care, consistent with the proposition that children with high hours and high center care come to resemble children with less child care. With respect to children's externalizing behaviors, the pattern was consistent with the third possibility. That is, the externalizing scores of children with low child-care hours increased over time and did not differ by third grade from the scores of children with high child-care hours.

We know of no work that examines how behavior patterns change over time when children with less extensive child-care experiences enter school and become classmates with children with more extensive child-care histories. The fact that teacher-child conflict shows one pattern and externalizing problem behavior a different pattern suggests that processes influencing one outcome are unlikely to be those influencing the other. This would seem especially so given the fact that the same respondent—caregivers/teachers—completed both reports at each time of measurement. Obviously, the need for additional research and, of course, continued follow up of the current sample is called for.

With the exception of an elegant study by Kellam and associates (Kellam, Ling, Merisca, Brown, & Ialongo, 1998) on the psychopathological effects of being in first grade classrooms

marked by high levels of aggression, it appears that very little research has addressed, at least in the primary school years, how the behavioral make-up of a classroom influences the behavioral functioning and development of children in the classroom. It will be useful for child-care researchers to work with those who study schooling to better illuminate the dynamics of classrooms and the determinants of children's behavior within them.

Conclusion

Once again we are left to conclude that early child care is associated with both advantages and disadvantages, having discerned evidence of consistent (but small) effects of child-care experience through the primary grades. The disadvantage is that more hours in child care across the first 4 ½ years of life is related to lower levels of teacher-rated social skills and poorer academic work habits through third grade and that more experience in center-based care is related to more mother-child conflict and teacher-rated externalizing problems. The advantage is that higher quality child care predicts better academic achievement, as revealed by standardized achievement test scores through third grade, and that more exposure to center-based care is associated with enhanced memory. It remains to be determined if these relations with early child care remain, dissipate, or grow in early adolescence, a critical transition period for many children. Because schooling is cumulative in nature with individual attainment increasingly stable with time, it will be important to determine if the observed academic advantages bring greater advancement over time and if the initial disadvantages in the socio-emotional domain are difficult to reverse.

Author Note

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