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Title
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Permalink
https://escholarship.org/uc/item/0995q98p

Journal
Child Development, 91(1)

ISSN
0009-3920

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Publication Date
2020

DOI
10.1111/cdev.13136

Peer reviewed

Cumulative and Differential Effects of Early Child Care and Middle Childhood Out-of-School Time on Adolescent Functioning

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Effects associated with early child care and out-of-school time (OST) during middle childhood were examined in a large sample of U.S. adolescents (N = 958). Both higher quality early child care *AND* more epochs of organized activities (afterschool programs and extracurricular activities) during middle childhood were linked to higher academic achievement at age 15. Differential associations were found in the behavioral domain. Higher quality early child care was associated with fewer externalizing problems, whereas more hours of early child care was linked to greater impulsivity. More epochs of organized activities was associated with greater social confidence. Relations between early child care and adolescent outcomes were not mediated or moderated by OST arrangements in middle childhood, consistent with independent, additive relations of these nonfamilial settings.

Both bioecological theory (Bronfenbrenner & Morris, 2006) and life course theory (Elder & Shanahan, 2006) highlight the significance of settings in which children spend substantial portions of their time. One body of research motivated by these theories has focused on the effects of early child care on child developmental outcomes. This attention is not surprising given the large number of children around the world who experience nonparental child care in their first 5 years (Burchinal, Magnuson, Powell, & Hong, 2015; Waldfogel, 2002). In the

United States, for example, more than half of children under 3 years are routinely cared for by nonrelatives and more than three-quarters of preschool-aged children attend organized child-care settings, averaging approximately 30-hr per week (Burchinal et al., 2015; Laughlin, 2014).

A separate body of research, also motivated by bioecological and life course theories, has examined relations between out-of-school time (OST) during middle childhood and child developmental outcomes (Vandell, Larson, Mahoney, & Watts, 2015). As is the case for early child care, substantial numbers of children participate in OST activities that can vary for children within a given day and across the week during the school year. In the United States, more than half of school-aged children (ages 6–11) engage in sports, lessons, or clubs outside of school hours (Laughlin, 2014), and almost one-quarter of elementary school children attend afterschool programs (Afterschool Alliance, 2014). Children also spend time after school in supervised informal care settings with nonfamilial adults. More than four million children (ages 5–14 years) care for themselves on a regular basis during OST in the United States (Laughlin, 2013).

Studies of child care during the first 5 years and OST during middle childhood have emerged as separate research literatures, although life course and bioecological theory have emphasized the need to study the interplay between important

developmental settings over time. In this study, we used data from the Study of Early Child Care and Youth Development (SECCYD), a prospective longitudinal study of more than 1,000 children, to examine relations between *both* early child care and middle childhood OST on adolescents' academic competencies and behavioral functioning. We asked if associations between early child care and adolescent functioning are mediated or moderated by OST activities in middle childhood, or if the effects associated with early child care and OST are cumulative or are related to different developmental domains.

Early Child Care and Child Developmental Outcomes

A large and robust body of research has found three aspects of early child care—its quality, quantity, and type—to be related to child developmental outcomes (Burchinal et al., 2015). Higher *quality* child care, defined by emotionally supportive and cognitively stimulating interactions with caregivers, is associated with higher preacademic competencies in reading and math, and larger vocabularies prior to entry into formal schooling (Burchinal, Zaslow, & Tarullo, 2016), whereas more *hours* in child care are related to higher externalizing behaviors at kindergarten entry (Huston, Bobbitt, & Bentley, 2015). More exposure to center-based child care is linked to higher math and literacy skills, but also more externalizing problems (Burchinal et al., 2015; NICHD Early Child Care Research Network, 2002).

A critical issue considered by several research teams is whether these initial relations between early child care and child developmental outcomes persist into middle childhood. Several investigators have linked early child-care experiences to children's academic and social functioning in middle childhood (Belsky et al., 2007; Dickinson & Porche, 2011; NICHD Early Child Care Research Network, 2005b; Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2011). Preschool teachers' use of sophisticated vocabulary predicted children's reading comprehension and word recognition in fourth grade (M_{age} = 9.3 years), with effects mediated by children's receptive vocabulary in kindergarten (Dickinson & Porche, 2011). In a large, prospective longitudinal study conducted in Great Britain, high-quality preschool care was linked to higher performances on standardized tests of math and reading achievement and higher self-regulation and prosocial behaviors at age 11 (Sylva et al., 2011). In previous reports from the SECCYD, child-care quality, quantity, and type were differentially associated

with children's development in middle childhood (Belsky et al., 2007; NICHD Early Child Care Research Network, 2005b). Higher quality child care was related to higher cognitive-academic performance in Grades 1, 3, and 5, whereas more hours of child care were linked to more externalizing problems. More experience in center-based care was associated with higher cognitive skills but also more externalizing problems.

Relations between early child care and adolescent functioning have been less investigated, although there is some evidence of associations here as well. In previously reported analyses of the SECCYD (Vandell et al., 2010), higher quality child care was associated with better academic skills and less externalizing behavior at age 15, with some evidence that the associations with academic skills were mediated by children's academic skills during middle childhood. More time (hours) in early child care was related to higher risk taking and impulsivity at age 15, associations that were not mediated by children's problem behaviors in middle childhood. In this study, we further investigated associations between early child care and adolescent functioning to determine if they were mediated or moderated by children's OST experiences in middle childhood.

OST Activities and Child Developmental Outcomes

OST activities during middle childhood occur in a variety of settings (Capizzano, Tout, & Adams, 2000; Carver, Iruka, & Chapman, 2006). Within a single day and over the course of a week, children may participate in organized activities at afterschool programs offered by their schools. They also can attend extracurricular enrichment activities such as sports or music. Children also may spend time with nonfamilial adults in informal care settings or spend time in settings in which no adults are present. In this article, we asked if these different types of OST experiences during middle childhood are linked to adolescents' academic and behavioral functioning.

Prior research has found OST activities to be associated with child developmental outcomes during middle childhood. For example, greater participation in organized enrichment activities such as afterschool programs and extracurricular activities is associated with both academic and social outcomes during middle childhood. Using data from the Early Childhood Longitudinal Study-Kindergarten (ECLS-K) cohort, Covay and Carbonaro (2010) found that third-grade children who participated in

organized activities received higher reading and math achievement scores compared with children who did not participate in these activities. In a second study using the ECLS-K data, Dumais (2006) found that the number of extracurricular activities during kindergarten and first grade was associated with gains in reading achievement test scores between first and third grades as well as third-grade teachers' evaluations of children's mathematics skills. In contrast, in analyses that utilized sibling fixed effects, more time in unsupervised care settings was linked to poorer school attendance and more problem behaviors during middle childhood (Aizer, 2004).

In a prior report from the SECCYD when the study children were in early elementary school, greater participation in extracurricular activities during kindergarten and first grade—measured as the number of epochs in which activity reports were obtained—was associated with higher literacy and math achievement at the end of first grade, controlling for child and family factors and for academic achievement prior to elementary school (NICHD Early Child Care Research Network, 2004). Participation in other OST arrangements such as care by sitters was not related to child outcomes in first grade. In a second study of the SECCYD sample, greater participation in organized activities from kindergarten through fifth grade was associated with teacher reports of higher academic performance and work habits as well as higher math achievement scores at Grade 5 (Auger, Pierce, & Vandell, 2013).

This Study: Early Child Care and Middle Childhood OST

In this study, we extend prior research by examining longitudinal associations between OST activities during middle childhood and later adolescent functioning, an area not previously studied. We considered four ways in which early child care and OST in elementary school (kindergarten through fifth grade) may be jointly related to adolescent functioning. The first possibility is that both early child care and OST activities are linked to adolescent development, with associations that are *cumulative* or *additive*. This view is consistent with life course theory (Elder & Shanahan, 2006) that posits that developmental pathways begin early in life and their effects cumulate to create marked differences over time. In this study, we tested the hypothesis that children benefit from the accumulation of both high-quality, center-based care in early

childhood and organized enrichment activities in middle childhood.

A second possibility is that children's early child care and OST care represent experiences that are pertinent or salient for different developmental domains. This *differential* model is consistent with Erikson's (1950) psychosocial theory, which posits that young children face different challenges than do children in middle childhood, meaning that experiences in the two periods may be relevant for different developmental domains. The quality of early child care, for example, could be relevant for language development whereas participation in afterschool activities in middle childhood could be pertinent to social competencies such as industry, initiative, and positive peer relations.

A third possibility is that relations between early child care and adolescent development are *mediated* by children's OST activities in middle childhood. In this case, children who experience higher quality child care subsequently have greater exposure to organized enrichment activities, and it is this later exposure to organized activities that accounts for observed relations between early child care and adolescent competencies.

A fourth possibility is that the effects associated with early child care are *moderated* by OST activities in middle childhood. In this case, the relations between early childcare and OST and adolescent functioning would be synergistic rather than additive. For example, effects associated with early child-care quality and later development may be accentuated for children who routinely participate in organized activities during middle childhood, or effects associated with early child care may persist only for children who routinely experience organized activities in middle childhood. This possibility that persistent child-care effects are conditional on children's later experiences has been proposed by Bailey, Duncan, Odgers, and Wu (2017) and others (Burchinal, Vandell, & Belsky, 2015).

We expected that all four types of relations involving early child care and OST activities were possible, depending on the adolescent outcomes in question. For this reason, we considered both academic and behavioral outcomes. Three academic-cognitive outcomes (math skills, reading comprehension, and vocabulary assessed using the Woodcock–Johnson Psycho-Educational Battery) were examined because previous research has linked early child care (Burchinal et al., 2015) and afterschool programming (Vandell et al., 2015) to these academic skills. By examining both early child care and OST activities, we were able to assess if

these associations are additive, or if OST activities mediate relations between early child care and adolescent academic skills, or if OST activities moderate associations of earlier child care.

In the area of behavioral outcomes, we focused on four domains: externalizing problems, risk taking, impulsivity, and social confidence. These domains were selected because prior research has linked higher child-care hours to risk taking and impulsivity, whereas higher quality child care is linked to less externalizing behavior (Vandell et al., 2010). OST research has linked unsupervised time with risk taking and externalizing behavior (Aizer, 2004) and organized activities with social confidence and social competencies (Vandell et al., 2015). An unanswered question is whether effects associated with early child care are mediated or moderated by later OST activities or if these extrafamilial care settings are associated with different developmental outcomes.

In summary, this study used data from the SEC-CYD to extend understanding of the longitudinal effects of early child care and OST experiences. This examination is the first study to our knowledge to investigate the joint effects of these two common extrafamilial care settings that span the developmental periods of early and middle childhood to adolescence.

Method

Participants

Hospital visits were conducted with mothers at 10 locations in the United States (Little Rock, AR; Irvine, CA; Lawrence, KS; Boston, MA; Hickory, NC; Philadelphia, PA; Pittsburgh, PA; Charlottesville, VA; Seattle, WA; Madison, WI) shortly after the birth of the study participants. During selected 24-hr intervals in 1991, infants were screened for eligibility (mothers were 18 years of age or older and spoke English as their primary language, and family did not plan to move in the next 3 years). A total of 1,364 families were recruited and completed a home interview at 1 month, thereby becoming study participants, with a 52% response rate from the original approach to families in the hospital to successful recruitment in the study. At recruitment, 26% of the mothers had no more than a high school education; 21% had incomes no greater than 200% of the poverty level; and 22% were of minority race or ethnicity (i.e., not non-Hispanic White). For details about the sample

and sample recruitment, see NICHD Early Child Care Research Network (2005a).

At age 15, measures of adolescent functioning were obtained for 958 youth (70% of the original recruitment sample). Of this number, 717 had complete data on all predictors and outcomes included in the analyses. To account for missing data, 50 datasets were imputed and cases that were missing the outcome variables were dropped from the analysis following the multiple imputation and delete (MID) approach (Allison, 2000; von Hippel, 2007).

Table 1 provides descriptive statistics for the age 15 sample and all variables included in the analyses. Comparisons of the age 15 analytic sample (n = 958) and the other 406 youth in the recruitment sample revealed some differences. Age 15 participants had more epochs of supervised informal care during middle childhood than did youth who did not participate in the age 15 data collection, and they were more likely to be female. Their mothers had more years of education, higher receptive vocabulary, and more hours per week of employment during the early childhood period. Participants at age 15 received higher Home Observation Measurement of the Environment (HOME) scores during early childhood, and they were less likely to live in single-parent households during early childhood compared with age 15 nonparticipants.

Measures

Early Child Care

During telephone and in-person interviews conducted at 3-month intervals (or epochs) through 36 months and 4-month intervals (or epochs) from 40 to 54 months, mothers reported the types and hours of all regularly used nonmaternal care since the previous interview. Arrangements were classified as center, child-care home (any home-based care outside the child's own home), in-home care (any care in the child's own home that was not the father or grandparent), father care, and grandparent care. The proportion of epochs (or interviews) in which children were reported to be in center care for at least 10 hr per week was computed and used as the measure of *center-based care*.

The hours per week in all types of nonmaternal care, excluding fathers and grandparents, were summed for each epoch, and the mean of nonrelative care hours across epochs make up the measure of *child-care hours*.

Table 1
Descriptive Statistics for the Age 15 Analysis and Attrition Samples

	Analysis sample (n = 958)		Attrition sample (n = 406)		Significant difference
	M or %	SD	M or %	SD	p value
Early child care (1–54 months)					
Observed quality	2.91	0.45	2.85	0.47	
Proportion center-based epochs	0.21	0.25	0.21	0.27	
Hours per week	16.65	14.10	15.95	14.34	
K–Grade 5 out-of-school time					
Proportion nonadult care epochs	0.13	0.19	0.12	0.22	
Proportion supervised informal epochs	0.36	0.28	0.41	0.33	.04
Proportion organized activity epochs	0.56	0.31	0.53	0.35	
Child characteristics					
Female	50%		44%		.04
Ethnicity					
European American	77%		74%		
African American	12%		15%		
Latino/a	6%		7%		
Other	5%		4%		
Maternal characteristics					
Personality	59.02	13.73	58.95	14.56	
Vocabulary score	99.82	18.42	96.21	17.86	.01
Education	14.44	2.44	13.74	2.61	.00
Maternal work hours					
Early childhood	18.81	13.45	14.62	13.38	.00
Middle childhood	26.94	16.49	27.56	18.09	
Maternal sensitivity					
Early childhood	5.01	0.66	4.98	0.77	
Middle childhood	16.59	2.18	16.23	2.64	
Maternal depression					
Early childhood	9.77	6.44	10.13	7.49	
Middle childhood	8.87	7.28	7.94	7.53	
HOME Inventory					
Early childhood	40.20	4.64	38.16	5.42	.00
Middle childhood	41.36	5.60	42.11	6.66	
Single-parent epochs (proportion)					
Early childhood	0.15	0.31	0.19	0.35	.03
Middle childhood	0.19	0.34	0.19	0.35	
Income-to-needs ratio					
Early childhood	3.68	2.77	3.37	3.05	
Middle childhood	4.27	3.46	4.16	3.45	

Note. HOME = Home Observation Measurement of the Environment.

Child-care observations were conducted when study participants were 6, 15, 24, 36, and 54 months, with priority given to more formal, center-based care arrangements that were attended for at least 10 hr per week. At 6–36 months, quality was assessed during two half-day visits scheduled within a 2-week interval. At 54 months, quality was assessed during one half-day visit. Observers completed four 44-min cycles of the Observational Record of the Caregiving Environment (ORCE) for each study child through 36 months and two 44-min ORCE cycles at 54 months.

Trained observers rated the child-care settings on various dimensions, including caregiver's sensitivity/responsivity and warmth to the study child using 4-point scales (1 = *not at all characteristic*, 4 = *highly characteristic*). 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. Reliability exceeded 0.90 at 6 months, 0.86 at 15 months, 0.81 at 24 months, 0.80 at 36 months, and 0.90 at 54 months. A mean *observed child-care quality* score was computed for each child.

OST Settings

Mothers or primary caregivers reported the study children's OST activities during middle childhood in a series of 13 telephone interviews that occurred between kindergarten and Grade 5. Mothers were interviewed twice annually in kindergarten, first grade, and second grade during the fall and the spring of the school year. At each interview, the mother reported the study child's before- and after-school care arrangements and activities between the hours of 7 a.m.–7 p.m. Interviews occurred during the school year on routine school days (i.e., not school holidays or early dismissal days). In Grades 3–5, questions were modified to ask about activities from the end of the school day to 6 p.m. Mothers reported OST activities three times (fall, winter, spring) during the school year when the study children were in Grades 3 and 4, and once when the study children were in Grade 5, for a total of 13 K–5 epochs.

At each of the 13 interviews, mothers indicated if study children spent time that week in *organized activities* (at before- or afterschool program or at structured enrichment activities or lessons), in *supervised informal activities* (at home or another home under adult supervision or supervised at other location), and in *nonadult care* (at home with older sibling[s], at home with younger sibling[s], at home with nonsibling minor, at home alone, or unsupervised at other location).

During the phone interviews, mothers also reported the amount of time (hours that week) the study children spent in each of these OST settings. Descriptive statistics summarizing the proportion of the study children who participated in the three types of OST settings and the mean hours per week in the three types of settings from kindergarten through Grade 5 are provided in Table 2. At each grade (K–Grade 5), the majority of the study children participated in organized activities and a minority spent time in nonadult care. Supervised informal care was more common in kindergarten and first grade than in Grade 5.

Mean hours per week in each of the three OST settings across the 13 epochs were highly correlated

Table 2

Descriptive Statistics for Participation in Out-of-School Time Settings by Grade Level

	% Participants with 0 hr	Hours per week			
		M	SD	Minimum	Maximum
Nonadult care					
Kindergarten	87	0.30	1.26	0	16.60
Grade 1	78	0.54	1.49	0	10.38
Grade 2	74	0.68	1.87	0	17.75
Grade 3	86	0.54	1.94	0	15.42
Grade 4	82	0.78	2.36	0	16.67
Grade 5	80	1.03	2.74	0	17.50
Supervised informal care					
Kindergarten	36	4.83	7.35	0	44.25
Grade 1	34	3.18	4.53	0	30.00
Grade 2	39	2.94	4.41	0	32.00
Grade 3	67	1.80	3.80	0	22.00
Grade 4	67	1.83	3.89	0	18.33
Grade 5	78	1.60	3.82	0	20.50
Organized activities					
Kindergarten	39	4.02	7.06	0	36.75
Grade 1	28	3.12	4.41	0	24.25
Grade 2	26	3.25	4.39	0	27.75
Grade 3	33	2.56	3.78	0	20.08
Grade 4	31	2.48	3.81	0	27.50
Grade 5	43	2.45	3.73	0	20.00

Note. N = 1,157.

with the proportions of epochs in each of these settings (*r* = .83 between proportion of epochs and mean hours per week of nonadult care; *r* = .80 between proportion of epochs of supervised informal care and mean hours per week of supervised informal care; and *r* = .60 between proportion of epochs and mean hours per week of organized activities). Proportion of epochs in the three types of OST settings was used in the primary analyses because it was less skewed than mean hours per week and had been previously linked to child developmental outcomes during middle childhood (Auger et al., 2013; NICHD Early Child Care Research Network, 2004). We did not contrast effects associated with K–2 OST epochs versus Grades 3–5 OST epochs because we had no a priori expectations of differential associations between these two age groups in relation to adolescent developmental outcomes.

Adolescent Academic Achievement

Academic achievement at age 15 was measured with the Woodcock–Johnson Psycho-Educational Battery–Revised (WJ–R) Tests of Achievement and Cognitive Ability (Woodcock & Johnson, 1989). Three tests were administered in a university lab: Applied Problems, Passage Comprehension, and Picture Vocabulary. *Applied Problems* assesses ability to analyze and solve math problems. *Passage Comprehension* measures understanding of written text. *Picture Vocabulary* is part of the Cognitive Abilities portion of the Woodcock–Johnson battery and measures word knowledge. Each assessment took approximately 5–10 min to complete. The standard scores were used in this study (national *M* = 100, *SD* = 15). Descriptive statistics for the age 15 adolescent outcomes are provided in Table 3.

Adolescent Behavioral Functioning

At age 15, adolescents self-reported their behavioral functioning in four areas: *impulsivity, risk taking, externalizing*, and *social confidence*, using an audio computer assisted self-interview. The Weinberger Adjustment Inventory (Weinberger & Schwartz, 1990) was used to measure *impulsivity*. It consists of eight items (α = .82) that are rated using a 5-point scale (1 = *false*, 5 = *true*). Higher values indicate more impulsive behavior. Sample items include "I do things without giving them enough thought" and "I should try harder to control myself when I am having fun."

Adolescents reported *risk-taking behaviors* using a 53-item questionnaire developed for use in the

Table 3

Descriptive Statistics for Age 15 Academic and Behavioral Outcomes

	M	SD	Minimum	Maximum
Academic skills				
WJ applied problems	102.92	14.22	48.00	168.00
WJ passage comprehension	107.71	15.72	44.00	160.00
WJ picture vocabulary	99.93	14.77	34.00	158.00
Behavioral functioning				
Impulsivity	2.49	0.90	1.00	5.00
Risk taking	6.16	5.67	0	53.00
Externalizing	49.31	9.91	25.00	86.00
Social confidence	13.97	3.13	5.00	20.00

N = 958. WJ = Woodcock–Johnson Psycho-Educational Battery–Revised.

SECCYD based on prior studies of adolescents (Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004; Halpern-Felsher, Cornell, Kropp, & Tschann, 2005). Items are responded to using a 3-point scale (0 = *not at all*, 1 = *once or twice*, 2 = *more than twice*) and recoded to 0/1 variables (0 = *none*, 1 = *some*) and summed. Possible scores range from 0 to 53, with higher values indicating more risk-taking behaviors by the adolescent (α = .89).

Adolescents completed the Youth Self-Report (Achenbach & Rescorla, 2001) to assess *externalizing* behavior. For each item, the adolescent rated how well that item describes him or her currently or within the last 6 months using a 3-point scale (0 = *not true*, 1 = *somewhat or sometimes true*, 2 = *very true or often true*). The *externalizing* scale includes 30 items (α = .86). Raw scores were converted to T-scores, with higher scores indicating a higher affinity to display delinquent and aggressive behaviors.

Adolescents responded to 10 items (α = .69) in which they rated their confidence in social situations (Gresham & Elliot, 1990). Sample items include "asking others for information" and "introducing oneself." Responses were made using a 3-point scale (0 = *never*, 1 = *sometimes*, 2 = *very often*). Ratings are added to create a *social confidence* score.

Covariates

Child, maternal, and family characteristics were included in our analyses as controls for potential selection differences and omitted variables. The child characteristics, reported by the mother at the 1-month home interview, were *child gender* (female = 1) and *ethnicity* (European American [reference], African American, Latino/a, and other).

Maternal characteristics were *maternal education* in years, reported at the 1-month interview; *maternal vocabulary* assessed by the Peabody Picture Vocabulary Test–Revised at the 36-month visit (Dunn & Dunn, 1981); *maternal personality*, created from the *Neuroticism*, *Extraversion*, and *Agreeableness* scales of the NEO Personality Inventory administered at the 6-month home visit (Costa & McCrae, 1989); *maternal depression*, measured in early childhood (mean of reports at 1, 6, 15, 24, 36, 54 months) using the Center for Epidemiological Studies Depression Scale (Radloff, 1977); *maternal sensitivity*, rated on a 4-point scale (1 = *not at all characteristic*, 4 = *highly characteristic*) from videotaped semistructured interactions in which the mother–child dyad played or worked together to solve developmentally appropriate tasks in early childhood (mean of ratings at 6, 15, 24, 36, and 54 months; NICHD Early Child Care Research Network, 2005a); and *maternal work hours* reported in early childhood (mean of employment hours reported at 6, 15, 24, 36, and 54 months). Also measured at 1, 6, 15, 24, 36, and 54 months were family characteristics and early childhood mean values of these measures were used: *income-to-needs ratio*, score on the HOME Inventory as a measure of the *quality of the home environment* (Bradley & Caldwell, 1979), and assessment periods or epochs the family was a *single-parent household*.

Comparable maternal and family measures were collected in middle childhood (Grades, 1, 3, and 5) and at age 15, and used as covariates in follow-up analyses.

Analytic Strategy

Ordinary least squares (OLS) multiple regressions were used to assess relations between early child care (quality, center-based, hours) and K–5

OST activities (epochs of organized activities, supervised informal care, and nonadult care) on adolescent outcomes at age 15. Four sets of OLS regressions were tested. In Model 1, early child-care variables (quality, type, hours) were examined as predictors of adolescent functioning. In Model 2, OST settings (organized activities, informal adult supervised, nonadult care) were examined as predictors of adolescent functioning. In Model 3, both early child care and OST settings were included as predictors. In Model 4, interactions between early child care and OST settings were tested.

In the primary analyses, covariates were child gender; child ethnicity; maternal vocabulary; maternal education; maternal personality; maternal work hours; maternal sensitivity; maternal depression; HOME score; income-to-needs ratio; and single-parent epochs collected during the early childhood period. In follow-up analyses, maternal and family assessments from the middle childhood period were also included as covariates.

In all analyses, the independent variables of interest (early child care and K–5 OST activities) and the dependent variables (adolescent outcomes at age 15) were standardized so that $M = 0$ and $SD = 1$. This was done so the coefficients can be interpreted as effect sizes (i.e., a standard deviation increase in the independent variable is associated with a percent standard deviation increase in the dependent variable).

Missing data were handled with multiple imputation. Fifty imputation datasets were created (with five burn-in imputations) for each outcome. Predictive mean matching was used for continuous variables, logistic regression for dummy variables, and multinomial logistic regression for categorical variables. The MID method was used during the multiple imputation process, where all cases are used for

Table 4

Intercorrelations for Early Child Care and K–5 Out-of-School Time Variables

	1	2	3	4	5
Early child care (1–54 months)					
1. Observed quality					
2. Center-based epochs	−.17***				
3. Hours per week	−.21***	.50***			
Out-of-school time epochs (K–Grade 5)					
4. Nonadult care	−.01	−.04	.02		
5. Supervised informal care	−.00	−.06*	.09**	−.05	
6. Organized activities	.14***	.19***	.21***	−.14***	−.08**

Note. N = 1,157.
*p < .05. **p < .01. ***p < .001.

imputation, but following imputation, cases with imputed dependent variables are excluded from the analysis. This protects the estimates from problematic imputations of the dependent variable because imputed dependent variables can add needless noise to the estimates (von Hippel, 2007). In follow-up analyses, we tested models that include participants with imputed dependent variables. This did not change the results of any of the analyses.

Results

Table 1 provides descriptive statistics for the measures of early child care, OST activities during middle childhood, and the child and family covariates in early childhood and middle childhood. Table 3 provides the descriptive statistics for the adolescent outcomes.

Zero-order correlations between early child care and middle childhood (K–5) OST activities are shown in Table 4. Within the early childhood period, higher quality child care was associated with fewer hours in child care and fewer epochs of center-based care. More hours in early child care was correlated with more epochs of center-based care. Within middle childhood, children who had more epochs of organized activities had fewer epochs of supervised informal care and fewer epochs of nonadult care. Children who experienced higher quality early childcare had more epochs of organized activities in middle childhood. More epochs of

center-based care in early childhood were associated with more epochs of organized activities and fewer epochs of informal activities during middle childhood. More hours in early child care were related to more epochs of organized activities and more epochs of supervised informal activities during middle childhood.

Table 5 shows the zero-order correlations between early child care and K-5 OST activities and adolescent academic and behavioral functioning. Higher quality early child care was correlated with higher scores on the Woodcock–Johnson Applied Problems, Passage Comprehension, and Picture Vocabulary assessments, and with lower scores on reports of impulsivity, risk taking, and externalizing behaviors at age 15. Higher quality child care also was related to greater social confidence at age 15. More center-based care in early childhood was related to higher vocabulary scores at age 15. More hours of early child care were associated with higher impulsivity at age 15.

In these bivariate correlations, K–5 organized activities were consistently associated with academic and behavioral outcomes at age 15. More epochs of organized activities were correlated with higher scores on the academic assessments and social confidence and with lower reports of risk taking and impulsivity at age 15. More epochs of K–5 nonadult care were associated with lower vocabulary scores and more risk-taking behaviors at age 15. Supervised informal care epochs were not related to age 15 functioning.

Table 5
Correlations Between Early Child Care and K–5 Out-of-School Time Variables and Adolescent Functioning

	Early child care			K–5 out-of-school time epochs		
Age 15 outcomes	Quality	Center-based epochs	Hours per week	Nonadult care	Supervised informal care	Organized activities
Academic skills						
WJ Applied Problems	.19***	.04	.03	−.02	−.02	.29***
WJ Passage Comprehension	.23***	.02	.02	−.03	.01	.31***
WJ Picture Vocabulary	.19***	.08*	.06	−.08*	−.00	.31***
Behavioral functioning						
Impulsivity	−.10**	.02	.08*	.01	−.02	−.08*
Risk taking	−.12***	.01	.06	.07*	.03	−.13***
Externalizing	−.11**	.01	.02	.05	.03	−.05
Social confidence	.07*	.03	.02	.03	.05	.09**

Note. $N = 958$. WJ = Woodcock–Johnson Psycho-Educational Battery–Revised.
*$p < .05$. **$p < .01$. ***$p < .001$.

Relations Between Early Child Care, K–5 OST Activities, and Adolescent Academic Achievement

OLS regressions were used to assess (a) relations between early child care and age 15 outcomes (Model 1), (b) relations between K–5 OST activities and age 15 outcomes (Model 2), and (c) the combined associations of early child care and K–5 OST activities on age 15 outcomes (Model 3). Following the logic outlined by Baron and Kenny (1986), mediation is evident when (a) the relation between early child care and age 15 outcomes is significant in Model 1, (b) the relation between K–5 OST activities and age 15 outcomes is significant in Model 2, and (c) the relation between early child care and age 15 outcomes is reduced when organized activities is included in Model 3. If the relations between early care and age 15 outcomes (Model 1) and between K–5 OST activities and age 15 outcomes are not reduced in Model 3, the hypothesis of additive models is supported.

Table 6 shows the results for academic achievement. In Model 1, higher quality early child care was linked to higher reading comprehension at age 15 years ($\beta = .08$, $p < .05$), and marginally related to math skills as assessed by WJ Applied Problems ($\beta = .06$, $p = .056$). Hours of early child care and center-based care epochs were not related to academic outcomes at age 15.

In Model 2, relations between middle childhood OST activities and adolescent academic achievement were found. More epochs of organized activities during middle childhood were associated with higher WJ Applied Problems ($\beta = .08$, $p < .05$), Higher Passage Comprehension ($\beta = .07$, $p < .05$) and higher WJ Picture Vocabulary ($\beta = .07$, $p = .05$) at age 15. In contrast, more nonadult care during middle childhood was linked with lower Picture Vocabulary scores at age 15 ($\beta = -.06$, $p < .05$).

The OLS regressions that included both early child care and OST activities (Table 6, Model 3) show no evidence that the inclusion of OST activities reduced associations between early child care and adolescent academic skills, as would be expected if early child-care associations were mediated by later OST activities. Rather, both early child-care quality and K–5 organized activities were significantly associated with math skills and reading comprehension. The effect sizes associated with early child-care quality and K–5 organized activities on adolescents' math achievement ($\beta = .06$ and $.08$, respectively) and passage comprehension ($\beta = .08$ and $.08$, respectively) were roughly the same size. Combined, these effect sizes are comparable to the effect sizes found in this sample for maternal education ($\beta = .15$ and $.09$, for math and reading, respectively) and maternal sensitivity during early childhood ($\beta = .09$ and $.09$ for math and reading, respectively). Appendix Table A1 provides the effect sizes and robust standard errors for all early childhood predictors in the model. Similar effect sizes were obtained in the OLS regressions that

Table 6

Early Child Care and K–5 Out-of-School Time Participation as Predictors of Academic-Cognitive Skills at Age 15

	Applied problems models			Passage comprehension models			Picture vocabulary models		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Early child care									
Observed quality	.06 (.04)[+]		.06 (.04)[+]	.08 (.03)*		.08 (.03)*	.05 (.03)		.05 (.03)
Center-based epochs	.02 (.03)		.01 (.04)	−.00 (.04)		−.01 (.04)	.05 (.03)		.05 (.03)
Hours per week	.01 (.04)		−.01 (.05)	−.02 (.04)		−.03 (.04)	−.04 (.04)		−.04 (.04)
K–5 out-of-school time epochs									
Nonadult care		.04 (.03)	.04 (.03)		.03 (.03)	.03 (.03)		−.06 (.03)*	−.06 (.03)*
Supervised informal care		.02 (.03)	.02 (.03)		.03 (.03)	.03 (.03)		.02 (.03)	.03 (.03)
Organized activities		.08 (.04)*	.08 (.04)*		.07 (.03)*	.08 (.04)*		.07 (.03)*	.06 (.03)+
Observations	887	887	887	887	887	887	889	889	889

Note. Robust standard errors in parentheses. Outcomes and predictors of interest were standardized to $M = 0$ and $SD = 1$, so the coefficients can be interpreted as effect sizes. Child and family covariates included in all models were child's gender and ethnicity; maternal vocabulary (PPVT) score, personality, education, work hours per week (6–54 months), depression (6–54 months), observed sensitivity (6–54 months); proportion of single-parent epochs (6–54 months), mean income-to-needs ratio (6–54 months), and observed Home Observation Measurement of the Environment quality (6–54 months). Site fixed effects also were included. Missing data were handled using the multiple imputation and delete approach. PPVT = Peabody Picture Vocabulary Test.
[+]$p < .10$. *$p < .05$.

included the full array of early and middle child-hood covariates.

Relations Among Early Child Care, K–5 OST Activities, and Adolescent Behavioral Functioning

Table 7 reports the relations between early child care, K–5 OST activities, and adolescent behavioral functioning. As shown in Model 1 of Table 7, higher quality child care was associated with less externalizing behavior at age 15 ($\beta = -.08$, $p < .05$). More hours in early care were associated with adolescent reports of more impulsivity ($\beta = .12$, $p < .05$) and marginally related to more risk taking ($\beta = .09$, $p < .07$).

Model 2 in Table 7 reports associations between K–5 OST activities and age 15 behavioral outcomes. More epochs of organized activities and supervised informal care were linked to adolescent reports of higher social confidence ($\beta = .08$, $p < .057$ and $\beta = .09$, $p < .05$, respectively).

Model 3, reported in Table 7, tested associations when both early child care and K–5 OST activities were included as predictors of adolescent behavioral outcomes. Relations between early child-care hours and adolescent impulsivity, and risk taking did not change with the addition of the OST variables ($\beta = .12$, $p < .05$ and $\beta = .08$, $p < .07$, respectively), and early child-care quality continued to be negatively associated with externalizing behavior ($\beta = -.08$, $p < .05$). Similarly, positive associations between organized activities and supervised informal care on social confidence remained when early child care was added to the model ($\beta = .08$, $p < .05$ and $\beta = .09$, $p < .05$, respectively). Appendix Table A2 provides the effect sizes and robust standard errors for all early childhood predictors. Similar associations were obtained when middle childhood covariates were included in the models.

Are Associations of Early Child Care With Adolescent Outcomes Moderated by K–5 OST Activities?

In the next series of analyses, we asked if relations associated with early child care are moderated by OST activities in middle childhood (Model 4). First, we tested if associations care *quality* and adolescent functioning varied as a function of children's participation in K–5 organized activities. We tested interactions between child-care quality and organized activities, with both scored as continuous, linear variables. No significant interactions were found.

Table 7

Early Child Care and K–5 Out-of-School Time (OST) Participation as Predictors of Behavioral Functioning at Age 15

	Impulsivity models			Risk taking models			Externalizing models			Social confidence models		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Early child care												
Observed quality	−.03 (.04)		−.03 (.04)	−.03 (.04)		−.04 (.04)	−.08 (.04)*		−.08 (.04)*	.06 (.04)		.06 (.04)
Center-based epochs	−.04 (.04)		−.04 (.04)	−.03 (.04)		−.02 (.04)	−.02 (.04)		−.02 (.04)	.05 (.04)		.06 (.04)
Hours per week	.12 (.05)*		.12 (.05)*	.09 (.05)+		.08 (.05)+	.01 (.05)		.01 (.05)	−.04 (.05)		−.05 (.05)
K–5 OST epochs												
Nonadult care		−.01 (.04)	−.01 (.04)		.05 (.03)	.05 (.03)		.05 (.03)	.05 (.03)		.04 (.03)	.04 (.03)
Supervised informal care		−.03 (.03)	−.03 (.03)		.03 (.03)	.03 (.04)		.01 (.04)	.01 (.04)		.09 (.03)*	.09 (.04)*
Organized activities		.04 (.04)	.04 (.04)		.04 (.04)	.04 (.04)		.02 (.04)	.03 (.04)		.08 (.04)*	.08 (.04)*
Observations	957	957	957	954	954	954	956	956	956	942	942	942

Note. Robust standard errors in parentheses. Outcomes and predictors of interest were standardized to $M = 0$ and $SD = 1$, so the coefficients can be interpreted as effect sizes. Child and family covariates included in all models were child's gender and race and ethnicity; maternal vocabulary (PPVT) score, personality, education, work hours per week (6–54 months), depression (6–54 months), observed sensitivity (6–54 months); proportion of single-parent epochs (6–54 months), mean income-to-needs ratio (6–54 months), and observed Home Observation Measurement of the Environment quality (6–54 months). Site fixed effects also were included. Missing data were handled with multiple imputation. PPVT = Peabody Picture Vocabulary Test.
+ $p < .10$. * $p < .05$.

We also tested nonlinear moderated associations by splitting child-care quality and K–5 organized activities into two, three, or four equal categories based on their frequency distributions. Testing interactions with these categories (e.g., 2 categories of child-care quality × 2 categories of K–5 organized activities, 3 categories of child-care quality × 3 categories of K–5 organized activities, and 4 categories of child-care quality × 4 categories of K–5 organized activities) yielded no significant interaction effects on adolescents' academic or behavioral functioning.

Finally, we tested a second set of interactions: linear (i.e., continuous) and categorical interactions between child-care *hours* and K–5 *nonadult care*. No significant interactions were found.

Discussion

Although life course and bioecological theories have argued for the importance of studying the interplay between developmental settings over time, studies of early child care and afterschool activities in middle childhood have focused on these settings in separate and distinct literatures. In this prospective longitudinal study, we sought to examine *both* early child care and K-5 OST in relation to adolescents' academic achievement and behavioral outcomes. In the academic domain, both higher quality early child care *and* more epochs of K–5 organized activities were linked to higher reading comprehension and math achievement at age 15. These findings are consistent with predictions of life course theory that functioning in adolescence and young adulthood reflects an accumulation of prior experiences, not simply individuals' early experience or their current experience (Elder & Shanahan, 2006). The effect sizes associated with early child-care quality and K–5 organized activities on academic functioning were similar to those found in this sample for maternal education and observed maternal sensitivity.

A third aspect of cognitive-academic functioning, adolescents' vocabulary, was linked to children's OST contexts during middle childhood (but not early child care). In particular, more epochs of organized activities during middle childhood were associated with higher vocabulary scores at age 15 and more epochs of nonadult care were linked to lower vocabulary scores at age 15. These relations suggest that organized activities such as sports, arts, and clubs may provide children with opportunities to expand their vocabularies, whereas unsupervised

time spent away from adults may limit children's exposure to adult language and opportunities to expand their vocabularies. Compared with the extensive research examining the home and school as developmental contexts, less attention has been paid to OST as a setting that might have meaningful implications for children's later academic competencies. The current results underscore the potential positive role of organized activities versus negative role of nonadult care in relation to children's later academic functioning.

With respect to behavioral outcomes, early child care and K–5 OST care settings were associated with different aspects of adolescent functioning. In results that are similar to prior SECCYD reports that utilized different analytic strategies (Vandell et al., 2010), higher quality early child care was associated with less externalizing behavior, and more hours in early child care were linked to greater impulsivity and risk taking. K–5 OST settings were not related to these adolescent outcomes, but were associated with adolescents' confidence in social situations. In particular, two aspects of OST contexts during middle childhood—more epochs of organized activities and more epochs of supervised informal care—were related to adolescents' self-reports of greater social confidence in situations such as speaking in groups and meeting new people. These are skills that afterschool programs and extracurricular activities often seek to foster (Lareau, 2011; Vandell et al., 2015). This study extends this prior research by documenting longitudinal associations between K–5 organized activities and adolescent functioning.

In addition to examining both cumulative and differential associations of early child care and K–5 OST contexts, this study asked if relations between early child care and adolescent functioning were either mediated or moderated by OST activities during middle childhood. Here, no evidence of either mediation or moderation was detected. Rather, the associations of early child-care quality and organized activities with reading comprehension and math achievement were roughly the same size when modeled separately and together, with each linked to these academic domains in all of our models. Similarly, associations of early child-care variables with externalizing behavior, impulsivity, and risk taking were much the same when modeled with or without the K–5 OST variables, suggesting that K–5 activities were *not* mediating effects related to early child care. There also were no significant statistical interactions between early child care and K–5

activities, indicating there was no evidence that relations between early child care and adolescent functioning were moderated by (or conditional on) children's subsequent organized activities.

Several limitations of this study should be noted. The first is that the measures of early child care were more comprehensive than the OST measures. The assessment of early child care included observational assessments of child-care quality as well as information about the types and amount of early child care collected in a series of 18 interviews with mothers; information about K–5 OST care settings was limited to 13 maternal interviews. Unfortunately, the SECCYD did not include observational assessments of the quality of organized activities or information about the specific types of organized activities during the K–5 period.

A second limitation is that the SECCYD study design is correlational, not experimental. Obtained relations may reflect selection effects and/or unobserved "third" variables. We sought to reduce this concern by including extensive child, maternal, and family covariates. We did not, however, control for children's academic and behavioral functioning at school entry because of our interests in effects associated with early child care as well as K–5 OST. Because children's skills at school entry may have influenced the extent that children were involved in organized activities, effect sizes associated with relations between OST and adolescent developmental outcomes may be biased upwards. It should be noted, however, that previous SECCYD papers that reported significant relations between K–1 OST activities and first-grade outcomes and between K–5 activities and Grade 5 outcomes did include controls for child skills at school entry (Auger et al., 2013; NICHD Early Child Care Research Network, 2004). We believe that these study limitations were outweighed by the opportunity to study longitudinally two common extrafamilial contexts that typically have been examined separately.

Both early child care and K–5 OST were found to be related to adolescent academic skills. Children who attended higher quality early child care had higher reading comprehension and math achievement at age 15, as did children who had more epochs of organized activities during middle childhood. It did not appear that relations of early child care with age 15 reading and math skills were mediated by later OST activities. Rather, the findings are consistent with an additive or cumulative developmental model in which both early child care and organized activities are linked to academic

skills. With respect to behavioral outcomes, early child care and OST activities were differentially related to behavioral outcomes. Higher quality early child care was linked to less externalizing behavior at age 15, whereas more hours of early child care were associated with higher impulsivity and risk taking. Organized activities and supervised informal care were linked to social confidence. These findings underscore the potential role of both early child care and K–5 OST in relation to adolescent development.

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Appendix

Table A1

Early Child Care and K–5 Out-of-School Time (OST) Epochs as Predictors of Academic-Cognitive Skills at Age 15, Including Early Childhood Covariates

	Applied problems	Passage comprehension	Picture vocabulary
Early child care			
Observed quality (6–54 months)	.06 (.04)[+]	.08 (.03)*	.05 (.03)
Center-based epochs (6–54 months)	.02 (.04)	−.01 (.04)	.05 (.03)
Hours per week (1–54 months)	−.01 (.05)	−.03 (.04)	−.04 (.04)
K–5 OST epochs			
Nonadult care	.04 (.03)	.03 (.03)	−.06 (.03)*
Supervised informal care	.02 (.03)	.03 (.03)	.03 (.03)
Organized activities	.08 (.04)*	.08 (.04)*	.06 (.03)[+]
Child characteristics			
Female	.25 (.06)***	.01 (.06)	.31 (.05)***
Ethnicity			
African American	−.16 (.11)	−.23 (.09)*	−.39 (.10)***
Latino/a	.00 (.13)	−.24 (.12)*	−.06 (.11)
Other	.13 (.16)	.14 (.13)	.22 (.14)
Family characteristics			
Maternal vocabulary (PPVT)	.13 (.05)**	.25 (.04)***	.33 (.04)***
Maternal education	.15 (.04)***	.09 (.04)*	.10 (.04)*
Maternal personality	−.07 (.04)	−.10 (.04)**	−.04 (.03)
Proportion single-parent epochs (1–54 months)	−.04 (.04)	.00 (.04)	.02 (.04)
Income-to-needs ratio (1–54 months)	−.01 (.04)	−.02 (.03)	−.01 (.04)
Maternal depression (6–54 months)	.02 (.04)	.01 (.04)	.05 (.04)
Maternal sensitivity (6–54 months)	.09 (.04)*	.09 (.04)*	.05 (.04)
HOME Inventory (6–54 months)	.14 (.05)**	.18 (.05)***	.17 (.04)***
Maternal work hours (6–54 months)	−.03 (.04)	.02 (.04)	.07 (.03)*
Constant	−.13 (.11)	−.32 (.11)**	.05 (.11)
Observations	887	887	889

Note. Robust standard errors in parentheses. Outcomes and predictors of interest were standardized to $M = 0$ and $SD = 1$, so the coefficients can be interpreted as effect sizes. Site fixed effects also were included. Missing data were handled with multiple imputation. HOME = Home Observation Measurement of the Environment; PPVT = Peabody Picture Vocabulary Test.
[+]$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table A2

Early Child Care and K–5 Out-of-School Time (OST) as Predictors of Behavioral Functioning at Age 15, Including Early Childhood Covariates

	Impulsivity	Risk taking	Externalizing	Social confidence
Early child care				
Observed quality (6–54 months)	−.03 (.04)	−.04 (.04)	−.08 (.04)*	.06 (.04)
Center-based epochs (6–54 months)	−.04 (.04)	−.02 (.04)	−.02 (.04)	.06 (.04)
Hours per week (1–54 months)	.12 (.05)*	.08 (.05)⁺	−.01 (.05)	−.05 (.05)
K–5 OST epochs				
Nonadult care	−.01 (.04)	.05 (.03)	.05 (.03)	.04 (.03)
Supervised informal care	−.02 (.03)	.03 (.03)	.01 (.04)	.09 (.04)*
Organized activities	.03 (.04)	.03 (.04)	.03 (.04)	.08 (.04)*
Child characteristics				
Female	−.14 (.06)*	−.33 (.06)***	−.18 (.07)**	−.16 (.07)*
Ethnicity				
African American	−.13 (.13)	.37 (.17)*	.10 (.13)	.19 (.13)
Latino/a	.33 (.14)*	.29 (.16)⁺	.38 (.14)**	.08 (.14)
Other	.25 (.15)⁺	.11 (.14)	.24 (.15)	.03 (.15)
Family characteristics				
Maternal vocabulary (PPVT)	−.03 (.05)	−.07 (.04)	.13 (.04)**	−.10 (.04)*
Maternal education	−.04 (.05)	−.02 (.05)	−.08 (.05)⁺	−.02 (.04)
Maternal personality	−.13 (.04)**	−.05 (.04)	−.10 (.04)*	.05 (.04)
Proportion single-parent epochs (1–54 months)	−.00 (.04)	.08 (.05)	.12 (.05)**	−.01 (.04)
Income-to-needs ratio (1–54 months)	−.11 (.04)**	−.10 (.03)**	−.08 (.04)*	.04 (.04)
Maternal depression (6–54 months)	−.03 (.05)	.02 (.04)	.00 (.04)	−.04 (.05)
Maternal sensitivity (6–54 months)	.01 (.05)	.01 (.05)	−.03 (.05)	.05 (.05)
HOME Inventory (6–54 months)	−.05 (.05)	.01 (.06)	.09 (.06)	.08 (.06)
Maternal work hours (6–54 months)	.02 (.04)	−.01 (.04)	.03 (.04)	.03 (.05)
Constant	.22 (.12)⁺	.18 (.12)	.02 (.11)	.02 (.12)
Observations	957	954	956	942

Note. Robust standard errors in parentheses. Outcomes and predictors of interest were standardized to $M = 0$ and $SD = 1$, so the coefficients can be interpreted as effect sizes. Site fixed effects also were included. Missing data were handled with multiple imputation. HOME = Home Observation Measurement of the Environment; PPVT = Peabody Picture Vocabulary Test.
⁺$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.