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Is the Prediction of Adolescent Outcomes From Early Child Care Moderated by Later Maternal Sensitivity? Results From the NICHD Study of Early Child Care and Youth Development

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Longitudinal data are used to examine whether effects of early child care are amplified and/or attenuated by later parenting. Analyses tested these interactions using parenting as both a categorical and continuous variable to balance power and flexibility in testing moderation. The most consistent finding was that maternal sensitivity during adolescence accentuated the association between child care quality and adolescent academic-cognitive skills at age 15 years when maternal sensitivity during adolescence was high. This interaction was obtained in analyses with maternal sensitivity as both a categorical and continuous variable. Relations between early child care hours and adolescent behavioral outcomes also were moderated by maternal sensitivity, with longer child care hours predicting more impulsivity and externalizing at age 15 when maternal sensitivity during middle childhood, scored as a categorical variable, was low to moderate and when maternal sensitivity during adolescence, scored as a continuous variable, was lower. These findings suggest that some child care effects are moderated by subsequent parenting and that this moderation may take both linear and nonlinear forms.

Keywords: early child care, parenting, academic-cognitive outcomes, behavioral outcomes

The widespread use of child care in the United States (Blau & Currie, 2006) and the increasing use of child care in other countries (Yamazaki & Ito, 2009) have led parents, policy-makers, and researchers to examine the effects of early child care on child development outcomes. Most of these studies have focused on relatively short-term effects of child care, finding higher quality related to higher levels of cognitive and social skills (Burchinal et al., 2009; Côté, Borge, Geoffroy, Rutter, & Tremblay, 2008; Mashburn et al., 2008) and longer hours of child care associated with more problem behaviors (Belsky, 2001; Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007; Nomaguchi, 2006). Reports from the NICHD Study of Early Child Care and Youth Development (SECCYD) extended consideration of the effects of early child care quality and quantity to Grade 5 (Belsky et al., 2007) and then to age 15 years (Vandell et al., 2010). In these reports, higher quality of child care was linked to higher academic-cognitive skills

in primary school and again at age 15. Higher hours of child care were associated with teacher reports of behavior problems in early primary school and youth reports of greater impulsivity and risk taking at age 15. The purpose of the current report is to determine whether the quality of later parenting moderates these relations. In particular, we asked whether the quality of subsequent parenting would amplify the positive effects of high quality child care on academic-cognitive skills and attenuate negative effects of high hours of early child care on social-behavioral outcomes.

The Legacy of Early Experience

Contemporary theorists (Bronfenbrenner & Morris, 2006; Elder & Shanahan, 2006; Sroufe, Egeland, Carlson, & Collins, 2005) have proposed that effects of early experience are related to later developmental outcomes but that those relations are conditional on subsequent experiences. For example, both life course and attachment theory posit that however stressful—or supportive—an early experience might be at the time, eventual consequences must be viewed in the context of children's family relationships *after* the event. A central task in developmental science, then, is identifying the conditions under which the effects of early experience are amplified, attenuated, or maintained. When there is long-term continuity of adverse experiences, subsequent experiences in the family likely reinforce earlier ones. Positive subsequent opportunities, in contrast, can redirect negative trajectories. Supporting this view is evidence showing that children with insecure attachments as infants are less likely to develop problem behaviors when

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they experience more sensitive parenting as preschoolers than are insecure infants who continue to experience less sensitive parenting (Belsky & Fearon, 2002; Sroufe et al., 2005).

These findings of moderating effects of later parenting are consistent with a developmental cascade model (Masten et al., 2005) in which experiences in subsequent developmental periods cascade in sequence, for example, with development in early childhood influencing development in middle childhood, which, in turn, influences development in adolescence. Most research on cascade models has described cross-domain *intrapersonal* longitudinal relations to explain why psychological characteristics at one point in time influence subsequent development in that or another domain (Bornstein, Hahn, & Haynes, 2010). To date, the interest has been on understanding how one personal characteristic (e.g., externalizing problems) influences other personal characteristics (e.g., academic skills) over time. The goal of the current study is to use the cascade framework to examine the extent to which early child care experiences are differentially related to adolescent skills depending on quality of parenting in middle childhood and adolescence.

Parenting Effects in Middle Childhood and Adolescence

We focus on maternal sensitivity and support for autonomy as a possible moderator of early experience because this aspect of parenting is a robust predictor of children's developmental outcomes and a protective factor that moderates earlier risk factors. In particular, high maternal sensitivity coupled with support of child autonomy is linked to positive academic and social emotional behaviors in middle childhood and adolescence, whereas harsh, punitive parenting is associated with higher rates of externalizing behavior and academic problems during these periods (Bradley et al., 2000; Deater-Deckard, Ivy, & Petrill, 2006; Shumow, Vandell, & Posner, 1998). Recent evidence from the Environmental Risk (E-Risk) Longitudinal Twin Study, a birth cohort investigation involving more than 2,200 children, observed that sensitive and responsive parenting in middle childhood moderates the relations between peer victimization and children's adjustment problems (Bowes, Maughan, Caspi, Moffit, & Arseneault, 2010). Relative to their identical twin, children who experienced greater maternal warmth and support were buffered or protected from the otherwise discerned negative effects of being victimized by classmates. Sensitive and stimulating parenting in middle childhood and autonomy-promoting supportive parenting in adolescence also have been shown to moderate the negative impact of early exposure to poverty and maternal depression on children's academic and social skills in middle childhood and adolescence (Burchinal, Roberts, Zeisel, Hennon, & Hooper, 2006; Gutman, Sameroff, & Eccles, 2002; Masten et al., 1999). Involved and sensitive parenting protected children from at least some of the negative impact of exposure to these early social risk factors.

Later Parenting as a Moderator of Early Child Care

When this developmental perspective is applied to the study of early child care, it raises the question of whether maternal sensitivity and support for autonomy in middle childhood and/or adolescence might moderate effects of early child care on later devel-

opment. That is, are the developmental benefits associated with high quality child care and academic-cognitive achievement amplified when later parenting is sensitive, or are they attenuated when later parenting is less sensitive? Do developmental risks associated with many hours of care and child behavior problems hold for adolescents when later experiences in the family are more supportive of child well-being? Are the developmental risks exacerbated by less sensitive parenting?

We hypothesize that later maternal sensitivity and support for autonomy will attenuate otherwise deleterious effects of high hours and/or low quality of child care, whereas less sensitive parenting will amplify the negative effects of high hours and/or low-quality care and attenuate the apparent benefits of high-quality and/or limited exposure to child care. Consistent with a developmental cascade model (Masten et al., 2005), we focus on parenting in two subsequent developmental periods—middle childhood (Grades 1, 3, and 5) and adolescence (age 15). Also considered in these analyses is parenting that coincided with early child care (i.e., parenting in early childhood) as a potential moderator.

Methodologically, we test interactions between early child care and maternal sensitivity in two ways. In the first set of analyses, we consider the cross-product of child care experience (i.e., hours or quality) and maternal sensitivity as two continuous variables. In the second set of analyses, we cross child care experiences as a continuous variable with maternal warmth as a categorical variable. These two approaches test different types of interactions. The crossing of two continuous variables provides a powerful test of whether the differences in the association between early child care and 15-year outcomes vary systematically with each unit increase in maternal sensitivity in middle childhood. That is, it constrains the interaction to be a linear increase in the magnitude of association between the child care variable and the 15-year outcome. Notably, this approach is not able to detect interactions in which child care slopes are very different in different ranges of maternal sensitivity. In the second set of analyses, we directly test our hypothesis that *high* levels of maternal sensitivity will moderate relations between early child care and age 15 outcomes. Maternal sensitivity is treated as a categorical variable reflecting high versus low maternal sensitivity, based on trained observers' ratings of high maternal sensitivity. The interaction between child care experiences and the categorized parenting measure (relatively high sensitivity vs. not) provides a stronger test when the association between child care experiences and adolescent outcomes are qualitatively different in the two parenting groups. This categorical approach, however, provides a much less powerful test when the underlying assumption of the interaction between continuous variables is met. Evidence of this approach to moderation is tested by determining if the slope of the child care variable is reliably different for children with lower and higher quality parenting in middle childhood. It is because we do not know, before the fact, which is the better way to evaluate moderation given the current inquiry, that both approaches are implemented.

The Study of Early Child Care and Youth Development (SECCYD) is well positioned to illuminate the moderating influence of maternal sensitivity and support for autonomy vis-à-vis effects of child care quality and quantity due to the fact that it was assessed during videotaped interactions between mothers and the study children repeatedly from 6 months through age 15 years. Measures of child care hours and quality were collected at regular

intervals from birth until kindergarten entry. Extensive family, school, and neighborhood characteristics were measured at every wave of data collection from infancy through adolescence. Finally, more than 900 youths participated in the age-15 assessments. As a moderately large, nonexperimental, longitudinal study, the SECCYD should be able to test the hypotheses regarding parenting as a moderator with some rigor, despite its inability to draw causal conclusions.

Method

Participants

Families were recruited during hospital visits shortly after the birth of a child in 1991 in 10 locations in the United States. During selected 24-hr intervals, all women giving birth ($n = 8,986$) were screened for eligibility. From that group, 1,364 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 [NICHD Early Child Care Research Network \(2005b\)](#). In terms of demographic characteristics, 26% of the mothers had no more than a high school education at time of enrollment, 31% had incomes no greater than 200% of the poverty level at the 6-month visit, and 22% were minority (i.e., not non-Hispanic European American).

As with any longitudinal study, not all families participated in every wave of data collection. A total of 958 children were retained in the sample at age 15 years and had at least one of the 15-year adolescent assessments, although most children had some missing data. Indeed, only 677 children had complete data on all predictors and outcomes included in these analyses. To account for missing data, full information maximum likelihood structural equation analyses were conducted ([Schafer & Graham, 2002](#)).

Measures

Children were followed from birth through age 15 years. Assessments occurred during early childhood (when the children were 1, 6, 15, 24, 36, and 54 months old), during middle childhood (when children were in kindergarten and Grades 1, 2, 3, 4, 5, and 6), and in adolescence (when participants were 15 years of age). The following sections describe the specific measures used in the present analyses. Additional details about all data collection procedures, psychometric properties of the instruments, and descriptions of how composites were derived and constructed can be found in the [Study of Early Child Care and Youth Development Manuals of Operation and Instrument Documentation](#) that are archived at the Inter-University Consortium for Political and Social Research (ICPSR; <http://www.icpsr.umich.edu/icpsrweb/ICPSR/studies?q=Study+of+Early+Child+Care+and+Youth+Development>).

Measurements are described in terms of their roles in the analyses to be reported. Measures of early child care are described first. The assessments of mother-child interaction are described next, followed by variables used as covariates in the analyses. Finally, we describe the social and cognitive outcome measures obtained at age 15 years.

Child care characteristics. Nonfamilial child care was defined as regular care by anyone other than the parents or grandparents. This includes other relatives, nannies (whether in home or

out of home), family day-care providers, and centers. Three aspects of nonfamilial child care were measured from birth through 54 months: child-care hours, child-care quality, and child-care type.

Child-care hours. Mothers reported children's hours of routine nonfamilial care during phone and personal interviews conducted at 3-month intervals through 36 months and at 4-month intervals thereafter, as well as the type(s) of child care being used (see below). The *hours* spent in all nonfamilial care settings (any routine child care except care by parents and by grandparents) were tallied for each of the 17 intervals or "epochs" and the mean hours-per-week was computed.

Child-care quality. 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 ages 6 through 36 months and two 44-min ORCE cycles at 54 months. Detailed descriptions of the ORCE assessments can be found in [NICHD Early Child Care Research Network \(2002\)](#), including coding definitions, training procedures, and interobserver agreement. The caregiver's interactions with the study child were rated for sensitivity, positive regard, negative regard (reflected), emotional detachment (reflected), cognitive stimulation, fostering of exploration (at 36 and 54 months), and intrusiveness (reflected). The ORCE total score was computed as the mean of these ratings. Reliability exceeded .90 at 6 months, .86 at 15 months, .81 at 24 months, .80 at 36 months, and .90 at 54 months.

Child-care type. For each epoch, up to three care arrangements were classified by type of care: center, child-care home (any home-based care outside the child's own home except care by parents or grandparents), and in-home care (any caregiver in the child's own home except parents or grandparents). The proportion of epochs in which the child received care in a center for at least 10 hr per week was used to represent *type of care*.

Maternal sensitivity. We videotaped mother and child interacting during 15–20 min semistructured sessions when the child was 6, 24, 36, and 54 months of age (early childhood); in Grades 1, 3, and 5 (middle childhood, approximately, 6, 8, and 10 years of age); and at age 15 years (adolescence). At each assessment age, the procedures involved two to four activities that were completed one at a time.

Mother-child interaction in early childhood. Maternal sensitivity was rated from videotapes of semistructured interactions between mother and child. The interactions were designed to assess the mother's capacity to interact in a sensitive, warm, and stimulating manner with her child. When the children were 6 months of age, the mothers were asked to play as they normally might with their infants, using toys of their own choosing for 7–8 min and then to play with a standard set of toys for the remaining 7–8 min. At 15, 24, and 36 months, children had an opportunity to play with toys in three containers for 15-min. The mother-child videotapes were coded at a central location. When the children were 6, 15, and 24 months of age, mothers' sensitivity to nondistress, intrusiveness, detachment, stimulation of cognitive development, positive regard for the child, negative regard for the child, and flatness of affect were originally rated on a 4-point scale that

was transformed to a 7-point scale to provide consistent scoring with other ages. When the children were 36 and 54 months of age, mothers' supportive presence, respect for the child's autonomy, stimulation of cognitive development, hostility, and confidence were rated using 7-point scales. Maternal sensitivity scores were composited to describe this type of parenting during early childhood, and computed by reverse-scoring the ratings of negative behaviors and computing the mean (alphas ranged from .70 to .84). The mean of these maternal sensitivity composites was computed to represent maternal sensitivity during early childhood ($\alpha = .77$).

Mother-child interactions in middle childhood. Videotaped observations of 15-min mother-child interactions were collected at Grades 1, 3, and 5. When the children were in first grade, the tasks included an Etch A Sketch activity task, a block task that required help from the mother, and a card game. In third and fifth grades, the interaction tasks involved discussion and problem-solving tasks. When the child was in third grade, the mother and child talked together about their views of different "rules" chosen randomly, regarding what kids and parents "should" do (e.g., "kids should be able to wear whatever they want"). The problem-solving activity was an errand-planning task in which the child and mother determined the best route around a town map to accomplish 11 errands in sequence (e.g., return book to library). The fifth grade discussion task was structured so that mother and child tried to resolve their differences with respect to three issues first selected by the dyad from a standard set of 22 issues (e.g., "bedtime," "playing computer or video games"). The problem-solving task was to construct a "bungee jump" for a raw egg.

Observers coded mothers' respect for child autonomy, supportive presence, and hostility using 7-point global rating scales that were refined at each time period for age and task appropriateness. Composite scores of *maternal sensitive support for autonomy* were created using the sum of the three ratings of respect for autonomy, supportive presence, and hostility (reversed) in each of these interactions. Cronbach's α for maternal sensitivity composites ranged from .82 to .84 across time periods. Interobserver reliability ranged from .84 to .91. The mean maternal sensitivity composite score from Grades 1, 3, and 5 was computed to represent maternal sensitivity and respect for autonomy during middle childhood ($\alpha = .70$).

Mother-child interaction in adolescence. The age-15 interaction task was designed to assess qualities of maternal behavior, adolescent behavior, and dyadic interaction during an 8-min (minimum of 5-min) discussion of one or more (typically two) areas of disagreement between the adolescent and mother (e.g., chores, homework, use of free time) selected by the adolescent from a list of possible topics. The interactions were rated using 7-point scales to describe the extent to which the mother recognizes and validates the adolescent's perspectives, and opinions, respects the adolescent's autonomy, was engaged, inhibits autonomy (reversed), was hostile or devaluing (reversed), and promotes relatedness. The sensitivity composite was formed as the mean of these ratings after reverse scoring negative scales ($\alpha = .81$). Interrater reliability ranged from .68 to .87 across scales.

High maternal sensitivity and support. A designation of relatively high maternal sensitivity in each developmental period was determined by scores on the maternal sensitivity composite. At all ages, a score of 5 on the underlying scale (1–7) designated mod-

erately high levels of maternal sensitivity, a score of 6 designated high levels of maternal sensitivity, and a score of 7 designated very high levels of sensitivity in interactions. Accordingly, we chose to designate mothers with scores between 5.5 and 7 as demonstrating high maternal sensitivity and scores of less than 5.5 as demonstrating moderate to low sensitivity. Using this categorical designation, *high maternal sensitivity* was observed in 57% of the mothers in early childhood, 58% in middle childhood, and 33% in adolescence.

Maternal, child, family, and school covariates.

Early childhood covariates. Measures of maternal, child, and family characteristics during early childhood were used as covariates in analyses: *maternal education* (in years); the study child's *race and ethnicity*; the mother's *vocabulary skills* as measured by the Peabody Picture Vocabulary Test—Revised (Dunn & Dunn, 1981) obtained when the study child was age 3 years; *maternal psychological adjustment* measured when the study child was age 6 months using the neuroticism, extraversion, agreeableness subscales of the NEO Personality Inventory (Costa & McCrae, 1985, 1989); the proportion of measurement 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 mean of *maternal depressive symptoms* assessed by the Center for Epidemiological Studies Depression Scales (Radloff, 1977) reported by the mother at 6, 15, 24, 36, and 54 months. The mean of the repeated assessments for each measure was included as a covariate.

Middle childhood and adolescent covariates. Many family demographic and psychological characteristics were obtained when children were in Grades 1, 3, and 5, and at 15 years-of-age. These variables included the *presence of a husband/partner* in the household, *income-to-needs ratio*, and *maternal depressive symptoms*. The mean of the repeated assessments from Grades 1, 3, and 5 for each measure was included as middle childhood covariates, whereas the 15 years-of-age assessments were included as the adolescent covariates.

Children's classroom experiences were measured using the Classroom Observation System for First Grade, Third Grade, and Fifth Grade (NICHD Early Child Care Research Network, 2004, 2005a). These observations focused on the classroom as well as the specific study child and his or her classroom experiences. The mean of the total scores from Grades 1, 3, and 5 was included to adjust for the quality of instruction during elementary school.

Adolescent outcomes. Paralleling earlier analyses by Vandell et al. (2010), cognitive and behavioral outcomes at age 15 are examined.

Academic achievement and cognitive skills. The Woodcock-Johnson Psycho-Educational Battery—Revised (WJ-R) is a wide-range, comprehensive set of individually administered tests that consists of two major parts: the Tests of Cognitive Ability and the Tests of Achievement (Woodcock & Johnson, 1989; Woodcock, 1990). At age 15, Cognitive Ability was assessed in two subscales, Picture Vocabulary and Verbal Analogies. Achievement was assessed using the Passage Comprehension and Applied Problems subscales. In this report, standard scores, based on a mean of 100 and a standard deviation of 15, are used.

Risk taking. Adolescents reported *risk taking* behaviors using an audio computer-assisted self-interview. Thirty-six risk-taking survey items were drawn from instruments used in prior studies of

adolescents (Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004). Adolescents reported the extent to which, over the past year, they had used alcohol, tobacco, or other drugs, behaved in ways that threatened their own safety (e.g., rode in a vehicle without the use of seatbelts), used or threatened to use a weapon, stolen something, or harmed property. Responses were made on a 3-point scale: *Never* = 0, *Once or Twice* = 1, and *More than Twice* = 2. Ratings were summed across component items and then subject to square root transformation to reduce skew and kurtosis related to low incidence of reported risk taking.

Impulsivity. At age 15, adolescents completed an eight-item questionnaire to assess reactions to external constraints. All items were taken from the Weinberger Adjustment Inventory (WAI; Weinberger & Schwartz, 1990). The measure asks participants to rate (1 = *False* to 5 = *True*) how closely their behavior matched a series of statements. Sample items include: "I'm the kind of person who will try anything once, even if it's not that safe," "I should try harder to control myself when I'm having fun," and "I do things without giving them enough thought." Seven items were used to create an impulsivity composite score (Cronbach's $\alpha = .82$).

Externalizing behaviors. The Youth Self-Report (YSR) scales (Achenbach, 1991b) at age 15 are based on adolescent responses to a list of 119 items that includes a broad range of adolescent behavioral/emotional problems as well as 16 socially desirable items. For each item, the adolescent is asked to determine how well that item describes him or her currently or within the last 6 months: 0 = *Not True*, 1 = *Somewhat or Sometimes True*, and 2 = *Very True or Often True*. The YSR is designed for obtaining self-reports from youth at ages 11 to 18 years. The format is similar to the other two scales by the same author, the Child Behavior Checklist (Achenbach, 1991a) completed by parents and the Teacher's Report Form (Achenbach, 1991c) completed by teachers. All three instruments contain overlapping items. *Exter-*

nalizing behaviors are assessed by 30 items ($\alpha = .86$), and a *t*-score is computed on which the expected mean is 50 and standard deviation is 10. The range of scores was from 25 to 86, with higher scores indicating a greater affinity to display delinquent and aggressive behaviors.

Results

Descriptive Analyses

Table 1 presents the sample size, means, and standard deviations for the child care variables and for the longitudinal measures of maternal sensitivity, family demographics, and schooling. Table 2 shows descriptive statistics for the 15-year outcomes. Table 3 presents the correlations among the child care hours, child care quality, and maternal sensitivity variables and the 15-year child outcomes.

Analysis Plan

Structural equation modeling (SEM) is used to test the extent to which maternal sensitivity and support for autonomy in early childhood, middle childhood, and adolescence moderate the association between early nonfamilial child care (hours, quality) and child outcomes at 15 years. The analyses extend the previously reported SEM analyses (Vandell et al., 2010) that indicated association between child care hours and adolescent behavior outcomes and between child care quality and adolescent academic/cognitive outcomes and externalizing problems. In that report, direct pathways were estimated from early child care to four 15-year outcomes (risk taking, impulsivity, externalizing, academic-cognitive achievement). Academic-cognitive achievement at age 15 was a latent variable consisting of the Woodcock-Johnson Vocabulary, Math, Reading, and Analogies scale scores.

Table 1
Descriptive Statistics for Child Care Variables and Covariates

Variable	Early childhood				Middle childhood				Adolescence			
	<i>N</i>	%	<i>M</i>	<i>SD</i>	<i>N</i>	%	<i>M</i>	<i>SD</i>	<i>N</i>	%	<i>M</i>	<i>SD</i>
Child care												
Hours	1,214		16.48	14.16								
Quality	1,005		2.90	0.45								
% Center	1,214		0.21	0.26								
Covariates												
Gender	1,364											
Male		52										
Race	1,364											
Black		13										
Hispanic		6										
White		66										
Other		5										
Maternal education	1,363		14.23	2.51								
Maternal vocabulary	1,167		99.01	18.35								
Maternal adjustment	1,272		59.00	13.95								
Income/needs ratio	1,302		3.60	2.85	1,140		4.19	3.37	924		5.26	5.79
% Time 2-parents	1,306		0.84	0.32	1,154		0.81	0.34	979		0.77	
Maternal depression	1,304		9.36	6.76	1,123		8.74	7.32	973		10.48	9.83
Maternal sensitivity	1,306		5.50	0.75	1,114		5.51	0.75	898		5.19	0.84
High maternal sensitivity		57				58				33		
Classroom quality composite					1,100		3.27	0.32				

Table 2
Descriptive Statistics for Outcomes at Age 15 Years, Grade 5, and 54 Months

Youth outcomes	15 years			Grade 5			54 months		
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Academic/cognitive composite	892	106.1	13.07	993	107.2	13.2	1,060	100.6	12.5
WJ-R Vocabulary	889	99.93	14.77	992	103.9	14.8	1,060	100.2	15.3
WJ-R Math	887	102.9	14.22	993	107.9	13.9	1,056	98.9	13.5
WJ-R Reading	887	107.7	15.72	993	110.7	17.4	1,053	102.9	15.6
WJ-R Analogies	891	113.7	16.02						
Externalizing Problems	956	49.31	9.91	927	51.0	9.2	705	50.2	9.6
Risk Taking	957	24.95	9.02						
Impulsivity	957	7.16	7.02						

Note. WJ-R = Woodcock-Johnson Psycho-Educational Battery—Revised (Woodcock & Johnson, 1989; Woodcock, 1990). Measures included were the WJ-R Picture Vocabulary, WJ-R Applied Problems (math), WJ-R Passage Comprehension (reading), WJ-R Analogies, Youth Self-Report (15 years), and Teacher Report Form—Externalizing *t* score (Grade 5 and 54 months), risk taking inventory, and adapted version of the Impulsivity Scale from the Weinberger Adjustment Inventory (Weinberger & Schwartz, 1990).

Externalizing, risk-taking, and impulsivity were analyzed separately because the fit was poor when they were treated as indicators of a latent variable (Vandell et al., 2010).

In this article we add paths (a) from interactions between maternal sensitivity at each developmental period and child care hours and (b) from interactions between maternal sensitivity at each developmental period and child care quality to the prediction of 15-year behavioral outcomes. The models are fit with full information maximum likelihood analyses to account for missing data. All variables included in interactions are grand-mean centered to improve interpretation of their main effects. Effect sizes are computed as the product of the coefficient of a predictor and the standard deviation of the predictor divided by the standard deviation of the outcome,

$$d = B_X SD_X / SD_Y.$$

Two forms of maternal sensitivity by child care interactions are tested in separate models. The crossing of child care and maternal sensitivity as two continuous variables allowed us to test linear moderation. The crossing of child care and maternal sensitivity as a categorical variable allowed us to test whether the slopes of the child

care variable are reliably different for the high and low maternal sensitivity groups.

Before conducting these analyses, we asked whether there was sufficient overlap between the child care variables (quality, hours) and maternal sensitivity in each of the three time periods. Quartiles for child care hours were crossed with the quartiles for maternal sensitivity at each time period to create a 4 × 4 cross-tabulation for child care hours and maternal sensitivity. Across the three ages, there were 5–9% of the sample in each cell of the 4 × 4 table and a minimum of 33 participants per cell. Comparable 4 × 4 cross-tabulations were created for quartiles of child care quality and maternal sensitivity at each time period. Again, there was 4–9% of the sample in each cell, with a minimum of 39 participants per cell. Similarly, we crossed the quartiles for child care hours with the categorized maternal sensitivity variables, resulting in 4 × 2 tables with 7–18% of the sample in each cell and a minimum of 54 participants per cell. Finally, we crossed the quartile for child care quality with the categorized maternal sensitivity variables. Again, each of the eight cells included 7–17% of the sample, with a minimum cell size of 54. Thus, there were sufficient cases in the cells to warrant further interaction analyses.

Table 3
Correlations Among Child Care Variables, Maternal Sensitivity, and Adolescent Outcomes

Variable	Child care		Maternal sensitivity			15-year outcomes		
	Hours	Quality	Early childhood	Middle childhood	Adolescence	Academic	Externalizing	Impulsivity
Child care								
Hours	1.00							
Quality	-.20	1.00						
Center	.42	.18						
Maternal sensitivity								
Early childhood	.04	.17						
Middle childhood	.03	.14	.60					
Adolescence	.02	.06	.35	.41				
15-year child outcomes								
Academic/Cognitive Skills	.03	.23	.47	.42	.20			
Externalizing	.04	-.11	-.11	-.16	-.14	-.07		
Impulsivity	.12	-.10	-.14	-.25	-.20	-.14	.61	
Risk Taking	.08	-.13	-.22	-.23	-.18	-.23	.50	.49

Child Care Experiences × Maternal Sensitivity as a Continuous Variable

The first set of SEM path models tested whether the association between early child care (hours, quality) and 15-year-old outcomes was moderated by maternal sensitivity during early childhood, middle childhood, and adolescence. The interactions between continuous measures of child care quality and quantity and maternal sensitivity provide the most power when maternal sensitivity moderates the association between child care experiences and adolescent outcomes in a linear manner. These interactions were tested in two steps. First, the model for each adolescent outcome included 6 interaction terms created by crossing the two child care variables (hour, quality) with maternal sensitivity during each of the three time periods. Second, the nonsignificant interaction terms were dropped from the model to ensure that high levels of correlations among the interaction terms were neither suppressing nor inflating the interaction coefficients.

Table 4 shows the base model without interactions, and the top half of Table 5 shows the results from the analyses that added the interaction terms. Separate columns in Table 5 describe the models for each outcome, with two columns per outcome. The first column shows the coefficients when the model included all six interaction terms and the second column shows the results when the model was reduced to include only interaction terms that were statistically significant for at least one outcome. The model fit was excellent for the analyses of both the social outcomes (root-mean-square error of approximation [RMSEA] = 0, comparative fit index [CFI] = 1) and the academic outcomes (RMSEA = .03, CFI = .95).

These analyses identified two significant interactions, both involving maternal sensitivity in adolescence. Maternal sensitivity in

adolescence scored as a continuous variable moderated the relation between child care quality and academic-cognitive outcomes at 15 years ($B = 2.74, p < .05$). To illustrate this interaction, effect sizes for child care quality were computed for maternal sensitivity at one standard deviation above and below the mean (see Figure 1). Child care quality was a positive predictor of academic-cognitive skills when maternal sensitivity at 15 years was high ($d = 0.20$) and not related when maternal sensitivity at age 15 was low ($d = 0.04$). In addition, the relation between child care hours and externalizing at age 15 was moderated by maternal sensitivity during adolescence ($B = -0.07, p < .05$). Child care hours was a positive predictor of externalizing behaviors when maternal sensitivity at 15 years was one standard deviation below the mean ($d = 0.11$) and a negative predictor when maternal sensitivity was one standard deviation above the mean ($d = -0.06$).

No evidence emerged suggesting that maternal sensitivity during middle childhood moderated the association between child care hours and 15-year behavioral outcomes.

Child Care Experiences × High Maternal Sensitivity

The next set of SEM path models tested whether the association between early child care (hours, quality) and 15-year-old outcomes was moderated by high maternal sensitivity during early childhood, middle childhood, and adolescence. These tests of moderation were conducted to provide a more flexible, but less powerful, approach to testing the hypothesized moderation. Again, analyses were first conducted including all interaction terms and then those models were trimmed by dropping nonsignificant interactions. Both the full and trimmed models provided an excellent fit to the social outcomes (RMSEA = 0, CFI = 1) and academic outcomes (RMSEA = .03, CFI = .96). The results from these analyses are

Table 4
Standardized Coefficients From Path Model From Analyses of Age 15 Outcomes

Variable	Impulsivity β	Externalizing β	Risk Taking β	Academic/ Cognitive β
Covariates				
Gender	.04	-.13***	.16***	.07*
Maternal education	-.02	-.00	.05	.16***
Maternal psychological adjustment	-.11*	-.05	-.07	-.03
Maternal vocabulary	.01	.10	-.11*	.32***
Income 6–54 months	-.07	.00	-.05	.00
Partnered 6–54 months	-.05	-.21***	-.14*	-.02
Maternal depression 6–54 months	-.02	-.11	-.12*	.04
Income K–G6	-.04	-.02	-.07	.05
Partnered K–G6	-.05	.01	.03	-.02
Maternal Depression K–G6	-.02	.06	.05	.05
Schooling Quality G1–5	-.04	.01	-.05	-.00
Income 15 years	.07	-.04	.11	-.03
Partnered 15 years	.03	-.03	-.07	.03
Maternal depression 15 years	.08	.08	.10*	-.00
Maternal sensitivity				
Maternal sensitivity 6–54 months	.07	.03	.04	.13*
Maternal sensitivity G1–5	-.22***	-.10	-.05	.08
Maternal sensitivity 15 years	-.13***	-.06	-.09*	-.03
Nonfamilial child care				
Hours/week 1–54 months	.13***	.02	.12**	.05
Prop time in center care 1–54 months	-.06	-.03	-.04	.01
Child care quality 6–54 months	-.05	-.08*	-.05	.12**

Note. K = kindergarten; G = grade. Model also includes site and race.

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

Table 5

Interactions Between Child Care Hours and Quality With Maternal Sensitivity in Early Childhood, Middle Childhood, and Adolescence

Variable	Impulsivity		Externalizing		Risk Taking		Academic/Cognitive	
	Full <i>B</i> (<i>SE</i>)	Trim <i>B</i> (<i>SE</i>)	Full <i>B</i> (<i>SE</i>)	Trim <i>B</i> (<i>SE</i>)	Full <i>B</i> (<i>SE</i>)	Trim <i>B</i> (<i>SE</i>)	Full <i>B</i> (<i>SE</i>)	Trim <i>B</i> (<i>SE</i>)
Interactions: M Sensitivity (continuous)								
CC Hours × M Sensitivity 6–54 months	–0.01 (.05)		0.05 (.06)		0.01 (.01)		–0.02 (0.07)	
CC Quality × M Sensitivity 6–54 months	–0.87 (1.63)		–2.07 (1.84)		–0.28 (0.22)		–2.28 (2.20)	
CC Hours × M Sensitivity G1–5	–0.01 (0.05)		–0.03 (0.05)		–0.01 (0.01)		–0.00 (0.07)	
CC Quality × M Sensitivity G1–5	–0.06 (1.55)		0.65 (1.75)		0.02 (0.21)		1.37 (2.17)	
CC Hours × M Sensitivity 15 years	–0.01 (0.03)		–0.08* (0.04)	–0.07* (0.03)	–0.00 (0.01)		–0.03 (0.05)	
CC Quality × M Sensitivity 15 years	0.45 (0.96)		1.30 (1.09)		0.11 (0.13)		2.90* (1.30)	2.74* (1.22)
Interactions: M Sensitivity (high/low)								
CC Hours × M Sensitivity 6–54 months	0.04 (0.06)		0.06 (0.07)		0.01 (0.01)		–0.02 (0.08)	
CC Quality × M Sensitivity 6–54 months	–2.01 (1.81)		–1.95 (2.03)		–0.10 (0.24)		0.48 (2.46)	
CC Hours × M Sensitivity G1–5	–0.10 ⁺ (0.06)	–0.11* (0.05)	–0.14* (0.07)	–0.14* (0.06)	–0.02 (0.01)		–0.05 (0.08)	
CC Quality × M Sensitivity G1–5	2.83 (1.82)		2.71 (2.04)		0.03 (0.24)		0.21 (2.48)	
CC Hours × M Sensitivity 15 years	–0.04 (0.05)		–0.09 (0.06)		–0.00 (0.01)		–0.06 (0.07)	
CC Quality × M Sensitivity 15 years	0.98 (1.62)		0.80 (1.82)		–0.02 (0.22)		3.85* (2.22)	4.39* (2.18)

Note. CC = child care; M = maternal; G = grade. Full model includes all interactions. Trim model includes only statistically significant interactions. Model also includes as covariates site and race. A square-root transformation was applied to Risk-Taking due to its skewed distribution.

⁺ $p < .10$. * $p < .05$.

shown in the bottom half of Table 5, labeling the categorical maternal sensitivity variable as high maternal sensitivity.

As shown in Table 5, three significant interactions were obtained. High levels of maternal sensitivity during middle childhood moderated associations between child care hours and two of the behavioral outcomes. The interactions between child care hours and high maternal sensitivity in middle childhood indicated that impulsivity ($B = -0.11$, $p < .05$) and externalizing problems ($B = -0.14$, $p < .05$) in adolescence were more strongly predicted by child care hours when mothers showed lower levels of sensitivity during middle childhood. When children experienced high levels of maternal sensitivity during middle childhood, child care hours were not related to adolescent impulsiveness ($d = -0.01$) or externalizing problems ($d = 0.06$). In contrast, when adolescents experienced lower levels of maternal sensitivity during middle childhood, child care hours were related to more impulsivity ($d = 0.42$) and externalizing behaviors ($d = 0.35$).

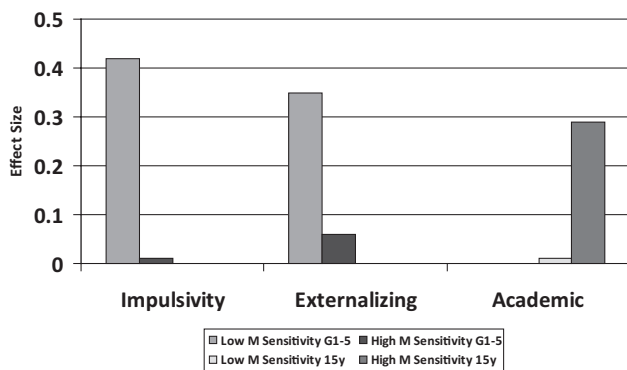


Figure 1. Effect sizes for child care hours and quality by maternal (M) sensitivity groups. G = grade; y = years.

In addition, high levels of maternal sensitivity during adolescence moderated associations between child care quality and the academic-cognitive latent variable. The interaction between child care quality and high maternal sensitivity in adolescence ($B = 4.39$, $p < .05$) indicated that academic-cognitive skills were more strongly predicted by child care quality when they also experienced high maternal sensitivity in adolescence. When children experienced high levels of maternal sensitivity in adolescence, child care quality was related to academic-cognitive skills ($d = 0.29$). In contrast, when adolescents experienced lower levels of maternal sensitivity in adolescence, child care quality was not related to academic-cognitive skills ($d = -0.01$).

These analyses yielded no evidence of interactions involving maternal sensitivity in early childhood.

Follow-Up Analyses

Several follow-up analyses were conducted to examine the robustness of the findings involving interactions between maternal sensitivity and child care. First, we tested whether other factors such as race or income might account for these interactions. Second, we examined earlier outcomes to see if there is evidence of moderated associations between child care and child outcomes that were measured at younger ages. Finally, we conducted a falsification test that evaluated the proposition that we would not find an interaction between hours of care and parenting in middle childhood on behavioral outcomes at 54 months, a logically impossible relation (i.e., the future predicting the past).

Testing alternative moderators: Demographics. To check whether the interactions between child care experiences and maternal sensitivity were explained by demographic factors, we examined interactions between child care and maternal education, family income, and race. Table 6 shows the estimated interaction coefficients from these analyses. Analyses did not yield any sig-

Table 6
Testing Interactions Between Child Care Experiences and Demographic Characteristics

Interaction	Impulsivity		Externalizing		Risk Taking		Academic/Cognitive	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Hours × Race	-0.01	0.07	0.02	0.08	-0.00	0.01	0.04	0.09
Quality × Race	-2.54	2.07	-0.85	2.36	-0.40	0.28	2.33	2.54
Hours × M Education	-0.00	0.01	0.00	0.01	-0.001	0.001	-0.01	0.01
Quality × M Education	0.24	0.36	0.02	0.41	-0.05	0.05	0.31	0.45
Hours × Income	-0.00	0.01	-0.00	0.01	-0.001	0.001	-0.01	0.01
Quality × Income	-0.40	0.26	-0.09	0.30	-0.02	0.04	-0.21	0.33

Note. M = maternal.

nificant interactions between these demographic factors and either child care hours or quality.

Earlier outcomes. The next set of analyses tested whether concurrent maternal sensitivity (scored categorically and continuously) moderated associations between child care and child outcomes at 54 months and Grade 5. Two of the four adolescent outcomes (externalizing and academic-cognitive skills) were measured at these earlier ages. At 54 months and in Grade 5, teachers rated children’s externalizing problems using the Teacher Report Form (Achenbach, 1991c), and children were administered the Woodcock-Johnson—Revised (WJ-R) by trained research assistants. The academic-cognitive composite was computed for each age from the WJ-R scales. SEM analyses tested whether maternal sensitivity in early childhood moderated association with the 54 months outcomes and whether maternal sensitivity in early and middle childhood moderated associations with the fifth grade outcomes.

Results are shown in Table 7. One interaction was statistically significant when all interactions were considered simultaneously. The interaction between maternal sensitivity during early childhood and child care hours remained statistically significant in the trimmed model for the analysis in which maternal sensitivity was scored categorically but not continuously. Unexpectedly, these analyses indicated that child care hours was a stronger predictor of

externalizing problems when maternal sensitivity was high during early childhood, than when it was low.

Falsification test. The final set of follow-up analyses tested specificity of the moderated model in a different manner. We asked whether maternal sensitivity during middle childhood moderated an association between early child care and child outcomes at 54 months, a logically impossible relation in which a later experience would modify an earlier experience. Teacher ratings of externalizing and the academic-cognitive composite at 54 months were analyzed. Externalizing at 54 months was predicted from child care experiences, the early childhood covariates and maternal sensitivity, maternal sensitivity during middle childhood, and the interactions between maternal sensitivity in middle childhood and child care hours. This analysis confirmed prior reports (NICHD Early Child Care Research Network, 2002) that higher child care hours was associated with more problem behaviors as reported by child care providers at 54 months ($B = 0.14, SE = 0.04, p < .001$) but did not indicate that maternal sensitivity in middle childhood had a main effect ($B = -0.46, SE = 1.65, p = .78$) or interacted with child care hours ($B = -0.05, SE = 0.06, p = .40$). Similar analysis of academic-cognitive skills at 54 months showed that higher child care quality was related to academic-cognitive outcomes at 54 months ($B = 3.18, SE = 1.04, p < .01$), but that maternal

Table 7
Testing Interactions Between Child Care Experiences and Parenting on Earlier Outcomes

Outcomes	Externalizing				Academic/Cognitive					
	M Sensitivity High/Low		M Sensitivity Continuous Full ^a		M Sensitivity High/Low Full ^a		M Sensitivity Continuous Full ^a			
	Full	Trim			Full ^a	Full ^a				
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>		
54-month outcomes										
CC Hours × M Sensitivity 6–54 months	0.07	0.05			0.05	0.04	-0.05	0.05	-0.01	0.04
CC Quality × M Sensitivity 6–54 months	1.49	1.69			0.37	1.22	-0.59	1.67	0.52	1.15
Grade 5 outcomes										
CC Hours × M Sensitivity 6–54 months	0.13*	0.05	0.10*	0.05	0.10*	0.05	0.03	0.06	0.01	1.65
CC Quality × M Sensitivity 6–54 months	0.81	1.60			0.74	1.39	-0.39	1.84	-1.75	1.66
CC Hours × M Sensitivity G1–5	-0.05	0.05			-0.05	0.04	-0.04	0.06	0.02	0.05
CC Quality × M Sensitivity G1–5	0.15	1.62			-0.67	1.35	1.03	1.88	1.14	1.65

Note. CC = child care; M = maternal; G = grade.

^a Only the full model is presented, because no interaction term obtained significance when the model was trimmed.

* $p < .05$.

sensitivity in adolescence did not predict academic-cognitive skills ($B = 0.55$, $SE = 1.71$, $p = .75$) nor did adolescent parenting interact with child care quality ($B = -0.003$, $SE = 0.06$, $p = .96$) for this 54-month outcome, both logically impossible relations.

Discussion

The findings from this report qualify some of the previously reported results from the NICHD Study of Early Child Care and Youth Development (Vandell et al., 2010) relating amount of early child care to adolescent behavior problems and quality of child care to adolescent academic skills. From the publication of the findings relating hours of care to behavior problems in toddlers (NICHD Early Child Care Research Network, 1998), during the early- and middle-childhood years (Belsky et al., 2007; NICHD Early Child Care Research Network, 2003, 2005b), and to risk taking and impulsivity at 15 years (Vandell et al., 2010), many parents and policy makers have been concerned that full- or near-full-time child care might result in elevated levels of problematic behavior. Similarly, publication of the findings relating child care quality to academic skills in early childhood (NICHD Early Child Care Research Network, 2002), middle childhood (Belsky et al., 2007; NICHD Early Child Care Research Network, 2005b), and adolescence (Vandell et al., 2010) have both comforted and concerned parents and policy makers who noted that higher quality care may promote cognitive skills while lower quality care may impair the early development of those skills.

The current study is, to our knowledge, the first to ask whether associations linking early child care to later development are conditioned by children's later experiences—in this case by later parenting—after the early childhood years. In posing this question, we were guided by the conceptualization of developmental cascades in which children's earlier development sets the stage for later development and in which later experiences can either attenuate or exacerbate effects of earlier experience (Elder & Shanahan, 2006; Masten & Cicchetti, 2010). We reasoned that developmental trajectories established in early childhood and shaped, at least in part, by early child care experience, could be modified as a result of experience in the family in the next developmental periods. Later maternal sensitivity in middle childhood and in adolescence were selected potential moderators of early child care experiences because previous research (Bowes et al., 2010; Burchinal et al., 2006) had identified this parenting process as a significant protective factor when maternal sensitivity is high and as a significant risk when maternal sensitivity is low.

The current analyses indicate that some of the associations between early child care and adolescent behavioral outcomes are moderated by later maternal sensitivity. In particular, high maternal sensitivity during middle childhood appeared to act as a compensatory factor that mitigated relations between high child care hours and externalizing behaviors and impulsivity at age 15. Prior analyses indicated that child care hours were associated with significantly more risk taking and impulsivity, but not externalizing at 15 years (Vandell et al., 2010). These findings suggest that the direct path from child care hours to impulsivity observed in the prior article is moderated by maternal sensitivity and that a non-significant direct path from child care hours to externalizing in the prior article emerged as a significant moderated path in these

analyses. Whereas associations between high child care hours and impulsivity and externalizing at age 15 were observed when maternal sensitivity was low during middle childhood, these associations were not evident when maternal sensitivity was high in middle childhood in the analysis involving categorical parenting variables and when maternal sensitivity was higher in adolescence in the analysis involving continuous variables. In the current analyses, the previously reported main effect between child care hours and risk taking behaviors at age 15 remained (Vandell et al., 2010); it was not moderated by maternal sensitivity in middle childhood.

The current analysis also indicates that the association between child care quality and academic-cognitive skills is moderated by maternal sensitivity during adolescence. Low to moderate maternal sensitivity during adolescence appeared to act as a risk factor that attenuated relations between high child care quality and academic-cognitive outcomes at age 15. The positive association between early child care quality and academic-cognitive skills at age 15 was evident when maternal sensitivity at age 15 was high, but not when maternal sensitivity was lower. These findings qualify our previous findings and support our somewhat specific hypotheses that subsequent maternal sensitivity would moderate associations between child care hours and adolescent social outcomes and between child care quality and adolescent academic outcomes.

These analyses provide an example of when current recommendations to use continuous variables to test interactions could result in failure to observe a potentially important moderator. DeCoster, Iselin, and Gallucci (2009) advised that continuous variables should not be categorized when testing interactions because of the information that is lost in the process. This approach, however, makes stringent assumptions about the form of interactions: it assumes that the "effect" of one variable increases linearly with a 1-point increase in the other variable. As demonstrated here, the categorical approach, but not the continuous approach, detected interactions in which the early child care predictor had very different slopes in different ranges of our hypothesized moderator, maternal sensitivity during middle childhood. The interactions were reliably different from zero when maternal sensitivity in middle childhood was categorized because the results indicated that child care hours was unrelated to the outcomes when maternal sensitivity was high and was a positive predictor when maternal sensitivity was low.

These analyses suggest that treating moderators as categorical variables might be an appropriate follow-up test when tests of interactions between two continuous variables fail to detect hypothesized moderation. The interaction between two continuous variables will always provide the most power to detect moderation if that interaction involves a constant linear change in the association between one variable and the outcome variable for each point higher (or lower) on the moderator. A follow-up test using of nonlinear terms or categorical variables in the interaction can be used to see if a null finding from the test of the cross-product of continuous variables could be due to nonlinear interaction effects. For example, we see evidence that parenting in middle childhood might be a nonlinear moderator of child care hours in predicting adolescent impulsivity and externalizing. For these reasons, we recommend testing the interaction as the cross-product of continuous variables, and if nonsignificant, conducting follow-up analyses using the moderator as a categorical variable.

The most consistent finding suggested that maternal sensitivity during adolescence accentuated the association between child care

quality and adolescent academic-cognitive skills when maternal sensitivity during adolescence was high. This interaction was obtained in analyses with maternal sensitivity as both a categorical and continuous variable. Whether maternal sensitivity in middle childhood or adolescence served as the moderator of child care hours varied depending on the outcome and whether maternal sensitivity was analyzed as a categorical or continuous variable. Maternal sensitivity in middle childhood moderated associations between child care hours and two of the adolescent behavioral outcomes when maternal sensitivity was analyzed as a categorical variable and maternal sensitivity in adolescence moderated those associations when analyzed as a continuous variable. This inconsistency could reflect differences in whether the moderation involved qualitatively different child care hours slopes for higher and lower sensitivity during middle childhood and a quantitative change in the slopes for sensitivity in adolescence. The inconsistency, on the other hand, could suggest that findings are spurious.

The current results are noteworthy for evidence of effects that were moderated by maternal sensitivity in middle childhood and in adolescence and also by what was not found. Consistent with several prior reports utilizing data from the SECCYD (NICHD Early Child Care Research Network, 2005b), we did not detect interactions between early child care and demographic factors such as income, race or maternal education. This may be because of the relatively privileged nature of the SECCYD sample at age 15. We also did not detect any significant interactions between early child care and maternal sensitivity during the early childhood period. This lack of concurrent moderation, especially in the face of the evidence of the conditional effects of later parenting, is an area that warrants additional research and theory. Further study of developmental cascades may illuminate issues of timing of experiences.

Several limitations of this research need to be noted. First, it is a concern that the NICHD Study of Early Child Care and Youth Development was nonexperimental and omitted variable bias. Although we included a large number of covariates, it is possible that other factors might account for these interactions. For this reason, causal inferences cannot be drawn from the type of analyses presented. Second, replications of the obtained interactions between quantity-of-care and parenting in middle childhood and between quality-of-care and parenting in adolescence are needed. The pattern of interactions was somewhat inconsistent depending on which outcomes were examined and whether maternal sensitivity was treated as a categorical or continuous variable. The interaction between child care quality and maternal sensitivity during adolescence on the only measure of 15-year-old academic/cognitive skills was obtained regardless of whether maternal sensitivity was treated categorically or continuously. In contrast, the interaction between hours of care and maternal sensitivity during middle childhood was obtained for two of the three behavioral outcomes, and there were some differences depending on whether maternal sensitivity was a categorical or continuous variable. We believe there is enough evidence to suggest that these findings are not spurious. Nevertheless, replication is important—especially with observational studies and for any study that detects a somewhat sparse set of interactions.

In summary, this study finds that associations between child care hours and adolescent externalizing and impulsivity and between child care quality and adolescent academic skills were moderated by subsequent maternal sensitivity. Externalizing and

impulsivity at age 15 were elevated for those youth who experienced longer hours of child care if they also experienced low quality maternal sensitivity in middle childhood or adolescence but not for youth who experienced high quality maternal sensitivity during these periods. Further, these analyses suggest that academic outcomes at 15 were higher for youth who experienced higher quality of child care if, as adolescents, they also experienced more sensitive and supportive interactions with their mothers. These findings are consistent with developmental theories and perspectives that maintain that development remains open to change beyond the opening years of life and therefore, that links between early experiences and later development may be conditioned by experiences subsequent to the early-childhood years. The fact, however, that maternal sensitivity during early childhood did not moderate any child-care effects raises interesting questions about which types of subsequent experiences can deflect these trajectories and the timing of moderating experiences. It is possible that other proximal relationships with peers and romantic partners could also serve as moderators of early experiences, especially as the children become young adults. Identification of factors such as quality of subsequent maternal sensitivity that reduce the apparent negative impact of extensive child care hours or low quality child care is important in light of the fact that long hours in nonfamilial child care beginning early in life, that is typically not high quality is a normative experience for American children.

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