

The Relation of Preschool Child-Care Quality to Children's Cognitive and Social Developmental Trajectories through Second Grade

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The cognitive and socioemotional development of 733 children was examined longitudinally from ages 4 to 8 years as a function of the quality of their preschool experiences in community child-care centers, after adjusting for family selection factors related to child-care quality and development. These results provide evidence that child-care quality has a modest long-term effect on children's patterns of cognitive and socioemotional development at least through kindergarten, and in some cases, through second grade. Differential effects on children's development were found for two aspects of child-care quality. Observed classroom practices were related to children's language and academic skills, whereas the closeness of the teacher-child relationship was related to both cognitive and social skills, with the strongest effects for the latter. Moderating influences of family characteristics were observed for some outcomes, indicating stronger positive effects of child-care quality for children from more at-risk backgrounds. These findings contribute further evidence of the long-term influences of the quality of child-care environments on children's cognitive and social skills through the elementary school years and are consistent with a bioecological model of development that considers the multiple environmental contexts that the child experiences.

INTRODUCTION

As the use of nonparental child care has risen in the United States, the long-term effects of preschool child-care experiences, especially center-based child care, has been a topic of growing interest to the general public as well as to the research community. A substantial majority of children now regularly experience center-based child care prior to school entry, with even higher rates for preschool-age children than for infants and toddlers. Recent estimates indicate that more than half of all 3- to 5-year-old children in the United States attend child-care centers prior to kindergarten, representing three quarters of the preschool-age children in out-of-home care (West, Wright, & Hausken, 1995). Given these high usage rates, the quality of these early child-care experiences has become an important public policy issue in the United States. Of particular interest for research in this field is the extent to which variations in the quality of these preschool child-care experiences influence children's readiness for and success in school.

A key question for parents, professionals, and policy makers involves the long-term impact of child-care experiences on the transition to and success in school. Examination of children's performance in kindergarten can provide information about the influences of earlier experiences on the transition to school, whereas examination of children's performance in second to third grade provides information about their school success. The mid-elementary school years

(second and third grade) seem to be the point in children's school careers when academic trajectories become more stable, and accordingly, more difficult to change (Alexander & Entwisle, 1988). Therefore, examining children's developmental status at this time point provides a good indication of the long-term effects of child-care experiences on children's school success.

Whereas several studies have explored the longitudinal effects of early intervention programs, few have examined the effects for children attending community child-care programs as they make the transition from preschool to school. A number of studies of early intervention programs for low-income children have found some long-term positive effects on children's cognitive development and academic achievement at least through the third or fourth grade and sometimes longer, especially for indicators of school success such as retention in grade, special education placement, and intellectual functioning (e.g., Burchinal, Campbell, Bryant, Wasik, & Ramey, 1997; Campbell & Ramey, 1994; Lazar, Darlington, Murray, Royce, & Snipper, 1982; Schweinhart, Barnes, & Weikart, 1993).

Research involving community child-care settings provides a more typical picture of the preschool experiences of a broad cross-section of children in this country, and provides necessary information for un-

derstanding variations in the developmental patterns of children and their success in the early school years. The literature on the long-term effects of child-care center quality contains mixed results from studies mostly conducted outside the United States: some studies found lasting effects through elementary school age (e.g., Broberg, Wessels, Lamb, & Hwang, 1997; Vandell, Henderson, & Wilson, 1988), although others did not (e.g., Chin-Quee & Scarr, 1994; Deater-Deckard, Pinkerton, & Scarr, 1996).

A few studies addressed this issue longitudinally for preschool-age child care, examining the long-term influences on both cognitive and socioemotional development, after adjusting for child and family factors known to be linked to both child outcomes and child-care quality (i.e., family selection factors such as socioeconomic status, gender, and ethnicity). In a study of Swedish children, child-care quality prior to school entry related positively to children's math abilities at 8 years of age, whereas verbal ability at age 8 related positively to the amount of center-based child care received before age 3½ (Broberg et al., 1997). Interestingly, these relations between child-care experiences and cognitive development were not obtained in studies of this same group of children at earlier ages; other studies have similarly found such "sleeper effects" (e.g., Andersson, 1989). In contrast, a study of children in Bermuda found that neither amount nor quality of preschool child care related to teacher report card ratings of children's academic achievement and social competence through the first 4 years of elementary school, although child-care quality was related to children's concurrent development while in child care (Chin-Quee & Scarr, 1994).

Other studies of socioemotional functioning have shown little or very modest longitudinal effects of child-care quality when family background factors were controlled. In a study of Canadian children, Jacobs and White (1994) found that better child-care center quality was marginally related to greater compliance in kindergarten. In a 4-year longitudinal follow-up of children in the United States, child-care center quality was not related to subsequent parent or teacher ratings of relatively low-frequency indicators of behavioral maladjustment, behavior problems, and social withdrawal (Deater-Deckard et al., 1996).

Although there are relatively few longitudinal studies, the relations between children's concurrent development and center-based child-care experiences have been extensively documented in the child-care literature. A number of studies have established that child-care quality has modest positive effects on children's cognitive and social functioning, after adjusting for child and family background factors. Several

studies have found that higher quality care is related to better child outcomes in the short term (e.g., Bryant, Burchinal, Lau, & Sparling, 1994; Dunn, 1993; Howes, 1990; McCartney, Scarr, Phillips, & Grajek, 1985; NICHD Early Child Care Research Network [ECCRN], 1998a, 2000; Phillips, McCartney, & Scarr, 1987; Schliecker, White, & Jacobs, 1991; Whitebook, Howes, & Phillips, 1989). Although most studies have found influences of child-care quality on children's outcomes, a few have found little effect (Clarke-Stewart & Gruber, 1984; Goelman & Pence, 1987; Kontos, 1991; Kontos & Fiene, 1987), perhaps because of restricted ranges of quality across the centers in these studies, relatively small sample sizes of centers, or both.

In addition to documenting whether child-care quality is related to later performance, it is useful to determine whether family characteristics moderate the influence of child-care experiences. Of particular interest is the issue of whether child-care quality is more strongly related to developmental outcomes among some groups of children, such as those who may already be at greater risk for less optimal development. Only a few of the studies that related child-care quality to concurrent child outcomes, and none of the studies that followed children to school, examined this question. A Swedish study found that child and family characteristics moderated the influence of child-care quality at 29 months on measures of socioemotional functioning at 4 years of age (Hagekull & Bohlin, 1995). Better quality child care had a stronger compensatory influence on ratings of aggressive behavior for children from lower socioeconomic homes and on ratings of internalizing problems and ego strength and effectance for boys. In some cases, similar results were found for younger children, indicating that the attachment security of infants from higher risk home environments was more affected by the quality of child care (NICHD ECCRN, 1997), although subsequent studies did not find such moderating effects for other socioemotional and cognitive outcomes with the same sample (NICHD ECCRN, 1998a, 2000).

However, none of the existing studies addressed the issue of long-term effects following school entry for a large sample of children in the United States. The present study was designed to examine the relation of child-care center quality in the preschool years to children's cognitive and social skills through second grade, using a relatively large sample of children in the United States. We controlled for child and family background characteristics and, further, examined whether they had any moderating effects on the influences of child-care quality. Two different aspects of child-care quality were considered in the design—

classroom practices and teacher–child closeness—to determine whether they were differentially associated with children’s development. In addition, none of the previous studies had considered the impact of later school environments when examining the longitudinal effects of child care. Therefore, we also explored the extent to which the quality of earlier child-care environments and subsequent kindergarten and second-grade school environments contributed to children’s developmental outcomes in second grade. These additional analyses provided information about the extent to which the effects of child care reflected long-term influences of early experiences versus continuity in earlier and later environments.

Our research design was guided by a bioecological theoretical perspective (Bronfenbrenner & Morris, 1998), in which development is viewed as the interactions, or proximal processes, that occur between individuals and their environments. The influence of these processes on development varies as a function of person characteristics (measured here as child background characteristics), environmental contexts (measured as family background characteristics and child-care quality), and the time periods in which these processes occur (measured both concurrently in child care and longitudinally from preschool through second grade).

The three major research questions addressed by this study were (1) Is the level of child-care quality in preschool related to children’s patterns of cognitive and social development between the ages of 4 and 8 years? (2) How long term are the influences of child-care quality? and (3) Are there differential effects of child-care quality on developmental outcomes for children at greater risk? We anticipated that better quality care in preschool would be longitudinally related to better cognitive and socioemotional outcomes for children, after adjusting for family selection factors and child characteristics. In addition, we believed that these background factors would display moderating influences, so that child-care quality would be more strongly related to cognitive and social skills for children at greater risk for less optimal developmental outcomes.

Further, none of the previous studies had considered the impact of later school environments when examining the longitudinal effects of child care. Therefore, in an additional set of analyses, we explored the extent to which earlier child-care quality predicts children’s cognitive and social development in second grade, after taking into account subsequent (kindergarten) and concurrent (second grade) school environments. These additional analyses provided information about the extent to which the effects of child care

reflect long-term influences of early experiences versus continuity in earlier and later environments.

METHOD

The present research is part of the Cost, Quality, and Child Outcomes (CQO) in Child Care Centers Study, a study of center-based community child care and children’s longitudinal outcomes in four states in the United States. The data included measurement of preschool child-care quality and longitudinal assessments of children’s language, cognitive, and socio-emotional functioning over a 5-year period from preschool through second grade. The data were gathered in five phases: (1) measures of the quality of preschool environments during children’s next-to-last year in preschool, (2) assessments of children’s developmental outcomes during their next-to-last year in preschool (at about age 4), (3) assessments of children’s developmental outcomes during their last year in preschool (at about age 5), (4) assessments of children’s developmental outcomes during kindergarten (at about age 6), and (5) assessments of children’s developmental outcomes during second grade (at about age 8). In addition, brief measures of the quality of children’s kindergarten and second-grade school environments were gathered during Phases 4 and 5.

Participants

The participants included the children and families who participated in the longitudinal outcomes component of the CQO study, which examined children’s development from preschool through second grade. An initial sample of 401 child-care centers was randomly selected from four regions in the United States: Los Angeles County in California, the Hartford corridor in Connecticut, the Frontal range in Colorado, and the Piedmont region in North Carolina. These regions were selected because they varied widely in both economic climate and the stringency of state regulations regarding child care (e.g., at the time, mandated staff–child ratios for 4-year-olds varied from 1:10 in Connecticut to 1:20 in North Carolina).

The outcomes component of the CQO study included a subsample of 183 of the selected preschool classrooms in 176 of the 401 centers. Only children with complete data on all of the preschool quality measures and with at least some child assessment data and parent survey data were included in the analysis sample, which included 167 classrooms from 160 centers. The mean number of participating children per classroom was 4.4 ($SD = 2.4$, $range = 1–12$). Classrooms were eligible if they served at least one child in

the next-to-last year of preschool (i.e., eligible for kindergarten in the second subsequent school year). Center refusal rates for the longitudinal outcomes component were modest; for example, of the eligible centers contacted in North Carolina, 18% refused to participate in this phase of the data collection.

Once a center and classroom teacher agreed to participate, consent forms were sent home to parents of all potentially eligible children, with up to 12 children randomly selected from each classroom. The four criteria for inclusion were (1) children were eligible to enter kindergarten in the second subsequent school year, (2) children were enrolled in the classroom during the quality observations, (3) parents expected to continue at that center the following year, and (4) the primary language spoken at home was English. Refusal rates were low; for example, of those eligible to participate in North Carolina, 7% of the parents or children refused (for further description of the sampling procedures, see Peisner-Feinberg & Burchinal, 1997).

The present study examined data over a 5-year period (i.e., from the 3-year-old year in preschool through second grade), which included 826 children in preschool Year 1, 579 in preschool Year 2, 451 in kindergarten, and 418 in second grade. Due to missing classroom or teacher data, the analysis sample included fewer children: 733 in preschool Year 1, 499 in preschool Year 2, 399 in kindergarten, and 345 in second grade. The average age of children each year was 4.3 ($SD = .36$), 5.1 ($SD = .34$), 6.0 ($SD = .34$), and 8.0 ($SD = .34$) years old, respectively, at the time of the child assessments. The average age at entry into child care was about 8 months ($M = .65$ years, $SD = .85$). The sample was approximately evenly divided by gender (51% male), and about 31% of the children were from diverse ethnic groups. Comparisons to recent Census data (Bryson & Casper, 1997) suggest that the sample was similar to U.S. families in general, with about 82% of the children living in two-parent families (versus 72% nationally for families with children under 18 years), average maternal education of 14.25 years (compared with 13 years for women in the United States), and average family income of \$47,753 (versus median income of \$37,500 for all U.S. households).

Procedure

Data collection took place in two phases during Year 1, with child-care quality data gathered from classrooms first, and child outcomes data gathered from children, teachers, and parents second. Three subsequent phases of child outcomes data collection were conducted during children's last year in

preschool, in kindergarten, and in second grade. In addition, a more limited set of information about elementary school quality was gathered from children's kindergarten and second-grade classrooms and teachers.

Child-care classroom observations. Teams of six to eight assessors from each of the four sites were trained during a week-long session. Interrater reliability visits were conducted at the midpoint of data collection, and included both within- and between-state assessments. Two assessors observed each classroom for approximately 3 to 4 hr in a single visit. One assessor gathered the first three measures, and the other collected the last (described below).

Child-care classroom practices measures. Four observational measures of the process quality of classroom practices were used: (1) classroom environment was measured using the Early Childhood Environment Rating Scale, or ECERS (Harms & Clifford, 1980); (2) teacher sensitivity was measured with the Caregiver Interaction Scale, or CIS (Arnett, 1989); (3) child centeredness was measured by the UCLA Early Childhood Observation Form, or ECOF (Stipek, Daniels, Galuzzo, & Milburn, 1992); and (4) teacher responsiveness was measured with the Adult Involvement Scale, or AIS (Howes & Stewart, 1987). These instruments are widely used and have been shown to relate to other measures of child-care quality and to children's outcomes (Arnett, 1989; Bryant et al., 1994; Dunn, 1993; Howes & Stewart, 1987; Schliecker et al., 1991; Stipek et al., 1992; Whitebook et al., 1989).

The quality of the classroom environment was measured by the ECERS, which examines the developmental appropriateness of classroom practices, including the activities, materials, equipment, interactions, supervision, organization, and scheduling for children. The ECERS contains 37 items in seven subscale areas: personal care routines (greeting/departing, meals/snacks, nap/rest, diapering/toileting, personal grooming); furnishings and display (furnishings for routine care, learning, and relaxation; room arrangement); language development (understanding language, using language, reasoning, informal language); fine and gross motor development (fine motor activities and supervision; gross motor space, equipment, time, and supervision); creative activities (art, music/movement, blocks, sand/water, dramatic play, schedule, and supervision); social development (space to be alone, free play, group time, cultural awareness, tone, provisions for exceptional children); and adult needs (adult personal area, adult opportunities, adult meeting area, provisions for parents). Each item is rated on a 7-point scale from inadequate (1) to excellent (7). Psychometric analyses in-

dicated that a single total score of the child-related items (1–32) most parsimoniously represented our data, Cronbach's $\alpha = .96$, with scores of 1.0 to 2.9 defined as poor quality, 3.0 to 4.9 defined as mediocre quality, and 5.0 to 7.0 defined as good quality (i.e., in the range of developmentally appropriate practices). Interrater reliability (correlations between raters) ranged from .83 to .98 for the total score, with a median of .94.

Teacher sensitivity was rated using the CIS, with 26 items measuring four subscales: teacher sensitivity (e.g., speaks warmly to children), harshness (e.g., seems critical of the children), detachment (e.g., doesn't seem interested in children's activities), and permissiveness (e.g., doesn't reprimand children when they misbehave). Items are rated on a 4-point scale indicating how characteristic they are of the teacher, from not at all (1) to very much (4). Psychometric analyses suggested a single factor most parsimoniously represented our data, $\alpha = .93$. Interrater reliability ranged from .89 to .98 for each subscale, with median subscale scores from .92 to .95.

The extent to which the teaching style was didactic versus child centered was rated using the ECOF, which includes five subscales: child initiation (e.g., children choose peers for activities), academic emphasis (e.g., teacher uses commercial materials to teach basic skills with little improvisation), discipline (e.g., teacher uses negative disciplinary techniques), performance pressure (e.g., teacher's emphasis is on outcome/performance, doing it right like others), and negative evaluation (e.g., rewards given for completing work correctly). This measure consists of 24 items scored on 3-, 4-, and 5-point scales, ranging from didactic (low) to child centered (high). A total mean score was computed after converting all items to the metric of a 5-point scale, $\alpha = .92$. Interrater reliability ranged from .81 to .97 for each subscale, with median scores ranging from .91 to .95.

Teacher responsiveness to children was measured using the AIS. For this instrument, 2 children (1 male and 1 female) were randomly selected in each classroom and observed for three observations of 5 min each, with teacher–child interactions coded every 20 s. (No additional information was gathered for these children.) This measure codes the level of the teacher's interactions with the target child on a 6-point scale: ignore (ignores/unaware of child), routine (routine caretaking but no verbal response), minimal (verbally directs, disciplines, or answers request for help), simple (responds to verbal initiations but does not elaborate), elaborative (maintains proximity and acknowledges and responds to child's statements), and intense (positive physical interaction, engages in conversa-

tion/play with child). For the present analyses, teacher responsiveness was calculated as the percentage of time the teacher was at least minimally responsive to the target child (the four upper points of the scale). The median interrater reliability using Cohen's κ was .92 (range = .83–.96).

The four observational child-care practices measures tended to be highly correlated, with correlations from .74 to .91 among the ECERS classroom environment, CIS teacher sensitivity, and ECOF teaching style, and from .26 to .31 between the AIS teacher responsiveness and the other measures. Therefore, a single composite index of the quality of classroom practices was computed. A principal components analysis of the four measures indicated that one factor accounted for 68% of the total variance, and that subsequent factors were unnecessary. The classroom practices quality index was calculated for each classroom based on this principal component and was computed as a z score ($M = 0$, $SD = 1$).

Elementary school classroom practices measures. Different instruments were used to obtain information about practices in children's kindergarten and second-grade classrooms. Briefer observations were conducted in these classrooms than in the preschool classrooms, with an average duration of 1 hr or less. For the kindergarten year, a shortened version of the ECERS was used, based on items that were readily observable, appropriate to the kindergarten setting, and highly correlated with the overall score from the first year's data. This 5-item version of the ECERS was completed while assessors were in the classrooms for the child assessments. The total mean item score for the kindergarten short ECERS was used for purposes of analysis, $\alpha = .83$.

In second grade, a modified version of the Instructional Environment Observation Scales, or IEOS (Secada, 1997) was used. This instrument is designed specifically to measure the instructional environment of second- and third-grade classrooms. The IEOS rates a number of characteristics of the classroom environments that students experience using a 5-point scale from 1 (low) to 5 (high), and yields information relevant to the domains measured in previous years. This measure consists of six subscales: classroom routines (extent to which transitions are well orchestrated versus major disruptions), classroom climate (extent to which the classroom is a place where students feel safe and respected), cross-disciplinary connections (extent to which activities are connected to multiple subject areas), linkages to life beyond the classroom (extent to which activities are connected to competencies or concerns beyond the classroom), social support for student learning (extent to which classroom

is characterized by atmosphere of support and respect for individual learning capabilities), and student engagement (extent to which students are engaged in the activities). Interrater reliability using Cohen's κ ranged from .50 to .79 for each subscale, with a median of .64. A principal components factor analysis performed on our data yielded two factors. The first factor, general climate, included the classroom routines, classroom climate, social support for student learning, and student engagement subscales, $\alpha = .84$. The second factor, linkages, included the cross-disciplinary connections and linkages to life beyond the classroom subscales, $\alpha = .79$.

Child outcomes assessment procedures. Information pertaining to children's cognitive and socioemotional functioning was gathered from individual assessments and from teacher ratings each year, and parents provided information on family characteristics. These child assessment measures have been used in a number of studies examining influences on children's development during the preschool and elementary school years (e.g., Bryant et al., 1994; Burchinal et al., 1997; Dunn, 1993; Osborne, Schulte, & McKinney, 1991; Pianta & Steinberg, 1992; Whitebook et al., 1989). Standard test procedures were used for all instruments, including establishment of basals and ceilings for standardized measures.

Site coordinators from each state were trained in the standard procedures for administering the individual child assessment instruments in a 3-day session. They then trained four to seven assessors at each site and monitored them throughout the data collection process. Children were assessed individually for about 30 min at their school in the spring of each year, to measure their language ability and math and reading skills. Questionnaires were given to teachers after the assessments to provide ratings of children's classroom behavior and the teacher-child relationship. Parent questionnaires were sent to their homes to gather information on family demographic characteristics. Preaddressed, stamped envelopes for returning questionnaires were included. The return rates were high—from 81% to 98% for parents and 81% to 96% for teachers each year.

Individual child assessments. Individual child assessments were conducted using two instruments. Receptive language ability was measured using the Peabody Picture Vocabulary Test-Revised, or PPVT-R (Dunn & Dunn, 1981); and preacademic skills were measured using the Woodcock-Johnson Tests of Achievement-Revised, or WJ-R (Woodcock & Johnson, 1990).

The format of the PPVT-R is appropriate for both younger and older children, and involves having

them point to the picture that matches the word spoken by the examiner. PPVT-R raw scores were converted into standard scores on the basis of age (i.e., $M = 100$, $SD = 15$ within norming sample). Based on the original test development, this measure has good split-half ($Mdn = .80$) and test-retest reliability ($Mdn = .82$), and correlates highly with other measures of vocabulary and moderately with intelligence tests and school achievement.

Children's academic achievement in reading and math each year was measured using two subtests of the WJ-R. The letter-word identification subtest measures reading ability, including association of pictures and symbols and recognition of letters and words. The applied problems subtest measures math skills, including understanding of basic numeracy, comparisons of differing numbers of items, counting, and solving mathematical problems. Test development information showed high internal consistency for these subtests ($Mdn = .92, .91$), and moderate correlations with other tests of achievement. Rasch scores were used for the analyses, which allowed for calculation of individual growth over time in the longitudinal data.

Teacher surveys. Teachers rated children's social and cognitive skills each of the 4 years, using the Classroom Behavior Inventory, or CBI (Schaefer, Edgerton, & Aaronson, 1978). In addition, each year teachers rated their relationship with each child using the Student-Teacher Relationship Scale, or STRS (Pianta, 1992), thus providing information on one aspect of children's contemporaneous classroom experiences in preschool, kindergarten, and second grade.

For each participating child, the lead teacher was asked to rate the child's social and cognitive skills using the 42-item research version of the CBI. Items represent 10 scales, and are rated for how well they describe the child, using a 5-point scale from not at all (1) to very much (5). Factor analysis of the 10 CBI scale scores from the first year resulted in three factors accounting for 76% of the variance. These factors replicated other factor analyses of the CBI (Osborne et al., 1991), yielding a cognitive/attention factor, a sociability factor, and a problem behaviors factor. The cognitive/attention factor consisted of the creativity, verbal intelligence, independence, task orientation, dependence (reversed), and distractibility (reversed) scales, $\alpha = .84$. The sociability factor included the extroversion and introversion (reversed) scales, $\alpha = .65$. The problem behaviors factor consisted of the distractibility, hostility, and consideration (reversed) scales, $\alpha = .77$.

A second aspect of the quality of children's experiences in preschool, kindergarten, and second grade was measured by teachers' ratings of their relationship with each participating child, using the STRS.

This measure contains 30 items rated on a 5-point scale indicating how characteristic they are of the particular teacher–child relationship, from definitely does not apply (1) to definitely applies (5). The original scoring of the measure sums the items into three factors representing different aspects of the teacher–child relationship: closeness (e.g., I share a warm, affectionate relationship with this child), conflict (e.g., this child easily becomes angry at me), and overdependency (e.g., this child reacts strongly to separation from me). Only the closeness factor was used in these analyses. Based on the first-year data, the internal consistency within this sample was very good (.86) for the closeness factor.

Parent surveys. Parents were asked to complete surveys each year, from which a variety of demographic information was obtained, including family income; parental education; marital status; age of entry into child care; and child ethnicity, gender, and birth date.

Data Analysis

Both descriptive and inferential analyses were conducted to examine the longitudinal influences of child-care quality on children's development. Descriptive analyses provided information about the quality of child care and school and about family selection factors relating to child-care quality. Two additional sets of correlational analyses examined the relations between child-care quality and child outcomes over time and between child-care quality and subsequent school quality in kindergarten and second grade.

The inferential analyses examined longitudinal patterns of development from ages 4 (next-to-last year of preschool) through 8 (second grade) using hierarchical longitudinal analyses. A separate analysis was conducted for each of the six developmental outcomes: assessments of children's receptive language ability (PPVT-R standard score), reading ability (WJ-R letter-word identification Rasch score), and math ability (WJ-R applied problems Rasch score); and teacher ratings of children's cognitive and attention skills (CBI cognitive/attention factor score), problem behaviors (CBI problem behaviors factor score), and sociability (CBI sociability factor score). In these analyses, both individual and group growth curves were estimated. A separate slope and intercept were estimated for each child and from these the group growth curves were computed as a function of background and child characteristics.

Patterns of development over time on these outcomes were predicted hierarchically from three sets

of predictors. State was entered in all analyses to represent the sampling frame including four sites of data collection. The first set of predictors, the background variables, included mother's education (in years), age of entry into child care (in months), child's ethnicity (White = 1, not White = 0), and child's gender (male = 1, female = 0). To describe patterns of change over time, this set of variables also included child age; child age, squared; and the four interactions between child age and mother's education, age of entry into care, child ethnicity, and child gender. The second set of predictors included two different aspects of preschool child-care quality: observed classroom practices and ratings of teacher–child closeness. Analysis variables included the classroom practices composite index, the STRS teacher–child closeness rating, and the interactions between child age and each of the two quality measures. The third set of predictors, the moderators of child-care quality, initially included all two-way interactions of the four background variables with the two child-care variables and the three-way interactions adding year, to test for changes in these associations over time. Four a priori contrasts were tested. The first contrast tested whether, as a block, mother's education interacted with either classroom practices or teacher–child closeness in two-way interactions or in three-way interactions adding year. The other three contrasts tested the same block of interactions for age of entry into child care, ethnicity, and gender. When any of these four contrasts were not significant, then that block of interactions was dropped from the analysis model. When these contrasts were significant, then the individual interaction terms were examined so that only the significant interactions were retained along with associated lower order interaction terms. In addition, to protect against the likelihood of Type I error, child-care quality (including both classroom practices and teacher–child closeness) was first tested as a block, and any main effects and interactions were interpreted only if the block test was significant.

An additional set of analyses examined the prior and contemporaneous effects of classroom quality on children's second-grade outcomes. The same six developmental outcomes were examined, using only the child's scores from the second-grade assessment. Hierarchical regression analyses were conducted. The first block of variables included state as a control variable and the background variables (mother's education, age of entry into child care, ethnicity, and gender). The second block added the two child-care quality measures from preschool (the observed classroom practices index and STRS teacher–child closeness rating by the preschool teacher) and any inter-

action between background and preschool quality identified in the longitudinal analyses. The third block added the two kindergarten quality measures (the shortened ECERS and STRS closeness rating by the kindergarten teacher), and the fourth block added the three second-grade quality measures (the two IEOS observed practices factor scores and STRS closeness rating by the second-grade teacher).

RESULTS

Descriptive Analyses

Child-care quality. The first set of descriptive analyses examined the individual components of the quality of child care (for full details, see Peisner-Feinberg & Burchinal, 1997). Mean scores on each of the observational measures of classroom practices and the teacher-child relationship are included in Table 1. In general, classroom practices tended to be in the medium range of quality. The mean ECERS global quality score of 4.38 was well within the medium quality range (i.e., between 3.0 and 5.0), suggesting that children were attending centers where their routine care needs were likely to be met, but where there were more limited opportunities for learning activities, individual attention, or language stimulation. In general, the teachers were moderately sensitive, as indicated by the CIS mean of 3.01 (*range* = 1–4). The AIS data indicated that, on average, teachers were observed as being at least minimally responsive to the children in their class about 31% of the time. The teaching style observed in the classrooms based on the ECOF was slightly closer to a child-centered than didactic approach. In contrast, teachers reported fairly close relationships to the children, with an average score of 4.17 on the STRS (*range* = 1–5).

School quality. Second, classroom practices and the closeness of teacher-child relationships in kindergarten and second grade were examined descriptively. Mean scores on each measure are presented in Table 1. The same measure of teacher-child closeness was used each year in child care and elementary school, while different measures of classroom practices were used each year. In general, teachers reported fairly close relationships with children each year based on the STRS, with similar average scores each year, although the scores were slightly lower in second grade than in preschool or kindergarten. The quality of classroom practices in kindergarten was similar to that in preschool, based on a shortened form of the ECERS used in preschool. Scores on the IEOS indicated that second-grade classrooms tended to be fairly high in general classroom climate, but fairly low in linkages across disciplines and to life beyond the classroom.

Table 1 Mean Scores for Quality and Child Outcome Measures over Time

Measure	<i>N</i>	<i>M</i>	<i>SD</i>
Year 1 preschool child care			
Quality			
Teacher-child closeness (STRS)	733	4.17	.57
Classroom practices index	733	.04	1.63
ECERS total	733	4.38	1.07
CIS total	733	3.01	.54
ECOF total	733	.06	.61
AIS % responsive	733	.31	.26
Outcomes			
PPVT-R language	733	94.21	18.10
WJ-R reading	731	99.94	13.06
WJ-R math	695	102.62	13.54
CBI cognitive/attention	732	3.62	.71
CBI problem behaviors	732	2.45	.86
CBI sociability	733	3.98	.71
Year 2 preschool child care			
Outcomes			
PPVT-R language	498	101.63	17.79
WJ-R reading	499	100.56	13.39
WJ-R math	499	106.36	15.08
CBI cognitive/attention	440	3.85	.71
CBI problem behaviors	440	2.39	.87
CBI sociability	440	4.15	.68
Kindergarten			
Quality			
Teacher-child closeness (STRS)	334	4.17	.58
Shortened ECERS	331	4.53	.97
Outcomes			
PPVT-R language	399	104.52	16.53
WJ-R reading	399	102.44	15.10
WJ-R math	399	107.23	15.06
CBI cognitive/attention	334	3.88	.69
CBI problem behaviors	334	2.20	.80
CBI sociability	334	4.05	.69
Second Grade			
Quality			
Teacher-child closeness (STRS)	268	3.98	.62
IEOS classroom climate	325	3.68	.74
IEOS linkages	325	1.93	1.11
Outcomes			
PPVT-R language	345	106.57	14.25
WJ-R reading	345	116.95	16.45
WJ-R math	345	120.10	16.98
CBI cognitive/attention	268	3.80	.74
CBI problem behaviors	268	2.18	.84
CBI sociability	268	3.97	.72

Note: STRS = Student-Teacher Relationship Scale; ECERS = Early Childhood Environment Rating Scale; CIS = Caregiver Interaction Scale; ECOF = Early Childhood Observation Form; AIS = Adult Involvement Scale; PPVT-R = Peabody Picture Vocabulary Test-Revised; WJ-R = Woodcock-Johnson-Revised; CBI = Classroom Behavior Inventory; IEOS = Instructional Environment Observation Scales.

Family selection factors. Next, the associations between child-care selection and family background characteristics were examined (for more details, see Peisner-Feinberg & Burchinal, 1997). Pearson product-

moment correlations were computed among child and family background factors, the observational measures of classroom practices, and the ratings of closeness of the teacher–child relationship. Information was included about the mother’s years of education; the family’s reported monthly income; and the child’s ethnicity, gender, and age of entry into child care. As shown in Table 2, children from more advantaged families were more likely to enter child care at a later age and to experience higher quality child care in the preschool years. Better classroom practices and closer teacher–child relationships were associated with higher maternal education and higher family income in child care, but not in elementary school. There was some relation of ethnicity to better quality practices in kindergarten and second grade but not in child care, with White children tending to be in higher quality care than children of color. Teacher–child relationships were associated with gender each year, with teachers reporting closer relationships with females than with males. From these analyses, mother’s education and child ethnicity, gender, and age of entry into child care were selected to represent the family selection factors for subsequent analyses. Family income was not included because it was highly correlated with maternal education and was missing for a portion of the sample.

Correlations among preschool child care, kindergarten, and second-grade quality. Pearson product-moment correlations were computed among child-care quality and elementary school (kindergarten and second grade) quality, to examine the relations between earlier and later environments. The two aspects of quality—classroom practices and teacher–child relationships—were examined separately. As seen in Table 2, there was little association between the quality of classroom practices in earlier and later settings. Correlations among child care, kindergarten, and second-grade practices ranged from .06 to .15. There was a slightly stronger association for the closeness of teacher–child relationships over time, although these relations were still modest, ranging from .20 to .30 among preschool, kindergarten, and second-grade ratings.

Correlations of child care and school quality with child outcomes. The associations between children’s developmental outcomes and the quality of child care and school experiences over time were examined. Pearson product-moment correlations of children’s longitudinal outcomes with the teachers’ ratings of the closeness of their relationships with children and the observed quality of classroom practices were computed from preschool through second grade. As shown in Table 3, classroom practices tended to relate to children’s language and math skills over time, whereas

Table 2 Correlations among Family Background, Child-Care Quality, and School Quality Measures

	Family Background					Child-Care Quality		Kindergarten Quality		Second-Grade Quality		
	1	2	3	4	5	6	7	8	9	10	11	12
Family background												
1. Maternal education												
2. Ethnicity (White = 1)	.18***											
3. Gender (male = 1)	-.00	.07										
4. Income	.50***	.29***	.01									
5. Age of entry	-.14***	-.04	-.02	-.17***								
Child care quality												
6. Teacher–child closeness (STRS)	.10**	.06	-.14***	.08*	.01							
7. Classroom practices index	.25***	.07	-.04	.16***	.08*	.17***						
Kindergarten quality												
8. Teacher–child closeness (STRS)	.11	-.04	-.26***	-.00	.00	.20***	-.01					
9. Shortened ECERS	.05	.13*	-.11	.11	-.06	.04	.15**	-.00				
Second-grade quality												
10. Teacher–child closeness (STRS)	.07	.05	-.29***	.00	-.02	.23***	.03	.30***	.02			
11. IEOS linkages	.07	.13*	.02	.05	.01	-.00	.06	-.07	.12	.08		
12. IEOS classroom climate	.11*	.01	.03	.10	-.01	.00	.12*	-.12	.14*	.00	.24***	

Note: STRS = Student–Teacher Relationship Scale; ECERS = Early Childhood Environment Rating Scale; IEOS = Instructional Environment Observation Scales.

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

Table 3 Correlations of Child Outcomes with Family Background, and Child-Care Quality, and School Quality Measures

Outcome	Maternal Education	Child-Care Quality		Kindergarten Quality		Second-Grade Quality		
		Teacher-Child Closeness (STRS)	Classroom Practices Index	Teacher-Child Closeness (STRS)	Shortened ECERS	Teacher-Child Closeness (STRS)	IEOS Classroom Climate	IEOS Linkages
Year 1 preschool								
PPVT-R language	.35***	.17***	.28***					
WJ-R reading	.29***	.03	.17***					
WJ-R math	.28***	.11**	.17***					
CBI cognitive/attention	.21***	.46***	.16***					
CBI problem behaviors	-.16***	-.34***	-.03					
CBI sociability	.09*	.55***	.14***					
Year 2 preschool								
PPVT-R language	.38***	.17***	.26***					
WJ-R reading	.22***	.03	.02					
WJ-R math	.28***	.07	.18***					
CBI cognitive/attention	.22***	.27***	.13**					
CBI problem behaviors	-.16***	-.23***	-.02					
CBI sociability	.09	.27***	.10*					
Year 3 kindergarten								
PPVT-R language	.40***	.11*	.23***	.09	.15**			
WJ-R reading	.18***	.03	.03	.13*	-.02			
WJ-R math	.29***	.02	.17***	.04	.13*			
CBI cognitive/attention	.17**	.21***	.02	.46***	.03			
CBI problem behaviors	-.12*	-.18***	-.05	-.36***	.02			
CBI sociability	.03	.20***	-.09	.55***	-.01			
Year 5 second grade								
PPVT-R language	.27***	.10	.14**	.12	.08	-.01	-.01	.06
WJ-R reading	.17**	.09	.09	.06	.11	.06	-.03	.06
WJ-R math	.23***	.15**	.17**	.09	.06	.06	.05	.10
CBI cognitive/attention	.20***	.20***	.12	.19**	-.02	.35***	-.03	.01
CBI problem behaviors	-.15*	-.23***	-.04	-.20**	.08	-.42***	-.01	-.06
CBI sociability	.08	.15***	.05	.35***	.10	.53***	-.03	.02

Note: STRS = Student-Teacher Relationship Scale; ECERS = Early Childhood Environment Rating Scale; IEOS = Instructional Environment Observation Scales; PPVT-R = Peabody Picture Vocabulary Test-Revised; WJ-R = Woodcock-Johnson-Revised; CBI = Classroom Behavior Inventory.

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

teacher–child closeness tended to relate to children’s social and behavioral skills over time. The composite index of child-care classroom practices during the first year of the study showed modest correlations with children’s language and math skills over time. Child-care classroom practices were also related to reading skills at the first assessment, to cognitive and attention skills during the preschool years, and to sociability at the first assessment. Child-care teachers’ ratings of the closeness of their relationships with children were modestly related to language and math skills at most assessment ages, and were moderately to modestly related to children’s social skills over time. Similarly, classroom practices in kindergarten were modestly related to children’s kindergarten language and math skills, and teacher–child closeness in both kindergarten and second grade was moderately to modestly related to children’s social skills in elementary school. In contrast, measures of second-grade classroom practices were not related to children’s cognitive or social skills in second grade. In comparison, maternal education was moderately related to children’s language and cognitive skills over time, and modestly related to cognitive and attention skills and problem behaviors over time.

Longitudinal Analyses

The inferential analyses examined the association between children’s preschool experiences and patterns of language, cognitive, and social development from 4 to 8 years of age. State was included as a control variable, and background variables of maternal education, age of entry into child care, ethnicity, and gender were entered to adjust for selection effects and to test for moderating effects on the association between child-care quality and children’s developmental patterns. The longitudinal regressions were fit hierarchically, entering state, age, and background variables first; the two measures of child-care quality and interactions between child care quality and age second; and the interactions between background and child-care quality last. Results are shown in Table 4, listing the unstandardized regression coefficients from the final model and group-specific slopes when interactions were significant.

Receptive language ability. Analysis of children’s language skills showed marked increases over time relative to the PPVT-R norming population. Background characteristics, $F(6, 655) = 30.74, p < .001$, and child-care quality, $F(4, 655) = 9.31, p < .001$, significantly contributed to describing patterns of change over time. After adjusting for the background variables, children attending child care with higher qual-

ity classroom practices tended to have higher language scores, $F(1, 655) = 10.69, p < .002$, but the magnitude of this association declined over time, $F(1, 655) = 7.99, p < .005$. This trend can be seen by examining the coefficients describing the association for Age \times Classroom Practices in Table 4. Figure 1 shows this relation for the 25th and 75th percentiles of quality based on the classroom practices index. The association between language scores and quality of classroom practices was strongest when assessed contemporaneously in Year 1, $B = 1.85, SE = .38$, and declined over time. The quality of child-care practices was a significant predictor of children’s language ability through kindergarten, but not in second grade. This finding is illustrated by examining the coefficients for child-care practices separately for each age. These estimated slopes are listed in Table 4 under the Age \times Classroom Practices interaction coefficient, and show a clear decline in magnitude across age.

In addition, children whose preschool teachers rated their relationship as closer tended to have higher language scores over time, $F(1, 655) = 7.52, p < .007$. Unlike the classroom practices quality index, the association between preschool teachers’ ratings of closeness with children and language scores did not significantly decline with age. There were no moderating effects for child and family background characteristics found for either aspect of child-care quality.

Reading ability. On the basis of the Rasch scores, which describe development using a developmental age score rather than a standard score, children’s reading skills increased between 4 and 8 years of age, as expected. Rasch scores for the letter-word identification subtest of the WJ-R over time were significantly related to the background variables, $F(6, 654) = 11.87, p < .001$, but were not significantly related to the child-care measures.

Math ability. Children’s math skills also increased greatly over time, based on the Rasch scores for the applied problems subtest of the WJ-R. Developmental patterns were related to the blocks of background variables, $F(6, 635) = 16.19, p < .001$; child-care variables, $F(4, 635) = 3.56, p < .007$; and interactions among background and child-care variables, $F(1, 635) = 5.53, p < .02$. Children tended to have slightly better math skills if they attended a child-care classroom with higher quality practices, $F(1, 635) = 6.38, p < .02$, and if their child-care teachers rated their relationship as closer, $F(1, 635) = 4.91, p < .03$. There was a moderating effect for maternal education on the association between classroom practices and children’s development, but not on the association for teacher–child closeness. The significant interaction between classroom practices and maternal education indi-

Table 4 Results from Hierarchical Linear Model Regression Analyses Predicting Children’s Longitudinal Outcomes

	PPVT-R Language	WJ-R Reading	WJ-R Math	CBI Cognitive/ Attention	CBI Problem Behaviors	CBI Sociability
State block	***	***	***	*	*	<i>ns</i>
Age block	***	***	***	***	**	***
Age	2.34***	29.66***	17.62***	.04	-.10**	-.00
Age, squared	-.66***	2.73***	.41**	-.06***	.01	-.03***
Background block	***	***	***	***	***	<i>ns</i>
Maternal education	1.50***	2.05**	1.30***	.05***	-.06***	.01
Gender (male = 1)	-1.38	-5.44***	-1.64	-.11*	.29***	-.02
Ethnicity (White = 1)	11.73***	6.12***	7.01***	.11	.01	.06
Age of entry	-.42	-.73	-.90	-.03	-.04	-.02
Age × Education	-.10	-.04	-.07	.01	-.01	.00
Age × Gender	.44	-1.64*	.43	.02	.03	-.03
Age × Ethnicity	-.60	1.60*	-.27	-.01	.00	.03
Age × Entry	.28	-.14	.23	-.01	.03	-.01
Child-care quality block	***	<i>ns</i>	**	***	***	***
Classroom practices index	1.10**	-.12	.80*	.01	.02	-.00
Teacher-child closeness (STRS)	2.61**	1.41	1.98*	.33***	-.33***	.38***
Age × Practices	-.38**	-.13	-.04	.00	-.02*	-.01
Practices slope, age 4	1.85***				.05*	
Practices slope, age 5	1.47***				.04	
Practices slope, age 6	1.10**				.02	
Practices slope, age 8	.34				-.02	
Age × Closeness	-.14	.79	.52	-.09***	.06*	-.14***
Closeness slope, age 4				.51***	-.45***	.65***
Closeness slope, age 5				.42***	-.39***	.52***
Closeness slope, age 6				.33***	-.33***	.38***
Closeness slope, age 8				.16*	-.21*	.11
Quality × Family Interaction block	<i>ns</i>	<i>ns</i>	*	<i>ns</i>	**	<i>ns</i>
Education × Practices			-.31*			
Practices slope, education = 12			1.41**			
Practices slope, education = 16			.19			
Education × Closeness					.04	
Education × Age × Closeness					.03**	
Closeness slope, age 4, education = 12					-.39***	
Closeness slope, age 5, education = 12					-.40***	
Closeness slope, age 6, education = 12					-.40***	
Closeness slope, age 8, education = 12					-.42***	
Closeness slope, age 4, education = 16					-.52***	
Closeness slope, age 5, education = 16					-.39***	
Closeness slope, age 6, education = 16					-.26***	
Closeness slope, age 8, education = 16					.00	

Note: PPVT-R = Peabody Picture Vocabulary Test-Revised; WJ-R = Woodcock-Johnson-Revised; CBI = Classroom Behavior Inventory. * $p < .05$; ** $p < .01$; *** $p < .001$; *ns* = nonsignificant.

cated that better quality child care had a stronger association with children’s math skills for children whose mothers had less education, $F(1, 635) = 5.53$, $p < .02$. To illustrate this finding, the coefficients for the classroom practices index were estimated separately for children whose mothers had a high school degree and a college degree as their highest level of educational attainment. These estimated slopes are shown in Table 4 under the coefficient for the Maternal Education × Classroom Practices interaction. The coefficient is significant and positive for children

whose mothers had only a high school degree, and nonsignificant for children whose mothers had a college degree. Figure 2 displays these same developmental patterns for Math Skills × Maternal Education and Classroom Quality, estimated for children whose mothers had high school and college degrees for the 25th and 75th percentiles of quality based on the classroom practices index. There were no interaction effects with year, indicating that the main effect associations for both aspects of child-care quality remained consistent over time.

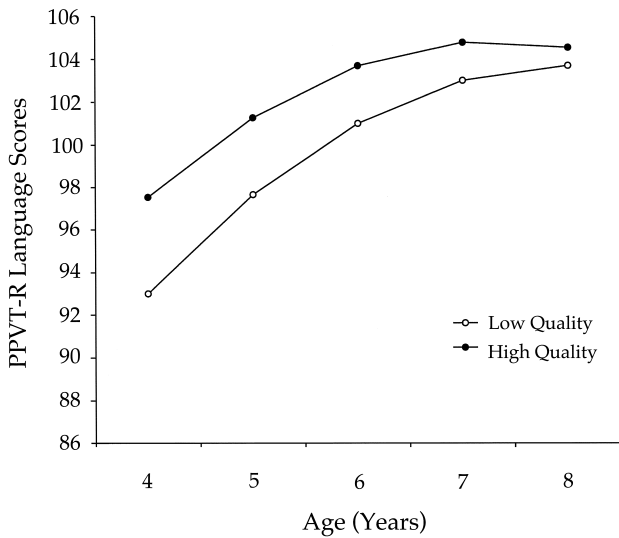


Figure 1 Children’s language skills over time for low-quality (25th percentile) and high-quality (75th percentile) child-care classroom practices. PPVT-R = Peabody Picture Vocabulary Test–Revised.

Cognitive and attention skills. Teacher ratings of children’s cognitive and attention skills on the CBI increased and then decreased over time, and individual patterns of change were related to the background, $F(6, 496) = 6.50, p < .001$, and child-care blocks, $F(4, 496) = 34.73, p < .001$. There was a positive association between child-care teacher–child closeness and cognitive/attention scores, $F(1, 496) = 54.82, p <$

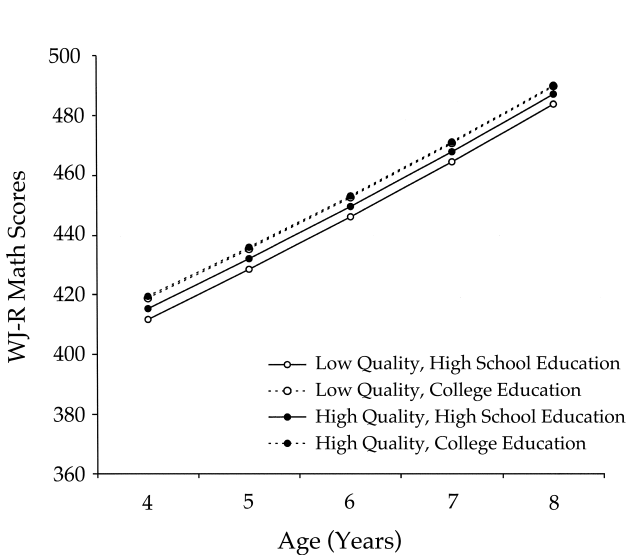


Figure 2 Children’s math skills over time for low-quality (25th percentile) and high-quality (75th percentile) child-care classroom practices by maternal education (high school and college education). WJ-R = Woodcock–Johnson–Revised.

.001, but this association declined over time, $F(1, 496) = 15.65, p < .001$. Table 4 shows the regression coefficients describing the association between teacher–child closeness in child care and cognitive/attention ratings over the 5-year period. Although there was a decline in the influence of teacher–child closeness as children got older, this association was still statistically significant through second grade. There were no moderating effects for child and family background characteristics on this relation.

Problem behaviors. Teacher ratings of children’s problem behaviors on the CBI declined slightly over time, and patterns of change were related to the blocks of background variables, $F(6, 496) = 6.94, p < .001$; child-care variables, $F(4, 496) = 16.43, p < .001$; and interactions among child-care and background variables, $F(2, 496) = 4.98, p < .008$. Children with closer relationships to their teachers in child care were rated lower on problem behaviors through second grade, $F(1, 496) = 37.04, p < .001$. The magnitude of this association declined over time, $F(1, 496) = 6.33, p < .02$, and maternal education had a moderating effect, so that there was less decline over time for children whose mothers had less education, $F(1, 496) = 9.77, p < .002$. Table 4 shows the regression coefficients describing the association between child-care teacher–child closeness and problem behaviors ratings for each age, estimated for children whose mothers had high school and college degrees (listed under the Maternal Education \times Age \times Teacher–Child Closeness interaction). Figure 3 displays these

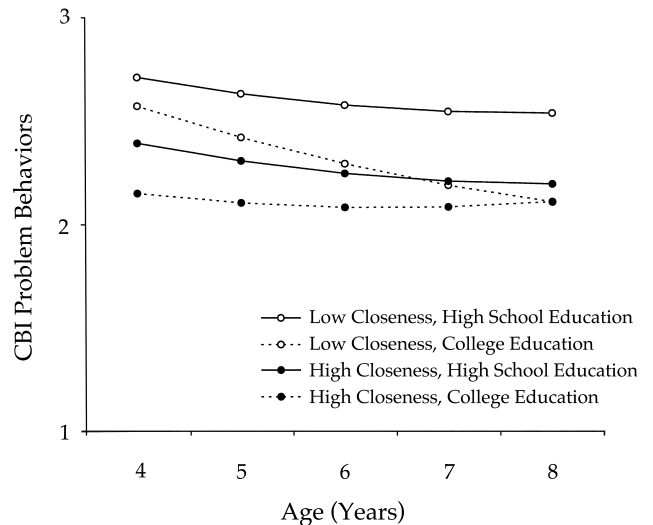


Figure 3 Children’s problem behaviors over time for low-quality (25th percentile) and high-quality (75th percentile) child-care teacher–child relationships by maternal education (high school and college education). CBI = Classroom Behavior Inventory.

same developmental patterns for Problem Behaviors \times Maternal Education for the 25th and 75th percentiles of quality based on ratings of teacher-child closeness. Whereas child-care teacher-child closeness was a consistent and significant predictor of problem behaviors for children whose mothers had a high school education, it became less predictive over time for children whose mothers had more education. In addition, there was a significant interaction between classroom practices and age, although no main effect for practices, indicating that higher quality practices were significantly associated with fewer problem behaviors in Year 1, but this association declined in subsequent years, $F(1, 496) = 4.31, p < .04$.

Sociability. Teacher ratings of children's sociability on the CBI increased and then decreased slightly over time, and individual patterns of change were related to the child-care block, $F(4, 496) = 60.25, p < .001$. Ratings of greater teacher-child closeness in preschool were related to higher ratings of sociability, $F(1, 496) = 81.76, p < .001$, but the magnitude of this association declined over time, $F(1, 496) = 33.36, p < .001$. Table 4 shows the regression coefficients describing the association between child-care teacher-child closeness and sociability over time. Teacher-child closeness in child care was a significant predic-

tor of children's sociability through kindergarten, but was not significant in second grade. There were no moderating effects for child and family background characteristics.

Second-Grade Outcomes in Relation to Background, Child Care, and Second-Grade Classroom Experiences

An additional set of analyses examined the data from the last assessment, second grade, to determine the extent to which child-care measures predicted outcomes in second grade and whether these associations held when adjusting for classroom experiences in kindergarten and contemporaneously in second grade. Hierarchical analyses were conducted, entering state and background variables first; child-care quality variables, including any significant interactions between background and child-care measures obtained in the longitudinal analyses, second; kindergarten quality variables third; and second-grade quality variables last. Results are shown in Table 5, which lists the standardized regression coefficients for each variable from the final model. It should be noted that these analyses included fewer children than the previous analyses due to missing classroom observation data in kindergarten or second grade.

Table 5 Results from Hierarchical Regression Analyses Predicting Children's Second-Grade Outcomes

	PPVT-R Language	WJ-R Reading	WJ-R Math	CBI Cognitive/ Attention	CBI Problem Behaviors	CBI Sociability
Total R^2	.16*	.12	.14	.16*	.25***	.39***
Background	***	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	**
Maternal education	.23**	-.03	.11	.04	-.12	-.04
Ethnicity (White = 1)	.15	.08	.11	.02	.01	.17*
Gender (male = 1)	.15	.03	.10	.16*	.05	.15*
Age of entry	.06	.07	.07	.02	-.09	-.06
Preschool child care	<i>ns</i>	<i>ns</i>	*	<i>ns</i>	*	<i>ns</i>
Classroom practices index	-.01	.09	.21*	.10	.04	.06
Teacher-child closeness (STRS)	.06	.12	.05	.14	-.18*	.05
Interactions						
Education \times Practices			-.09			
Education \times Closeness					-.19*	
Kindergarten	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	***
Shortened ECERS	.05	.05	.00	.01	.01	.10
Teacher-child closeness (STRS)	.17*	.06	.13	.12	-.10	.25***
Second grade	<i>ns</i>	*	<i>ns</i>	**	**	***
IEOS classroom climate	-.16	-.23**	-.06	-.14	.02	-.07
IEOS linkages	.07	-.03	.06	-.13	-.04	-.08
Teacher-child closeness (STRS)	-.08	-.11	.00	.23**	-.28***	.51***

Note: Standardized regression coefficients are listed. State was entered as a covariate. PPVT-R = Peabody Picture Vocabulary Test-Revised; WJ-R = Woodcock-Johnson-Revised; CBI = Classroom Behavior Inventory; STRS = Student-Teacher Relationship Scale; ECERS = Early Childhood Environment Rating Scale; IEOS = Instructional Environment Observation Scales.

* $p < .05$; ** $p < .01$; *** $p < .001$; *ns* = nonsignificant.

The results provide some evidence that preschool child-care quality is related to children's skills in second grade, even after adjusting for background characteristics and kindergarten and second-grade classroom practices and teacher-child relationships. Higher math scores were associated with better quality child-care classroom practices, $F(2, 153) = 3.27, p < .04$. In addition, teachers reported fewer problem behaviors in second grade for children who had closer relationships with their preschool teachers, $F(3, 152) = 3.50, p < .02$. However, this association was moderated by maternal education, indicating a stronger effect for children whose mothers had less education.

In addition, second-grade teacher-child relationships predicted children's second-grade social skills, after controlling for all other variables, although these associations may be partially explained by common source variance, because the teacher provided both sets of ratings. Closer teacher-child relationships in second grade were associated with better ratings of children's social skills—higher ratings of cognitive

and attention skills and sociability and lower ratings of problem behaviors. Closer kindergarten teacher-child relationships were also associated with higher ratings of sociability in second grade. In contrast, there were no relations between observed kindergarten classroom practices and children's cognitive or socioemotional functioning. There was one association between observed second-grade classroom practices and children's outcomes, with higher reading scores for children in classrooms rated lower in classroom climate.

Effect Sizes

Effect sizes were computed using partial correlations to provide a context for interpreting the findings from the longitudinal regression analyses. The data from each year were examined separately for each aspect of child-care quality. The partial correlations included the covariates of state, maternal education, child ethnicity, child gender, age of entry into child

Table 6 Effect Sizes of Child-Care Quality and Maternal Education for Children's Longitudinal Outcomes

Outcome	Child Care (<i>N</i> = 628–633)	Kindergarten (<i>N</i> = 318–378)	Second Grade (<i>N</i> = 256–330)
PPVT-R language			
Classroom practices index	.18	.11	.04
Teacher-child closeness (STRS)	.10	.08	.08
Maternal education	.22	.29	.18
WJ-R reading			
Classroom practices index	.06	-.05	.02
Teacher-child closeness (STRS)	-.01	.06	.08
Maternal education	.23	.13	.12
WJ-R math			
Classroom practices index	.08	.07	.11
Teacher-child closeness (STRS)	.05	.03	.11
Maternal education	.19	.20	.14
CBI cognitive/attention			
Classroom practices index	.03	-.08	.06
Teacher-child closeness (STRS)	.43	.18	.15
Maternal education	.12	.14	.13
CBI problem behaviors			
Classroom practices index	.11	.02	.04
Teacher-child closeness (STRS)	-.32	-.16	-.17
Maternal education	-.14	-.09	-.15
CBI sociability			
Classroom practices index	.04	-.15	.05
Teacher-child closeness (STRS)	.56	.19	.13
Maternal education	.02	.07	.03

Note: Partial correlations are listed. State, child ethnicity, child gender, and age of entry into child care were included as covariates. In addition, for each child-care measure, maternal education and the other child-care quality measures were covaried. For maternal education, both child-care quality measures were covaried. PPVT-R = Peabody Picture Vocabulary Test-Revised; STRS = Student-Teacher Relationship Scale; WJ-R = Woodcock-Johnson-Revised; CBI = Classroom Behavior Inventory.

care, and the other child-care quality measure (i.e., classroom practices index when computing effect sizes for teacher-child closeness and teacher-child closeness rating when computing effect sizes for classroom practices). In addition, the effect sizes of maternal education were computed as a contrast for the effect sizes of child-care quality, under the assumption that family characteristics should provide the strongest prediction of child outcomes. In those analyses, both measures of child-care quality were included as covariates, as well as state, ethnicity, gender, and age of entry.

The results from these analyses are shown in Table 6. The first row under each outcome displays the effect sizes for the child-care classroom practices index; the second row, for child-care teacher-child closeness ratings; and the third row, for maternal education. Only effect sizes corresponding to significant results from the longitudinal regression analyses were interpreted. In addition, effect sizes for teacher-child closeness associated with ratings of social skills from Year 1 were not interpreted because the resulting large effect sizes were likely influenced by the child-care teacher being the common informant for both types of data. Cohen (1988) recommends that effect sizes around $r = .10$ be regarded as modest, around $r = .30$ as moderate, and around $r \geq .50$ as large. Using those criteria, there were modest effect sizes for child-care practices on preschool and kindergarten language ability, and on preschool through second-grade math skills. Teacher-child closeness showed modest effect sizes for language ability and math skills over time. There were slightly stronger effect sizes for teacher-child closeness for teachers' ratings of children's cognitive and attention skills, problem behaviors, and sociability over time.

Maternal education displayed modest to moderate effect sizes for language and math skills over time, and more modest effect sizes for classroom behaviors of cognitive and attention skills and problem behaviors. Comparisons of the effect sizes for preschool child-care quality and for maternal education indicate that both were associated with five of the six outcomes, and that the effect sizes for child-care quality were about one fourth to three fourths of those for maternal education. The effects of maternal education, however, reflected both genetic and environmental influences. This confound was greatly reduced for child-care effects, because genetic influences related to family selection factors were controlled statistically.

DISCUSSION

As the labor force participation rates for women with young children have increased, so has the proportion

of children attending child-care centers during the preschool years. The majority of preschoolers regularly receive some form of nonparental care, with more than half of 3- to 5-year-old children in the United States attending child-care centers (West et al., 1995). Whereas many studies have documented both variations in the quality of these child-care environments and associations between child-care quality and children's cognitive and socioemotional functioning, few have examined the long-term impact of these early experiences into the school years. Utilizing a longitudinal design, the present study provided evidence for the long-term effects of child-care quality on children's language, cognitive, and social skills through early elementary school. These findings have implications for both the public policy arena and early school practices in terms of enhancing children's readiness for and subsequent success in school.

In most domains of development that were examined, there was evidence for a continued influence of preschool child-care quality on children's skills through elementary school. Longitudinal effects were found for receptive language ability, math ability, cognitive and attention skills, problem behaviors, and sociability, indicating that children who had better quality preschool experiences were more advanced in their development over a 5-year period. As expected, there was some evidence indicating a diminishing influence of child-care quality over time. Although the effects of child-care quality were modest, especially by second grade, they are consistent with some of the other longitudinal studies that have documented long-term effects following school entry (e.g., Broberg et al., 1997; Jacobs & White, 1994).

These findings of long-term effects in the present study, after adjusting for child and family characteristics, are noteworthy for several reasons. First, these results were obtained on a varied sample of community child-care programs in four regions of the United States. Whereas long-term effects of preschool experiences have been established for a variety of early intervention programs (e.g., Campbell & Ramey, 1994; Lazar et al., 1982; Schweinhart et al., 1993), much less is known about the long-term effects across the range of child-care experiences and for children from a range of backgrounds. The children and families in our study were enrolled in typical community child-care programs, which represented a range of quality. Furthermore, the families themselves comprised a variety of backgrounds. A generally positive influence of child-care quality was found for children from diverse backgrounds, although in some cases, stronger

influences of child care were found for children at greater risk, who are presumably more similar to the participants in the early intervention programs. Specifically, maternal education showed such a moderating effect for children's math skills and problem behaviors, indicating that child-care quality had a stronger positive effect on development for children from families with less highly educated mothers. These results are consistent with other studies that, at least within the domain of socioemotional development, have found stronger effects for child-care quality for children from less advantaged backgrounds (e.g., Hagekull & Bohlin, 1995; NICHD ECCRN, 1997). These findings extend the results of both the early intervention and the child-care research, and suggest that child-care experiences, both concurrently and over the long term, have an even greater influence on some aspects of both cognitive and social development for children at greater risk.

Second, for all but one of the outcomes studied, child-care quality continued to exhibit an influence at least through kindergarten, and in some cases, through second grade, 4 years later. These long-term effects covered a substantial portion of time, representing about half of these children's lives at that point. The finding of consistent kindergarten effects provides evidence that the quality of children's preschool experiences is an important predictor of their readiness for school. Children who experienced higher quality preschool child-care settings demonstrated better skills in their first year of school. Other studies suggest that these early positive school experiences may enable children to establish a more positive academic trajectory for their future school careers (e.g., Alexander & Entwisle, 1988). Further evidence of the lasting nature of these effects, at least through second grade, was found for some aspects of both cognitive and social development, namely math skills, cognitive and attention skills, and problem behaviors.

Third, comparisons with the influence of family characteristics indicate the relative contribution of child-care quality to different aspects of children's development. As with several other studies (e.g., Chin-Quee & Scarr, 1994; Deater-Deckard et al., 1996; NICHD ECCRN, 1998a, 2000), this study found stronger relations with child outcomes for family characteristics such as maternal education than for child-care quality. It is to be expected that characteristics of the home would significantly predict children's development, as the family provides the primary environment for the child as well as the one consistent environment over time. Other studies have shown that family characteristics, especially indicators of environmental risk such as maternal education and eth-

nicity, are consistent predictors of children's cognitive development over time (e.g., Sameroff, Seifer, Baldwin, & Baldwin, 1993). Moreover, recent evidence suggests that the influence of family factors on the prediction of children's outcomes is not diminished by participation in full-time child care (NICHD ECCRN, 1998b). Child-care experiences, in contrast to the family environment, provide a secondary environment for only part of this time, being replaced by other school environments as well as other preschool or school-age child-care environments as children grow older. Examination of the effect sizes for family and child-care measures in the present study suggests that maternal education was a somewhat stronger predictor of children's language and cognitive skills over time, whereas child-care quality exhibited an effect size about one quarter to three quarters as large. In contrast, the closeness of the child's relationship with the preschool teacher tended to be a similar or even stronger predictor of children's behavioral and social skills in the classroom compared with maternal education.

Overall, our findings support a bioecological perspective, wherein children's development is the product of proximal processes or interactions that occur within the multiple environments in which they live (Bronfenbrenner & Morris, 1998). Whereas the family is the primary environment, for children in full-time child care, the child-care environment is likely to be the second most frequent environment in which they spend time. Our findings showed that the quality of these secondary environments also plays a role in determining young children's developmental outcomes, not only contemporaneously but also longitudinally through the early school years. The findings of the diminishing influence of child-care quality over time would be predicted from this model, given that child care becomes an increasingly remote environmental context. However, our findings of the moderating influences of maternal education for some of the outcomes studied suggest that there may be differential pathways that lead to these developmental outcomes. In other words, the long-term influence of the proximal processes occurring within the child-care context may differ on the basis of the characteristics of other environmental contexts existing simultaneously during that point in development.

Fourth, given the nature of longitudinal designs, children have a number of intervening experiences in out-of-home environments over the specific time period. A more complete rendering of the bioecological approach takes into account the variety of environmental contexts experienced by children over this time period, as well as the degree of continuity across

these environments over time. From their next-to-last year in preschool through second grade (ages 4 to 8), children have experienced a variety of care and education settings, including the transitions to and experiences in kindergarten, first, and second grade. Even high-quality preschool child-care experiences cannot be expected to serve as an inoculation, protecting children from the potential effects of subsequent negative experiences and superceding the influences of subsequent positive experiences. However, the findings of longitudinal child-care effects despite the variety of subsequent experiences suggest the long-term importance of early experiences on children's development. Further evidence for this conclusion was supported by the additional analyses that examined second-grade outcomes as a function of preschool, kindergarten, and second-grade environments. Although somewhat reduced, a similar pattern of child-care effects was found, even when controlling for the subsequent experiences in kindergarten and second grade.

Although the measures of elementary school classroom practices were not as comprehensive as the child-care measures, there is little indication in our data that children who initially experience higher quality environments in child care remain in higher quality environments once they enter school. Correlations among the observed practices measures for child care, kindergarten, and second grade ranged from .06 to .15, and suggest that there was little similarity in the quality of classroom practices over time. There was a somewhat stronger indication of similarity in the nature of teacher-child relationships over time, however. The correlations among ratings of teacher-child closeness over time ranged from .20 to .30, with the strongest correlation between kindergarten and second grade.

It may be that children are learning ways of interacting and establishing relationships with nonparental caregivers during their preschool years that carry over, at least to some extent, into the relationships they form with their teachers in elementary school. Such an interpretation is consistent with a bioecological perspective (Bronfenbrenner & Morris, 1998), which acknowledges that person characteristics of the child that develop within a particular environmental context (i.e., child care) influence the proximal processes that occur in subsequent environmental contexts over time (i.e., school). For example, it may be easier to establish closer relationships with some children because they engage in more facilitating behaviors. Similarly, children may learn patterns of behavior that are likely to elicit certain patterns of responses on the part of caregivers, so that continuity in these behaviors over time would enhance the likelihood that earlier and later caregivers respond in a

similar manner (e.g., Howes, 1999; Pianta & Steinberg, 1992; Pianta, Steinberg, & Rollins, 1995). Although there may be adaptations for the school setting as opposed to the child-care setting that result in greater consistency from kindergarten to second grade than from child care to kindergarten, there still seems to be a modest effect for such early experiences that is maintained over time.

Fifth, this study examined two different aspects of the child-care experience—the quality of observed classroom practices and the closeness of the teacher-child relationship. The results demonstrated that these two aspects were differentially associated with children's patterns of development. Observational measures of classroom practices tended to relate more strongly to children's cognitive skills, whereas ratings of the teacher-child relationship were related to both cognitive and social skills, although even more strongly to the latter. These findings suggest that child-care experiences influence cognitive and socioemotional development somewhat differently. Whereas actual classroom practices, including the materials, activities, and interactions, contributed most strongly to children's language and cognitive development both concurrently and over time, the establishment of closer relationships with caregivers provided an additional contribution. Further, these early relationships with caregivers were the strongest longitudinal predictors of children's social skills. It may be that children with positive early experiences with nonparental caregivers learn a pattern of interacting that facilitates their relationships with future caregivers, as well as their ability to utilize the learning experiences provided in these environments to further their development.

This study's findings have direct relevance to ongoing public policy debates regarding the care and education of young children during both the preschool and early school years. Our results indicate that child-care quality continues to predict children's development during the elementary school years for a variety of cognitive and socioemotional outcomes. Furthermore, our initial examinations of the data showed no evidence of nonlinear relations between child-care quality and children's outcomes, indicating that there is not a specific threshold at which quality begins to have a positive effect. Rather, the linear relations that were found indicate that better quality child care is related to better outcomes for children across the spectrum of quality, so that the more quality is increased, the better off children are. These findings provide support for the importance of high-quality preschool experiences as a mechanism for promoting school readiness and school success. Because so many children are experiencing center-based child

care before they enter school, it is important to examine the longer term effects of variations in the quality of these programs on children's development and subsequent school success. This study provides longitudinal evidence that higher quality care is modestly associated with a wide variety of better cognitive and socioemotional outcomes for children from diverse backgrounds, including differences in gender, ethnic background, and level of maternal education. Although in some cases the positive effects of higher quality care were even stronger and longer lasting for children at greater risk, higher quality child care was still associated with better outcomes for all groups of children. From a policy perspective, these findings indicate that the need for high-quality child care is of universal importance, and that policies promoting better quality child care have benefits that last into the early school years.

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