

Associations Between Publicly Funded Preschool and Low-Income Children's Kindergarten Readiness: The Moderating Role of Child Temperament

Anna D. Johnson
Georgetown University

Jenna E. Finch
University of Nebraska-Lincoln

Deborah A. Phillips
Georgetown University

Publicly funded center-based preschool programs were designed to enhance low-income children's early cognitive and social-emotional skills in preparation for kindergarten. In the U.S., the federal Head Start program and state-funded public school-based pre-kindergarten (pre-k) programs are the two primary center-based settings in which low-income children experience publicly funded preschool. Although evidence suggests that these programs generally promote cognitive and social-emotional skills for low-income children overall, whether the benefits of program participation vary for low-income children with difficult temperaments is unexplored. Difficult temperament status is a source of vulnerability that connotes increased risk for poor early school outcomes—risks that may be ameliorated by public preschool programs known to promote kindergarten readiness among other vulnerable populations. Using a nationally representative sample of low-income children ($N \approx 3,000$) drawn from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B), this study tests whether associations between public preschool participation and children's cognitive and social-emotional skills in kindergarten are moderated by difficult temperament status. We focus on Head Start and public school-based pre-k, comparing both with parental care and with each other. Results provide weak evidence that public preschool's benefits on children's cognitive and social-emotional skills in kindergarten are moderated by child temperament. School-based pre-k is significantly associated with better reading skills relative to parental care only for children with difficult temperaments. Additionally, for children with difficult temperaments, Head Start is significantly associated with better approaches to learning relative to parental care, and with reduced externalizing behavior problems relative to school-based pre-k.

Keywords: ECLS-B, low-income, Head Start, pre-k, temperament

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Publicly funded center-based preschool programs have the potential to support children's cognitive and social-emotional functioning at kindergarten entry (e.g., Phillips et al., 2017; Zhai, Brooks-Gunn, & Waldfogel, 2011), with especially strong benefits for children from low-income households (Gormley, Phillips, & Gayer, 2008; Weiland & Yoshikawa, 2013). Only recently have researchers studying the efficacy of public preschool programs begun to expand their inquiries

beyond moderation of preschool impacts by low-income status to other child-level indicators of vulnerability. To date, such child-level vulnerability factors have been limited almost exclusively to child immigrant, language minority, or special needs status (e.g., Bloom & Weiland, 2015; Johnson, Han, Ruhm, & Waldfogel, 2014), again finding that associations between public preschool and outcomes are as large—if not larger—for vulnerable children. Scholars studying individual differences in preschool impacts have called for extending these inquiries to an additional, yet unexplored, child-level indicator of vulnerability: child difficult temperament status (Phillips, Fox, & Gunnar, 2011). Difficult temperament typically distinguishes children who are more emotionally reactive and less behaviorally regulated from their peers. Children with difficult temperaments display more negative emotions (e.g., crying, distress) and challenging behaviors that may be hard for parents and teachers to manage (Curby, Rudasill, Edwards, & Perez-Edgar, 2011).

Despite evidence that temperament moderates the effects of early education experiences for nonpoor children in privately funded programs (Phillips et al., 2012; Pluess & Belsky, 2009, 2010), no studies have explored the role of temperament in mod-

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Anna D. Johnson, Department of Psychology, Georgetown University; Jenna E. Finch, Department of Psychology, University of Nebraska-Lincoln; Deborah A. Phillips, Department of Psychology, Georgetown University.

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Correspondence concerning this article should be addressed to Anna D. Johnson, Department of Psychology, Georgetown University, White-Gravenor Hall, 3700 O Street, Northwest Washington, DC 20057. E-mail: anna.johnson@georgetown.edu

erating preschool impacts for low-income children attending public preschool programs. This is surprising, given that difficult temperament status connotes increased risk for negative early school experiences: children with difficult temperaments—including those identified in infancy—have higher rates of behavior problems, psychopathology, and are more distractible, less adaptable, and less well-regulated than their peers (e.g., Curby et al., 2011; Earls & Jung, 1987; Galéra et al., 2011; Goldberg, Corter, Lojkasek, & Minde, 1990; Moffitt et al., 2011). Thus, difficult temperament status is an unexplored, but theoretically plausible, child-level vulnerability factor that might moderate the benefits of public preschool for low-income children.

The current study fills this information gap, using a low-income subsample from the nationally representative Early Childhood Longitudinal Study – Birth Cohort (ECLS-B). We explore associations between public preschool exposure and children’s kindergarten skills, asking whether attending publicly funded center-based preschool in the year before kindergarten is differentially linked with low-income children’s kindergarten cognitive and social-emotional skills, depending on observer-rated child temperament. We focus on comparisons of the primary publicly funded center-based settings in which low-income children experience preschool—Head Start centers and pre-k classrooms located in public schools—to each other and to parental care, one of the most commonly used reference setting in the literature and one of the most populated settings in national samples.

Publicly Funded Preschool and Children’s Developmental Outcomes

Center-based preschool settings are higher in observed quality, on average, than home-based alternatives (Rigby, Ryan, & Brooks-Gunn, 2007). For low-income families, two publicly funded center-based preschool programs—Head Start and school-based public pre-k—provide the highest-quality early education relative to other available options (Johnson, Ryan, & Brooks-Gunn, 2012). Given extensive evidence that exposure to higher-quality early education is generally, albeit modestly, associated with enhanced developmental outcomes (e.g., Finch, Johnson, & Phillips, 2015; McCartney, Dearing, Taylor, & Bub, 2007; Duncan & the National Institute of Child Health and Human Development Early Child Care Research Network, 2003), we might expect participation in Head Start or school-based pre-k to better prepare low-income children for kindergarten success than available alternatives.

Indeed, studies that have examined impacts of Head Start and public pre-k on the cognitive and social school readiness skills of low-income kindergarteners generally produce positive results. Head Start, which serves approximately 900,000 low-income children per year, is the federal government’s oldest public preschool program and is targeted to children in households at or below the federal poverty line (U.S. Department of Health & Human Services, 2018). Evidence on the school readiness impacts of Head Start demonstrates that program participation can boost the cognitive and social-emotional skills of low-income children at school entry (Gormley, Phillips, Adelstein, & Shaw, 2010; Ludwig & Phillips, 2008; U.S. Department of Health & Human Services, 2005; Zhai et al., 2011). Findings from the national Head Start Impact Study (HSIS), the only large-scale randomized experiment in Head Start history, are consistent albeit weaker: children who

enrolled in Head Start demonstrated modest program impacts at the end of one year in Head Start on early literacy and prewriting assessments (U.S. Department of Health & Human Services, 2005).

Unlike Head Start, public pre-k programs are primarily state-funded and can be either means-tested (available only to families who are income-eligible) or available to all age-eligible children regardless of household income. In 2017, approximately 1.5 million children were served in state-funded public pre-k programs. About half of the programs limited enrollment to low-income children, and nearly two thirds were administered solely in school-based settings (Friedman-Krauss et al., 2018). Results from recent pre-k evaluation studies across nine states suggest that participation in public pre-k is linked to increased letter-word identification, spelling, and early numeracy scores at the end of pre-k or at kindergarten entry (Gormley et al., 2008; Weiland & Yoshikawa, 2013; Wong, Cook, Barnett, & Jung, 2008). Pre-k participation has also been associated with enhanced attention skills and lower timidity at kindergarten entry (Gormley, Phillips, Newmark, Welti, & Adelstein, 2011), as well as greater executive functioning and emotion recognition in kindergarten (Weiland & Yoshikawa, 2013).

Only a few studies have directly compared Head Start with public pre-k. In single-site studies with relatively high-quality pre-k programs, children in pre-k tend to outperform their peers in Head Start. Specifically, in Georgia, children who attended the state’s pre-k program had modestly higher vocabulary, language, and early numeracy skills compared with a matched sample of children who attended Head Start (Henry, Gordon, & Rickman, 2006). In Tulsa, Oklahoma, public pre-k participation had stronger positive impacts on cognitive outcomes and attention skills than did Head Start participation (Gormley et al., 2010, 2011). Yet in a multistate study, children in Head Start demonstrated better social outcomes than children in pre-k. In the 18-site Fragile Families and Child Wellbeing Study, children who attended Head Start had higher social competence scores than children in public pre-k, though that effect size was smaller than effect sizes comparing children in Head Start to those in parental care (Zhai et al., 2011). Thus, it is important to compare public preschool programs with each other as well as with parental care, as associations between program participation and child outcomes vary depending on the comparison group.

Compensatory Benefits of Preschool for Children’s School Readiness Skills

Only recently have studies of public preschool impacts gone beyond estimating average program effects to exploring variation by child-level characteristics. This research generally finds that the positive impacts of public preschool exposure on school readiness are often as large, if not larger, for low-income children (Bloom & Weiland, 2015; Gormley et al., 2008; Weiland & Yoshikawa, 2013), children of immigrants or dual-language learners (DLLs; Bloom & Weiland, 2015; Gormley, 2008; Puma, Bell, Cook, & Heid, 2010), children with special needs (Bloom & Weiland, 2015), and children with low cognitive pretest scores (Bloom & Weiland, 2015).

To explain why more vulnerable children reap greater benefits from public preschool exposure, scholars have turned to a compen-

satory theory of education (Sameroff & Chandler, 1975). This theory posits that programs like Head Start and public pre-k offer children more intensive supplemental—or compensatory—instruction, materials, and resources beyond what they would receive at home. These compensatory impacts of preschool are then observed more strongly for children with “more room to grow” (Bloom & Weiland, 2015). The program features that underlie these differential impacts on cognitive outcomes are thought to cluster around high-quality instructional practices and the effective use of intensive, developmentally focused curricula that devote adequate time to early literacy and mathematics (Johnson, Markowitz, Hill, & Phillips, 2016; Weiland & Yoshikawa, 2013; Yoshikawa et al., 2013). The program features that might constitute compensatory supports for children whose “room to grow” is in the social-emotional or behavioral domains may center on teacher support and scaffolding to manage emotions and navigate peer interactions. These different types of compensatory supports might be more common in some preschool settings than others. However, whether such a pattern emerges, whereby Head Start or public pre-k offers differing compensatory supports that matter more or less for the developing skills of low-income children with varying temperamental profiles, is an open question.

The Intersection of Preschool Experiences and Child Temperament

Temperament is a multidimensional construct, reflecting biologically based (though environmentally influenced) individual differences in reactivity and self-regulation in the domains of emotion, activity, and attention (Rothbart & Bates, 1998). Our operationalization of temperament encompasses both reactive and regulatory components of affect, behavior, and attention as captured by observer ratings on the Behavior Rating Scales (BRS) from the Bayley Scales of Infant Development (Bayley, 1993; Harden, 2002; Vallotton & Ayoub, 2011). Child difficult temperament represents a risk factor that could shape preschool effects on children’s development. Children with “difficult” temperaments exhibit intense and often negative emotions (e.g., sadness, fear, anger) early in life: for example, they may be overactive and hard to soothe, or shy and withdrawn and have difficulty adapting to novel situations (Curby et al., 2011). Not surprisingly, difficult temperament is a risk factor for higher rates of behavior problems and psychopathology in later childhood and beyond (Earls & Jung, 1987; Goldberg et al., 1990; Moffitt et al., 2011). Further, low-income children are more likely to be classified as temperamentally difficult, compared with their higher-income peers (Curby et al., 2011; Walters, 2014). These associations among low-income status, difficult temperament, and behaviors in school suggest that investigating the moderating role of temperament as it affects children’s responses to preschool environments may be particularly important for low-income children (Johnson, 2017; Johnson & Brooks-Gunn, 2012).

Although no studies have explored whether the impacts of public preschool programs that serve low-income children vary with individual differences in temperament, there are both theoretical and empirical reasons to believe they might. As described above, theories of compensatory education imply that more vulnerable children stand to benefit the most from preschool exposure, relative to children without those risk factors (Sameroff & Chandler, 1975). This indicates that children with difficult tem-

peraments who experience preschool—versus stay home with a parent, for instance—may gain more of a boost to their kindergarten skills than children with average temperaments.

If there are different patterns of association between public preschool participation and outcomes for children of varying temperamental profiles, we suspect that such patterns may also vary among the different public preschool types—Head Start versus pre-k—and not just compared with parental care. As mentioned above, recent research has found the impact of public preschool to differ considerably by the comparison setting (e.g., Feller, Grindal, Miratrix, & Page, 2016; Lee, Zhai, Brooks-Gunn, Han, & Waldfogel, 2014; Zhai et al., 2011). For instance, in a sample of low-income children (not disaggregated by temperament status) when Head Start is compared directly with public pre-k, Head Start is more promoting of children’s social competence (Zhai et al., 2011).

Why might this be? Head Start has historically emphasized the “whole child” (Zigler & Bishop-Josef, 2006; Zigler & Styfco, 2010), placing social-emotional domains of development alongside cognitive and health outcomes in importance (National Head Start Association, 2018). The expectation is thus that Head Start classrooms provide supports for all dimensions of development, whereas public pre-k classrooms may be more focused on promoting academic outcomes (Gormley et al., 2010; Jenkins, Farkas, Duncan, Burchinal, & Vandell, 2016). For children with difficult temperaments, an equal focus on social and behavioral outcomes and on academic skills may be particularly important (Phillips et al., 2011).

Additionally, Head Start teachers may be better equipped to provide the social scaffolding and appropriate responses to challenging behavior exhibited by preschoolers with difficult temperaments. Head Start teachers are more likely than teachers in public pre-k classrooms to have training and experience specifically in early childhood education (Desimone, Payne, Fedoravicius, Henrich, & Finn-Stevenson, 2004), which predicts more developmentally appropriate beliefs (Heisner & Lederberg, 2011). More developmentally appropriate beliefs are in turn linked with better social skills among children (Jones & Gullo, 1999; Stipek, Feiler, Daniels, & Milburn, 1995), which is especially relevant for children with difficult temperaments in early educational settings (Curby et al., 2011; Rimm-Kaufman et al., 2002; Rudasill, Gallagher, & White, 2010).

In contrast, pre-k teachers in public schools work in environments that educate mostly kindergarten through fifth-grade students, with colleagues and under the leadership of principals who must adhere to district-wide standards for accountability and testing. As a result, pre-k teachers in public schools may experience a “push down” of academic content and focus more heavily on academic rather than social-emotional and behavioral skill building (Desimone et al., 2004). Preschool teachers in public schools report feeling increased pressure to respond to school district accountability standards designed for elementary-grade students, not for preschoolers with different developmental needs (Desimone et al., 2004). Public school-based pre-k teachers’ in-school professional developmental opportunities are also likely to have less relevance for early childhood teachers than teachers in the elementary grades (Desimone et al., 2004). Together, these circumstances may increase Head Start centers’ capacity—relative to public pre-k—to provide the kinds of social-emotional compensa-

tory supports most needed by temperamentally difficult young children. Indeed, Head Start programs have been observed to provide relatively high emotional support (Moiduddin, Aikens, Tarullo, West, & Xue, 2012) which may explain why, in a predominantly low-income sample, Head Start classrooms were more promotive of early social competence than were classrooms in public pre-k programs (Zhai et al., 2011). This pattern of association could be even more potent for children with difficult temperaments who may be especially reliant on social-interactional scaffolding from their teachers. For cognitive outcomes, in contrast, being embedded in school-based pre-k classrooms led by teachers focused on delivering academic content may be especially beneficial for children whose temperaments pose special challenges to their early academic learning (e.g., difficulty following directions, avoiding distractions, working in peer groups).

Method

Data Source

Data for this study were drawn from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B), a nationally representative sample of children born in 2001. Given that the ECLS-B data were previously collected and deidentified, this study was exempt from review by the Georgetown University Institutional Review Board. Approximately 14,000 birth certificates were sampled from 96 counties or clusters of counties. In 2001, 10,700 children participated in the first wave of data collection, when they were 9 months old. Four subsequent waves of data collection followed: Wave 2, in 2003, when children were approximately 2 years old; Wave 3, in 2005–2006, when children were preschool-age; and Waves 4 and 5, in 2006–2007, when children were in kindergarten (because not all children entered kindergarten in the fall of 2006, Wave 4 collected data on children who entered kindergarten for the first time in September of 2006 and Wave 5 collected data on children who entered kindergarten for the first time in September of 2007). The current study uses data from all waves.

At each wave, the child's primary caregiver (>90% biological mother) was interviewed and the child's cognitive and social development was directly assessed. At the preschool wave, preschool providers completed phone interviews about their program and the children served. For children in center-based settings at the preschool wave, center directors completed questionnaires about program characteristics, including funding source, program type and auspice, and enrollment of subsidized children. The preschool provider interview and director questionnaire were conducted with the child's primary care provider, defined as the arrangement in which the child spent the greatest amount of time per week.

Analytic Sample

Our primary focus is on publicly funded preschool programs, and nearly all public programs are targeted to low-income children. Thus, our sample was restricted to low-income families with household incomes at or below 185% of the federal poverty line in the preschool year to avoid confounding correlates of low-income status with developmental outcomes. Limiting to a low-income sample permits a cleaner comparison of outcomes among children

who were eligible for public preschool programs. All analyses were weighted using NCES-constructed longitudinal weights (WK1C0 for kindergarten cognitive outcomes and WK45T0 for kindergarten social-emotional outcomes), which adjust for the complex sampling strategy and attrition so that results are representative of children born in the United States in 2001. Missing data on covariates were imputed using the *MI* procedure in Stata Version 13. Twenty data sets were imputed using all variables included in the analytic models. Estimates were combined across imputed data sets using Rubin's rule. The final analytic sample included approximately 3,000 cases for models predicting reading and math outcomes, and approximately 2,300 cases for models predicting social-emotional outcomes (*N*s for teacher-reported social emotional outcomes are lower because approximately 23% of the analytic sample was missing kindergarten teacher report). Regression models used only cases with an unimputed value on the dependent variable, and *ns* are noted in tables accordingly. Additionally, all regression models were run with the *subpop* command in Stata so that standard errors would account for cases excluded from our analytic sample because they were not low-income.

Measures

Preschool type. Our key independent variable is the type of preschool setting in which children spent the most hours per week, in their preschool (4-year old, waves 3–4) year. We constructed six mutually exclusive preschool type categories (Head Start, school-based public pre-k, subsidized or unsubsidized community-based centers, home-based care, or parental care) using both preschool provider and director reports, verified with parent report (see [online supplemental material](#) for more detail). Center directors and providers identified children who were in *Head Start*, and children were classified as being enrolled in *school-based public pre-k* if their pre-k program was located in a public school. Children were classified as being enrolled in a *community-based center* (CBC) if their primary arrangement was a center-based setting that was not a Head Start or a school-based public pre-k program. Children in CBCs were then further categorized into either subsidized (providers reported that the program accepted and/or served children whose care is primarily funded via the federal Child Care and Development Fund) or unsubsidized (the family either paid out-of-pocket or used care outside the market [i.e., the provider does not charge]) CBCs. Children were classified as recipients of *home-based care* if their primary arrangement was a home-based setting. Finally, children who did not attend any nonparental early education or care setting were coded as receiving *parental care*.

We focus on Head Start and school-based public pre-k, as they constitute the two publicly funded center-based preschool programs designed to promote school readiness for low-income children. In analyses discussed in further detail below, we compared Head Start and public pre-k with each other and with parental care. Comparisons to the other types were conducted and are available in [Supplemental Tables S1–S4](#).

Child temperament. Child temperament was assessed when children were 9 months old using a subset of items drawn from the Behavior Rating Scale (BRS), a component of the Bayley Short Form – Research Edition (BSID-II; Bayley, 1993). We draw our measure of temperament from infancy because (a) we sought to measure temperament as a biologically based phenomenon, before

substantial accrual of environmental influences, and (b) because temperament is largely stable from infancy through early childhood (Lemery, Goldsmith, Klinnert, & Mrazek, 1999; Pedlow, Sanson, Prior, & Oberklaid, 1993; Rothbart, Derryberry, & Hershey, 2000). Trained assessors rated children on seven items (1 = *never* to 5 = *always*) measuring how often the child displayed positive affect, negative affect, social engagement, and control of movement; how well the child adapted to new materials and paid attention to tasks; and how much interest the child showed in materials.

We use a binary indicator of difficult temperament because it represents a categorical trait characterized by a unique collection of behaviors (Bradley & Corwyn, 2008; Kagan, 1994, 2003; Kagan & Snidman, 2004). This approach is consistent with a long-standing literature on individual differences in temperament dating back to original categorical conceptualizations by Thomas and Chess (1977). Measurement studies attempting to understand latent constructs that load on difficult versus other temperament support a categorical approach to temperament classification (Loken, 2004; Woodward, Lenzenweger, Kagan, Snidman, & Arcus, 2000) as do neurobiological studies differentiating children with difficult or reactive temperaments from those with more average temperaments using a binary distinction (Chronis-Tuscano et al., 2009; Guyer et al., 2006; Pérez-Edgar et al., 2007; Schwartz et al., 2003). It is therefore not surprising that studies seeking to distinguish children with more extreme temperaments from those with average temperaments have also used a binary classification of “difficult” versus “average” or “easy” (see Bradley & Corwyn, 2008; Guyer et al., 2015; Rimm-Kaufman et al., 2002), including use of one standard deviation above the mean as a cutoff for difficult temperament (Bradley & Corwyn, 2008). It is these classifications of “extreme” or difficult temperament—above versus below a threshold—that have been linked strongly with later behavior problems. Practically, parents and preschool teachers tend to distinguish categorically “difficult” children from “nondifficult” children in ways that impact their interactions (e.g., Almas et al., 2011), which makes this approach most relevant and meaningful for our analysis.

To create our indicator of “difficult” temperament, we first constructed a composite of the average standardized values across the seven BRS items ($\alpha = .80$). We then classified children who were one standard deviation above the sample mean on the continuous temperament scale as having *difficult temperament* (21.84% of the sample); the remainder of the sample was classified as having *nondifficult* or *average temperament* (78.16% of the sample). Our binary indicator of infant difficult temperament was significantly associated with all of our social-emotional outcomes into children’s preschool and kindergarten years (results available upon request); thus, we are confident in its validity. Nevertheless, we experimented with an alternate conceptualization of child temperament: a continuous temperament (0–7 scale, where higher = more difficult) variable. The pattern of results we present using our binary indicator for difficult temperament was substantively similar to that achieved with the continuous temperament measure (see Supplemental Tables S5 and S6), but interpretability was compromised with the continuous version.

Kindergarten skills. All kindergarten outcomes were measured in the year the child first attended kindergarten (fall 2006 for 78% of the analysis sample; fall 2007 for the remainder). To ease

interpretation, all outcome variables were standardized and thus coefficients reflect effect sizes.

Cognitive skills. *Reading* and *math* ability were assessed using measures developed specifically for the ECLS-K and ECLS-B. The reading measure evaluated important prereading and reading concepts such as letter and letter-sound knowledge, print conventions, and expressive and receptive vocabulary skills. The math measure evaluated children’s number sense, properties, operations, measurement, geometry, and spatial abilities. IRT scale scores, calculated by the ECLS-B, are used in the current study and demonstrated high reliability ranging from .89 to .93 (Najarian, Snow, Lennon, & Kinsey, 2010).

Social-emotional skills. Using items drawn from the Preschool and Kindergarten Behavior Scales – Second Edition (PKBS-2; Merrell, 2003) and the Social Skills Rating Scale (SSRS; Gresham & Elliott, 1990), kindergarten teachers rated children’s behavior on a 5-point scale (1 = *behavior never observed* to 5 = *behavior observed very often*). Following prior studies using the ECLS-B (e.g., Coley, Votruba-Drzal, Collins, & Cook, 2016), we created three measures of social-emotional development which showed high reliability: *approaches to learning*, which averaged six items rating how attentive, focused, independent, and eager to learn the child was ($\alpha = .89$); *externalizing behaviors*, which averaged seven items rating how aggressive, impulsive, and disruptive the child was ($\alpha = .92$); and *prosocial behaviors*, which averaged six items rating how friendly, empathic, and interested the child was in other children ($\alpha = .87$).

Covariates. Covariates were selected based on their empirical or theoretical link to selection of preschool type, child temperament, and/or child kindergarten skills. Three categories of covariates were used in the current study: family background characteristics, prior measures of child cognitive and behavioral skills, and other child characteristics.

Family background characteristics. All family background variables were drawn from either the baseline (9-month) or preschool waves. Covariates drawn from the 9-month wave include maternal race (white, black, Hispanic, or Asian/other race with white omitted), maternal education (less than high school, high school diploma/GED, some college, or BA or higher with BA or higher omitted), number of children in the home age six and younger, number of children in the home age seven and older, maternal employment status (worked full-time, worked part-time, was looking for work, in an education or training program, or unemployed with unemployed omitted), a dummy variable for maternal relationship status (1 = *single*), and a dummy variable for whether the family experienced any food insecurity in the past year (1 = *yes*). We also included a dummy variable for maternal English proficiency. At the 9-month wave, mothers were asked how well they read, wrote, spoke, and understood English; responses were scored on a 4-point scale (1 = *not well at all* to 4 = *very well*). After summing responses across the four items and assigning native-English speaking mothers who skipped these questions a ‘4’ on each item, mothers who achieved a 12 or higher on the composite were deemed proficient in English.

We drew two additional covariates from the preschool wave, as they are theoretically predictive of preschool type selection (but unlikely to be predicted by preschool type selection); these include a dummy variable for whether the family lived in an urban area (1 = *urban*), and continuous family income-to-needs ratio.

Prior measures of child skills. We included as controls lagged measures of child kindergarten skills drawn from the preschool wave, so that associations between preschool type and kindergarten outcomes are isolated to experiences in the pre-kindergarten year; this method also adjusts for unobserved selection factors that impact the lagged outcome in the same way they would impact the kindergarten outcome (Duncan & the National Institute of Child Health and Human Development Early Child Care Research Network, 2003). Lagged reading and math outcomes were analogous to those from the kindergarten year; lagged social-emotional skills were also analogous but reported by preschool providers (rather than kindergarten teachers). For children in parental care at the preschool year, parent-rated social-emotional skills were used as lagged measures of social-emotional skills, given that parents were the children's care provider before kindergarten.

Other child characteristics. All analyses controlled for the child's age (in months) at assessment, and for whether the child entered kindergarten in the fall of 2006 (as opposed to the fall of 2007). Because the ECLS-B collected kindergarten data in two waves, children who did not enter kindergarten in the fall of 2006 may have received an additional year of preschool. Thus, not only were these children older when they were in kindergarten, but they may also have been exposed to more preschool in the years before school entry. We also controlled for child sex (1 = *female*), whether the child had a diagnosed disability (1 = *yes*), and the child's state of residence to account for cross-state variation in preschool policies, funding, quality, and availability.

Analytic Strategy

To assess whether associations between public preschool type and children's cognitive and social-emotional skills in kindergarten varied according to child temperament status, we employed OLS regression models. Two sets of regression models were estimated, separately for each of the five kindergarten readiness outcomes. The first model included indicators for the six mutually exclusive preschool type variables (with one category omitted), as well as the binary child temperament variable. The second model added a set of interaction terms that multiplied the two. To permit pairwise comparisons among public preschool types of interest relative to parental care and to each other, we repeated these analyses with a different omitted group: first, we omitted parental care. Next, Head Start was omitted. Results of all pairwise comparisons (i.e., with preschool types other than parental care and Head Start) are available in [Supplemental Tables S1–S4](#).

Results

Bivariate Associations

Table 1 presents descriptive statistics on all study variables for the full low-income sample, and separately for Head Start, school-based public pre-k, and parental care. Differences between groups emerged on several demographic characteristics. Children in parental care were more likely to have white mothers, less likely to have black mothers, and less likely to have single mothers than were children in Head Start or pre-k. In general, families who used parental care were more advantaged than those who used a publicly funded preschool program: for instance, children in school-

based public pre-k were more likely to have mothers who did not complete high school, relative to children in parental care. Not surprisingly, mothers with children in Head Start or pre-k were more likely to work full time or to be looking for work than were mothers who used only parental care. However, mothers who used only parental care were less likely to be English-proficient than were mothers whose children were enrolled in Head Start. Children in Head Start were, on average, slightly younger than those in pre-k but more likely to enter kindergarten in the fall of 2006 (rather than the fall of 2007). Children in Head Start also spent more time in that preschool setting than children whose primary preschool arrangement was school-based public pre-k.

With regard to outcomes in the preschool year, children in parental care had lower cognitive skills than children in pre-k and the highest levels of externalizing behavior problems, as well as greater prosocial behaviors (compared to children in pre-k only). By the kindergarten year, children in parental care had lower reading scores than their peers who had attended pre-k, but also fewer externalizing behavior problems, more pro-social behavior, and better approaches to learning than children who had experienced pre-k the prior year.

Regression Results

Table 2 presents associations between the different preschool settings and kindergarten readiness outcomes, relative to parental care. Model 1 presents the main effect results of preschool settings on kindergarten skills. There were no significant associations between any preschool type and children's cognitive outcomes. Only Head Start, public pre-k, and community-based centers attended by children with child care subsidies were associated with social-emotional outcomes; most associations between preschool type and social-emotional outcomes were nonsignificant. Specifically, children in Head Start and children in pre-k displayed more externalizing behaviors ($\beta = 0.273, p = .005$; $\beta = 0.350, p < .001$) compared with children in parental care. Children in pre-k also demonstrated fewer prosocial behaviors ($\beta = -0.217, p = .013$) and approaches to learning ($\beta = -0.188, p = .034$) compared with children in parental care.

Model 2 adds an interaction term (difficult temperament by preschool setting) to test whether associations between preschool setting and outcomes differ by child temperament. Only two interactions were significant at conventional alpha levels. First, pre-k was positively associated with reading skills for children with difficult temperaments only ($\beta = 0.417, p = .012$). This interaction is represented graphically in [Figure 1a](#), whereby the difference in reading skills between children in pre-k and parental care is greater for children with difficult temperaments ($M = 40.449$ for pre-k vs. $M = 35.978$ for parental care). The same pattern does not exist for nondifficult temperament children, whose reading scores are relatively similar across preschool types (Head Start = 39.990, pre-k = 38.016, parental care = 39.596). Second, a significant positive association between Head Start and approaches to learning was observed for children with difficult temperaments only ($\beta = 0.457, p = .011$). As highlighted in [Figure 1b](#), children with difficult temperaments had significantly higher approaches to learning in Head Start ($M = 3.906$), compared with parental care ($M = 3.621$). Among children with nondifficult temperaments, there was not a significant difference in approaches to learning

Table 1
Sample Descriptive Statistics

Characteristic	Full sample	Parental care	Head Start	Public Pre-K
Maternal race				
Mother is white ^{ab}	39.29%	45.70%	31.98%	35.56%
Mother is black ^{ab}	21.16%	12.16%	27.97%	25.51%
Mother is Hispanic/Latino	33.66%	36.97%	33.73%	35.13%
Mother is Asian/other race	5.90%	5.17%	6.31%	3.80%
Maternal education				
Mother has < HS education ^b	34.90%	44.64%	37.77%	33.77%
Mother has HS diploma or GED	39.46%	35.16%	41.30%	39.82%
Mother has some college	21.94%	16.98%	19.12%	22.30%
Mother has BA or higher	3.69%	3.21%	1.81%	4.11%
Maternal employment				
Mother works full time ^{ab}	23.15%	15.25%	23.25%	23.55%
Mother works part time	18.20%	15.24%	18.21%	16.61%
Mother is in school/job training	6.51%	5.31%	6.96%	6.98%
Mother is looking for work ^{ab}	13.71%	10.44%	16.21%	15.75%
Mother is not in labor force ^{ab}	38.43%	53.75%	35.36%	37.11%
Mother is single ^{ab}	31.94%	21.25%	35.01%	31.03%
Mother's age at focal child's birth	26.06 (6.24)	26.40 (5.94)	25.86 (6.39)	26.01 (6.29)
Mother is proficient in English ^a	80.16%	73.01%	81.02%	79.06%
Number of children in HH ≤ age 6	0.76 (0.86)	0.81 (0.81)	0.76 (0.95)	0.81 (0.86)
Number of children in HH > age 7	0.65 (1.01)	0.72 (1.00)	0.66 (1.08)	0.64 (0.99)
Family lives in urban area at preschool	81.70%	81.28%	78.83%	78.79%
Food insecurity since child's birth	37.70%	42.99%	42.03%	36.31%
Child age at preschool wave (months) ^c	68.09 (4.45)	68.37 (4.38)	67.75 (4.30)	68.72 (4.54)
Child entered kindergarten in 2006 ^c	73.43%	69.79%	76.02%	67.82%
Child is female	47.72%	51.49%	46.35%	49.21%
Child has a diagnosed disability	6.43%	5.20%	6.65%	7.10%
Temperament				
Difficult	17.81%	17.16%	18.68%	18.58%
Average	82.19%	82.84%	81.32%	81.42%
Preschool (lagged) outcome variables				
Reading ^{ab}	22.94 (8.86)	21.13 (7.56)	22.69 (8.43)	23.80 (9.72)
Math ^{ab}	27.95 (8.87)	25.89 (8.51)	27.68 (8.59)	28.47 (9.15)
Approaches to learning	3.88 (0.65)	3.93 (0.60)	3.88 (0.65)	3.90 (0.73)
Externalizing ^{ab}	2.22 (0.78)	2.36 (0.64)	2.08 (0.86)	2.06 (0.84)
Prosocial behaviors ^b	3.78 (0.63)	3.78 (0.60)	3.69 (0.63)	3.65 (0.71)
Kindergarten outcome variables				
Reading ^b	40.36 (13.42)	37.90 (13.23)	39.59 (13.29)	40.26 (13.65)
Math	41.14 (9.47)	40.85 (10.27)	40.99 (8.71)	41.17 (9.39)
Approaches to learning ^b	3.75 (0.79)	3.83 (0.73)	3.72 (0.84)	3.65 (0.81)
Externalizing ^b	2.00 (0.83)	1.89 (0.76)	2.05 (0.88)	2.07 (0.88)
Prosocial behaviors ^b	3.79 (0.71)	3.84 (0.65)	3.73 (0.76)	3.69 (0.74)
Preschool type of care				
Parental care	23.18%			
Head Start	22.70%			
Public school-based pre-k	16.80%			
Subsidized CBC	15.35%			
Unsubsidized CBC	5.61%			
Home-based care	16.36%			
Hours/week in preschool care setting				
Parental care	N/A			
Head Start	29.48			
Public school-based pre-k	26.88			
Subsidized CBC	27.45			
Unsubsidized CBC	22.84			
Home-based care	39.13			
<i>N</i>	3,150	700	700	500

Note. Data are drawn from the ECLS-B 9-month to Kindergarten restricted-use data file. All analyses weighted by WK1C0 and all *N*s rounded to the nearest 50 for security compliance reasons. HS = high school; GED = general education diploma; BA = bachelor's degree; HH = household; pre-k = prekindergarten; CBC = community-based center.

^a Significant difference between parental care and Head Start at 95% confidence level. ^b Significant difference between parental care and pre-k at 95% confidence level. ^c Significant difference between Head Start and pre-k at 95% confidence level.

Table 2
Associations Between Publicly-Funded Preschool Type and Kindergarten Outcomes, Relative to Parental Care

Preschool type	Reading			Mathematics			App to learn			Externalizing			Prosocial behaviors		
	Model 1	Model 2		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2		Model 1	Model 2	
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	
Head Start	.074 (.061)	.036 (.063)	.015 (.054)	.039 (.054)	.015 (.061)	-.081 (.081)	-.081 (.081)	-.081 (.081)	.221 (.080)**	.276 (.094)**	-.044 (.083)	-.050 (.104)	-.044 (.083)	-.050 (.104)	
Pre-k	-.011 (.065)	-.081 (.067)	-.103 (.063)	-.071 (.061)	-.103 (.063)	-.208 (.089)*	-.208 (.089)*	-.208 (.089)*	.350 (.080)***	.309 (.078)***	-.217 (.087)*	-.137 (.097)	-.217 (.087)*	-.137 (.097)	
Sub CBC	.001 (.067)	-.050 (.067)	-.049 (.060)	-.049 (.060)	-.049 (.060)	-.093 (.098)	-.093 (.098)	-.093 (.098)	.273 (.097)**	.241 (.100)*	-.115 (.102)	-.059 (.108)	-.115 (.102)	-.059 (.108)	
Unsub CBC	-.060 (.117)	-.081 (.126)	-.062 (.083)	-.062 (.083)	-.062 (.083)	-.041 (.150)	-.041 (.150)	-.041 (.150)	.117 (.109)	.107 (.137)	-.158 (.172)	-.128 (.190)	-.158 (.172)	-.128 (.190)	
Home-based care	-.046 (.057)	-.067 (.057)	-.000 (.052)	-.000 (.052)	-.000 (.052)	-.018 (.085)	-.018 (.085)	-.018 (.085)	-.067 (.093)	-.034 (.102)	-.011 (.082)	-.049 (.094)	-.011 (.082)	-.049 (.094)	
Diff temp	-.047 (.064)	-.249 (.095)*	-.090 (.046)*	-.090 (.046)*	-.090 (.046)*	-.062 (.065)	-.062 (.065)	-.062 (.065)	.114 (.073)	.142 (.131)	.025 (.077)	.238 (.152)	.025 (.077)	.238 (.152)	
Head Start \times Diff temp		.240 (.141) [†]	.141 (.109)	.141 (.109)	.141 (.109)	.457 (.190)*	.457 (.190)*	.457 (.190)*	-.293 (.183)	-.293 (.183)	-.020 (.197)	-.020 (.197)	-.020 (.197)	-.020 (.197)	
Pre-k \times Diff temp		.417 (.165)*	.187 (.123)	.187 (.123)	.187 (.123)	.119 (.223)	.119 (.223)	.119 (.223)	.202 (.206)	.202 (.206)	-.455 (.263) [†]	-.455 (.263) [†]	-.455 (.263) [†]	-.455 (.263) [†]	
Sub CBC \times Diff temp		.314 (.214)	.291 (.159) [†]	.291 (.159) [†]	.291 (.159) [†]	.124 (.244)	.124 (.244)	.124 (.244)	.171 (.267)	.171 (.267)	-.350 (.276)	-.350 (.276)	-.350 (.276)	-.350 (.276)	
Unsub CBC \times Diff temp		.151 (.240)	-.246 (.209)	-.246 (.209)	-.246 (.209)	.054 (.277)	.054 (.277)	.054 (.277)	.017 (.243)	.017 (.243)	-.199 (.370)	-.199 (.370)	-.199 (.370)	-.199 (.370)	
Home-based care \times Diff temp		.132 (.181)	.105 (.165)	.105 (.165)	.105 (.165)	.126 (.209)	.126 (.209)	.126 (.209)	-.181 (.202)	-.181 (.202)	-.374 (.210) [†]	-.374 (.210) [†]	-.374 (.210) [†]	-.374 (.210) [†]	
N	3,000	3,000	3,000	3,000	3,000	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	

Note. Data are drawn from the ECLS-B 9-month to Kindergarten restricted-use data file. All analyses weighted by WK1C0 (for cognitive outcomes) and WK45T0 (for social-emotional outcomes). All *N*s rounded to nearest 50. Models include: maternal education, race, employment status, mother's age at child's birth, a dummy indicating whether the mother is a single parent, mother's English fluency, and age at the first wave of data collection; number of children in the household under six and over seven, a dummy indicating whether the household is urban in the preschool year, average income from in preschool year, child gender, child disability status, household food insecurity at the first wave, and lagged dependent variables at the preschool year. The omitted preschool type group is parental care. Analyses restricted to those families at or below 185% the federal poverty line in the preschool year. Sub CBC = subsidized community-based center; unsub CBC = unsubsidized community-based center.

[†] $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

when comparing Head Start ($M = 3.697$) to parental care ($M = 3.757$). There was no evidence of moderation by temperament for associations between public preschool and math, externalizing behaviors, or prosocial behaviors when the comparison group was children in parental care.

Table 3 presents the same associations, but with children in Head Start as the omitted group. As with the comparison with parental care, there are few significant main effect associations between preschool types and outcomes, relative to Head Start (Model 1). The only exception in Model 1 is a significant negative association between pre-k and approaches to learning ($\beta = -0.191$, $p = .031$), compared with Head Start.

Model 2, which examined whether associations between preschool type and outcomes were moderated by difficult temperament, showed that pre-k was significantly associated with increased externalizing behavior problems ($\beta = 0.495$, $p = .024$) for children with difficult temperaments only, relative to Head Start. As shown in Figure 1c, children with difficult temperaments showed elevated externalizing behavior problems in pre-k ($M = 2.419$) compared with Head Start ($M = 1.969$). For children with nondifficult temperaments, externalizing behavior problems were nearly identical for children in pre-k ($M = 2.134$) and Head Start ($M = 2.117$).

Supplemental Analyses

We conducted a series of supplemental descriptive analyses to explore the possibility that variation in teacher and classroom characteristics across program types might explain variation in observed associations between Head Start and public pre-k. We reasoned that, for instance, perhaps pre-k teachers had higher levels of education, which might explain why pre-k had a stronger positive association with reading skills than did Head Start, relative to parental care. In contrast, perhaps pre-k teachers had spent fewer years working in early education classrooms and thus had less experience managing child behavior, which might explain why pre-k was associated with poorer social-emotional outcomes relative to Head Start. Indeed, some of these hypotheses were supported by the descriptive data: school-based public pre-k teachers were in fact more highly educated than Head Start teachers but also less likely to have a specific early education degree (Head Start teachers were more likely to have a CDA credential); Head Start teachers had more experience working in early education settings and longer tenure at their current programs, were more likely to follow a written curriculum, and were more likely to have received more ECE-specific training in the last year. Head Start teachers were also more likely to spend more time in small-group instruction (which is appropriate for young learners). Finally, Head Start teachers reported higher scores on a set of 6 items that summed teacher responses to how positive their relationship was with the focal child. On all other variables, Head Start and public school-based pre-k teachers were quite similar. These supplemental results are presented in Supplemental Table S7.

Discussion

The potential of publicly funded preschool programs to enhance kindergarten cognitive and social-emotional skills for children from low-income families has captured national attention. This is

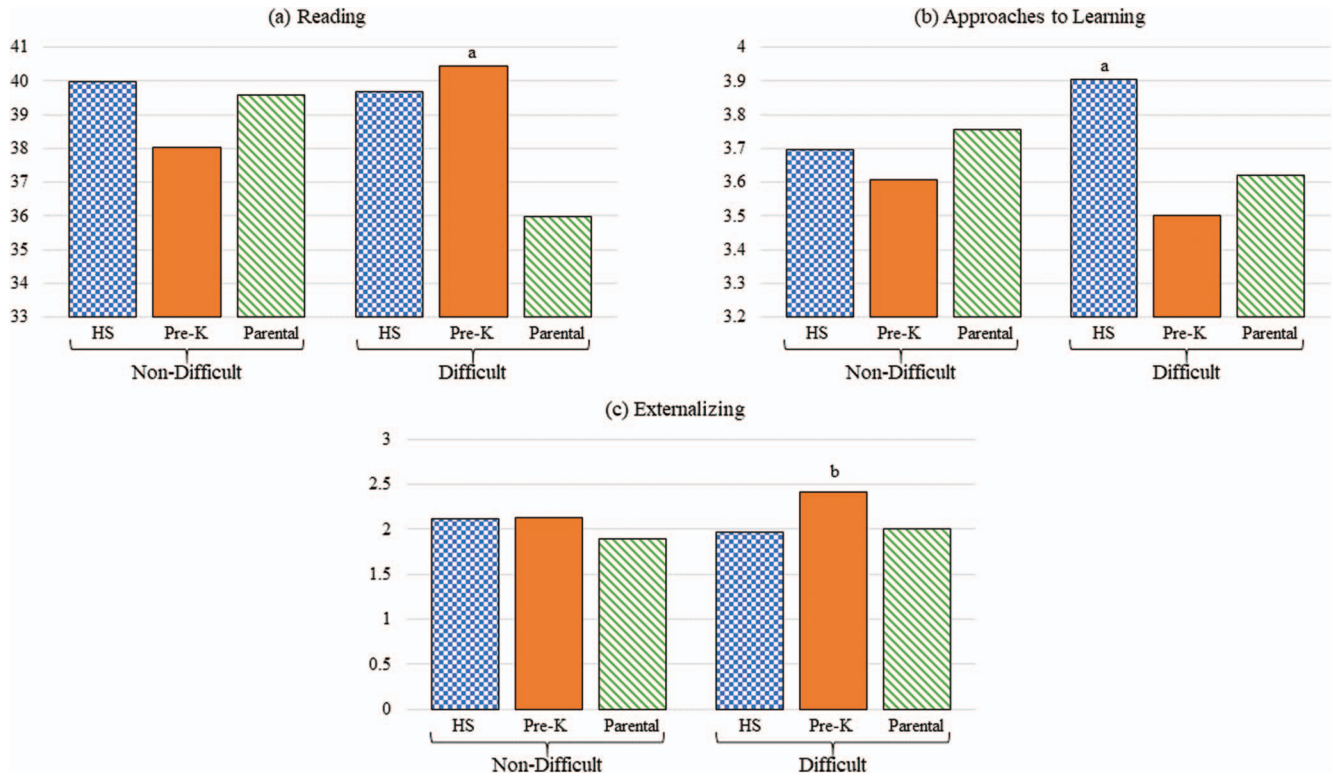


Figure 1. Covariate-adjusted means of school readiness outcomes, by temperament status, for significant interactions from regression models. ^a Significant difference between type and parental care mean at $p < .05$ level. ^b Significant difference between type and Head Start mean at $p < .05$ level. Across the full nationally representative sample, reading scores in kindergarten ranged from 12.39 to 82.48, with a mean of 38.60 and a standard deviation of 14.84 in 2006 and a mean of 48.95 and standard deviation of 13.23 in 2007. Math scores in kindergarten ranged from 10.85 to 69.69, with a mean of 40.40 and standard deviation of 10.56 in 2006 and a mean of 47.72 and standard deviation of 9.52 in 2007. Children's approaches to learning, externalizing behaviors, and prosocial behaviors were rated by teachers on a Likert scale: 1 = *behavior never observed*, 2 = *behavior rarely observed*, 3 = *behavior sometimes observed*, 4 = *behavior often observed*, and 5 = *behavior observed very often*. Approaches to learning averaged six items rating how attentive, focused, independent, and eager to learn the child was. Externalizing behaviors averaged seven items rating how aggressive, impulsive, and disruptive the child was. Prosocial behaviors averaged six items rating how friendly, empathic, and interested the child was in other children ($\alpha = .87$). See the online article for the color version of this figure.

largely attributable to observed positive associations between exposure to different public preschool settings and children's kindergarten outcomes (Phillips et al., 2017; Weiland & Yoshikawa, 2013). Recent evidence further suggests that the positive effects of program participation detected in prior studies may be stronger for, or even restricted to, children in vulnerable subgroups and that they may depend on whether participating children are compared with children in parental care versus other preschool types. This paper is the first to explore whether child difficult temperament moderates associations between the types of publicly funded preschool low-income children attend and children's kindergarten outcomes.

The Main Effects of Publicly-Funded Preschool Programs on Kindergarten Skills

Perhaps unexpectedly, we found no associations between any public preschool program and children's reading or math skills in kindergarten for children in public preschool versus parental care

or alternatives. On the one hand, this is surprising given that center-based preschool is generally more promoting of early academic skills than is staying home with a parent, especially in low-income samples (e.g., Gormley et al., 2008; Weiland & Yoshikawa, 2013; Zhai et al., 2011). On the other hand, even arguably higher-quality programs serving low-income populations, like Head Start and public pre-k, have been found to produce immediate gains that fade out in kindergarten (Puma et al., 2010), which is when our study outcomes were assessed. Additionally, public pre-k programs that have generated positive associations with kindergarten cognitive skills may not be representative of the range of programs captured in our national sample with regard to quality or other program effectiveness features (e.g., Phillips et al., 2017; Yoshikawa et al., 2013). Thus, it may not be reasonable to expect similar results.

With regard to social-emotional outcomes, results from our main effects models are more consistent with prior evidence find-

Table 3
Associations Between Publicly-Funded Preschool Type and Kindergarten Outcomes, Relative to Head Start

Preschool type	Reading				Mathematics				App to learn				Externalizing				Prosocial behaviors			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Pre-k	-.086	(.061)	-.118	(.059)*	-.110	(.057) [†]	-.118	(.062) [†]	-.127	(.102)	.129	(.075) [†]	.033	(.079)	-.172	(.099) [†]	-.086	(.120)		
Sub CBC	-.073	(.077)	-.087	(.072)	-.087	(.065)	-.117	(.068) [†]	-.013	(.105)	.052	(.088)	-.036	(.100)	-.071	(.100)	-.008	(.115)		
Unsub CBC	-.134	(.117)	-.118	(.129)	-.101	(.087)	-.022	(.096)	-.043	(.136)	-.103	(.107)	-.169	(.141)	-.114	(.152)	-.077	(.181)		
Home-based care	-.121	(.062) [†]	-.103	(.069)	-.039	(.053)	-.032	(.061)	.070	(.109)	-.288	(.091)**	-.311	(.095)**	.033	(.086)	.100	(.107)		
Parental care	-.074	(.061)	-.036	(.063)	-.039	(.054)	-.015	(.061)	-.003	(.081)	-.221	(.080)**	-.276	(.094)**	.044	(.083)	.050	(.104)		
Diff temp	-.047	(.064)	-.009	(.112)	-.090	(.046)*	-.056	(.071)	.233	(.138) [†]	.114	(.073)	-.151	(.148)	.025	(.077)	.218	(.154)		
Pre-k × Diff temp			.177	(.152)			.047	(.113)					.495	(.219)*			-.436	(.264) [†]		
Sub CBC × Diff temp			.074	(.196)			.150	(.147)					.333	(.226)			-.330	(.266)		
Unsub CBC × Diff temp			-.089	(.258)			-.386	(.215) [†]					-.404	(.286)			-.180	(.352)		
Home-based care × Diff temp			-.108	(.182)			-.036	(.145)					.112	(.194)			-.354	(.206) [†]		
Parental care × Diff temp			-.240	(.141) [†]			-.141	(.109)*					-.457	(.190)*			.020	(.197)		
N			3,000		3,000		3,000		2,300	2,300		2,300		2,300		2,300		2,300		2,300

Note. Data are drawn from the ECLS-B 9-month to Kindergarten restricted-use data file. All analyses weighted by WKIC0 (for cognitive outcomes) and WK45T0 (for social-emotional outcomes). All *N*s rounded to nearest 50. Models include: maternal education, race, employment status, mother's age at child's birth, a dummy indicating whether the mother is a single parent, mother's English fluency, and age at the first wave of data collection; number of children in the household under six and over seven, a dummy indicating whether the household is urban in the preschool year, average income from in preschool year, child gender, child disability status, household food insecurity at the first wave, and lagged dependent variables at the preschool year. The omitted preschool type group is Head Start. Analyses restricted to those families at or below 185% the federal poverty line in the preschool year. Sub CBC = subsidized community-based center; unsub CBC = unsubsidized community-based center.

[†] $p < .10$. * $p < .05$. ** $p < .01$.

ing increased behavior problems among children in center-based preschool settings versus parental care (e.g., Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007). In our study, children in public pre-k demonstrated poorer approaches to learning and fewer prosocial behaviors than children in parental care, and children in Head Start, public pre-k, and community-based centers serving children with child care subsidies all exhibited increased externalizing behavior problems, relative to children who stayed home with a parent.

Moving beyond comparisons of public preschool types to parental care, when we compared public preschool types to each other we found that public pre-k was associated with less effective approaches to learning relative to Head Start. As discussed earlier, considering their exclusive focus on preschool-aged children, Head Start programs may be better equipped to support children's emerging social-emotional and self-regulatory skills than public pre-k programs in public schools (e.g., Desimone et al., 2004; Schindler et al., 2015; Walter & Lippard, 2017; Zigler & Styfco, 2010). Our measure of approaches to learning captures children's attentiveness, focus, and independence, which may be more emphasized and more strongly promoted in Head Start classrooms than in school-based pre-k programs. Indeed, a national study of Head Start found the program to have relatively high levels of emotional support (Moiduddin et al., 2012), which may enhance children's approaches to learning as operationalized in the current study.

The Interplay Between Child Difficult Temperament and Public Preschool Type

Our study generated very weak evidence of differential associations between public preschool attendance and children's kindergarten readiness skills by temperament status. To be precise, only three of 15 interactions we tested met conventional standards for statistical significance; the majority of interactions testing for differential associations between public preschool type and kindergarten skills by difficult temperament status were not significant, although they were in the expected directions. Clearly, more research—with even larger samples—is needed to understand whether the preponderance of null associations is attributable to small cell sizes or true null effects.

Each of the three interactions that were statistically significant, were consistent with our hypotheses. Specifically we found that public pre-k, which we argue is focused on boosting academic outcomes, is better than parental care at promoting reading (but not math) skills for children with difficult temperaments only. This may be because school-based pre-k teachers receive relatively high levels of preparation for academic instruction (Phillips, Gormley, & Lowenstein, 2009), which tends to focus more on reading than math (e.g., Rudd, Lambert, Satterwhite, & Zaier, 2008). At the same time, preschool teachers report discomfort and uncertainty around teaching math (Ginsburg, Lee, & Boyd, 2008), which could explain why they spend less classroom time on math- than literacy-promoting activities (Farran, Lipsey, & Wilson, 2011; Phillips et al., 2009). This could lend pre-k teachers a distinct advantage over many low-income parents for introducing temperamentally difficult young children to foundations of early reading, but would

explain why there was no pre-k ‘math advantage’ over parental care.

With regard to social-emotional outcomes, we hypothesized that Head Start teachers would be uniquely suited to promote social-emotional development for children with difficult temperaments. We had initially reasoned that Head Start’s “whole-child” focus and long history of attending to the social-emotional development of low-income preschoolers would be particularly beneficial for temperamentally difficult children compared with the more academic focus of school-based pre-k programs (National Head Start Association, 2018; U.S. Department of Health & Human Services, 1996; Zigler & Styfco, 2010). Indeed, the Head Start teachers in our sample had more experience working with young low-income children than pre-k teachers (Supplemental Table S7), consistent with other research (e.g., Desimone et al., 2004). They also had more specific training in early education than did the pre-k teachers in our sample; more early education training correlates with more developmentally appropriate beliefs (Heisner & Lederberg, 2011; Walter & Lippard, 2017) which are in turn linked with enhanced child social development (Jones & Gullo, 1999; Stipek et al., 1995). This may be especially important for children with difficult temperaments, who struggle with attention and focus (measured by our approaches to learning scale) and with aggressive and disruptive behavior (measured by our externalizing behavior scale), which could explain why in our study, children with difficult temperaments in Head Start demonstrated better approaches to learning compared with similar children in parental care, and fewer externalizing behavior problems compared with similar children in public pre-k.

Yet, it is puzzling that we did not detect analogous patterns across the other social-emotional outcomes or comparisons. One explanation could be that Head Start supports approaches to learning only relative to parental care because classroom activities and collaboration with peers affords greater opportunities to acquire and practice self-regulatory skills compared to unstructured time at home. Because both Head Start and school-based pre-k offer classroom-based opportunities to practice approaches to learning skills, one may not offer a distinct advantage over the other for temperamentally difficult children, which could be why this comparison was not statistically significant. However, the capacity of Head Start teachers to provide the kinds of scaffolding and external regulation needed to promote constructive classroom-based approaches to learning among children with difficult temperaments may be greater than is the typical capacity of low-income parents.

Why would Head Start be associated with reduced externalizing behavior problems relative to pre-k, for children with difficult temperaments? Prior research comparing “whole child” focused preschool programs with an explicit emphasis on supporting children’s social-emotional development—including Head Start—to preschool programs without such a focus revealed that the former programs have more potential to reduce externalizing behavior problems than do the latter (Schindler et al., 2015). Alongside Head Start teachers’ more extensive experience in early education—specifically with low-income preschoolers where more difficult temperament and more externalizing behavior is more common (Curby et al., 2011; Walters, 2014)—the climate in which Head Start teachers work could allow them more flexibility and freedom than pre-k teachers to adjust their disciplinary methods to

support temperamentally reactive children in controlling their externalizing behaviors. This is because Head Start serves an exclusively preschool-age population whereas pre-k teachers are part of a larger elementary school context that includes accountability, testing, and disciplinary practices appropriate for older children (Desimone et al., 2004). However, in our study, relative to parental care, neither Head Start nor pre-k was differentially associated with externalizing behaviors for children with difficult temperaments. In light of evidence that center-based preschool is associated with increased externalizing behavior problems compared to parental care (e.g., Belsky et al., 2007), this may not be especially surprising.

There were no differential associations between public preschool setting and children’s prosocial behaviors according to temperament status. This may be because difficult temperament is not a significant predictor of children’s prosocial behaviors, whereas difficult temperament is more commonly linked to challenges in academic performance (e.g., Martin, Drew, Gaddis, & Moseley, 1988) and behavioral regulation (Earls & Jung, 1987; Goldberg et al., 1990; Moffitt et al., 2011). Thus, different preschool settings likely influence the development of prosocial skills for children with difficult temperaments similar to those with average temperaments.

Limitations and Future Directions

This study is not without its limitations, nearly all of which offer fruitful directions for next-stage research. First, the estimates presented are associations and not causal. Despite the inclusion of a comprehensive set of covariates as well as lagged outcomes, we cannot be certain that other unobserved factors do not account for observed associations between preschool settings and kindergarten skills. Second, despite the national sample, our analyses had relatively low power to detect significant results given small cell sizes by preschool type and temperament status. Third, the ECLS-B data were collected approximately a decade ago. Since the early 2000s, public pre-k programs have expanded, mixed delivery models with blended and braided public funding streams for preschool have become the norm, and the quality of public preschool programs may have improved with increased public investment and attention.

Further, although our measure of child temperament is objectively (rather than parent) reported, it is still imperfect. More extended observations of temperament and reliance on assessments by multiple informants, along with physiological assessments of stress reactivity over time, need to be utilized in studies of publicly funded preschool and outcomes. Additionally, the questions that preschool providers were asked in the ECLS-B limited our ability to identify children who experienced multiple preschool settings at the same time and precluded us from parsing funding sources within programs. Given that these programs mix different funding streams, our findings are restricted to program-level conclusions and may not fully capture the realities of Head Start and public pre-k. Indeed, our strict adherence to preschool provider report of program type instead of parental report could explain why we find no associations between public preschool attendance and children’s cognitive outcomes.

Finally, despite our descriptive exploration of a range of classroom and teacher variables (Supplemental Table S7), we are

limited in our ability to get “inside the classroom door” and understand the processes that may explain variation in outcomes associated with preschool attendance by children with differing temperaments, as well as how much program exposure each individual child actually received. Future data collection efforts would benefit from capturing the extent of children’s program exposure by, for example, accessing program administrative data on attendance and gathering a more complete set of proximal contextual variables including data on content and quality of preschool curricula and fidelity and quality of curricular implementation. Enhanced information on both “what” and “how much” children—particularly temperamentally reactive children—are experiencing in their preschool settings would offer a more nuanced understanding of how temperament interacts with preschool experiences to associate with kindergarten cognitive and social skills.

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