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Is sensitive caregiving in child care associated with children's effortful control skills? An exploration of linear and threshold effects

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ABSTRACT

This study examined associations between caregiver sensitivity and responsiveness in child care experienced at age 4 and children's effortful control skills at age 5, among 154 preschoolers who attended community-based child care settings. Sensitive caregiving was measured using a modified version of the Observational Ratings of the Caregiving Environment and children's effortful control skills were assessed using both a parent questionnaire and a laboratory assessment. Results suggest that effortful control is sensitive to thresholds of caregiver sensitivity. Specifically, positive associations between caregiver sensitivity and effortful control skills a year later were observed only for children in settings with relatively high-quality caregiver sensitivity. These findings suggest that supporting the development of children's effortful control skills may require exposure to child care that exceeds typical levels of caregiving quality experienced by young children in the United States.

Introduction

In 2012, 60% of children under the age of five were in some type of non-parental child care (Mamedova & Redford, 2013). Given that preschoolers spend, on average, 33 h per week in child care (Laughlin, 2013), deepening our understanding of the role child care experiences play in shaping early cognitive and socio-emotional development is critical. A large body of research has addressed the basic question of whether child care experiences matter for children's development. Evidence has consistently demonstrated that the wide variation in quality that characterizes child care in the United States is associated with variation in a range of developmental outcomes (Helburn, 1995; Lamb & Ahnert, 2006; National Institute of Child Health and Human Development Early Child Care Research Network (NICHD ECCRN), 1998, 2000; Phillips, McCartney, & Sussman, 2006). Related research has addressed the need to identify policy levers that can enhance the child care experiences of young children, thereby increasing their odds of readiness for and success in school (Early et al., 2007; Johnson, Ryan, & Brooks-Gunn, 2012; Mashburn et al., 2008).

Child care research, as well as policy efforts to improve care quality, is now focused on the possibility that thresholds of child care quality exist above and below which the development of children is more strongly impacted (Burchinal, Kainz, & Cai, 2011). Emerging developmental research aimed at identifying thresholds of child care quality suggests that benefits to children are most likely to accrue at higher levels of quality as it exists in the United States (Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Vandell, Belsky, Burchinal, Vandergrift, & Steinberg, 2010; Weiland, Ulvestad, Sachs, & Yoshikawa, 2013). To the extent that positive benefits of child care are stronger above a certain quality threshold, policies aimed at ensuring young children are in child care and early education settings that promote school readiness should support programs in meeting or exceeding that quality level. Moreover, understanding what levels of child care quality are linked to children's positive development helps inform parents of all socioeconomic backgrounds as they select the best care settings for their children.

Children's cognitive outcomes have received the most longstanding attention in examinations of both linear and threshold effects of child care quality on child development (Burchinal et al., 2010), although substantial research has also examined socioemotional outcomes (Crockenberg & Leerkes, 2005; Phillips et al., 2012; Pluess & Belsky, 2009, 2010). The domain of outcomes captured under the broad umbrella of regulatory skills, including effortful control, has only recently begun to receive attention in this literature. Self-regulation is a rich and active area of study, and thus the terminology is evolving as new work aims to connect the various lines of research that inform our understanding of the development of children's regulatory skills. The measures of *effortful control* used

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in this study capture children's abilities to intentionally manipulate their attention and behavior and tap their capacities for inhibitory control, attentional focusing, attentional shifting, and perceptual sensitivity (Liew, 2012; Rothbart & Bates, 2006).

Some studies have reported that regulatory skills are more strongly related to school performance than IQ, entry level math and reading skills, or student GPAs from the previous semester (Blair & Razza, 2007; Valiente, Lemery-Chalfant, & Reiser, 2007). As with other domains of development, higher-quality child care has been linked to improved capacities for focused attention (Peisner-Feinberg et al., 2001) and studies of relatively high-quality preschool environments have reported benefits to children's regulatory outcomes assessed with measures of attention, self-control, and compliance (Barnett et al., 2008; Diamond, Barnett, Thomas, & Munro, 2007; NICHD ECCRN, 1998; Weiland et al., 2013). Although this robust literature has linked child care quality to children's more general regulatory skills, to date no studies have attempted to link effortful control to variation in quality found in the wider range of community-based child care settings that serve households with 4-year-olds across the socioeconomic spectrum.

Our short-term, longitudinal study extends prior work on child care outcomes to children's effortful control skills, which encompass aspects of regulation that have been linked to later academic achievement and social competence (Blair & Razza, 2007; Liew, McTigue, Barrois, & Hughes, 2008; McClelland et al., 2007). Specifically, we bring evidence on the developmental importance of effortful control skills to bear on efforts to examine both linear and non-linear relationships between an aspect of child care quality, namely caregiver sensitivity and responsiveness, and later child outcomes in a sample of preschoolers attending a range of community-based child care arrangements.

Thresholds of child care quality

Child care research over the past few decades has focused nearly exclusively on detecting linear relationships between child care quality and child developmental outcomes. The heritage of this research is firm evidence that more positive, nurturing, and language-rich child care environments with ample early learning opportunities are associated with stronger cognitive, academic, and socioemotional outcomes (NICHD ECCRN & Duncan, 2003; Phillips et al., 2012; Vandell et al., 2010). However, the typically weak associations reported in this literature have recently led researchers to explore non-linear relations using analytic approaches that examine whether associations between quality and outcomes are stronger at certain ranges along the quality spectrum compared to others.

Evidence suggests that the relationship between care quality and child cognitive and social outcomes may indeed be better captured by non-linear patterns. Several studies have reported that positive associations between care quality and short- and long-term outcomes are stronger for children who experienced care in the moderate-to-high quality range as compared to those experiencing low-to-moderate quality care (Burchinal et al., 2010; Burchinal, Vernon-Feagans, Vitiello, & Greenberg, 2014; Howes, Phillips, & Whitebook, 1992; Vandell et al., 2010), although other efforts to detect thresholds have not found them (NICHD ECCRN & Duncan, 2003). There is virtually no evidence regarding such threshold effects on young children's effortful control capacities, beyond one recent evaluation of the Boston Public Schools pre-kindergarten program (Weiland et al., 2013). This study reported that children's scores on a Pencil Tapping task that assessed inhibitory control were more strongly affected in public school-based preschool classrooms characterized by higher classroom quality scores on the Classroom Assessment Scoring System (CLASS; Pianta, La Paro, & Hamre, 2008) subscales of instructional and emotional support and classroom organization. Whether this pattern is replicated in a relatively more-advantaged sample using community-based child care arrangements that include, but are not restricted to, preschool settings and that reflect a broader range of caregiver sensitivity and responsiveness is an unanswered question addressed by the present study.

Effortful control

Effortful control is defined as the ability to suppress a dominant response to perform a subdominant response, to detect errors, and to engage in planning (Kochanska, Murray, & Harlan, 2000; Rothbart & Rueda, 2005). Effortful control has been used to describe both a set of self-regulatory mechanisms and the behaviors resulting from the self-regulatory aspect of temperament (Kochanska et al., 2000). It encompasses both inhibitory and excitatory response tendencies (i.e. suppressing a prepotent behavioral response as well as initiating and maintaining a subdominant response) across a broad range of domains of functioning including cognitive, social, emotional, motor, and behavioral performance (Kochanska et al., 2000). A child's capacity for effortful control is widely viewed as contributing to the early development of emotional regulation and executive functions (Kochanska, 1991; Kochanska, Murray, & Coy, 1997; Kochanska & Knaack, 2004), prosocial behavior (Eisenberg et al., 1995, 1997), and social competence (Ciairano, Visu-Petra, & Settanni, 2007; Eisenberg et al., 1995; Lengua, 2002, 2003). Further, effortful control has been found to promote resilience and adaptive functioning for children growing up in adversity (Buckner, Mezzacappa, & Beardslee, 2003; Cumberland, Eisenberg, & Reiser, 2004; Obradović, 2010). In the current study, we use measures of effortful control that capture children's inhibitory control, perceptual sensitivity, and planning skills.

Individual differences in effortful control appear early in life and exhibit both modest continuity over the lifespan (Martel, 2007; Murphy, Eisenberg, Fabes, Shepard, & Guthrie, 1999; Pedlow, Sanson, Prior, & Oberklaid, 1993), as well as change with age (Eisenberg et al., 2005; Nigg, 2006; Rothbart & Bates, 2006). Though effortful control is temperamentally based, it emerges in toddlerhood and develops significantly during the preschool years as the underlying brain networks demonstrate considerable age-related changes (Rothbart, Ellis, Rueda, & Posner, 2003; Rothbart, Sheese, & Posner, 2007). These skills show especially rapid development between 3 and 6 years of age (Carlson, 2005; Diamond, 2006) as children's prefrontal cortexes mature (Casey, Giedd, & Thomas, 2000; Gogtay et al., 2004), and are influenced by early rearing experiences (Eisenberg et al., 2005; NICHD ECCRN, 2005; Tarullo, Obradović, & Gunnar, 2009; Taylor, Eisenberg, Spinrad, & Widaman, 2013). Additionally, preschoolers' effortful control skills can improve with training (Dowsett & Livesy, 2000). Since effortful control skills are amenable to intervention, malleable to early experiences, and have not been a specific focus in child care research, the impact of child care experiences on these abilities is an important area of investigation.

The role of child care in the development of effortful control

A handful of studies have explored associations between child care experiences and children's early regulatory skills. However, these studies have been limited in one of three ways: they have considered early competencies related to children's self-regulation, but not effortful control per se (Burchinal et al., 2014; NICHD ECCRN, 2005), have examined preschool classrooms using specific curricula to promote children's regulatory skills (Barnett et al., 2008), or have focused on a specific type of child care setting, such as public school-based pre-kindergarten classrooms (Weiland et al., 2013).

The few studies that have examined associations between child care quality and skills related to self-regulation have not yielded evidence in support of such a link (Burchinal et al., 2014; NICHD ECCRN, 2005). Specifically, early caregiving quality predicted increased short-term memory skills but was not associated with children's sustained attention, impulsivity, long-term memory, or planning skills once home environment quality was controlled for (NICHD ECCRN, 2005). Likewise, a recent study exploring threshold effects of child care quality on children's academic, behavioral, and working memory skills found that high quality settings were associated with behavioral competence and decreased behavioral problems, but no evidence of threshold effects on children's working memory skills (Burchinal et al., 2014). While these results inform the current investigation, neither study examined effortful control specifically. Questions about whether caregiver sensitivity and responsiveness are related to effortful control skills as distinct from related concepts of memory and attention, remain.

With regard to studies examining specific curricula designed to promote regulatory skills, Barnett et al. (2008) found that an intervention focused explicitly on the development of regulatory skills increased children's regulatory skills along with global classroom quality, classroom productivity, the literacy environment and literacy instruction, and teachers' scaffolding of students' activities. The study did not examine associations between child care quality and children's regulatory skills.

Finally, the Boston Public Schools pre-kindergarten study, mentioned above, found evidence for both linear and curvilinear associations between child care quality and children's regulatory outcomes: children in classrooms with higher quality literacy activities demonstrated greater concurrent inhibitory control capacities, while children in classrooms with greater emotional, instructional, and organizational support only demonstrated greater inhibitory control if their classroom was among those with the *highest* scores on those quality measures (Weiland et al., 2013). Additionally, for children in classrooms with low instructional support, inhibitory control was negatively associated with instructional quality. However, as discussed above, this study focused only on associations between quality and self-regulation skills in a public pre-kindergarten program, with well-implemented mathematics and literacy curricula as well as a high percentage of masters-level teachers. While informative, these latter two studies leave open questions regarding the generalizability of these findings to community-based child care settings that are not designed specifically to boost school readiness in at-risk populations or improve regulatory skills. These are, nevertheless, the settings that most 4-year-olds experience (Laughlin, 2013), despite recent expansions in school-based preschools.

Current study

The current study seeks to understand whether caregiver sensitivity and responsiveness in community-based child care settings, is associated with effortful control and if so, whether that association is stronger at higher levels of sensitivity. We address two specific questions: (1) Is caregiver sensitivity at age 4 associated with better effortful control at age 5? (2) Are there thresholds of child care quality, as measured by caregiver sensitivity and responsiveness, above which children's effortful control outcomes are more strongly affected? In an attempt to address the possibility that other factors correlated with both caregiver sensitivity and effortful control might confound our findings, we included standard demographic controls, as well as an observational measure of maternal sensitivity, that prior research has indicated is associated with both the selection of quality child care settings and with children's effortful control skills (Kochanska et al., 2000; NICHD ECCRN, 1997). Among the strengths of this study is the use of two assessments of effortful control – a parent report and a laboratory assessment. This enables us to provide a more comprehensive picture of children's effortful control behavior based on different informants who observe the child in distinctive contexts.

Consistent with previous research, child care quality, as measured by caregiver sensitivity and responsiveness, is predicted to be positively and linearly associated with effortful control skills. Additionally, we hypothesize that a threshold effect will be detected, such that children who received higher caregiver sensitivity and responsiveness would experience the greatest benefits with regard to their developing effortful control skills. We acknowledge the relatively more advantaged nature of our sample, compared to related research on predominantly low-income populations (Burchinal et al., 2014; Weiland et al., 2013), and leave open the possibility that our findings might differ from the extant literature.

Methods

Participants

The sample for the present study consisted of a subset of children selected during infancy to participate in a study designed to examine the development of temperamentally reactive infants (Hane, Fox, Henderson, & Marshall, 2008). The current study focuses on 154 preschoolers (80 females and 74 males) who were observed in routine non-parental child care (≥10 h per week) between 47 and 58 months of age ($M = 52.14$ months, $SD = 2.42$ months). Children with reactive temperaments at infancy were oversampled: 36 percent ($N = 56$) of the preschoolers had negatively reactive temperaments, 36% ($N = 56$) had positively reactive temperaments, and 27 percent ($N = 42$) constituted a control group without extreme temperaments as determined by laboratory assessments of affect and motor reactivity at four months of age.

On average, the children entered routine non-parental child care at 13.05 months of age (range: 0–52 months) and, at age 4, were in care for an average 26 h per week (range: 2.31–60.98). The vast majority of the children were in center-based care (93.10%, including one child in Head Start), a few children were in family day care centers (6.03%) and nanny-care (0.87%). Most child care providers obtained at least a college education (73%), with only a small portion of the providers receiving a high school education or less (10%). The majority of the children are Caucasian (68%) with mothers who were at least college educated (82%).

Measures

Caregiver sensitivity and responsiveness

Our key predictor was an aspect of child care quality, caregiver sensitivity and responsiveness, measured at age 4 using a modified version of the "Observational Ratings of the Caregiving Environment" used in the NICHD Study of Early Child Care and Youth Development (ORCE; NICHD ECCRN, 2000). The M-ORCE was designed to rate the quality of both home-based and center-based child care (Kryzer, Kovan, Phillips, Domagall, & Gunnar, 2007; Phillips et al., 2012). Modifications to the original instrument (ORCE) were made to better capture caregiver support for social development, including peer interaction, as well as dimensions of the setting that capture a sense of community among the children and adults. Quality ratings, collected at three time points over the course of the child care day, were gathered as both frequency counts of caregiver behaviors specific to the study child and qualitative ratings of caregiver behaviors toward both the study child and the peer group, as well as of the overall child care environment. As such, the M-ORCE differs from the Early Childhood Environment Rating Scale-Revised (ECERS-R; Harms, Clifford, & Cryer, 2005) and the

Classroom Assessment Scoring System (CLASS; Pianta et al., 2008) that provide quality ratings only at the level of the overall group and setting, but is similar in capturing the emotional support dimensions of caregiver-child interactions and the emotional climate of the environment.

Coding of the M-ORCE was performed by four research assistants who were trained by the Principal Investigator using master tapes and live coding to meet a standard of reliability (Cohen's kappa ≥ .80) prior to collecting data. During data collection, coder agreement was re-assessed approximately every sixth session by having the reliability coder jointly complete the M-ORCE. On all behavioral and qualitative variables used in the current analyses, coders maintained a Cohen's kappa ≥ .80.

A composite *positive caregiving quality* score was created as an average of the qualitative ratings of the following four subscales: *caregiver sensitivity*, *caregiver detachment* (reversed), *positive regard* for the child, and *overall positive emotional climate*. The score shares the focus on caregiver sensitivity and positive regard of the child with the ORCE measure of caregiving quality, but does not include items addressing stimulation of cognitive development and exploration (see NICHD ECCRN, 2000). For *caregiver sensitivity*, *caregiver detachment*, and *positive regard*, the unit of observation was the focal child in the classroom, whereas *positive emotional climate* measured the overall classroom environment. Scoring for each item could range from a low of 1 to a high of 4, creating a possible range of 1–4. The actual range of scores in the current sample was 1.42–4, with a mean of 2.91. Reliability for this composite measure was high (Cronbach's $\alpha = .90$).

Effortful control

Our key dependent variables were parent-reported child effortful control skills at age 5, and a direct laboratory assessment of child effortful control skills at age 5, both collected as part of the larger Temperament Over Time Study. Parent ratings of *Effortful Control* (EC) were assessed using the Child Behavior Questionnaire (CBQ). The total parent-rated *Effortful Control* score, as created by Rothbart and colleagues, was the mean of four subscales: *attention focusing*, *inhibitory control*, *low intensity pleasure*, and *perceptual sensitivity* (Putnam & Rothbart, 2006). The *attention focusing* subscale measured the child's tendency to maintain attentional focus during tasks. *Inhibitory control* captured the capacity to plan and suppress inappropriate approach responses under instructions or in novel situations. The *low intensity pleasure* subscale tapped the child's regulation of affect. *Perceptual sensitivity* captured how well the child sustained focus to detect low intensity stimuli. Reliability for this composite *Effortful Control* measure was marginal (Cronbach's $\alpha = .65$).

A laboratory assessment of children's effortful control was conducted using the Zoo Game, a computer based Go/NoGo task designed for use with young children (McDermott, 2005). During this task, children were presented with pictures of animals on a computer screen and were told to help the zookeeper catch all of the animals that escaped from their cages. Children were instructed to press a button for all of the animals (Go trials), except for the monkey who helps the zookeeper catch the animals (NoGo trials). Children were given 12 practice trials and a total of 120 test trials, presented in two blocks of 60 trials each. Response accuracy was calculated on both Go (90) and NoGo (30) trials. Children who had correct scores on at least 65% of the Go trials were included in the analysis. In the current study, the percent correct on the NoGo trials served as the index of effortful control.

Covariates

To reduce the likelihood that any observed association between sensitive and responsive caregiving and effortful control skills was explained by other factors that are correlated with choice of child care or child effortful control skills, we included covariates that have been theoretically or empirically linked to child care selection, child outcomes, or both. When children were four months old, mothers reported basic family-level demographic data. These data provided a dummy variable for *child gender* (female = 0, male = 1), as well as two dummy variables for *maternal education* to indicate whether the mother had a high school degree or less, a bachelor's degree, or a graduate degree. We also controlled for *child temperament* for reasons of sampling and because of previous literature demonstrating differential effects of child care quality on temperamentally reactive children (Pluess & Belsky, 2009, 2010), specifically evidence that caregiver sensitivity interacted with difficulty of infant temperament in predicting behavior problems and social competence at 54 months and in kindergarten.

Infants were brought into the laboratory at 4 months of age for a temperament screening, during which affect (positive = sum of frequencies of smiling and positive vocalizations, and negative = sum of frequencies of fussing and crying) and motor reactivity (sum of frequencies of arm waves, arm wave bursts, leg kicks, leg kick bursts, back arches, and hyperextensions) during the presentation of novel visual and auditory stimuli were observed (for more details, see Degnan et al., 2011; Hane et al., 2008). Infants with high negative affect and high motor reactivity were labeled *negatively reactive* and infants with high positive affect and high motor reactivity were labeled *positively reactive*.

We also controlled for *maternal sensitivity*, assessed using videotaped observations of mother–infant interactions in the home when children were nine months of age (Hane et al., 2008; Hane & Fox, 2006). The sensitivity of maternal behavior was rated on a Likert scale (1–9) based on ratings of acceptance, appropriateness, availability, cooperation, delight, encouragement, and sensitivity where higher scores indicate greater maternal sensitivity (Ainsworth, 1976). Inter-rater reliability based on an intra-class correlation was moderately high (.80). The continuous *maternal sensitivity* composite included in our analysis was calculated by averaging the ratings across observations ($M = 6.49$, $SD = .71$).

Beyond family-level covariates, we also included the number of *hours of child care* per week at age 4 years as well as a lagged measure of caregiver sensitivity (*positive caregiving quality* at age 3) in all of our models to address selection into care quality and to isolate the unique contribution of age 4 quality from that of quality experienced earlier. The composite age 3 *positive caregiving quality* score, like the age 4 score, included measures of *caregiver sensitivity*, *caregiver detachment* (reversed), *positive regard* for the child, and *overall positive emotional climate*. Reliability for this composite measure was high (Cronbach's $\alpha = .88$). Additionally, we include a lagged measure of the effortful control outcomes, measured at age 4. Both the parent-rated measure and the laboratory assessment of effortful control were calculated the same way for 4- and 5-year-olds.

Analytic strategy

To examine the relationship between caregiver sensitivity and children's effortful control outcomes, we fit linear regression models for each of our two measures of effortful control (parent-reported and lab-observed), controlling for all covariates listed above.

To address the main question of the study, which considers whether the association between child care quality and children's effortful control outcomes differ along the quality continuum, we fit spline regression models. For these analyses, we identified three categories of quality (low, medium, and high) based on consideration of both distributional and conceptual criteria, following Burchinal et al. (2010). The low- and high-quality groups each represented approximately 25% of the sample. The "low-quality group" represented environments that were minimally

Table 1
Sample descriptive statistics.

	Full sample $N = 154$ Mean (*SD*)/%	Range	*n*	Low/Med. quality $N = 85$ Mean (*SD*)/%	*n*	High quality $N = 31$ Mean (*SD*)/%	*n*
Family characteristics							
Mother has college degree	42.21%	0–1	154	41.18%	85	51.61%	31
Mother has graduate degree	39.61%	0–1	154	37.65%	85	41.94%	31
Maternal Sensitivity*	6.49 (0.71)	4.33–8.56	139	6.39 (.74)	75	6.72 (.58)	29
Child characteristics							
Child is male	48.05%	0–1	154	44.71%	85	41.94%	31
Positive infant temperament	36.36%	0–1	154	38.82%	85	32.26%	31
Negative infant temperament	36.36%	0–1	154	35.29%	85	32.26%	31
Child care characteristics							
Provider sensitivity (Age 3)*	2.83 (0.61)	1.42–4.00	95	2.70 (0.58)	57	3.15 (0.64)	14
Provider sensitivity (Age 4)**	2.91 (0.58)	1.42–4.00	116	2.65 (.45)	85	3.61 (.23)	31
Average hours/week of child care**	26.25 (13.83)	2.31–60.98	154	30.42 (13.05)	85	13.62 (10.00)	31
Teacher has college degree*	72.90%	0–1	107	67.53%	77	86.67%	30
Child outcomes: Effortful Control							
Parent-Rated EC (Age 4)	5.03 (.49)	3.62–6.28	136	5.01 (.49)	77	5.08 (.55)	30
Parent-Rated EC (Age 5)*	5.27 (.57)	3.68–6.68	141	5.18 (.56)	80	5.48 (.59)	29
Laboratory Assessment of EC (Age 4)*	.34 (.31)	0–1	125	.30 (.30)	75	.45 (.32)	28
Laboratory Assessment of EC (Age 5)	.46 (.29)	0–.97	136	.45 (.29)	78	.50 (.28)	28

Note: Tests of statistical significance are between low/medium versus high child care quality.
* $p < .05$.
** $p < .001$.

characteristic of high quality child care settings and the "high-quality group" represented environments that were moderately to strongly characteristic of high quality child care settings. Specifically, the lower quality threshold was set at 2.5 on the M-ORCE ($N = 29$) and the higher quality threshold was set at 3.25 ($N = 31$). Child care settings rated between 2.5 and 3.25 were considered medium quality for the purposes of this study ($N = 56$).

We used a spline technique to estimate piecewise linear models to test our second hypothesis (Marsh & Cormier, 2002). The model estimated separate "splines" or linear regressions for the child care settings considered to be low quality, medium quality, and high quality, and thus estimated three separate slopes, each describing the association between child care quality and children's effortful control, using the *mkspline* command in Stata version 13. The fitted line was allowed to change slope, but not intercept at each of the knots or thresholds. Eq. (1), illustrates the spline models, where β_1, β_2, and β_2 are the associations between child care quality and effortful control skills for children in low, medium, and high quality settings, respectively.

$$EC_i = \beta_0 + \beta_1 \text{Qual}_L + \beta_2 \text{Qual}_M + \beta_3 \text{Qual}_H + \text{Covariates}_i + \in_i \quad (1)$$

$$\text{Qual}_L = \begin{cases} \text{Qual}, & \text{Qual} \leq 2.50 \\ 2.50, & \text{Qual} > 2.50 \end{cases}$$

$$\text{Qual}_M = \begin{cases} 0, & \text{Qual} \leq 2.50, \\ \text{Qual} - 2.50, & 2.50 < \text{Qual} \leq 3.25 \\ 0.75, & \text{Qual} > 3.25 \end{cases}$$

$$\text{Qual}_H = \begin{cases} 0 & \text{Qual} \leq 3.25 \\ \text{Qual} - 3.25, & \text{Qual} > 3.25 \end{cases}$$

We estimated effect sizes (Cohen's *d*) by multiplying the coefficient of the predictor (child care quality) by the standard deviation of the predictor and dividing by the standard deviation of the outcome (effortful control) (Burchinal et al., 2010; NICHD ECCRN & Duncan, 2003; Weiland et al., 2013).

$$d = \frac{\beta_{\text{quality}} SD_{\text{quality}}}{SD_{\text{outcome}}}$$

To account for missing data on our covariates and on child care quality at age 4, we imputed 20 data sets using the Multiple Imputation (MI) command in Stata version 13. The MI command in Stata was then used to generate estimates in multivariate analyses across the 20 imputed data sets.

Results

Bivariate results

Table 1 presents descriptive statistics on caregiver sensitivity at age 4 and effortful control skills at age 5, as well as on the covariates for the total sample and for children in low- or medium- and high-quality child care settings, as measured by caregiver sensitivity. On average, most child care was of medium quality ($M = 2.91$, $SD = .58$); only 27% of the settings were classified as high quality care (≥3.25 on the M-ORCE), and the remaining 25% were categorized as low quality (<2.5 on the M-ORCE). For descriptive purposes, we assessed bivariate associations between quality level and each covariate. To simplify the presentation of results, and because we were primarily interested in understanding how children in high-quality care differed from their peers in lower quality care on our control variables, we combined low- and medium-quality care.

Most mothers were rated as being moderately sensitive in their caregiving toward their children. There was a significant difference in maternal sensitivity for children in low/medium versus high quality child care ($t(102) = -2.16$, $p = .033$). On average, our mothers were highly educated, 42.21% of the sample had a college degree and 39.61% of the mothers obtained a graduate degree. There were not significant differences in maternal education for children in low/medium versus high quality care.

Our sample had slightly more girls than boys; there were no statistically significant gender differences in the proportion of children in low/medium- versus high-quality child care. On average, children attended 26.25 h of child care per week, and children in low/medium quality care spent significantly more time in child care than children in high quality care settings ($t(114) = 6.50$, $p < .001$). The majority of teachers in our study had a college degree (72.90%), and significantly more teachers in the high quality settings had college degrees, compared to those teaching in low/medium quality settings ($t(105) = -2.02$, $p = .046$).

Next, we examined bivariate associations between child care quality and the two measures of effortful control skills (as well as between the key independent and dependent variables and the

Table 2
Correlations.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Mother has a college degree	–												
2. Mother has graduate school degree	−.69***	–											
3. Maternal sensitivity	.10	.17	–										
4. Male	−.03	.02	.18*	–									
5. Positively reactive temperament	−.02	.02	.06	−.11	–								
6. Negatively reactive temperament	.07	−.09	−.04	−.11	−.57***	–							
7. Child care provider sensitivity (age 3)	.03	.06	.23*	−.15	−.05	.08	–						
8. Child care provider sensitivity (age 4)	.09	.16	.25**	−.06	.07	.01	.24*	–					
9. Hours/week in child care	− 08	−.05	−.17*	.14	−.02	.00	−.31**	−.52***	–				
10. Parent-rated EC (age 4)	−.04	.05	−.05	−.40***	−.06	.00	.28*	.07	−.15	–			
11. Parent-rated EC (age 5)	−.02	.02	.06	−.33***	.08	.02	.24*	.24*	−.13	.70***	–		
12. Laboratory assessment of EC (age 4)	.12	−.05	.16	−.21*	−.01	.00	.05	.15	−.29***	.08	.21*	–	
13. Laboratory assessment of EC (age 5)	−.06	.02	.06	−.32***	−.01	.08	−.13	.10	−.09	.16	.32***	.48***	–

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

covariates; see Table 2). The two measures of effortful control – parent ratings and laboratory assessments – were positively associated with each other at age 5, but not at age 4. Both measures displayed relatively high stability from age 4 to age 5. Higher parental ratings of effortful control were associated with higher child care quality at age 5, but not at age 4. The laboratory assessment of effortful control was not associated with quality of care at either age.

Multivariate results

Linear regression models

Our first research question asked if a linear relationship exists between child care quality at age 4 and children's effortful control skills at age 5. To test this, we estimated a multiple linear regression model predicting effortful control from child care quality, while controlling for child gender, maternal education, maternal sensitivity, child temperament, hours per week in child care, and lagged measures child care quality (age 3) and children's effortful control skills (age 4). There were no statistically significant associations between child care quality and parent-rated effortful control ($\beta = 0.073$, $p = .403$) or the laboratory assessment of effortful control ($\beta = 0.092$, $p = .379$, Table 3).

Spline regression models

Our second research question asked whether a non-linear relationship exists between quality and effortful control and, more specifically, if there are thresholds of quality above and below which children's development of effortful control is more strongly affected. As mentioned above, spline knots based on the distribution of quality scores in our data were set at 2.5 and 3.25 on the M-ORCE positive caregiving quality scale. The cutpoint for the low quality settings was set at 2.5, and the cutpoint for the high-quality settings was set at 3.25. Child care settings rated between 2.5 and 3.25 were considered medium quality. Each model controlled for the covariates listed above.

Results from the spline regression analyses (Table 4) suggest that higher quality child care was significantly and positively related to parent-rated effortful control skills at age 5 ($\beta = 0.201$, $p = .021$, $d = .23$). There was not a significant association between lower ($d = .02$) or medium ($d = .03$) quality child care and children's parent-rated effortful control skills. Similarly, higher quality child care was positively rated to laboratory assessments of effortful control at age 5 ($\beta = 0.190$, $p = .061$, $d = .23$). There was not a significant association between low ($d = .13$) or medium ($d = .09$) quality child care and children's laboratory assessments of effortful control. Post-estimation Wald tests were conducted to compare coefficients between high and medium quality for parent-rated and laboratory-assessed effortful control, ($F(1,92.1) = 3.20$, $p = .077$; $F(1,61.5) = 3.20$, $p = .078$, respectively); these coefficients were not statistically significantly different from each other at conventional alpha levels ($p < .05$).

Discussion

Despite a rich knowledge base that has consistently linked child care quality to child developmental outcomes (NICHD ECCRN & Duncan, 2003; Peisner-Feinberg et al., 2001; Pluess & Belsky, 2009; 2010), no study has tested whether caregiving quality in community-based child care settings is associated with children's subsequent effortful control skills. If such an association exists, the emerging literature on thresholds in child care quality-child outcome associations raises the question of whether it is stronger at higher levels of caregiving quality. This study extends prior work to address these questions.

In light of research positively linking higher quality care to other components of self-regulation, we expected that caregiver sensitivity and responsiveness, an aspect child care quality, would be positively linearly associated with effortful control. We also anticipated that this association would display a threshold pattern, such that it would be strongest at higher levels of quality. Overall, we found support for the thresholds hypothesis, but not for a linear association between child care quality and children's effortful control skills upon entering elementary school. Specifically, we found that variation in sensitive caregiving at the high level, but not the medium or low level, was significantly linked to children's developing effortful control skills. Additionally, these positive associations were found for both parent-reported and laboratory-observed measures effortful control. These results suggest that children's experiences in child care will advance their effortful control skills only if they exceed the typical level of quality experienced by young children in the United States.

There are various reasons why relatively *high*-quality caregiving may carry the benefits of child care for children's developing effortful control skills. The development of effortful control may require high levels of scaffolding and individualized support from adults so that children can acquire the inhibitory capacities that underlie these skills. In this study, child care quality was assessed using a measure of *positive caregiving quality* that captured teacher sensitivity and the emotional climate of the classroom. While not specifically focused on scaffolding of regulatory behavior, highly sensitive teachers who establish a supportive emotional climate in their programs also likely provide young children with early

Table 3
Linear regression models predicting effortful control at age 5 from child care quality at age 4.

	Parent-rated EC			Laboratory assessment of EC		
	B	(*SE*)	*β*	*B*	(*SE*)	*β*
Child care provider sensitivity (Age 4)	0.070	(0.083)	0.073	0.045	(0.051)	0.092
Covariates						
Mother has college degree	−0.100	(0.093)	−0.087	−0.104	(0.065)	−0.178
Mother has graduate school degree	−0.115	(0.089)	−0.100	−0.053	(0.067)	−0.088
Maternal sensitivity	0.019	(0.060)	0.025	0.039	(0.039)	0.092
Gender (male)	−0.124	(0.078)	−0.110	−0.152	(0.046)	−0.262**
Negatively reactive temperament (4 mos)	0.040	(0.090)	0.034	0.078	(0.057)	0.131
Positively reactive temperament (4 mos)	0.133	(0.094)	0.115	0.045	(0.058)	0.075
Average hours/week of child care	0.002	(0.003)	0.054	0.001	(0.002)	0.054
Child care provider sensitivity (Age 3)	0.084	(0.081)	0.096	−0.081	(0.053)	−0.178
EC parent/laboratory (Age 4)	0.764	(0.085)	0.658***	0.411	(0.071)	0.466***

Note:
* $p \leq .05$.
** $p \leq .01$.
*** $p \leq .001$.

experiences that are conducive to the development of effortful control skills. A related body of research has shown that sensitive and positive parenting predicts later attention and self-control (Bernier, Carlson, & Whipple, 2010; Olson, Bates, & Bayles, 1990).

Our findings may also be driven by the demographic characteristics of our sample, specifically the fact that the majority of children came from relatively advantaged homes with college-educated mothers. Higher-income parents tend to provide more developmentally supportive home environments (Bradley et al., 1994; Garrett, Ng'andu, & Ferron, 1994; Miller & Davis, 1997). Additionally, children growing up in middle- to high-income households have consistently performed better on tests of effortful control, executive functioning, and self-regulation, compared to their less advantaged peers (Farah et al., 2006; Howes, Lange, Farran, & Boyles, 2003; Noble, McCandliss, & Farah, 2007; Noble, Norman, & Farah, 2005). Taken together, this evidence suggests that the children in our sample likely entered child care with comparatively strong effortful control skills, supported by sensitive parenting, and thus did not benefit from increased child care quality until it reached a relatively high threshold.

Limitations

The contributions of our study must be considered alongside its limitations. First, the study is exploratory and does not provide causal evidence. Despite the use of several important control variables, the possibility of selection bias and omitted variable bias cannot be eliminated, especially given significant differences on covariates between the low, medium, and high quality groups. Second, the small size of our sample may have decreased our power to detect significant results. Indeed, we recognize that our post-estimation Wald tests were not significant at the conventional alpha level ($p < .05$), a pattern of results that we attribute to small sample size. Third, we acknowledge that our reliability on the parental measure of effortful control is marginal. We chose to retain all components in our measure of effortful control, as specified by Rothbart and colleagues, because the CBQ is frequently used in research studies, and thus we decided to maintain consistency with the broader literature. Additionally, the children in this study were also oversampled for temperamental reactivity as infants. Although we have attempted to control for this in our analyses, our results may be specific to this group of children that, while reflecting the full spectrum of low- to high-temperamental reactivity at infancy, do not represent a normal distribution of temperamental styles.

The sample was also non-representative with regard to demographic characteristics. It included very few children from demographically high-risk families. Child care quality has consistently interacted with children's socio-economic status such that those from low-income families have been conferred greater benefits in higher quality child care settings as compared to their more

Table 4
Spline regression models predicting effortful control at age 5 from low, medium, and high child care quality at age 4.

	Parent-rated EC			Laboratory assessment of EC		
	B	(*SE*)	*β*	*B*	(*SE*)	*β*
Low-quality child care provider sensitivity	−0.037	(0.224)	−0.017	0.138	(0.148)	0.107
Medium-quality child care provider sensitivity	−0.087	(0.180)	−0.047	−0.117	(0.111)	−0.124
High-quality child care provider sensitivity	0.590	(0.252)	0.201*	0.285	(0.149)	0.190†
Covariates						
Mother has college degree	−0.074	(0.093)	−0.065	−0.088	(0.066)	−0.152
Mother has graduate school degree	−0.084	(0.089)	−0.072	−0.040	(0.068)	−0.066
Maternal sensitivity	0.013	(0.059)	0.016	0.036	(0.039)	0.084
Gender (male)	−0.130	(0.078)	−0.115†	−0.158	(0.046)	−0.272**
Negatively reactive temperament (4 mos)	0.051	(0.090)	0.043	0.073	(0.057)	0.122
Positively reactive temperament (4 mos)	0.143	(0.093)	0.123	0.043	(0.057)	0.071
Average hours/week of child care	0.003	(0.003)	0.076	0.001	(0.002)	0.069
Child care provider sensitivity (Age 3)	0.076	(0.081)	0.087	−0.083	(0.052)	−0.182
EC parent/laboratory (Age 4)	0.749	(0.085)	0.646***	0.402	(0.073)	0.456***

Note:
† $p \leq .10$.
* $p \leq .05$.
** $p \leq .01$.
*** $p \leq .001$.

advantaged peers (Burchinal et al., 2010; Votruba-Drzal, Coley, & Chase-Lansdale, 2004; Watamura, Phillips, Morrissey, McCartney, & Bub, 2011). Thus, it is possible that linear associations between quality and child outcomes commonly found in the literature were attenuated by the compensatory benefits of high-quality home environments. Relatedly, a lower quality threshold for developmental benefits may have emerged with a more representative sample. And finally, we investigated only one dimension of child care quality: caregiver sensitivity and responsiveness. Although this particular aspect of child care quality has been consistently predictive of child outcomes, future work should seek to test the full range of child care quality features that matter for regulatory and other developmental competencies.

Conclusions, preliminary implications, and next steps for research

This study represents a first attempt to estimate associations – both linear and non-linear – between caregiver sensitivity and children's effortful control skills. These early-stage findings suggest that there is a relationship between caregiver sensitivity and subsequent effortful control skills, and that relatively high-quality caregiving may be necessary to promote the development of these skills. These results should be replicated before policy recommendations are made, particularly with samples that include children growing up in less advantaged homes and with other measures of classroom quality, such as behavior management. Nevertheless, if our findings are replicated in larger, nationally-representative data sets that include low-income children who receive publicly-funded child care, they carry important implications for recent policy work on child care quality assessments, especially as they are used as a consumer information mechanism and linked to state and federal funding. Specifically, if results from this study are extended and replicated, they may be used to help guide efforts to bring publicly funded early care and education environments up to a level of quality that will best support children's school readiness.

In sum, it is our hope that future research will explore associations between child care quality and children's regulatory capacities, including effortful control skills, in more representative samples that include a diverse population of preschoolers and the full range of child care settings they attend. There is also a pressing need for experimental evaluations of quality improvement initiatives to provide the causal evidence that is most useful for policy reforms. Future studies should also explore other aspects of child care quality and classroom experiences that best promote effortful control skills. Greater attention to classroom management and instructional approaches that support the development of planning skills, response inhibition, and the capacity to defer rewards in early child care settings are potentially fruitful avenues to pursue. Such research would inform next stage child care quality assessments (Burchinal et al., 2011), as well as approaches to early childhood teacher education and professional development (Zaslow et al., 2010) that hold strong potential for fostering young children's critical capacities for learning as they move into formal schooling.

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