THE INFLUENCE OF ELEMENTARY SCHOOL QUALITY ON FIFTH- AND EIGHTH-GRADE EFFECTS OF PUBLIC-SCHOOL PRE-K, CENTER-BASED, AND FAMILY CHILDCARE PROGRAMS

by

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A Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at George Mason University

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DEDICATION

This is dedicated to my loving parents, Robin and Jeff Mumma. Thank you all for everything you have done and continue to do for me every day.

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I would like to thank my parents, friends, relatives, and supporters who have made this possible. Thank you to the many teachers and mentors I have had that have guided me and encouraged me to pursue my dreams - Señora Blauch, Mary Bruce Webb, and Andy Feldman especially. To the members of my committee – Dr. Winsler, Dr. Curby, and Dr. Gormley – thank you so much for your patience and input throughout this process. Finally, I would like to give special thanks to the members of the Winslab and to the Drafate family – I am so lucky to have all of you wonderful people in my life!

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ABSTRACT

THE INFLUENCE OF ELEMENTARY SCHOOL QUALITY ON FIFTH- AND EIGHTH-GRADE EFFECTS OF PUBLIC-SCHOOL PRE-K, CENTER-BASED, AND FAMILY CHILDCARE PROGRAMS

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The preschool fadeout effect refers to the situation where initial advantages seen in later student school performance as a function of attending a certain kind of pre-k program disappear over time, typically by third grade. Researchers have begun to focus on the quality of the elementary school that children later attend as one explanation of preschool fadeout (or lack thereof). Some studies show increased sustained effects of preschool when students go on to attend high-quality elementary schools, while others find sustained effects of pre-K only when lower-quality schools are attended.

The present dissertation examined 5th and 8th grade student performance (G5 N = 14,144; G8 N = 12,907 for children (52% male; 59% Latinx, 34% Black, 7% White/other) who had attended different types of pre-K at age four using data from the Miami School Readiness Project (MSRP). The following research questions were addressed: 1) Are there sustained positive effects of public-school pre-K programs in 5th

and 8th grade, relative to center-based (CBC) and family childcare (FCC) programs? 2) Do children who attend public-school pre-K programs later attend schools of differing quality in 5th grade compared to children who attend CBC or FCC programs? 3) To what extent are sustained pre-K program effects on 5th and 8th grade outcomes dependent on the quality of school attended in 5th grade? 4) Are differential fadeout effects associated with school quality similar for males and females, and for Black or Hispanic/Latinx students? Multiple regression analyses were conducted in Mplus using TYPE=COMPLEX to deal with nesting, and FIML to deal with missing data. Outcome variables included GPA, high stakes standardized math and reading test scores, and grade retention in both 5th and 8th grade. Elementary school quality came from the school's 'grade' (A, B, C, D, F) given each school by the State Department of Education. Models included the covariates of age-4 cognitive skills, gender, ethnicity, lunch status, and disability status in 5th or 8th grade.

Positive sustained effects for all academic outcomes in 5th grade were found for students who attended public-school pre-K programs compared to students who attended CBC and FCC. In 8th grade, fadeout was more common but effects favoring pre-K were seen for GPA, FSA reading, and middle school retention. In 5th grade, elementary school quality moderated the pre-K effects for math and reading test scores, but not for other outcomes, with the pattern being fadeout occurring more for children who went on to attend lower quality schools, and sustained effects being greater for children attending better-performing schools. For 8th grade math, the same pattern of fadeout seen at low-quality schools and persistence seen at high-quality schools was found, favoring the

public-school pre-K group. Results did vary in some cases by child gender and by race/ethnicity, with stronger pre-K type by quality interactions present for boys than for girls (G5 GPA, FCAT Math and Reading, FSA Math, FCAT 2.0 Reading), and the same pattern for Hispanic/Latinx students on FCAT Reading, and for Black students on middle school retention. The current study provides additional evidence of sustained effects of pre-K programs and support the funding of public-school pre-K programs, since the pre-K advantage was still seen on some outcomes as late as 8th grade. Results also suggest that fadeout is related to later school quality, that school quality matters, and that a high-quality elementary school appears particularly important for boys, and for Black students if they are to gain and sustain the most from their early education.

Keywords: early childhood education, preschool fadeout, school quality

INTRODUCTION

Research shows that early childhood education (ECE) programs are effective in improving school readiness skills in children, especially for children in poverty (Barnett, 1995; Currie & Thomas, 1996; Dearing, McCartney, & Taylor, 2009; Phillips et al., 2017; Yoshikawa et al., 2013). "ECE programs" is a bit of a catch-all term, encompassing public-school prekindergarten programs, center-based childcare, Head Start, and non-relative family childcare. School readiness refers to the plethora of skills a child may have upon reaching kindergarten that are linked to later academic success. These include abilities related to language, mathematics, and science, in addition to social and emotional skills and physical health (Snow, 2007). Improving child school readiness through high quality ECE programs can help reduce the difference in performance seen between ethnic groups and White students, or between those in poverty and those with more financial resources - otherwise known as the early achievement or opportunity gap (Hemphill & Vanneman, 2011). For example, one study showed that Head Start attendance reduced the gap in test scores at school entry between Hispanic and White children by about 25% (Currie & Thomas, 1996).

Effects of ECE Programs on School Readiness

In one of the first literature reviews on longitudinal outcomes of ECE programs, Barnett (1995) examined 36 studies that investigated the long-term effects of ECE

programs (defined broadly as Head Start, child care, or home-visiting programs). The review concludes that most of the preschool programs assessed produced large short-term benefits for children's development. The largest effect sizes were seen on intelligent quotient (IQ) scores at age 5, with gains typically ranging from 8 – 25 IQ points. Moderately large effect sizes were also seen for standardized tests, grade retention, placement in special education, and "social adjustment." Notably, these effects were all neutral or positive, in that program attendance was typically associated with increased student test scores and decreased grade retention, special education placement, and delinquency and crime through grade 3 and sometimes up to grade 11 (Barnett, 1995).

Recently, two additional literature reviews have been published summarizing the research of the effects of preschool education (Phillips et al., 2017; Yoshikawa et al., 2013). In their executive summary, Yoshikawa and colleagues (2013) stated that large-scale preschool programs are more than worth their investments. They cite a meta-analysis of 84 preschool programs that found that students who attended these programs gain on average a third of a school year in knowledge in language, reading, and math by the end of the program (Advisory Committee on Head Start Research and Evaluation, 2012).

Researchers have also investigated the impacts of Head Start attendance on developmental outcomes. Head Start is a publicly-funded federal early childhood education program that provides preschool education, medical, dental, and mental health care, and nutrition services (U.S. Department of Health and Human Services, 2010). Every student that comes from a family that makes 200% of the poverty line or less is

eligible to attend Head Start free of charge. The Head Start Impact study (U.S. Department of Health and Human Services, 2010) assessed a nationally representative sample of approximately 5,000 3- and 4-year old children to determine if attending Head Start improved cognitive and social-emotional skills. Children were randomly assigned either to the "experimental" group (Head Start) or the "control" group. Children in the control group did not have access to Head Start services, but their parents had the option of enrolling their child(ren) in other non-Head Start, ECE programs. About 60% of parents in the control group did enroll their children in a different program, and about 15% of children in the control group entered the Head Start program at some point during the program year. Analyses were conducted on two cohorts: the first investigating children who entered the program at age 3 and consequently spent two years in the program, and the second including children who entered the program at age 4 and spent one year in the program. It is important to note that the demographic characteristics of these cohorts did differ significantly, with the 3-year old cohort having approximately equal representation of Hispanic, Black, and White students, and the 4-year-old cohort including 51.6% Hispanic students, 17.5% Black students, and 30.8% White students (U.S. Department of Health and Human Services, 2010).

Results found that children in the Head Start group significantly outperformed the control group on all measures of preschool experiences in the study. Notably, analyses on the 3-year-old cohort found positive effects on vocabulary, letter-word identification, letter naming, phonological processing, motor skills, and parent-related behaviors like spanking, reading, and cultural-enrichment practices. Analyses on the 4-year-old cohort

found similar positive effects on vocabulary, letter-word identification, spelling, color identification, letter-naming, and parent-reported emergent literacy (U.S. Department of Health and Human Services, 2010).

Several additional studies have investigated the effects of pre-K enrollment on cognitive development. For example, researchers have focused on pre-K programs in Tulsa, Oklahoma (Gormley, Gayer, Phillips, & Dawson, 2005), a state which has implemented universal public pre-K since 1998. Gormley et al. obtained data from administrative records and parent surveys. Each cohort was composed of a treatment group and a control group. Children in treatment groups were enrolled in the Tulsa preschool (TPS) pre-K program or they were enrolled in another program, such as Head Start, a different preschool program, or cared for at home (Gormley et al., 2005). Cognitive development was measured by several subscales on the Woodcock Johnson test (Woodcock & Johnson, 1989). Regression discontinuity analyses determined that attending the TPS program predicted a 3.05 point increase in letter-word identification scores (0.80 of a standard deviation for control group), a 1.88 point increase in spelling scores (0.65 of a standard deviation for control group), and a 1.96 point increase on applied problems scores (0.38 of a standard deviation for control group). This study again shows support for ECE programs improving children's academic skills.

Another similar study investigated the effects of a Boston pre-K program on the prereading and reading skills, vocabulary, and numeracy and early math skills of 2,018 four-and five-year-old children. There were no income limitations to be eligible for the free, year-long program. Any child who turned 4 by September 1st was able to apply.

Children who attended the Boston Public School (BPS) pre-K program were in classrooms that had implemented both the literacy and language curriculum Opening the World of Learning (OWL; Schickedanz & Dickinson, 2005) and the mathematics curriculum, Building Blocks (Clements & Sarama, 2007). Additionally, teachers of these children were provided professional development supports of several days of training in OWL and Building Blocks and weekly to biweekly meetings with an early childhood coach. Attending the BPS program resulted in significant improvements in receptive vocabulary (effect size = 0.45), early reading (effect size = 0.62), numeracy (effect size = 0.58), and geometry (0.49) when measured at the end of the program year.

Tennessee has also implemented statewide voluntary pre-K programs. In one study, over 3,000 students were randomly assigned to receive an offer of admission to the Tennessee pre-K program, with 1,076 children included in the evaluation study (Lipsey et al., 2013). Parent reports disclosed the type of care that the non-pre-K-participating children enrolled in during the pre-K year. Nearly 60% of these children received parental care and did not attend any other type of ECE program, while 15% attended private childcare, 11.5% attended Head Start, and the remaining 13.5% of participants reported their child attended a combination of programs or they did not report the type of care that the child received. At the end of the program year, researchers found positive, statistically significant effects on the average score of six Woodcock Johnson achievement subscales for children who attended the pre-K program compared to those that did not, even when controlling for baseline child and family characteristics (effect sizes = .32). They also discovered sizable effects on literacy measures like letter-word identification and

spelling, math measures like applied problems and quantitative concepts, and language measures like oral comprehension and picture vocabulary (ES = .09-.41).

Furthermore, Winsler and colleagues (2008) found that in Miami, ethnically- and linguistically-diverse children attending pre-K and CBC programs significantly increased school readiness skills by the end of the program year. This study included children who received childcare subsidies to attend either free Title-1 public-school pre-K programs, fee-supported public-school pre-K programs, and CBC. Children who attended public school pre-K (free or fee-supported) had higher gains in cognitive and language development compared to children who attended CBC. In fact, the children in this study improved from ranking between the below average, at the 32nd-43rd percentile on national norms of language, cognition, and fine motor skills, to about average, at the 47th-52nd percentile ranking.

Similarly, when using a nationally-representative sample from the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K), researchers found that children who attended pre-kindergarten programs showed the greatest achievement on reading and math scores in the fall of kindergarten when compared to students who attended a "preschool" (which the authors define as typically part-day or part-week, privately funded programs with fee-based participation serving mostly 3- and 4-year-olds) or a center-based day care program (which the authors define as typically 9-10 hour, five days/week care that serve children of all ages) (Magnuson, Meyers, Ruhm, & Waldfogel, 2004). Pre-K program attendance was associated with an OLS regression coefficient of 1.66 compared to a coefficient of 1.32 for children that attended preschool

and a coefficient of 0.80 for children that attended center-based care. Regression models included controls for a variety of demographic, home and family, and neighborhood and school characteristics. For example, the authors included covariates of household income-to-needs ratio, parents' and grandparents' educational attainment, the region of the country in which the child lived, the size and structure of the family of the child, home language, and race, ethnicity, gender, age, birth weight, and (at time of data collection) height and weight. The results from this study are yet another example of how ECE program attendance can positively affect children's development and school readiness skills.

Preschool Fadeout

Though the summarized research shows that ECE programs are certainly effective in improving school readiness skills, a concept known as "preschool fadeout" questions how long these benefits last. Policymakers generally wish to see that children who attend publicly-funded preschool programs fare better than those who did not, even many years after the program took place. Several studies find that differences in performance outcomes that were initially seen between students who attended ECE programs and those who did not disappear, usually around third grade (hence, "fadeout") (Lipsey, Farran, & Durkin, 2018; Magnuson, Ruhm, & Waldfogel, 2007; Puma et al., 2012; Yoshikawa et al., 2013; Zhai, Brooks-Gunn, & Waldfogel, 2011; Zhai, Raver, & Jones, 2012).

"Fadeout" can take several different forms, but typically it involves the children who did not receive the early intervention "catching-up" over time to the children

exposed to the pre-K program (thus, the alternative term ‘convergence’). In some cases, a comparison group actually starts to outperform the pre-K group years later (Lipsey, Farran, & Durkin, 2018) and in still other cases, there are “sleeper effects,” where previously full fadeout was observed but then later, the pre-K/intervention group starts excelling again relative to the comparison group (Clements, Sarama, Wolfe, & Spitler, 2013; Magnuson, Ruhm, & Waldfogel, 2007).

Several researchers have pointed out that it is necessary to consider our expectations of preschool programs with more nuance (Bailey, Duncan, Odgers, & Yu, 2016; Garcia, Heckman, Leaf, & Prados, 2016; Winsler & Mumma, in press; Whitehurst, 2016). The education system is meant to be the “great equalizer” and reduce opportunity/achievement gaps, yet it can do very little to change systematic barriers such as family income, neighborhood resources, poverty, and racism (Winsler & Mumma, in press). Because of these contextual factors, it is difficult to disentangle exactly why some preschool effects persist while others fade out. However, it is likely that these and other factors may be able to partially explain fadeout effects, though they have nothing to do with the ECE program itself. Still, researchers and policymakers deem the longitudinal effects of these programs worthy of study, especially because some programs do have lasting benefits despite the obstacles that children in poverty face.

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A multitude of studies have looked at longer-term academic effects of ECE programs. While some have looked at earlier elementary years, such as kindergarten through second grade, many researchers are particularly focused on effects that are present at third, fifth, and eighth grade – when students typically take standardized tests that are often linked with grade promotion. The following section will review (in chronological order) a selection of studies focused on these outcomes.

As they did for the end of the program year, researchers on the Head Start Impact Study (summarized above; HSIS) also analyzed effects of the Head Start program in kindergarten through third grade (Puma et al., 2012). While positive results from the HSIS were present at the end of the program year, there were no clear patterns that supported evidence of persistence of these effects into the early elementary school years (Puma et al., 2012). These results are similar to that of Tennessee pre-K researchers, who found positive effects for children who attended pre-K at the end of the program year, but fadeout and even a reversal effect in later years (Lipsey, Farran, & Durkin, 2018). By the end of first grade, children who attended pre-K did not perform significantly differently on Woodcock Johnson achievement test subscales compared to nonparticipants (Lipsey et al., 2015). In third grade, the researchers found that control group children outperformed pre-K children in third grade on the Woodcock Johnson achievement scales (Lipsey et al., 2013).

North Carolina is another state that has encouraged work on early childhood policies, implementing two initiatives called Smart Start and More at Four to provide

high-quality childcare for children between the ages of 0-5, and especially for disadvantaged children. Smart Start allocated state funds to improve early childhood services. More at Four (also known as NC pre-K) is a state-funded pre-K program intended for 4-year-old children of families with an annual income less than or equal to 75% of the state median, or for 4-year old children with limited English proficiency, a disability status, an illness, or developmental needs. Researchers were interested in assessing the third through fifth grade reading and math standardized test scores of students who had attended the NC pre-K program compared to those that did not (Dodge, Bai, Ladd, & Muschkin, 2017). Hierarchical linear models (level 1 = time point within child, level 2 = child, level 3 = county) controlling for birth weight, ethnicity and race, maternal education and marital status, father's presence, immigrant status, free and reduced lunch status, and county-level covariates (i.e., percent of the population receiving food stamps, Medicaid, and median family income) were conducted. Results showed that at the end of third grade, students in counties with Smart Start-allocated funds performed better on math and reading achievement tests compared to students in counties without Smart Start funds. Students who attended NC pre-K also had higher math and reading scores compared to children that did not attend the pre-K program (Dodge et al., 2017).

Ansari and Winsler (2013) investigated the kindergarten readiness of children in the Miami School Readiness Project (MSRP; $N = 16{,}176$) who earlier attended public school pre-K, center-based care (CBC), or family childcare (FCC). Kindergarten readiness was measured by the Dynamic Indicators of Basic Early Literacy Skills

(DIBELS) (Kaminski & Good, 1998), Early Screening Inventory – Kindergarten (ESI-R) (Meisels, Marsden, Wiske, & Henderson, 1997), Early Childhood Observation System (ECHOS) (Harcourt Assessment, 2006), Work Sampling System (WSS) (Meisels, Liaw, Dorfman, & Nelson, 1995), and kindergarten grades. Children who were enrolled in public school pre-K received higher year-end grades than their peers who attended CBC programs (ES = 10% of a standard deviation), even controlling for demographic variables and cognitive skills at preschool entry. Also, children who were enrolled in public school pre-K performed better than their peers who attended FCC (ES = 17% of a standard deviation). Children who were enrolled in center-based care achieved higher scores on kindergarten readiness assessments compared to their peers who attended family childcare. These results were found even when controlling for cultural and language backgrounds (Ansari & Winsler, 2013).

Another very recent study using data from Miami-Dade County public schools was published on students' grade promotion to first grade, school stability, and early exit from ELL status (Conger, Gibbs, Uchikoshi, & Winsler, 2019). Results from linear regression analyses, controlling for age 4 cognitive skills, child race/ethnicity, gender, and eligibility for free and reduced price lunch status, found that children who attended public-school pre-K programs were two percent more likely to be promoted to first grade compared to children who did not attend pre-K programs, but may have attended another type of formal care (CBC, Head Start, family childcare) or did not attend any sort of ECE program. Students who attended pre-K were also four percent less likely to have moved schools between kindergarten and grade compared to those who did not attend pre-K.

Finally, ELL children who attended pre-K were eight percent more likely to exit ELL status by first grade compared to those who did not attend the public-school pre-K program (Conger et al., 2019).

Hill, Gormley, and Adelstein (2015) examined Tulsa's pre-K program effectiveness on third grade academic outcomes. All children were administered the Oklahoma Core Curriculum Test (OCCT) in third grade, designed to fulfill No Child Left Behind and state mandates for math and reading standardized testing. Results from regression discontinuity analyses showed no significant differences in third grade test scores between children who attended the TPS pre-K and children in the comparison group for the three-year-old cohort. However, significant differences were found for the four-year-old cohort for math test scores, but not for reading test scores, and only for boys. On math standardized tests, male pre-K attendees scored nearly 18 points higher compared to their male peers who did not attend the pre-K program. This resulted in an effect size of 0.18. There were no significant differences in girls' test scores for those who attended the TPS pre-K compared to those in the comparison group at third grade (Hill et al., 2015).

Program maturation, innovation, or an overall shift toward greater accountability are reasons the authors cite for the differences in effects between the early and late cohorts (Hill et al., 2015). New curricula embraced in the later cohort may have encouraged higher math scores for the experimental group in third grade. The findings of the Tulsa pre-K study show evidence of both persistence of preschool effects *and* convergence; considering that the only significant difference reported was math test

scores of one cohort, and only for boys, but not reading scores, and no significant differences between groups for any test scores for the first cohort.

Additional work on the MSRP by Ansari and Winsler, a follow-up examining differences of third-grade outcomes of Latinx children (N = 11,902) provides evidence that there are sustained effects of pre-kindergarten through third grade. In other words, there was little convergence between students who attended public-school pre-kindergarten programs compared to children who attended center-based care or family childcare (Ansari et al., 2016). Results from Ordinary Least Squares regression and propensity score analyses found that children who were enrolled in public school pre-K outperformed children who attended CBC on standardized assessments of math and reading, and also earned a higher GPA. There were no significant differences in third-grade outcomes between children who attended CBC and FCC (Ansari & Winsler, 2016). This indicates that there is fadeout/ convergence present when making the FCC to CBC contrast.

Fifth and eighth grade outcomes

Several of the same groups of researchers have investigated fifth grade outcomes of their respective ECE programs. For instance, the NC pre-K researcher group found that positive effects on math and reading test scores and reductions in grade retention persisted to the end of the fifth-grade year (Dodge et al., 2017). New Jersey pre-K researchers found that children who were nonrandomly assigned to attend Abbott preschool programs had increased language arts and literacy, math, and science achievement test scores in fifth grade compared to children who did not attend the

program (Barnett, Jung, Young, & Frede, 2013). Furthermore, two years of the program increased the effects compared to just one year in the program. These effects roughly translated into reducing 10-20% of the achievement gap between white and minority students when they attended one year of the program, and 20-40% of the achievement gap when attended for two years (Barnett et al., 2013).

As of late, studies on preschool programs have also been publishing results on outcomes in eighth grade and in adolescence. For instance, Ansari and Pianta (2018) used propensity score matching on ECLS-K data to find that academic achievement effects on standardized reading and math assessments persisted through the end of eighth grade (effect sizes = 0.09-0.16 SDs). Though these effect sizes are small to moderate, Ansari controlled for a variety of child-varying demographic variables and for family and community characteristics. Tulsa pre-K researchers also found persisting effects for children who attended TPS pre-K programs on seventh grade math standardized test scores, middle school honors courses enrollment, grade promotion to eighth grade, and less grade retention in middle school (Gormley, Phillips, & Anderson, 2018). NC pre-K researchers again found that math and reading standardized test scores were significantly higher for students in Smart Start counties and for children who had attended the NC pre-K program in eighth grade (Dodge, Bai, Ladd, & Muschkin, 2019). They additionally found that these students were less likely to be retained in sixth, seventh, and eighth grade(s) and less likely to be placed in a special education service during these years (Dodge et al., 2019). It seems that even though some studies have found fadeout in earlier

elementary school years, it is also clear that other studies who have looked at middle school outcomes have found persistence in ECE program effects.

Adulthood

Classic studies have shown preschool effects that last into adulthood (Campbell et al., 2012; Ou & Reynolds, 2006; Ou, Reynolds, & Topitzes, 2004; Schweinhart, Berrueta-Clement, Barnett, Epstein, & Weikart, 1985). Studies like the Abecedarian Project, the Chicago Longitudinal Study, and the Perry Preschool Project have been classified as "boutique" programs; or programs that generally had small samples, were from well-funded research projects, and conducted up to 40 years ago, and therefore may not be generalizable to the current population. In spite of this critique, large effect sizes have been reported for several studies analyzing the efficacy of such programs. For instance, both the Carolina Abecedarian Project and the Chicago Longitudinal Study report that as adults (aged 30 and 22, respectively), subjects who participated in their respective programs reached higher levels of education than did children who did not participate in their respective interventions (Ou, Reynolds, & Topitzes, 2004).

The Carolina Abecedarian Project was one of the first randomized trials to investigate the effects of a longitudinal intervention program on cognitive and social development (Ramey et al., 1976). Beginning from infancy, 111 at-risk children from low-income families from Orange County, North Carolina, enrolled in the treatment program. The treatment group was exposed to high-quality childcare, which they called the Abecedarian Project, five days a week from age six weeks to 5 years. The "Abecedarian Approach" was designed to support age-appropriate development across

the infant, toddler, and preschool years geared towards language, cognition, social, emotional, and physical development. In the preschool treatment, participants were given nutritional supplements, family support social services, pediatric care and referrals, individualized learning experiences in natural preschool atmosphere, promotion and support for parent involvement, and daily transportation. The control group received nutritional supplements, family support social services, and pediatric care and referrals. The Abecedarian Project is unique in that it also performed a school-age intervention for half of the preschool control group and half of the preschool intervention group. This follow-up intervention shows evidence of the extent to which gains from the intervention program might be maintained in elementary school if there was an additional program compared to if the child was enrolled in a normal education program.

The school-age intervention program consisted of master-level teachers (known as home/school resource teachers) providing parents supplemental educational activities and social and emotional support to parents and teachers (Ramey & Campbell, 1991). During this intervention, the home/school resource teacher visited the parents every other week to introduce new activities and report on the child's classroom behavior. Further, parents were provided with assistance with finding better housing, employment opportunities, and social services. The school-age intervention program continued into the summer months, with day camps, tutoring, and field trips all organized by the home/school resource teacher.

Results from multiple analyses of variance performed as part of this study demonstrated that third grade IQ scores, math, and reading scores of children who were

part of the preschool and school-age intervention groups outperformed children who were in the preschool and school-age control groups (Ramey & Campbell, 1991). This finding is particularly encouraging because it alludes to the importance of later school quality and experiences and how this can affect the results of a preschool intervention program. This is especially true since children who were involved in only the preschool intervention groups (but without the elementary school follow-on program) did not demonstrate any significantly different cognitive outcomes in third grade compared to their peers who were in the preschool control group (Ramey & Campbell, 1991).

Also contributing to the longitudinal effects of preschool programs, the Chicago Longitudinal Study (CLS) followed children involved in a preschool – third grade intervention program through age 22. Although this study conducted an intervention project within Head Start classrooms, it was funded by a university, which is why I am classifying it as a Boutique program. This study found that preschool participation was significantly correlated with higher educational attainment and lower rates of juvenile arrest (Ou & Reynolds, 2006; Ou, Reynolds, & Topitzes, 2004). The CLS originally included a sample of 1,539 low-income children from Title-I-eligible neighborhoods who graduated from kindergarten in 1985-1986. Data were collected from youth, parents, teachers, and administrative records.

The children in the intervention group were enrolled in the CPC Program, a center-based early intervention for impoverished 3- and 4- year old children that lasted through the third-grade year. As this was a quasi-experimental study, the children were not randomly placed into the intervention group, although there was a comparison group

in which the participants received a kindergarten intervention without the CPC preschool experience. The CPC Program focused on increasing students' school readiness and academic achievement with services such as free breakfasts, lunches and health screenings, coordinated adult supervision, reduced class size, and emphasis on reading instruction, and parental attendance at the program for at least one half-day a week. These services were provided to children in the intervention group from preschool to early elementary school. In order to have been eligible for the intervention group, a child was required to have residency in school neighborhoods that received Title-I funds, to attend the program at least one half-day per week, and was not permitted to have been enrolled in any other intervention program. Children in the control group were enrolled in other programs.

To investigate the effects of the program two years post-completion, Reynolds (1994) conducted ANOVAs and multiple regression to determine if the effects of the intervention were stable (N = 1,106) When assessed in the fifth grade year, children who were involved in the intervention program for their entire preschool through third grade experience had significantly higher reading and math test scores, notably more positive teacher-ratings, higher parental involvement in the school, and less grade retention and special education placement compared to the control group (Reynolds, 1994). Children who did not attend the follow-up intervention, but attended just the preschool intervention, did however show evidence of fadeout, with their third-grade reading and math scores not being significantly higher than their peers in the control group (Reynolds, 1994).

This program has also demonstrated effects possibly lasting through the high school years. Children in the CPC program had significantly higher rates of high school graduation when compared to the control group. Effect sizes reported were relatively small, with .30 for high school completion, .23 for highest grade completed, and .18 for college attendance; although the authors warn that effect sizes should be interpreted with caution due to social and economic significances of outcomes varying dramatically. Instead, percent improvement over comparison group provides more insight into how the CPC program influenced participants. Although the effect size is only .18 for college attendance, the CPC preschool group attendees were 28.5% more likely to attend college than the comparison group (Ou & Reynolds, 2006).

One of the oldest studies evaluating the effects of preschool was the Perry Preschool Program (Schweinhart et al., 1985). Beginning in 1962, the Perry Preschool study included 123 black children spread amongst five cohorts, each separated into an experimental group and a control group. Children in the study were selected by identifying them on a Perry Elementary School census, referrals from neighborhood groups, and by door-to-door canvasing. Forming the experimental group and the control group was done by creating pairs of children with similar pretest IQs and randomly assigning one child from each pair to one of the two groups.

Children in the experimental groups were enrolled in the Perry preschool program for 2.5 hours, 5 days a week, for one or two school years. Children in the control group did not attend preschool. Preschool through fourth grade data were collected annually from the Stanford-Binet Intelligence scale (Terman & Merrill, 1960), the Peabody Picture

Vocabulary test (PPVT; Dunn & Dunn, 1997), and home observations. Attending the Perry preschool program was positively associated with IQ scores, academic achievement, and teacher ratings of social-emotional skills, and negatively associated with grade retention. While differences between the experimental and control groups increased over time for academic achievement (with children who attended the program performing increasingly better as time went on and indicating no convergence on this measure), differences on IQ scores *decreased* over time (indicating convergence) (Weikart et al., 1978). Since this study was extremely well-funded, data were collected on the participants of the study up through age 40, showing especially promising results post-high school. For instance, subjects in the experimental group graduated from high school at a rate of 67%, while their control group counterparts graduated at a rate of 49%. Subjects in the preschool group attended college at a rate of 38%, while the control group attended at a rate of 21% (Schweinhart et al., 2005).

Results from the Perry Preschool program point out that improvements on social skills for former participants of the program may manifest later in life (such as when they were measured in this particular follow-up study, at age 19). This may suggest that if participants of more recent studies, whose cognitive effects may fade out by third grade, were to be studied longitudinally, they may also have sustained social effects, and researchers may then find results similar to the Perry Preschool Program. This illuminates yet another rationale of studying convergence; if policymakers had canceled programs that had shown fade out in third grade, then researchers would not be able to see possible long-term effects that may emerge in adulthood.

Why Mixed Effects?

As the summarized research demonstrates, sometimes ECE programs have effects that last through eighth grade or even longer, while other ECE programs show that effects fade out in the earlier elementary school grades. There have been several explanations postulated for why preschool effects persist in some studies, but not others, such as: differences in comparison groups, alignment of pre-K to kindergarten, and later school quality.

Counterfactuals

One possible explanation of fadeout is the difference in comparison groups that ECE program evaluation studies use. For example, adult outcome studies on programs like the Abecedarian and Perry Preschool Programs compare individuals who had attended an intensive pre-K intervention program to individuals who did not experience any formal childcare (Barnett et al., 2016; Feller, Grindal, Miratrix, & Page, 2016). However, in the time since these studies have been published, and families and schools have become more informed on the importance of early childcare, most children are now attending some sort of formal care before they begin kindergarten. Indeed, 44% of children in the United States attend publicly funded preschool at age 4 (Friedman-Krauss et al., 2019). This translates to more recent studies using comparison groups quite different from these classic boutique program studies. It perhaps also may lead to smaller effect sizes, since more recent studies are often comparing children who attended two types of formal care rather than children who attended formal care and to children who experienced informal care only.

We must also consider that the mixed results of preschool fadeout/persistence could be due to studies using different comparison groups from one another. It is especially challenging to assess the differences in comparison groups of studies since several studies use a comparison group composed simply of children who did not attend their ECE program of interest – but this could mean that the children instead attended a wide variety of programs (Head Start, CBC, FCC, etc.) (Winsler & Mumma, in press). In these ambiguous comparison groups, it is often unknown how many children are attending similar programs versus how many children are in non-formal care settings. Relatedly, it is also possible for children in comparison groups of experimental studies to later go on to attend the program in the experimental group (Love, Chazan-Cohen, Raikes, & Brooks-Gunn, 2013). This very issue occurs within the Head Start Impact Study, where approximately 16% of the control group did attend a Head Start program (Love et al., 2013). Recently, researchers of the Boston pre-K programs also found that 88% of the control group (did not attend BPS program) did attend a center-based preschool program, and only 6% of children stayed at home (Weiland, Unterman, Shapiro, & Staszak, 2019).

Similarly, in the Tennessee evaluation, researchers note that even when children were randomly assigned to either attend or not attend the Tennessee pre-K program, this did not mean that the participants "complied with that assignment," meaning that some children assigned to the control group actually ended up in the pre-K program, and vice-versa (Lipsey, Hofer, Dong, Farran, & Bilbrey, 2013, p.20). In the randomized control trial analytic sample, 1,852 children received offers for admission (intent-to-treat

treatment of the analysis; ITT), and 1,138 did not receive offers (control group). Boston pre-K evaluation researchers took a similar approach – their ITT group included children who were offered the opportunity to attend a BPS program. However, researchers of the Tennessee program also analyzed children who actually attended a VPK program – regardless of their randomized assignment. In this analysis, 1,997 children that attended the VPK program for at least one day made up the treatment-on-treated (TOT) group, and the 993 children who did not attend the program made up the control group for this analysis. Researchers evaluating the North Carolina pre-K program differed on their ITT group – children in the treatment group were any children (of appropriate age) living in the county during that year, not just children that participated in the services (Dodge et al., 2017). The authors argued that this was to capture "spillover" effects of the pre-K program even for children that did not attend.

Eligibility requirements also vary across pre-K programs. For example, in the Head Start Impact study, children from families with income levels below the federal poverty line were eligible to apply, with 10% of openings allocated specifically to children with disabilities (Puma et al., 2012). The Tennessee pre-K study also distributed openings first based on economic disadvantage, then to children with disabilities, dual-language learners, and if remaining seats were available, to any child. Similarly, disadvantaged students from families with less than or equal to 75% of the state median income level (some of which specifically allocated for children of military families), were able to apply to the North Carolina pre-K program (Dodge et al., 2017). In the Tulsa pre-K study, seats in programs were given to children on a first-come, first-served basis.

Any remaining openings were allocated via a lottery system (Hill et al., 2015). Finally, as of 2005, children in the Miami School Readiness Project (from which the data of the current study are obtained) had access to half-day public-school pre-K programs for free if they lived within the boundaries of a Title-1 school district, and seats were available on a first-come, first-served basis.

Subgroup Differences

It is also important to note that subgroup differences in fadeout are often found, where sustained effects are seen among only certain types of children (i.e., Black, male, Latinx, or ELL students) (Anderson, Kitchens, & Phillips, 2016; Bassok, 2010; Mumma & Winsler, in review; Phillips, Gormley, & Anderson, 2016). This might be partially explained by the fact that children of varying racial/ethnic backgrounds enroll in ECE programs at differing rates (Bassok, 2010). Indeed, in 2016, 42% of 3-5-year-old White children and 45% of 3-5-year-old Asian children participated in preschool programs, compared to 35% of 3-5-year-old Hispanic children and 35% of Black children (MacFarland et al., 2018). After accounting for these differences in ECE program participation rates, one study (Bassok, 2010) found that when comparing children from families with incomes of less than 130% of the federal poverty line, there were no significant differences in preschool effects for children of different racial/ethnic backgrounds who attended "preschool" (i.e., daycare, private or public CBC, state-funded pre-K, but not Head Start) on early literacy assessments at 48 months of age. On the other hand, when the author compared children from families with incomes of 130% or more of the federal poverty line, Black children who attended preschool scored 3.4 points

higher (ES = 0.34) on early literacy assessments compared to Black children who had parental care. Effect sizes were similar within Hispanic children (ES = 0.29-0.32, larger for Hispanic families who speak mainly Spanish at home). These results contrast with those for White children from families with incomes of 130% of the federal poverty line, who did not perform significantly differently from their peers in parental care (Bassok, 2010). The author predicts that this effect may have manifested due to the possibility of Black children beginning preschool at an earlier age and attending for more hours per week compared to their White and Hispanic peers (Magnuson & Waldfogel, 2005; Snyder & Hoffman, 2002), though this needs further exploration (Bassok, 2010).

Other studies exploring sub-group differences produce different results. For example, Tulsa pre-K researchers found that pre-K effects persisted for White students who attended Tulsa pre-K programs for standardized math test scores in third and seventh grades, but for Black students, there were no significant differences between children who had previously attended Tulsa pre-K and those who were enrolled in another type of ECE program or received parental care (Anderson, Kitchens, & Phillips, 2016). For reading, there were similar patterns, but there were no significant differences between White students who attended pre-K and those that did not by seventh grade. For Black students, fadeout was present at third grade and seventh grade for standardized reading test scores (Anderson et al., 2016). Since this study uses outcome data several years after the pre-K program took place compared to Bassok's (2010) 48-month data, this could be a defining factor of these mixed results.

Recent work with the Miami School Readiness Project (MSRP) has also

investigated differential fadeout effects in third grade for Black and Hispanic/Latinx students when attending elementary schools of varying quality (Mumma & Winsler, 2016). For Hispanic/Latinx students, children who previously attended pre-K programs had on average higher GPAs than Hispanic/Latinx children who previously attended CBC programs, and these differences were largest when attending lower-quality schools. For Black students, children who previously attended pre-K programs had higher average third grade GPAs than Black students who previously attended CBC, but these differences were smallest when they subsequently attended low-quality schools. Similar patterns were seen for both Black and Hispanic/Latinx children when assessing third grade standardized math test scores (Mumma & Winsler, 2016).

While the studies summarized in this section have varying results, their outcomes were also measured at different time points. It is also important that we consider the overall demographics of the samples, for these and other fadeout studies. For example, the MSRP has only 8-10% of its students who identify as "White/Other." Because of the diversity of this area, it is possible that students of color in Miami have different school experiences than students in another area of the United States, where they are the minority. Considering these cultural contexts and the demographic makeup of samples is critical for researchers investigating the longitudinal effects of ECE programs.

Pre-K-3 Alignment

An additional factor that may influence fadeout is the extent to which the pre-K school system and the K-3 school system are "aligned." Alignment refers to the coordination and communication between the pre-K and public-school K-3 systems, and recently the PK-3

movement is working to create a smoother transition for children moving from ECE programs to the more formal education environment (Graves, 2006; Kauerz, 2006; Stipek, Franke, Takanishi, 2017). PK-3 advocates are concerned that for PK and K-3 systems that do not communicate, the kindergarten curriculum may be repetitive and/or not sufficiently challenging for children who have had some type of formal ECE already (Winsler & Mumma, in press). To increase this coordination, schools may want to consider locating pre-K programs in the same building as the elementary school, implementing curricula and learning standards that are appropriately sequenced across grades, and using formative child assessments and integrated student data systems (Winsler & Mumma, in press). While these ideas certainly hold potential, there are few studies that determine whether they have any influence on pre-K fadeout effects (Stipek, Clements, Coburn, Franke, & Farran, 2017; Whyte, McMahon, Coburn, Stein, & Jou, 2016).

Broekhuizen and colleagues (2016) conducted some of the first research on alignment, finding benefits for children who experienced similar high-quality environments in both pre-K and in kindergarten. Data were collected from nearly 1,200 children in rural North Carolina and central Pennsylvania, 83% of which attended private or state/federal center-based care or preschool. Preschool and kindergarten quality were assessed with the Classroom Assessment Scoring System (CLASS; Pianta, La Paro, & Hamre, 2008), averaging the scores on the Emotional Support and Classroom Organization domains. Teacher-reported questionnaires were used as measures for social skills and behavior problems. Results showed that children who experienced high-quality

pre-K and kindergarten environments had more social skills and fewer behavior problems at the end of kindergarten compared to their peers who only experienced a high-quality environment at either pre-K or kindergarten, but not both (Broekhuizen, Mokrova, Burchinal, Garett-Peters, & The Family Life Project Key Investigators, 2016). While this study does shed light on the consistency of environments for the early years of childhood and the potential importance of maintaining high-quality schooling environments for children, it did not collect information on whether kindergarten teachers were actively communicating with the pre-K teachers on curricula (Broekhuizen et al., 2016).

Another paper reviewed a study which implemented a high-quality mathematics instruction intervention in preschool (Bailey et al., 2016). When these children later attended kindergarten, they were placed in classrooms where only the most basic mathematics skills were being taught. Although this was a good environment for children who had little to no mathematics skills upon entering kindergarten, the authors hypothesized that during these sensitive periods of development, high-achieving students might lose momentum. They predict that if high-quality instruction is not maintained, higher-achieving students will spend time re-learning content they already know instead of learning new material and further advancing their skills. This would then translate to a slower rate of learning than they would have otherwise been able to achieve in a high-quality educational setting.

School Quality

The quality of school later attended is another factor that could influence whether and how preschool effects persist or fadeout in multiple ways. One is that it is possible

that children who attended public school pre-K programs might go on to nonrandomly sort into certain schools of different quality compared to children who attended another type of program (Conger et al., 2019; Lee & Loeb, 1995). For example, Conger et al. (2019) note that children who attend a pre-K program will likely attend an elementary school in a nearby location. Furthermore, since targeted pre-K programs typically occur in neighborhoods with fewer resources, this likely also means that these same children will later attend schools of lower quality (Lee & Loeb, 1995). A separate, but similar issue is that the quality of school later attended might be a moderator of preschool effects. Bailey and colleagues (2016) suggest that when children attend high-quality schools after attending a high-quality ECE program, preschool effects are likely to persist. While this is a certainly a logical hypothesis, one could also argue that high-quality schools will raise up all students regardless of prior ECE experience, leading to convergence (Winsler & Mumma, in press). Therefore, it is necessary for researchers and policymakers alike to delve into the research that has investigates these issues. Both of these possibilities are discussed more below.

Sorting into schools of different quality

Lee and Loeb (1995) and Currie and Thomas (2000) concluded that students that attend Head Start may be more likely to later enter middle schools of lower quality compared to their peers who did not attend a Head Start program - a potential explanation for the fade out of Head Start effects over time. In contrast to the previous studies that focused on outcomes in elementary school, Lee and Loeb instead focused on identifying the quality of schools Head Start attendees were likely to attend as eighth

graders. Data were obtained from the National Education Longitudinal Study of 1988 (NELS-88), a nationally representative sample. A composite school quality variable included measures of the school's average socio-economic status, average academic achievement, perceived school safety, and teacher-student relational quality (Lee & Loeb, 1995). The authors compared students who had attended Head Start, other preschool, or no preschool. Data were collected from student, parent, and teacher surveys, and student achievement tests in math, science, reading, and social studies. Analyses of variance (ANOVA) determined that former Head Start students attended middle schools of significantly lower SES, lower average achievement, and tended to be in schools that were perceived to be less safe compared to students that did not attend Head Start, but attended a different preschool program (Lee & Loeb, 1995). To summarize, this would mean that students who attended Head Start are later attending worse schools than their peers who attended different early education programs.

Similarly, Currie and Thomas (2000) also used the NELS-88 as their sample, and concluded that Black children who attended Head Start also attend schools of lower quality in eighth grade compared to Black children who attended other types of preschool programs, even when controlling for family background characteristics. Despite the fact that these studies analyzed middle school quality instead of elementary school quality, these results suggest that later education quality may indeed have an impact on the lasting effects of preschool.

School quality as a moderator

The influence of later school quality, be it elementary or middle school, is one explanation for fadeout that has gained traction among researchers (Ansari & Pianta, 2018; Currie & Thomas, 2000; Lee & Loeb, 1995; Magnuson, Ruhm, & Waldfogel, 2007; Zhai, Raver, & Jones, 2012). In 2007, Magnuson et al. conducted a study using the Early Childhood Longitudinal data (ECLS-K). School quality was measured by class size and time spent on reading instruction. Class size was dichotomized - classes were considered large if there were above 20.5 students (the median class size), and small if there were below 20.5 students. The authors divided reading instruction per day into four levels – 1-30 minutes, 31-60 minutes, 61-90 minutes, and more than 90 minutes. Multivariate Ordinary Least Squares (OLS) regressions were conducted that compared children who attended the intervention program to a control group of children who did not receive consistent non-parental care. Preschool type was parent-reported, with options to indicate if their child had attended center-based childcare, relative care, non-relative care, or Head Start.

Magnuson and colleagues (2007) showed that intervention preschool attendance was linked to an increase in kindergarten entry math and reading scores by 4.12 (effect size .41) and 4.02 points (effect size .40), respectively. By the end of the third grade, these effect sizes had decreased to about 0.06, indicating that there were not significant differences in test scores between the two groups. When the authors adjusted their model for subsequent classroom experiences (i.e., large versus small class sizes and high versus low reading instruction), effect sizes disappeared, especially for children who

experienced higher quality elementary schools. For children who experienced large classes or low reading instruction, third grade math and reading test scores were .37 standard deviations higher for children who had attended pre-kindergarten programs, preschool, Head Start, and other non-parental care compared to children who attended only parental care. Magnuson et al. (2007) also attempted to control for selection effects by adding covariates into their models, such as child and family characteristics, as well as home, neighborhood, and policy environments. These results provide evidence for fadeout when students who did not attend preschool but later attended elementary schools of high quality, but sustained effects when the children attended schools of low quality (Magnuson et al., 2007).

Relatedly, Zhai et al. (2012) analyzed data from the Chicago School Readiness Project (CSRP) to investigate whether attending the CSRP showed effects on children's language, literacy, and math skills, as well as both internalizing and externalizing behavior problems in kindergarten. They also tested the moderating effect of later school quality. CSRP participants included students and teachers of 18 Head Start sites. The CSRP intervention provided four services – a 30-hour teacher training focusing on behavior management strategies, the placement of mental health consultants in intervention classrooms, stress reduction workshops for teachers, specialized curricula that implemented behavior management strategies, and individual mental health consultation services for 3-4 children per classroom that experienced high emotional and behavioral problems. Initially, they found that children who attended the CSRP had higher levels of cognitive and social abilities and reduced attention problems at the end of

their kindergarten year compared to their peers in the control group (Zhai et al., 2012). The comparison group was composed of children who attended Head Start programs but did not receive the CSRP intervention.

Children were randomly assigned to attend the CSRP. Later school quality was obtained from school records and defined by school-wide scores attained on the Illinois standardized tests (ISAT), which was conducted at the end of the third grade. A school deemed "high-performing" had a percentage of students that met or exceeded state math and reading standards beyond 0.5 standard deviations above the mean. On the other hand, "low-performing" schools' percentage of students meeting or exceeding state standards in math or reading was 0.5 standard deviations below the mean. The authors only compared "high-performing" and "low-performing" schools according to these standards; schools that met standards between these two extremes were not evaluated. Students' academic skills and behavioral problems were measured by teacher-reports, which were completed in the fall and spring of the Head Start year.

The authors concluded that when children are assessed in the kindergarten year, children in the CSRP intervention group who later attended high-performing schools in kindergarten had scores 0.58 points (effect size of 0.53) higher in language and literacy scores than did the children in the matched control group who did not receive the intervention. On the other hand, children who attended the CSRP and later attended low-performing elementary schools did not show any significant difference from their peers who were not assigned to the CSRP intervention program and attended low-performing schools. Thus, the CSRP intervention showed significant effects on children who

subsequently attended high-performing schools (resulting in no fadeout) but not on children who subsequently attended low-performing schools (resulting in fadeout). One explanation the authors provide is that due to the new social and academic demands of kindergarten compared to preschool, children may need higher quality kindergarten experiences in order to maintain the benefits from an intervention program like the CSRP (Zhai et al., 2012). These results show sustained effects for children when enrolled in a high-quality school environment, which is the opposite of what Magnuson et al. reported.

Ansari and Pianta (2018) used data from the ECLS-K to examine elementary school quality and the persistence of preschool effects on math, language, and literacy outcomes. By utilizing propensity-score matching techniques, they found that when students who previously attended pre-K later attended elementary schools of high quality, preschool effects were sustained through the end of fifth grade. But, when children later attended elementary schools of low quality, effects faded out. Notably, the authors controlled for children's characteristics, cultural background, household characteristics, family SES, family involvement, and community characteristics. The authors additionally used a classroom quality measure for school quality, creating a composite variable based on observations of teacher-child interactions (i.e., classroom control, emotional climate, teacher sensitivity, and use and time of instruction).

Ansari and Pianta's (2018) results and Zhai et al.'s (2012) results contrast with the Magnuson et al. study (2007) mentioned previously. It is unclear why these studies produced opposite results, but it could be due to the type of instruction given to the children involved in each preschool program, the different comparison groups used in

each study, and/or the differences in school quality measures. For instance, the post-preschool programs in Magnuson and colleagues' studies focused on reading instruction as a measure of school quality, while Zhai and colleagues used a school-wide measure of standardized test scores for school quality. It is possible that the emphasis on reading instruction in the high-quality classrooms in Magnuson's study helped the children who did not attend the preschool intervention improve to their peers' achievement level.

Results from my Master's thesis (Mumma, Manfra, Bleiker, Dinehart, Hartman, & Winsler, in review) are consistent with Ansari and Pianta's (2018) work and provide insight into the mixed results of Zhai et al. (2012) and Magnuson et al. (2007). I used data from the Miami School Readiness Project (MSRP) to compare third grade GPA and standardized math and reading test scores of children who previously attended Title-1 public school pre-K, center-based care, or family childcare. When controlling for free and reduced lunch status in third grade and age-4 cognitive skills, students who attended Title-1 pre-K programs had higher third grade GPA and standardized reading test scores compared to children who attended center-based care or family childcare (Mumma et al., in review). Alternatively, standardized math test scores did not vary as a function of ECE program type.

We also examined the degree to which the quality of the later elementary school moderated effects from attending Title-1 public school pre-K programs compared to center-based care programs or family childcare programs in 3rd grade. Elementary school quality was determined by a "grade" (A-F), given to each school by their respective school district. Similar to Zhai et al. (2012), school quality was based on the school's

performance on high-stakes standardized tests and how it improved from one year to the next. Analyses of variance showed that third grade performance depended both on the comparison being made (children who attended Title-1 public school pre-K vs. children who attended CBC; children who attended CBC vs. to children who attended FCC), and the quality of elementary school later attended. Children who attended pre-K outperformed their peers who attended CBC on third grade GPA and standardized reading and math test scores, and effect sizes for this difference increased as school quality increased. That is, pre-K students out-performed CBC kids by a small margin when both groups attended poor-quality schools, and the gap between the groups increased as school quality increased. On the other hand, when comparing CBC kids to FCC kids, a "catch-up" effect seemed to be present. While CBC students out-performed FCC students by a large margin when both groups later attended schools of poor quality, effect sizes *decreased* and there were no significant differences between CBC and FCC students when subsequently attending schools of high quality.

We additionally conducted analyses of covariance to examine the degree to which the quality of later elementary school moderated effects from attending Title-1 public school pre-K programs compared to center-based care programs. We were unable to make the CBC to FCC contrast when including covariates, as too few children attended FCC programs. Still, we conducted the same analyses as above except for adding in covariates and only comparing students who attended Title-1 pre-K programs or center-based care. When controlling for important covariates of gender, ethnicity, age-4 cognitive scores, and free/reduced lunch status in third grade, children who previously

attended Title-1 pre-K typically had higher third grade GPA scores and standardized math test scores compared to children who previously attended CBC programs, and these differences increased as quality increased. There was no interaction effect on third grade reading test scores; group differences between reading scores did not vary depending on elementary school quality.

Finally, we investigated whether or not differential fadeout effects associated with school quality were similar for Black and Hispanic/Latinx students. For Black students' third grade academic outcomes, children who previously attended Title-1 pre-K typically performed worse or as well as children who attended CBC programs when they later attended poor-quality schools, but out-performed CBC children when attending elementary schools of higher quality. This might suggest that attending poor-quality schools after attending public school pre-K (likely at the same low-quality schools) is particularly bad for Black students. For Hispanic/Latinx students, children who previously attended Title-1 public school pre-K programs out-performed children who previously attended CBC programs. Differences were largest at poor quality schools, decreased slightly as quality increased, but remained stable. This pattern was consistent across all third-grade outcomes (GPA, standardized math and reading test scores) for Hispanic/Latinx students.

These findings help explain the mixed results of the previously mentioned studies, since the amount of fadeout observed depends on the comparison group used and the quality of school later attended. Elementary school experiences clearly affect children's academic achievement *and* affect differences between groups of children who attend

different pre-K programs. The current literature typically discusses results of fadeout without considering the type or quality of the elementary school children later attend. Future fadeout research should be sure to investigate whether children who attend pre-K programs and children who attend other types of ECE programs later enroll in the same type/quality of schools, or examine whether children who attend certain types of ECE programs systematically attend particular later educational environments. My thesis also illustrates the need for additional research into how later school experiences may moderate long-term ECE effects.

Gaps in the Literature

More research is needed on whether preschool effects persist into middle school, and especially whether the quality of school later attended moderates group differences between children who attend different types of programs. Previous studies typically have ambiguous counterfactuals; that is, they know which children attended their preschool program, but their control group is typically made up of children who attended several other programs (Ansari & Pianta, 2018; Claessens, Engel, & Curran, 2014; Love et al., 2013; Magnuson et al., 2007). The current study will be able to make specific comparisons of children who attended public-school pre-K programs and center-based care on childcare subsidies. An advantage to this study is that ECE type was determined by administrative records rather than parental reports, as in other studies (Ansari & Pianta, 2018; Claessens et al., 2014; Magnuson et al., 2007). Since ECE programs have considerable variation, it is possible for parents to have indicated an inaccurate program type, different from administrative records that are sourced directly from the programs

themselves. Researchers generally also have used an extreme-groups design to compare children who attend schools of differing quality (Magnuson et al., 2007; Zhai et al., 2012). However, the current study will be able to compare children who attended a range of quality of schools. While some authors have argued that schools in the middle of the range of quality are more similar to one another than those in extreme groups (Zhai et al., 2012), this study will be able to directly evaluate this hypothesis. This project will bridge these gaps in the literature and provide new information on if/how the effects of preschool last into adolescence.

The Present Study

The current project used a subset of the MSRP (G5 *N* = 14,146;; G8 *N* =12,901) to examine whether effect sizes contrasting the academic performance of fifth and eighth graders who attended public-school pre-K programs, center-based care (CBC), or family childcare (FCC), vary as a function of elementary school quality.

The following research questions will be addressed in this study: 1) Are there sustained positive effects of public-school pre-K programs in 5th and 8th grade, relative to center-based and family childcare programs? 2) Do children who attend public-school pre-K programs attend schools of differing quality in fifth grade compared to children who attend CBC or FCC programs? 3) To what extent are sustained pre-K program effects on 5th and 8th grade outcomes dependent on the quality of school attended in 5th grade? 4) Are differential fadeout effects associated with school quality similar for males and females, and for Black or Hispanic/Latinx students?

METHOD

Sample

The overall dataset of the MSRP encompasses nearly all children in Miami-Dade County who were receiving child-care subsidies or attended public school pre-K in the years 2002-2006. In order to have received a subsidy, family income was capped at 150% of the federal poverty line. The centers within the MSRP included licensed and license-exempt for-profit and non-profit childcare centers, local/individual and national chains, faith-based church preschools, nurseries, and daycares. The pre-K programs of this sample employed certified teachers with a child-adult ratio of 20:2 or less, while CBC programs in the sample were of average quality, with fewer than 10% being accredited. Children were subsequently followed through eighth grade. The sample of the current study consists of 12,901 - 14,144 (52% male; 59% Latinx, 34% Black, 7% White/other children) who attended public school pre-kindergarten, center-based care, or family childcare at age 3-4 and had data for age-4 cognitive scores and fifth (N =14,144) or eighth grade outcome data (N = 12,901) on at least one outcome. Table 1 displays characteristics and demographics of the sample by the type of ECE program they attended at age 4.

Participants

The majority of the current sample attended center-based care (CBC; *n* = 7,231; 51.1%) though many attended public school pre-kindergarten (pre-K; n = 6,734; 47.6% and some attended family childcare (FCC; *n* = 179; 1.3%). The public-school pre-K group included children who attended Title-1 pre-K programs for free (*n* = 4,554), and also children from families who paid a fee to attend the programs (*n* = 2,180).

I conducted analyses for all research questions twice – once comparing similarly-poor children who attended Title-1 pre-K to children that attended CBC and FCC programs, and once comparing all children who attended pre-K programs to children that attended CBC and FCC programs to contextualize and compare our results to the literature mentioned above that often was not limited to children in poverty (Ansari & Pianta, 2018; Magnuson et al., 2007; Zhai et al., 2012).. My largest *N* included children who attended Title-1 or fee-supported pre-K, CBC, or FCC programs in fifth grade. Since there was a relatively small number of children who attended family childcare, I only included these children in my analyses for the first two research questions.

Measures

Gender.

Gender was dichotomously coded as female = 0 and male = 1.

Race/ethnicity.

The three groups included in this variable are Hispanic, African American, and White/Other. In my regression equations, this variable was dummy-coded, with Black students as the reference group.

Poverty status.

The child's Free and Reduced Lunch (FRL) status in fifth grade was used to indicate if the student is in poverty for regression equations on fifth grade outcomes. FRL status in eighth grade was used to indicate if the student is in poverty for analyses on eighth grade outcomes. Free lunch was provided to students from families with incomes of 130% or less of the federal poverty line (Schulman & Blank, 2011). Reduced lunch was provided to students from families with incomes of 185% or less of the federal poverty line (Schulman & Blank, 2011). I used a dummy-coded three-level FRL status variable, with reduced-price lunch as the reference group, distinguishing between students who received free lunch, reduced lunch, or paid full-price for their lunches. Evaluating the differences between children at all three levels is similar to the approach used by Magnuson et al. (2007), who used nine dummy-coded variables measured at the beginning of kindergarten to assess household income-to-needs ratios.

School-entry cognitive skills.

To control for school-entry cognitive skills, I used the child's Learning Accomplishment Profile Diagnostic (LAP-D; Nehring, Nehring, Bruni, & Randolph, 1992) scores. Specifically, I used the child's percentile rank on the cognitive subscale of this measure, which assessed matching and counting abilities.

The LAP-D is strongly correlated with similar exams (Hardin, Peisner-Feinberg, & Weeks, 2005) such as the Woodcock Johnson (Woodcock, McGrew, & Mather, 2001) and the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997). At the beginning of the preschool year, children were individually assessed by pre-K teachers or by bilingual

assessors. The LAP-D was administered in the child's strongest language. Children's dominant language was determined by teacher reports and an initial rapport-building session with the bilingual assessor in which the assessor used both languages with the children. Approximately 43% of participants took the LAP-D in Spanish, and 57% took it in English (Winsler et al., 2008). According to Hardin, Peisner-Feinberg, and Weeks (2005), both the English and Spanish version of the LAP-D have strong test-retest reliability (α = .93–.97). Previous literature has established that school-entry cognitive skills control for most other selection effects involved in sorting into CBC, FCC, and pre-K programs. These other potential selection effects (like parental education and cognitive stimulation at home) are expected to have already influenced child cognitive skills by age 4 (Ansari & Winsler, 2012, 2013).

Preschool type.

The three-level preschool type variable distinguishes between children who went to different types of preschool at age 4. Regression analyses were conducted separately using dichotomously-coded pre-K type variables to make all pairwise comparisons. For example, analyses comparing the public-school pre-K group (1) and CBC (0) included only children who attended these two types of programs. Children that attended FCC programs were coded as missing. In analyses comparing Title-1 pre-K (1) to CBC (0), children that attended fee-supported or FCC programs were coded as missing. In analyses comparing FCC (1) to CBC (0), children that attended public-school pre-K programs were coded as missing. In analyses comparing public-school pre-K (1) to FCC (0), children that attended CBC were coded as missing. In analyses comparing Title-1 pre-K

(1) to FCC (0), children that attended fee-supported or CBC were coded as missing. Most children and families of this dataset are of low SES (Table 1).

It is important to note that in 2005, Florida initiated its Voluntary pre-K program, significantly changing the cost and access of ECE to families of four-year-olds. Before 2005, Title-1 pre-K programs provided free, full-day pre-K for students of families whose primary residence was within a Title-1 school boundary. Fee-supported programs, while also full-day pre-K, were free for families for the first part of the day, but families were responsible for a fee for the second-half of the day. Some families may have chosen to pay a fee for the other half of the day in order for their children to stay at that program for the full day. However, we do not know the percentage of families that did this or instead chose to take their child to another type of care (or have no care). When VPK started, families of four-year-olds could enroll their child(ren) in a half-day program for free. Title-1 pre-K programs, CBC programs, and FCC programs were able to register as VPK programs, although most took place in the former two contexts. In 2013-2014, 80% of VPK programs were located within private centers, 18% were located within a public-school setting, and 1% were housed within FCC (Bassok, Miller, & Galdo, 2016). Agency records provided the specific type of pre-K attended for MSRP children, but did not provide information on the number of hours attended for CBC or FCC children, though we know that most attended for the full day and for five days of the week. In the first year that VPK was initiated, Florida served half of its population of families with 4-year-old children (Bassok et al., 2016). Today, approximately three-quarters of Florida's population of families with 4-year-old children are enrolled in VPK (Bassok et al., 2016).

School quality.

Publicly available school quality data - the "grade" (A, B, C, D, F) given to each school by the state department of education- was used for school-level quality. Though largely based on the percentage of students achieving proficiency on standardized testing is an imperfect measure, it is similar to the quality measures used in Currie and Thomas's (2000), Lee and Loeb's (1995) and Zhai et al.'s study (2012). Furthermore, I conducted bivariate correlations between the school quality grade with other potential predictors of school quality. School grade was moderately-largely correlated with the percentage of children receiving FRL status (r = -0.27, p <.01), the average staff salary (r = 0.46, p < .01) the school's dropout percentage (r = -0.51, p < .01), the number of computers used for student instruction (r = 0.51, p <.01), and the school's total expenditure per student (r = 0.53, p <.01). However, components and calculation of this measure changed throughout the years that the current sample was enrolled in fifth grade. These changes typically aligned with the years that Miami-Dade school district changed their standardized test assessments.

In this sample, students may have attended fifth grade in the academic years of 2007-2008 through 2014-2015. From 2007-2009, a school quality grade of "A" translated to a score of 525-800 points, "B" was 495-524 points, "C" equaled 435-494 points, "D" was equivalent to 395-434 points, and "F" meant that fewer than 395 points were earned. According to the Florida Department of Education (Florida Department of Education, 2010), points were attained as follows:

1. One point for each percent of students who meet high standards by scoring at or above FCAT Achievement Level 3 in reading.
2. One point for each percent of students who meet high standards by scoring at or above FCAT Achievement Level 3 in mathematics.
3. One point for each percent of students who meet high standards by scoring at or above FCAT Achievement Level 3 in science.
4. One point for each percent of students who meet high standards by scoring 3.5 or higher on the FCAT writing assessment. In the event that there are not at least 30 eligible students tested in writing, the district average in writing is substituted.
5. One point for each percent of students making learning gains in reading.
6. One point for each percent of students making learning gains in mathematics.
7. One point for each percent of the lowest performing students making learning gains in reading. In the event that there [were] not at least 30 eligible students, the school's reading learning gains [were] substituted.
8. One point for each percent of the lowest performing students making learning gains in mathematics. In the event that there [were] not at least 30 eligible students, the school's mathematics learning gains are substituted.

In the years 2007-2014, there were three ways in which a student could demonstrate learning gains. For example, if a student improved their achievement level by at least one (1-2; 2-3, 3-4, 4-5), or if a student maintained their achievement level score of a 3, 4, or 5, they were classified as having made an annual learning gain. Finally, if a student "demonstrated more than one year's growth within achievement levels 1 or 2" (not including retained students), this also classified a student as making an annual learning gain.

Schools earning an "A" were required to test at least 95% of their students. All schools were required to test at least 90% of their students. If a school tested fewer than 90% of its students, the school received a grade of "I" (Incomplete), and the school board would conduct an investigation into that school. No schools in the current study ever received an "I." All students' scores (including those with disabilities and English Language Learners) are included in the calculation of the learning gains component. Only

"standard curriculum students," – which includes speech-impaired, gifted, hospital/homebound, and English Language Learners with more than two years in an English as a Second Oral Language (ESOL) program - were included in the performance components calculation.

From 2010-2014, as in previous years, half of the possible points of a school's grade was derived from "performance components," or the percentage of students within a school meeting a certain threshold on standardized tests (Miami-Dade County Public School). The other half of the possible points scored was based upon "learning gains components." As in 2007-2010, schools earning an "A" were required to test at least 95% of their students, and schools earning a "B", "C", or "D" were required to test at least 90% of their students. In contrast to the previous years, instead of a point obtained per percentage of students who obtained a 3.5 in the Writing section, this score changed to a 4 or higher on the FCAT Writing essay (100 points maximum).

In 2014-15, calculation of school quality changed with the administration of the Florida Standard Assessments (FSA). In 2014, each school's grade could include up to seven components: English Language Arts achievement (100 points possible), Mathematics achievement (100 points possible), Science achievement (100 points possible), Social Studies achievement (100 points possible), and middle school acceleration success (the percentage of students who passed a high school level end of course assessment or industry certification; 100 points possible). The other two components were graduation rates and high school acceleration – both based on high school data, which were not applicable for the schools in the current study. Grades were

then given as follows: A = 62% of points or greater, B = 54% to 61% of points, C = 41% to 53% of points, D = 32% to 40% of points, F = 31% of points or fewer. It is also important to note that for 2014-2015, learning gains components could not be assessed since it was the first year of the new test. Schools were also required to test at least 95% of all students, instead of at least 90% as in previous years. If a student were enrolled in an alternative school, their scores were still incorporated into the Achievement component of the school quality grade.

Finally, although the calculation of quality grades did change several times, the percentage of schools that changed grades from one year to the next did not shift substantially as a function of these transitions. Furthermore, the categories of grades given (A-F) remained relatively stable throughout the years. Figure 1 shows the percentages of schools by type (elementary vs. middle) that changed grades by academic year. For these reasons, and since the Florida department of education worked hard to make the grades comparable across years, I did not use any methods to standardize the quality grades.

Fifth and eighth grade standardized tests.

The high-stakes Florida Comprehensive Assessment Test **(**FCAT; Human Resources Research Organization & Harcourt Assessment, 2007) math and reading scores or Florida State Assessment (FSA) math and reading scores were used as dependent variables in my analyses. All Florida public school children are required to take the FCAT for the first time in third grade. Students followed in the MSRP took one of two versions of the FCAT: the FCAT (scores range from 100-500) or the FCAT 2.0 (scores range from

140-302). In 2010, schools changed from the FCAT to the FCAT 2.0, and then again in 2014, they changed from the FCAT 2.0 to the Florida Standardized Assessments (FSA). It is important to note that when in fifth grade, all students in this sample were either administered the FCAT or the FCAT 2.0, but never the FSA. When in eighth grade, the sample was either administered the FCAT 2.0 or the FSA, but never the FCAT. Table 2 shows the cohort-level design of the MSRP and the years in which the various standardized tests were administered. For fifth grade, an aggregate FCAT variable was created so that students' scores, regardless of the version of the exam taken, could be compared. The scores of each version were standardized to z-scores using the mean of the full MSRP sample. These scores were treated continuously in analyses. The FCAT 2.0 reading and math exams were taken for the last time in spring 2014, apart from re-take exams that were accessible for students who needed to re-take an exam for graduation requirements. In analyses, z-scores of FCAT 2.0 reading and math scores (standardized on its own) were used and treated continuously. Transitioning to the FSAs was a decision made by the MDCPS school district to address the new Florida Standards in English Language Arts and in Math. The FSA scores were not z-transformed; possible scores on the FSA ELA ranged from 240 to 403, and from 240 to 393 for the FSA Math. These scores were treated continuously in analyses.

GPA.

Fifth and eighth grade point average (GPA) were also used as dependent variables. These scores range from 1.0 (F) to 5.0 (A). Fifth and eighth grade GPA were composite measures including children's grades in multiple subject areas (reading,

writing, language arts, math, science, social studies, art, music, and physical education; Winsler et al., 2008). The individual grades of these courses were averaged into an overall measure of GPA because of the correlations between the subject areas (*rs* = .22-.73; Ansari et al., 2016). These scores were treated continuously in my analyses.

RESULTS

Q1. Are there sustained positive effects of pre-K programs in 5th and 8th grade, relative to center-based programs and family childcare programs?

I performed a series of analyses to examine the fifth and eighth grade academic performance of children who attended public school pre-K programs, center-based programs, and family childcare programs. Given that children are nested within schools, I conducted several complex models (function TYPE = COMPLEX) in Mplus to separately predict fifth and eighth grade GPA, FCAT Math, and FCAT Reading. In eighth grade, children either took the FCAT 2.0 Math and Reading tests, or the FSA Math and English Language Arts (ELA) tests. In eighth grade analyses, I separately modeled the FCAT 2.0 math and reading tests and the FSA math and reading tests. In all of these models, I used fifth-grade school ID to adjust standard errors for school-level nesting. For elementary and middle retention status, I conducted a logistic regression using Monte Carlo integration without controlling for nesting. This was due to the skewed nature of the outcome and lack of convergence of the models when controlling for nesting.

Fifth grade analyses.

Predictors included dummy-coded three-level FRL status in G5 (with Reduced Lunch as the reference group), gender (male=1), dummy-coded ethnicity (Black as the reference group), age-4 cognitive skills, disability status in fifth grade (primary

exceptionality status=1), and dichotomous-coded preschool type (separate models conducted for all pairwise comparisons). “Public-school pre-K” will always refer to the combined group of children who attended Title-1 programs for free and children from families who paid a fee to attend the programs. Conversely, “Title-1 pre-K” will refer to only children who attended Title-1 pre-K programs for free. First, I conducted all pairwise comparisons for public-school pre-K (*including* fee-supported and Title-1 students), CBC, and FCC. I then conducted all pairwise comparisons for Title-1 pre-K, CBC, and FCC students. School IDs were the clustering variable. Missing data were handled using the Full-Information Maximum Likelihood (FIML) procedure for all covariates and outcomes. FIML was not performed for preschool-type (variance not requested), as I intentionally wanted to include only children in the specific pairwise comparisons for each analysis. When possible, reported main effects for covariates are taken from the model comparing public-school pre-K (including fee-supported and Title-1 students) and CBC students, as this model consistently had the largest sample size and the effects rarely differed across models. All pre-K type comparisons reported in tables were conducted in separate models with all covariates included.

GPA.

Table 3 shows β’s, standard errors, and the R^2 of all models. The models accounted for 21-29% of the variance in fifth grade GPA. Students with higher age-4 cognitive skills, White and Hispanic/Latinx students (compared to Black students), and students not in poverty had higher fifth grade GPAs than their respective counterparts.

Males, and students with a primary exceptionality status in fifth grade (compared to those without) had lower fifth grade GPA.

Children in the public-school pre-K group significantly outperformed those who attended CBC (p <.01) and those who attended FCC (p <.01). There was also a significant difference in the fifth grade GPA for students who attended Title-1 public school pre-K programs compared to those who attended center-based care, with Title-1 pre-K students out-performing those who attended CBC. There were no significant differences in fifth grade GPA between students who attended center-based care and those who attended family childcare, nor between children who attended Title-1 pre-K programs and those that attended family childcare programs (p's >.05).

FCAT Math.

Table 4 summarizes associations between pre-K type and fifth grade FCAT Math scores. The models accounted for 14-19% of the variance in fifth grade FCAT math scores. Students with higher age-4 cognitive skills, White and Hispanic/Latinx students (compared to Black students), students not in poverty, males, and students without disability status (compared to those with disability status) had higher math scores. Students who received lunch for free had lower FCAT math scores than students who received reduced-price lunch.

Net of these covariates, the public-school pre-K group significantly out-performed CBC students on fifth grade FCAT math scores (p <.01). There was not a significant difference between the public-school pre-K group and FCC children's fifth grade math scores. There was not a significant difference in the fifth grade FCAT math scores for

students who attended Title-1 pre-K programs compared to those who attended center-based care, nor between students who attended Title-1pre-K programs and those who attended family childcare. There were also no differences in math scores between students who attended center-based care and those who attended family childcare.

FCAT Reading.

Table 5 summarizes associations between pre-K type and fifth grade FCAT reading scores. The model accounted for 11-20% of the variance in fifth grade FCAT Reading scores. Students with higher age-4 cognitive skills, White students and Hispanic/Latinx students (compared to Black students), females, students not in poverty, and students without disabilities had significantly higher reading scores in fifth grade.

Even when controlling for covariates, students in the public-school pre-K group out-performed CBC students on FCAT reading scores in fifth grade ($p < .05$). There were no significant differences in fifth grade FCAT reading scores when comparing public-school pre-K and FCC students ($p > .05$). There were also no significant differences in reading scores when comparing Title-1 pre-K students to CBC students, Title-1 pre-K students to FCC students, nor when comparing CBC students to FCC students (p's $> .05$).

Elementary School Retention.

Table 6 summarizes associations between pre-K type and elementary school retention. Students with higher age-4 cognitive skills, Hispanic and White students (compared to Black students), females, students not in poverty, and students without disabilities were significantly less likely to be retained in elementary school. Compared to White students, Black students were 39% more likely to be retained, and compared to Hispanic students,

they were 36% more likely to be retained. Males were 24% more likely to be retained compared to females. Students who received lunch for free were 62% more likely to be retained compared to students who received reduced-price lunch. Students not in poverty were 31% less likely to be retained compared to students who received reduced-price lunch. Finally, students with a disability status in fifth grade were over five times more likely to be retained in elementary school compared to those without a disability status. Students who received lunch for free were significantly more likely to be retained in elementary school compared to students who received reduced-price lunch. Although the odds ratio associated with age-4 cognitive skills was relatively small (0.98), this indicates that for every one point percentile increase of cognitive skills, students were 2% less likely to be retained. That is, a student in the fiftieth percentile would be 50% less likely to be retained compared to a student in the twenty-fifth percentile (25 x .02).

Estimates for the pre-K variables suggest that pre-K type is often associated with being retained in elementary school. The likelihood of being retained in elementary school was reduced for children in the public-school pre-K group compared to children who attended CBC (p <.01) and when compared to children who attended FCC (p <.01). Compared to CBC students, students in the public-school pre-K group were 37% less likely to be retained in elementary school. Compared to FCC students, public-school pre-K students were 45% less likely to be retained. Children who attended Title-1 pre-K were less likely to be retained compared to children that attended CBC (p <.01) or FCC (p <.05). Compared to CBC students, Title-1 pre-K students were 18% less likely to be retained in elementary school. Compared to FCC students, Title-1 pre-K students were

30% less likely to be retained in elementary school. There were no differences in the likelihood of being retained in elementary school when comparing CBC students to FCC students ($p > .05$).

Fifth grade summary.

Overall, it seems that students in the public-school pre-K group had positive sustained effects lasting through fifth grade on all academic outcomes when compared to students that attended CBC. When limiting the sample to only students who attended Title-1 pre-K, there were still sustained effects through fifth grade on most academic outcomes compared to CBC students, except for standardized math and reading scores. Effects seemed to fade out more frequently when comparing the public-school pre-K group and the Title-1 pre-K group to FCC students, though this could be due to the smaller sample size and larger standard errors when comparing to the FCC group. Finally, there seems to be fadeout in fifth grade for the different subsidized CBC and FCC students, with no significant differences between the two groups on any fifth-grade outcome.

Eighth grade analyses.

Models for eighth grade were mostly identical to those conducted for fifth grade outcomes. Instead of using the z-transformed FCAT Reading and FCAT Math scores, however, I instead conducted separate analyses for FCAT 2.0 Math and FSA Math tests and FCAT 2.0 Reading and FSA Reading. Missing data was handled using the Full-Information Maximum Likelihood (FIML) procedure for all covariates and outcomes except FSA Math and Reading scores. Again, I did not request the variance of the

preschool-type predictor, as I intentionally wanted to include only children in the specific pairwise comparisons for each analysis. Similarly, I did not request the variance of FSA Math and Reading scores since I wanted these estimates to be based upon only children with data on those outcomes, and not the other type of standardized test.

GPA.

Table 7 shows β's, B's, standard errors, and the R^2 of estimates of all pre-K contrasts and associations with eighth grade GPA. Students with higher age-4 cognitive skills, White and Hispanic/Latinx students (compared to Black students), students not in poverty and in less poverty had higher eighth grade GPAs. Males and students with disabilities in eighth grade had lower eighth grade GPAs than their respective counterparts. Models accounted for 10-19% of the variance in GPA.

Students in the pre-K group significantly outperformed those who attended CBC (p <.01) and those who attended FCC (p < .01), even after controlling for the above covariates. There were no significant differences in the eighth grade GPA of students who attended Title-1 pre-K and those in CBC, nor between Title-1 pre-K and FCC (p's > .05). There were also no differences in the eighth grade GPA of students who attended CBC and those who attended FCC.

FCAT 2.0 math.

Table 8 shows β's, B's, standard errors, and the R^2 of estimates of models of all pre-K contrasts and associations with FCAT 2.0 Math scores. Like the other outcomes, students with higher age-4 cognitive skills, White and Hispanic/Latinx students (compared to Black students), males, students not in poverty (and in less poverty)

students without FRL status and typically-developing students had higher eighth grade FCAT 2.0 Math scores. Models explained 11-20% of the variance in FCAT 2.0 Math scores.

Students who attended Title-1 pre-K to students had significantly lower FCAT 2.0 Math scores in eighth grade compared to CBC students (p <.05). There were no other significant differences in eighth grade FCAT 2.0 Math scores based on pre-K type.

FSA math.

Table 9 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting all pre-K types and associations with eighth grade FSA math scores. Main effects of covariates were consistent with other outcomes, except that there was not a difference between students who received free lunch and those who received reduced-price lunch. FSA math scores did not vary depending on type of ECE attended at age 4. Models accounted for 8-13% of the variance in FSA math scores.

FCAT 2.0 reading.

Table 10 shows β's, B's, standard errors, and the R^2 of estimates of models contrasting all pre-K types and associations with FCAT 2.0 Reading. Patterns for covariates were consistent with other outcomes. Models accounted for 12-22% of the variance in eighth grade FCAT 2.0 Reading scores. There were no significant differences in FCAT 2.0 Reading scores by pre-K type for any of the pre-K contrasts.

FSA reading.

Table 11 shows β's, B's, standard errors, and the R^2 of estimates of models contrasting all pre-K types. Effects of covariates were in the expected directions, except

that there was not a significant main effect when comparing children who received free lunch compared to reduced-price lunch. Models accounted for 18-26% of the variance in FSA Reading scores. Children who attended public-school pre-K or Title-1 pre-K out-performed the CBC group on eighth grade FSA Reading scores (p <.01). There were no other significant pre-K type effects.

Middle school retention.

Table 12 shows β's, B's, standard errors, and odds ratios of models contrasting all pre-K types for middle school retention. Main effects for covariates were consistent with their patterns on other outcomes. Compared to Black students, White students were 44% less likely to be retained in middle school, and compared to Black students, Hispanic students were 43% less likely to be retained in middle school. Males were over twice as likely (219%) more likely to be retained compared to females. Students who received lunch for free were 69% more likely to be retained compared to students who received reduced-price lunch. Students without FRL status were 42% less likely to be retained compared to students who received reduced-price lunch. Finally, students with a disability status (compared to those without disability status) in eighth grade were not significantly more likely to be retained in middle school.

Students in the public-school pre-K group had 25% less odds of being retained in middle school compared to the CBC group (p <.01). No other center type contrasts were significant for middle school retention.

Eighth grade summary.

By eighth grade, many of the differences previously seen between students that attended public school pre-K programs and those that attended CBC or FCC have faded out. While effects did persist for the public-school pre-K group compared to CBC and FCC students for the outcomes of eighth grade GPA, FSA reading scores, and middle school retention, there were no differences between the public-school pre-K group and CBC or FCC students on FCAT 2.0 math or FSA math scores. An interesting "reversal effect" was seen on FCAT 2.0 math scores, when children who attended CBC out-performed the Title-1 pre-K group on FCAT 2.0 math scores. Furthermore, the Title-1 pre-K group only showed an advantage on FSA reading and middle school retention outcomes when compared to CBC students, though since this was not the same pattern seen for FCAT 2.0 math scores, this could suggest that that this was more a function of the assessment. There were never differences between the Title-1 pre-K group and FCC students nor between CBC and FCC students in eighth grade.

Q2. Do children who attend public-school pre-K, CBC, or FCC programs attend schools of differing quality in fifth grade?

My second research question investigated whether children systematically sort into schools of varying quality depending on their preschool type. To answer this question, I conducted a series of chi-square analyses with pre-K type as the independent variable and school quality, treated categorically, as the dependent variable (DV). First, I used a five-level school quality variable (A, B, C, D, F) as the DV and compared children who attended fee-supported, Title-1 pre-K, center-based care, or family childcare.

Overall, there was a significant difference in quality of school attended in fifth grade between children who attended fee-supported, Title-1, CBC, and FCC programs (χ^2 (12) = 3171.55, $p < .001$; Figure 2).

Interestingly, 87% of students from families who were able to pay a fee for their pre-K attended schools of A quality, 9.9% of these children attended schools of B quality, and about 3% or less of these children attended schools of C, D, or F quality. Of students who attended Title-1 pre-K programs and did not pay a fee, 40.5% of these students attended A quality schools, 18.9% of these students attended B quality schools, 29% attended C quality schools, 9.3% attended D quality schools, and only 2 % attended F quality schools. When these children were combined into one overall "public-school pre-K" group, 55.2% of these students attended A quality schools, 16.4% attended B quality schools, 20.2% attended C quality schools, 6.6% attended D quality schools, and 1.6% attended F quality schools. Similarly, of students who attended CBC, 54.9% attended schools of A quality, 16.4% attended schools of B quality, 20.9% attended schools of C quality, 6.7% attended schools of D quality, and 1.2% attended schools of F quality. Of children who attended FCC, 42.4% attended A quality schools, 23% attended B quality schools, 24% attended C quality schools, 9% attended D quality school, and 1.4% attended F quality schools.

Next, I collapsed the fee-supported and Title-1 into one category and compared this group to CBC and FCC children. While there was still a significant difference between these three groups (χ^2 (8) = 29.27, $p < .001$), the proportion of students who attended public school pre-K programs and later attended schools of A quality was more

similar to the other two groups than when comparing the groups separately. Therefore, I conducted supplementary analyses in which I combined Title-1 and fee-supported children into one category (called the public-school pre-K group) and compared them to children who attended CBC and FCC for the models that follow in the third and fourth research questions.

Since children from families who were able to pay a fee for their programs attended schools of significantly higher quality compared to their peers who did not pay a fee for their programs, I conducted additional analyses to investigate if there were still significant differences in the quality of school attended in fifth grade when comparing children who attended only Title-1 pre-K, CBC, or FCC programs. Furthermore, because only 1.4% of students across all four types of ECE programs attended schools of F quality, and just 6.7% of all students attended schools of D quality, this confirmed my choice to combine schools of D and F quality into one category. There was still a significant difference in quality of school attended in fifth grade by program type when comparing the three ECE types ($\chi 2$ (6) = 467.37, $p < .001$).

Children who attended Title-1 pre-K programs attended schools of lower-quality compared to CBC children ($\chi 2$ (1) = 323.77, $p < .001$) and FCC children ($\chi 2$ (1) = 4.13 $p < .05$). Children who attended CBC programs attended schools of higher quality compared to FCC children ($\chi 2$ (1) = 4.37, $p < .05$). Then, I collapsed CBC and FCC children into one category. This group still went on to attend schools of higher quality in fifth grade compared to Title-1 pre-K children ($\chi 2$ (1) = 319.84, $p < .001$). Results from this series of analyses suggest that in fifth grade, children who attended CBC go on to

attend schools of higher quality than children who attended FCC, and children who attended FCC go on to attended schools of higher quality than children who attended Title-1 pre-K programs.

Q3. To what extent are sustained pre-K program effects on 5th and 8th grade outcomes dependent on the quality of school attended in 5th grade?

My third research question determined whether the level of school quality attended in fifth grade moderated any existing pre-k type group differences in fifth and eighth grade academic outcomes. Given that children are nested within schools, I conducted several complex models (function TYPE = COMPLEX) in Mplus to separately predict fifth grade GPA, FCAT Math, and FCAT Reading. Since the MSRP is a cohort-sequential design, students in fifth grade may attend the same school, but in different years. For example, in 2008, students in the first cohort who were on-time (never retained and never skipped a grade) attended fifth grade for the first time. However, students in the second cohort who were on-time did not attend fifth grade until 2009. Even though the students with the same School ID attended the same school and were in the same grade, the cohort-level design can result in different school quality grades since school quality grades are assigned annually and can change from year to year. Therefore, instead of using a two-level model where the between-group variable does not allow for variation within groups, I used the TYPE=COMPLEX option in Mplus with fifth-grade school ID as the clustering variable to adjust standard errors for school-level nesting. Covariates included age-4 cognitive skills, gender, ethnicity (Hispanic/Latinx compared to Black students as reference group; White/Other students excluded due to small cell sizes), FRL status (two dummy-coded variables with reduced lunch as the reference group and either free lunch or no FRL status as the counterfactual),

and disability status in G5 (1=has primary exceptionality status in G5). Main predictors of interest included preschool type (dichotomously coded; CBC=0 and Title-1 pre-K = 1; CBC=0 and public-school pre-K group=1, conducted in separate analyses), school quality (4-level variable treated continuously, 0-4), and the multiplicative interaction term of preschool type by four-level school quality treated continuously. The reported main effect for school quality is taken from the public-school pre-K (including both fee-supported and Title-1) compared to CBC students, as this model consistently had the largest sample size. For elementary school retention status, I conducted separate logistic regressions with the same predictors using Monte Carlo integration without controlling for nesting. This was due to the skewed nature of the outcomes and lack of convergence of the models when controlling for nesting. Full-information Maximum Likelihood (FIML) procedures were used to handle missing data.

Fifth grade outcomes.

GPA

Table 13 shows β's, B's, standard errors, and the R^2 of estimates of models contrasting public-school pre-K and Title-1 pre-K students to CBC students and associations with fifth grade GPA and school quality interactions. Models accounted for 23-26% of the variance in fifth grade GPA. School quality had a significant, positive main effect on fifth grade GPA. The pre-K type by school quality interaction was not significant when comparing the public-school pre-K group to CBC children nor when comparing the Title-1 pre-K group to CBC children.

FCAT math.

Table 14 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with FCAT math scores and school quality. School quality had a significant main effect, such that as school quality increased, FCAT math scores increased. The pre-K type by school quality interaction was not significant when comparing the public-school pre-K group to CBC students. However, the pre-K type by school quality interaction was significant when comparing Title-1 pre-K students to CBC students ($p < .05$; Figure 3). While Title-1 pre-K students slightly out-performed CBC students across all levels of quality, the differences were largest at the worst-quality schools and smallest at the highest quality schools. Differences between the two groups decreased (more convergence) as school quality increased.

FCAT reading.

Table 15 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with fifth grade FCAT reading scores and school quality. School quality had a significant positive main effect on FCAT reading scores. The pre-K by school quality interaction term was significant when comparing public school pre-K students (including fee-supported) to CBC students, but not in other pre-K contrasts involving only Title-1 pre-K. The patterns of how school quality affected group differences between pre-K students and CBC students are reflected in Figure 4. Pre-K students typically had higher FCAT reading scores compared to CBC students. Fadeout existed at poor quality schools,

but as school quality increased, differences between the groups slightly increased, with pre-K students increasingly out-performing CBC students. The largest differences existed when students attended the highest-quality schools (lack of fadeout/convergence).

Elementary school retention.

Table 16 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with elementary school retention and school quality. The pre-K type by school quality interaction was not significant for either of the pre-K contrasts for elementary school retention. The quality of school attended in fifth grade did not differentially change the group differences seen in elementary school retention when comparing the public-school pre-K group to center-based care or when comparing Title-1 pre-K to CBC.

Summary.

School quality did not moderate differences between public-school pre-K and CBC in a consistent way. For example, it did not moderate effects between either the public-school pre-K group and CBC students nor the Title-1 pre-K group and CBC students for fifth grade GPA. School quality did moderate the effects of differences between the public-school pre-K group and CBC students on FCAT Math scores, such that differences were largest at poor quality schools, and smallest at the best quality schools (a catch-up effect for CBC students). On the other hand, the opposite pattern was seen for FCAT Reading scores when comparing Title-1 pre-K and CBC students (fadeout at the worst quality schools, persistence at the highest quality schools).

Eighth grade outcomes.

GPA.

Table 17 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with eighth grade GPA and school quality. The pre-K type by school quality interaction was not significant for either of the pre-K contrasts. The quality of school attended in fifth grade did not differentially change the group differences seen in eighth grade GPA when comparing the public-school pre-K group to CBC nor did it change when comparing Title-1 public school pre-K to CBC.

FCAT 2.0 Math.

Table 18 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with eighth grade FCAT 2.0 math scores and school quality. The pre-K type by school quality interaction was not significant for either of the pre-K contrasts for FCAT 2.0 math scores.

FSA Math.

Table 19 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with eighth grade FSA math scores and school quality. The pre-K type by school quality interaction was significant when comparing the public-school pre-K group to CBC students (Figure 5). While the public-school pre-K group typically out-performed CBC students, there were no differences in FSA math scores when students attended the

poorest quality schools. As school quality increased however, differences between the groups increased, with the public-school pre-K group out-performing CBC students, and the largest differences present at the highest-quality schools. The pre-K type by school quality interaction was not significant when comparing Title-1 pre-K students to CBC students on FSA math scores.

FCAT 2.0 Reading.

Table 20 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with eighth grade FCAT 2.0 reading scores and school quality. The pre-K type by school quality interaction was significant when comparing the public-school pre-K group to CBC students (Figure 6). While CBC students slightly out-performed public-school pre-K students at the lowest quality schools, there were no differences between the two groups at middle-quality schools. When attending the highest-quality schools, the public-school pre-K group slightly out-performed CBC students. The pre-K type by school quality interaction was not significant the Title-1 pre-K to CBC contrast for FCAT 2.0 reading scores.

FSA Reading.

Table 21 shows β's, B's, standard errors, and the R^2 of estimates of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with eighth grade FSA reading scores and school quality. The pre-K type by school quality interaction was not significant for either of the pre-K contrasts (*p*'s >.05) for FSA reading scores.

Middle School Retention.

Table 22 shows β's, B's, and standard errors of the model contrasting the public-school pre-K group and Title-1 pre-K to CBC students and associations with middle school retention and school quality. The pre-K type by school quality interaction was significant when comparing Title-1 pre-K students to CBC students. I performed two follow-up regression analyses selecting only CBC and then only pre-K children to more closely examine the pre-K type by school quality interaction. Results showed that quality was more strongly associated with reducing the likelihood of middle school retention for children that attended CBC. A one-point increase in school quality (e.g., going from a B-quality to A-quality school) decreased the likelihood of being retained in middle school by 24% for those who attended CBC at age 4 (B = -0.23). Comparatively, school quality was less associated with middle school retention for students that attended public-school pre-K. For these students, a one-point increase in school quality decreased the likelihood of being retained in middle school by only nine percentage points (B = -0.09). The pre-K type by school quality interaction was not significant when examining the full public-school pre-K group to CBC group contrast.

Summary of School Quality and Eighth Grade Outcomes.

School quality moderated the effects of pre-K on eighth grade academic outcomes in complex ways. The pre-k by school quality interaction was not significant for the outcomes of GPA, FCAT 2.0 math, or FSA reading. The pre-K advantage increased as school quality increased for the outcomes of FSA math. For FCAT 2.0 reading scores, the pre-K advantage was only present at the highest quality schools, and students who

attended CBC programs out-performed pre-K students at the lowest quality schools. School quality was more important in reducing odds for middle school retention for CBC students than for pre-K students.

Q4. Are differential fadeout effects associated with school quality similar for males and females, and for Black or Hispanic/Latinx students?

My final research question determined if the way in which school quality moderated preschool effects depended upon the gender or ethnicity of the child. Models did not converge in regressions using the three-way preschool type by quality by gender, or preschool type by quality by ethnicity multiplicative terms. Instead, I selected only males, only females, only Black students or only Hispanic/Latinx students and then used the multiplicative preschool type by school quality interaction term in separate linear regressions for continuous outcomes (GPA, FCAT Math, FCAT Reading). In each of these models, I controlled for school-level nesting and used FIML to handle missing data. For the binary outcome of elementary school retention, I did not control for nesting, but instead used a logistic regression with Monte Carlo estimator and FIML for missing data.

Gender

Fifth grade.

GPA.

Table 23 shows β's, B's, standard errors, and R^2 estimates of the pre-K type by school quality interaction for males and females (separately) for fifth grade GPA. Females who attended the public-school pre-K group and the Title-1 pre-K group significantly out-performed CBC students on fifth grade GPA. On the other hand, there

was not a significant main effect for pre-K type present for males who attended public-school pre-K or Title-1 pre-K compared to CBC. The pre-K type by school quality interaction was never significant for females. However, there was a significant quality by pre-K type interaction for males who attended public-school pre-K compared to males who attended CBC ($p < .05$; Figure 7). While males in the public-school pre-K group consistently out-performed males who attended CBC across all levels of quality, differences were smallest at the worst quality schools and increased as school quality increased. Differences were largest at the highest quality schools. Main effects for school quality and for other covariates were similar across the two genders. For fifth grade GPA, the pre-K advantage was more evident for girls, regardless of school quality. Meanwhile, school quality was more important for males, such that the pre-K advantage was only true when attending schools of higher quality.

FCAT math.

Table 24 shows β's, B's, standard errors, and R^2 estimates of the pre-K type by school quality interaction for males and females on fifth grade FCAT math scores. While females in the public-school pre-K group had higher trending FCAT math scores compared to females that attended CBC, males in the public-school pre-K group had more negative scores than males who attended CBC (though this effect was not significant). There was not a significant quality by type interaction for females in the public-school pre-K group compared to females who attended CBC, but there was for males ($p < .05$; Figure 8). While the smallest differences between the groups existed at the poorest quality schools, the public-school pre-K males out-performed CBC males at

all other levels of school quality. Differences between the groups also increased as school quality increased, so that the largest differences and persistence of effects were present at the highest quality schools for boys. There was not a significant pre-K type by school quality interaction when comparing Title-1 pre-K to CBC students for males nor females. Main effects for school quality and for other covariates were similar across the two genders.

FCAT Reading.

Table 25 shows β's, B's, standard errors, and R^2 estimates of the pre-K type by school quality interaction for males and females on fifth grade FCAT reading scores. There was not a significant main effect for pre-K type for females in the public-school pre-K group compared to CBC females. There was a significant negative main effect for males in the public-school pre-K group compared to CBC males, with CBC males out-performing public-school pre-K males. There was not a significant main effect for pre-K type for males or for females when comparing Title-1 pre-K students to CBC students. The pre-K type by school quality interaction was significant for males when comparing the public-school pre-K group to CBC students ($p < .01$, Figure 9). The pattern was the same for males as it was for the overall pre-K public-school pre-K and CBC students on FCAT reading. While CBC males slightly out-performed public-school pre-K males at the lowest quality schools, there were no differences between the two groups at schools of average quality. At the highest quality schools, public-school pre-K males out-performed CBC males on FCAT reading scores. The pre-K type by school quality interaction was not significant for males or females when comparing Title-1 to CBC

students. Main effects for school quality and for other covariates were similar across the two genders.

Elementary School Retention.

Table 26 shows β's, B's, standard errors, and odds ratios of the pre-K type by school quality interaction for males and females on elementary school retention. Main effects for pre-K type when comparing both the public-school pre-K group and Title-1 pre-K students to CBC students were similar for males and females. The pre-K type by school quality interaction was not significant when comparing the public-school pre-K group nor Title-1 pre-K to CBC students for either gender. Most covariates were similar across the two genders, apart from disability status in fifth grade. While students with a disability were significantly more likely to be retained across both males and females ($p < .01$), females with a disability status were 7.45 times more likely to be retained compared to females without a disability status. Males with a disability status were 4.48 times more likely to be retained in elementary school compared to males without a disability status.

Eighth grade outcomes.

GPA.

Table 27 shows β's, B's, standard errors, and R^2 estimates of the pre-K type by school quality interaction for males and females on eighth grade GPA. The main effects for pre-K type and school quality were similar across males and females. There was a significant pre-K type by school quality interaction for females when comparing the public-school pre-K group to CBC students ($p < .05$; Figure 10). While females in the

public-school pre-K group always out-performed females who attended CBC, differences were smallest at the lowest quality schools, and increased as school quality increased. Differences were largest at the highest quality schools. Males showed a similar pattern for this contrast, but the interaction was not statistically significant. There was not a significant pre-K type by school quality interaction when comparing Title-1 pre-K to CBC students for males nor females. Main effects for other covariates were similar for males and females, again apart from disability status. Females with a disability had significantly lower eighth grade GPAs compared to females without a disability ($p < .01$). However, there was no difference in eighth grade GPA when comparing males with and without a disability.

FCAT math.

Table 28 shows β's, B's, standard errors, and R^2 estimates of the pre-K type by school quality interaction for males and females on eighth grade FCAT 2.0 Math scores. There was not a significant main effect for pre-K type when comparing the public-school pre-K group or Title-1 pre-K to CBC students for either gender. There was not a significant pre-K type by school quality interaction when comparing the public-school pre-K group or Title-1 pre-K to CBC students for either gender. The main effects for school quality and other covariates were similar for males and females. In summary, pre-K and school quality effects did not differ depending on gender for FCAT 2.0 Math scores.

FSA math.

Table 29 shows β's, B's, standard errors, and R^2 estimates of the pre-K type by school quality interaction for males and females on eighth grade FSA Math scores. There was no main effect for pre-K type comparing the public-school pre-K group or Title-1 pre-K group to CBC students for females. However, there was a significant pre-K effect for both pre-K contrasts for males, such that CBC students slightly outperformed the public-school pre-K group and Title-1 pre-K students (more so for Title-1 pre-K students). School quality did not have a significant main effect for either males or females. There was no pre-K type by school quality interaction comparing the public-school pre-K group or Title-1 pre-K to CBC students for females, but both were significant for males (p's < .01). Figure 11 shows the public-school pre-K males to CBC males contrast for the pre-K type by school quality interaction. While CBC males slightly outperformed males in the public-school pre-K group when attending the lowest-quality schools, males in the public-school pre-K group outperformed CBC males across all other levels of school quality. Differences between the two increased as school quality increased, with the largest differences seen at the highest quality schools. CBC students performed similarly across all levels of school quality. In this graph, there is evidence of fadeout at the lowest quality schools, but persistence of effects for boys in the public-school pre-K group across schools of higher quality. This indicates that despite the significant negative main effect of pre-K type in the model, it is important to be cautious of interpreting main effects within models with significant interaction terms. Instead, graphs of interactions illustrate the patterns more effectively.

Main effects for covariates also somewhat differed by gender. Cognitive skills, while significant for both males and females (p's < .01), had a more positive relationship with FSA math scores for males compared to females. Other covariates had similar patterns across both genders.

FCAT 2.0 reading.

Table 30 shows β's, B's, standard errors, and R^2 estimates of the pre-K type by school quality interaction for males and females on eighth grade FCAT 2.0 reading scores. There was not a significant main effect for pre-K type for females when comparing the public-school pre-K group to CBC students, but there was for males ($p < .05$). Males who attended CBC significantly out-performed males in the public-school pre-K group on FCAT 2.0 reading scores in eighth grade. There was not a significant main effect for pre-K type when comparing Title-1 pre-K to CBC for either gender. There was not a significant pre-K type by school quality interaction for females when comparing the public-school pre-K group to CBC students, but there was for males ($p < .05$; Figure 12). Male students who attended CBC out-performed male students in the public-school pre-K group at the lowest-quality schools and at "C" level schools. There were no differences between the groups at "B" level schools. At the highest quality schools, males in the public-school pre-K group out-performed males who attended CBC. There was not a significant pre-K type by school quality interaction when comparing Title-1 pre-K to CBC students for either gender. Main effects for school quality and other covariates did not differ by gender.

FSA reading.

Table 31 shows β's, B's, standard errors, and R^2 estimates of the pre-K type by school quality interaction for males and females on eighth grade FSA Reading scores. FSA reading scores did not differ by pre-K type for either gender. School quality did not have a significant effect for either gender, nor was the pre-K type by school quality interaction significant for either gender. Main effects for covariates were similar for both males and females.

Middle school retention.

Table 32 shows β's, B's, standard errors, and odds ratios of the pre-K type by school quality interaction for males and females on middle school retention. There was a significant main effect for pre-K type when comparing the public-school pre-K group to CBC students for females, although this effect was not significant for males. Females in the public-school pre-K group were 58% less likely to be retained in middle school than females who attended CBC. There was not a significant pre-K type main effect when comparing Title-1 pre-K to CBC for either gender. There was never a significant pre-K type by quality interaction. Main effects for school quality, cognitive skills at age 4, race/ethnicity, and disability status were also similar for males and females.

Ethnicity

Fifth grade.

GPA.

Table 33 shows β's, B's, standard errors, and R^2 of the pre-K type by school quality interaction on fifth grade GPA for Hispanic/Latinx and Black children. Fifth grade

GPA did not vary depending on pre-K type for either race/ethnicity. School quality was positively associated with fifth grade GPA for both groups. There was not a significant pre-K type by school quality interaction when comparing the public-school pre-K group or Title-1 pre-K to CBC students for either race/ethnicity. The main effects for school quality and other covariates were similar for each group. In summary, pre-K and school quality effects did not differ depending on race/ethnicity for fifth grade GPA.

FCAT math.

Table 34 shows β's, B's, standard errors, and R^2 of the pre-K type by school quality interaction on fifth grade FCAT math scores for Hispanic/Latinx and Black children. Pre-K type was not differentially associated with standardized math scores. While school quality was positively associated with fifth grade GPA for both groups, the pre-K type by school quality interaction was never significant. Covariates of cognitive skills and disability status had similar effects across the two groups.

FCAT reading.

Table 35 shows β's, B's, standard errors, and R^2 of the pre-K type by school quality interaction on fifth grade reading for Hispanic/Latinx and Black children. Main effects for pre-K type were never significant, although school quality was positively associated with fifth grade GPA for both groups. There pre-K type by school quality interaction was only significant when comparing Hispanic/Latinx public-school pre-K students to CBC students ($p < .01$; Figure 13). While there were no differences at the lowest quality schools, Hispanic/Latinx students in the public-school pre-K group out-performed CBC at higher quality schools. Differences between the two increased as

school quality increased, with the largest differences seen at the highest quality schools. In this graph, there is evidence of fadeout at the lowest quality schools, but persistence of effects for children in the public-school pre-K group across schools of higher quality. Covariates of cognitive skills, gender, non-FRL status, and disability status were similar for both races.

Elementary school retention.

Table 36 shows β's, B's, standard errors, and odds ratios of the pre-K type by school quality interaction on elementary school retention for Hispanic/Latinx and Black children. Of interest, Hispanic/Latinx children who attended public-school pre-K were 45% less likely to be retained by fifth grade compared to Hispanic/Latinx children who attended CBC, but there was not a difference in the likelihood of being retained for Black students who attended different types of pre-K. Attending schools of higher quality always reduced the likelihood of being retained by fifth grade. The pre-K type by school quality interaction was never significant. Main effects for covariates of cognitive skills, receiving free lunch, and not having FRL status were similar across race/ethnicity. For Hispanic/Latinx students, having a disability in fifth grade increased the odds of being retained by fifth grade much more so than for Black students (6.45 compared to 3.81, respectively).

Eighth grade.

GPA.

Table 37 shows β's, B's, standard errors, and R^2 of the pre-K type by school quality interaction on eighth grade GPA for Hispanic/Latinx and Black children.

Hispanic/Latinx children that attended public-school pre-K had significantly higher eighth grade GPAs compared to CBC students, but this was the only significant pre-K type main effect. School quality was positively associated with eighth grade GPA for both groups. The pre-K type by school quality interaction was never significant. Covariates had similar effects across the two groups.

FCAT 2.0 math.

Table 38 shows β's, B's, standard errors, and R^2 of the pre-K type by school quality interaction on FCAT 2.0 Math scores for Hispanic/Latinx and Black children. There was never a significant pre-K type main effect on FCAT 2.0 Math scores. School quality was always positively associated with fifth grade GPA, but it was not a significant moderator of pre-K effects. Main effects for covariates were similar across the two groups.

FSA math.

Table 39 shows β's, B's, standard errors, and R^2 of the pre-K type by school quality interaction on FSA scores for Hispanic/Latinx and Black children. Like FCAT 2.0 math scores, neither pre-K type main effects nor the pre-K type by school quality interaction term were significant. However, children that attended schools of higher quality earned higher FCAT 2.0 math scores. Effects of covariates occurred in the expected directions.

FCAT 2.0 reading.

Table 40 shows β's, B's, standard errors, and R^2 of the pre-K type by school quality interaction on FCAT 2.0 Reading scores for Hispanic/Latinx and Black children.

There was not a significant pre-K type main effect on FCAT 2.0 Reading scores. School quality was positively associated with FCAT 2.0 reading scores for both groups, but only significantly so for Black students. The pre-K type by school quality interaction was never significant. Main effects for covariates were similar across both groups.

FSA reading.

Table 41 shows β's, B's, standard errors, and R^2 of the pre-K type by school quality interaction on FSA reading scores for Hispanic/Latinx and Black children. FSA reading scores did not vary as a function of pre-K type attended. School quality was positively associated with fifth grade GPA for both groups, but it was not statistically significant. There was not a significant pre-K by school quality interaction for either race/ethnicity when comparing public-school pre-K or Title-1 pre-K to CBC students.

Middle school retention.

Table 42 shows β's, B's, standard errors, and odds ratios of the pre-K type by school quality interaction on middle school retention for Hispanic/Latinx and Black children. Pre-K type was only a significant predictor of middle school retention or the public-school pre-K and Title-1 pre-K to CBC comparisons for Black children ($p < .01$). Black children who attended public-school pre-K were 60% less likely to be retained in middle school compared to Black children who attended CBC. Black children who attended Title-1 pre-K were 55% less likely to be retained in middle school compared to Black children that attended CBC. School quality was significantly negatively associated with the likelihood of being retained in middle school for both groups). The pre-K type by school quality interaction was nearly significant for Black children when comparing

the public-school pre-K group and Title-1 pre-K to CBC children. To more closely examine the quality by pre-K type interaction, I also did two follow-up regression analyses selecting only CBC and then only pre-K children. Results showed that quality was more strongly associated with reducing the likelihood of middle school retention for Black CBC students than for Black pre-K students. A one-point increase in school quality (e.g., going from a B-quality to A-quality school) decreased the likelihood of being retained in middle school by 23% (B = -0.23). Comparatively, school quality was less associated with middle school retention for Black students that attended public-school pre-K. For these students, a one-point increase in school quality decreased the likelihood of being retained in middle school by only two percentage points (B = -0.02). There was not a significant pre-K type by school quality interaction for Hispanic/Latinx children when comparing either the public-school pre-K group or Title-1 pre-K to CBC. Covariates were similar across both groups.

DISCUSSION

As policymakers wish to see lasting effects from investments in ECE programs, it is important to study the long-term academic outcomes of children who attend various types of programs. Along with recent studies exploring the associations between ECE program attendance and academic performance in Grades 3, 5, and 8 (Ansari et al., 2016; Hill et al., 2015; Phillips et al., 2016, Weiland & Yoshikawa, 2013), the current study provides important information about how attendance in various types of ECE programs relate to students' later academic performance in school. Few studies have investigated the potential moderating influence of elementary school quality on the association between ECE program attendance and later academic performance (Ansari & Pianta, 2018; Magnuson et al., 2007; Zhai et al., 2012), which was the primary goal of the current study. Specifically, I explored fifth and eighth grade academic performance for children who had attended FCC, CBC, or public-school pre-K programs at age four and then attended elementary schools of varying quality.

In fifth grade, positive sustained effects for all academic outcomes and reduced odds of being retained were found for students who attended public-school pre-K programs compared to students who attended CBC. While this pattern was not always seen when comparing the public-school pre-K groups to FCC, this could be due to the low sample size and higher standard deviations of scores for students who attended FCC.

Limiting the public-school pre-K sample to only students that attended high-poverty, Title-1 pre-K programs resulted in fewer sustained effects compared to CBC - but positive sustained effects were still seen for GPA and being retained in elementary school. There were no differences in scores between Title-1 pre-K students and CBC students on the standardized math or reading tests. Except for retention, there were never differences in academic outcomes when comparing Title-1 pre-K students to FCC students. Further, there were never differences in fifth grade outcomes when comparing CBC students to FCC students. These results are similar to those found in third grade for the same sample, when sustained positive effects were found for Title-1 pre-K children on third grade GPA and reading scores, but not on FCAT math scores (Mumma & Winsler, in review).

Other studies have also found sustained effects for pre-K children (Barnett et al., 2013; Dodge et al., 2017). However, these studies have been conducted with samples of more White, higher-income children, and did not distinguish between types of poverty like the current study. For example, 61% of the North Carolina study's sample was comprised of White children, and neither study distinguished between free or reduced lunch status (Barnett et al., 2013; Dodge et al., 2017). Furthermore, about 71% of the NJ Abbot Study had children with FRL status, compared to the 85% of children in the current study. The North Carolina study did not report the percentage of students on FRL status. It is important to consider the impact of these results in the context of the study's population: high-poverty, linguistically and ethnically diverse children. The effects of poverty are far-reaching and contribute much to gaps in achievement between children from low- and high-SES families (Duncan & Brooks-Gunn, 1997; Duncan, Ziol-Guest, &

Kalil, 2010). The fact that positive, sustained effects of attending public-school pre-K are still seen at least six years post-program for an at-risk population is very encouraging. Findings like these could also support policy initiatives that expand access to public-school pre-K for age-4 children.

In eighth grade, we found patterns of fadeout were more common than in earlier years. For example, while the public-school pre-K group still out-performed the CBC group on outcomes of GPA and FSA reading, and were less likely to be retained in middle school compared to CBC, there were no differences between the two groups on either of the standardized math tests or on FCAT 2.0 reading. This contrasts with results seen in fifth grade, when the public-school pre-K group outperformed the CBC group on FCAT math and reading scores. Similarly, Title-1 pre-K students only out-performed the CBC group on FSA reading. Although Title-1 pre-K students had higher fifth grade GPAs and less likelihood of being retained in elementary school compared to CBC students, this was not the case in eighth grade, when there were no differences between the two groups. Particularly interesting, while there were no overall differences in fifth grade FCAT math scores between Title-1 pre-K children and CBC children, by eighth grade, the CBC group had significantly higher scores on FCAT 2.0 math tests. Consistent with results in fifth grade, there were never differences in eighth grade academic outcomes between students that attended Title-1 pre-K and FCC nor between those that attended CBC and those that attended FCC. Furthermore, there were no differences by pre-K type on outcomes of FSA math or FCAT reading scores. These findings may indicate that fadeout is more likely to

occur as students progress through their academic career and other factors become more important predictors of academic outcomes than a child's ECE experience.

Eighth grade results found for the current study were similar to those found in the other studies assessing the persistence/fadeout of preschool effects in eighth grade (Ansari & Pianta, 2018; Dodge et al., 2019; Gormley et al., 2018). For example, Dodge et al. (2019) and Gormley et al. (2018) both found that the likelihood of being retained in middle school was reduced for children who attended pre-K compared to children who attended a different type of ECE program. Persistence of pre-K effects was also found for standardized reading and math assessments through the end of seventh or eighth grade for children in Tulsa, North Carolina, and the nationally representative sample of the ECLS-K (Ansari & Pianta, 2018, Dodge et al., 2019, Gormley et al., 2018).

Researchers and policymakers should also carefully consider their expectations of pre-K programs. Children in these programs later go on to attend the same school systems which are dedicated towards being the "great equalizer" and *reducing* achievement gaps (Bernardi & Ballarino, 2016; Winsler & Mumma, in press). As noted in Jenkins et al. (2018), the only way for pre-K programs to meet the demand of policymakers is to have pre-K students learn material faster than students that did not attend pre-K, even though all students are going on to attend the same schools. Furthermore, the schools that students later go on to attend could very well be of low-quality, considering that many pre-K programs are targeted towards high-poverty populations (Pianta et al., 2007; Stipek, 2004; Winsler & Mumma, in press). Although the pre-K program of interest itself may be of high quality, it is critical to also investigate the

quality of school attended later, at least through elementary school. Maintaining a high-quality environment is clearly relevant for expecting the persistence of effects.

Given that the "pre-K advantage" was present for several outcomes in fifth and eighth grade, it was important to investigate whether elementary school quality moderated these group differences. Results in third grade from this sample on outcomes of GPA and FCAT reading scores indicated that as school quality increased, differences between pre-K students and CBC students increased, so that there was fadeout at the lowest-quality schools, but persistence of effects at the highest quality schools (Mumma & Winsler, in review). In fifth grade, the pre-K type by school quality interaction was significant for FCAT Math and Reading, but not for GPA or elementary school retention, when the pre-K advantage was seen regardless of the quality of school attended. Recall that when averaging across all levels of school quality, there were no differences between Title-1 pre-K and CBC students on fifth grade math scores. However, patterns of differences between the two groups varied across levels of quality. Differences were largest at the lowest quality schools and decreased as quality increased (persistence at low-quality schools, convergence at high-quality schools). Considering that CBC students had higher scores than Title-1 pre-K students by eighth grade, perhaps this is an indication school quality is more important for CBC students on math outcomes. Interestingly, the opposite effect was seen for fifth grade reading scores, consistent with what was found in third grade (fadeout at lowest quality schools, persistence at highest-quality schools).

In eighth grade, the outcomes of GPA (no significant interaction) and FCAT reading scores (pre-K advantage more present at higher quality schools) were consistent with findings in fifth grade. The most common pattern of fadeout at low-quality schools and persistence at high-quality schools was found again for eighth grade FSA math scores, favoring the public-school pre-K group. On the other hand, the pre-K type by school-quality interaction was not significant for FSA reading scores, suggesting the pre-K advantage was present across all levels of quality for this measure. Finally, although the pre-K type by quality interaction was not significant for elementary school retention, it was significant for middle school retention. Attending schools of higher quality was associated with more significant decreases in the odds of being retained in middle school for CBC students than for pre-K students.

Variance in fadeout/persistence of effects between the math and reading outcomes could be due to the amount of instruction of mathematics and reading content taught in ECE programs. Perhaps fadeout existed on math outcomes in this study because ECE programs focused less on mathematics content during the pre-K year, and more on reading instruction (Balfanz, 1999; Clements, Sarama, & DiBiase, 2004; Lee & Ginsburg, 2007). Although today, ECE curricula are beginning to include more mathematical content, this was not the case in the early 2000's when this study was conducted; the National Council of Teachers of Mathematics did not include prekindergarten in its standards until 2000 (Clements, et al., 2004). Differences in parental emphasis of mathematics content is another possible explanation. Children from low-SES families receive less support in mathematics instruction at home compared to

children from higher-SES families (Klein, Starkey, Clements, Sarama, & Iyer, 2008). It may be more common for families to be aware of the importance of reading to their children at home than for the home instruction of mathematical content (Klein et al., 2008; Starkey & Klein, 2008; Wakeley, 2002).

While the pre-K type by school quality interaction was significant for few outcomes, results typically resulted in the same patterns seen in third grade. Again, this provides evidence that for in order for pre-K effects to persist into the later academic years, it is important for students to attend elementary schools of high quality. Students that go on to attend lower-quality schools may be more exposed to foundational instruction that is appropriate for lower-achieving children, but may not be challenging enough for higher-achieving children (Jenkins et al., 2018, Winsler & Mumma, in press). Another popular theory, the "skills begets skills" hypothesis, posits that children with higher school readiness skills (theoretically, the children who attended pre-K programs), are more prepared for instruction in elementary school and will therefore advance through material faster than their peers (Barnett, 2011; Miller, Farkas, Vandell, & Duncan, 2014; Swain, Springer, & Hofer, 2015).

To better clarify the findings of this study and how they change from fifth to eighth grade, Table 43 lists the effect sizes on the outcomes for 5^{th} and 8^{th} grade for the overall pre-K group vs CBC contrast and for the pre-K type by quality interaction. Persistence of the pre-K advantage is evident in fifth grade, but by eighth grade, fadeout is more present. School quality moderates the effects of pre-K programs in both fifth and eighth grades, but this depends on the particular outcome assessed.

The final contribution of this work is that we examined whether moderation of sustained ECE program effects by elementary school quality operated in the same way for males and females, and for Black and Latinx children. Previous work investigated the three-way interaction terms of pre-K type, school quality, and gender, and pre-K type, school, quality, and ethnicity, but in an ANCOVA framework and did not control for nesting (Mumma & Winsler, in review). I was interested in investigating these same effects, but in a regression framework and while controlling for school-level nesting, to determine if patterns would be consistent in both third, fifth, and eighth grades.

Previous work with this sample did not find significant differences in the three-way interaction of pre-K type, school quality, and gender in third grade (Mumma & Winsler, in review). While girls in this sample typically out-performed males on most academic outcomes in fifth and eighth grade (except for some math test scores), the pattern found was that generally, school quality seems to have more of an effect on outcomes for boys. For example, while the pre-K type by school quality interaction was only significant for females for eighth grade GPA, there were significant school quality by pre-K type interactions for boys fir the outcomes of G5 GPA, 5th grade math and reading scores, and 8th grade FSA math and FCAT 2.0 reading scores. Generally, the patterns for the pre-K type by school quality interaction for males indicated that while fadeout was present when attending the lowest-quality schools, as elementary school quality increased, boys who attended public-school pre-K increasingly out-performed the boys who had attended CBC at age four. It seems that for persistence of pre-K effects to happen for boys, it is essential that they later attend elementary schools of high quality.

On the other hand, it seems that school quality makes less of an impact on the academic performances of girls who attend public-school pre-K programs vs. CBC. Research has showed that girls typically perform better in school compared to boys; commonly known as the "gender gap" in achievement (Duckworth & Seligman, 2005; Perkins et al., 2004). Recent work has investigated whether the school context is more suited towards students with higher social-emotional and self-regulation skills – abilities that may come somewhat more naturally to girls (Francis 2000; Legewie & DiPrete, 2012). Should this hypothesis be true, this may indicate that schools of higher quality do a better job at providing an environment in which boys can thrive and maintain their early gains made in preschool. Indeed, Autor and colleagues (2016) found exactly these results – that exposure to higher quality schools benefits boys more than girls. While this study did not investigate or control for the effect of pre-K type, authors compared within-family, between-sibling contrasts with ordinary least squares estimates and found that the gender gap was reduced when siblings later attended schools of higher quality (Autor et al., 2016). This study used data from the Florida Bureau of Vital Statistics, and like the current study, investigated outcomes of sixth-eighth grade FCAT math and reading scores in addition to absenteeism and school suspension rates. Their measure of school quality was school-level "gain scores" determined by the Florida DoE. "Gain scores" were defined as "schools' average contribution to student outcomes," and this calculation (percent of students making gains in math and reading) seems to be closely aligned with the overall school quality grades used for the current study.

When I previously investigated the three-way interaction of pre-K type, school quality, and ethnicity on third grade outcomes, results showed a persistence of pre-K effects for Black students, but only when attending schools of average or better quality (Mumma & Winsler, in review). Black students who attended CBC had more positive academic outcomes than Black students who attended pre-K when attending the lowest-quality schools. This suggested that having an extra year in a poor-quality school system was more negative for Black students. The opposite effect was seen on third grade outcomes for Hispanic/Latinx students; the pre-K advantage persisted at the lowest quality schools but there were no differences in academic outcomes between pre-K and CBC students at "C" or better schools. These findings perhaps indicated differential treatment of Hispanic/Latinx and Black students at poor-quality schools. In fifth grade, the pre-K type by school quality interaction was only significant on FCAT reading scores for Hispanic/Latinx students that attended public-school pre-K or CBC. Unlike in third grade, the smallest differences were at the lowest quality schools, and differences increased as quality increased. In eighth grade, the pre-K type by school quality interaction was not significant for either race/ethnicity. In terms of reducing the odds of middle school retention, school quality was more important for Black students that attended CBC than public-school pre-K at age four.

Consistent with third grade results, Hispanic/Latinx children in this sample typically performed better academically compared to Black/African American children in fifth and eighth grades. This might be because Black children are a relative minority in this community compared to Hispanic/Latinx children, which might mean they are

susceptible to unequal treatment or are more likely to be of even lower SES and have fewer family and community resources than their Latinx peers. Research has shown that students often have more positive outcomes when they are in classrooms with teachers of their same race (Downer, Goble, Myers, & Pianta, 2016; Gershenson, Holt, & Papageorge, 2016; Wright, Gottfried, & Le, 2017). With over half of the instructional staff population in this school system identifying as Hispanic/Latinx and 25% identifying as Black, it is possible that this might partially explain the difference in academic performance between the two groups.

Limitations

This project has several limitations. As mentioned, the school quality variable is based largely on average performance of standardized tests at the schools, and this is a suboptimal (but often used) estimator of overall quality in the literature (Magnuson et al., 2007, Pearman et al., 2019; Zhai et al., 2012). Though the measure may be suboptimal, studies have shown that other school quality indicators, such as class size, curricular strength, and teacher qualifications, are highly correlated with the school grade/resource variables (Gagnon & Schneider, 2017). Considering that the school quality measure also changed depending upon the standardized test that was administered that year, the varied results on the FSA compared to the FCAT may well be due to the school quality measure's implicit bias towards FCAT scores rather than FSA scores. That is, since two cohorts were administered the FSA, but the school quality measure was based upon FCAT and FCAT 2.0 for the first four cohorts, the school quality measure may not be as related to FSA scores as to FCAT scores.

This study would have also benefited from a larger sample size of children who attended family childcare, since we were unable to compare children who attended FCC programs with children who attended pre-K or CBC programs in analyses exploring the moderating effects of school-quality, or separately by gender and ethnicity. Similarly, there was a low number of White students, so we were unable to compare these students to Hispanic/Latinx and Black/African American students in higher-level analyses. The population in this county is extremely diverse, and these results might not be generalizable to other populations. However, there is still value in studying specific communities to glean information about those inhabitants, especially when research has not typically investigated these populations. Nationally-representative samples blur the lines between high- and low-poverty communities and areas of high and low diversity and can only provide information about the population as a whole (Jager, Putnick, & Bornstein, 2017).

Strengths

Despite these limitations, this study also has many strengths. We had information on the type of ECE program children in this study previously attended, while other studies generally only have ECE program information on children who receive the evaluated intervention and nothing on ECE program for children in comparison groups. Our data on ECE program attendance also come directly from agency records rather than less reliable parental or school/teacher reports as in other studies (Ansari & Pianta, 2018; Magnuson et al., 2007). Similar studies have investigated the Grade 3 academic performance of Hispanic/Latinx children who attended public school pre-K (Ansari et al.,

2016), whereas the present study uses fifth and eighth grade data on Hispanic/Latinx children, Black/African American children, and White/other children. My focus on the comparison between Hispanic/Latinx children is particularly novel, especially within the "majority-minority" population of Miami. Other studies that have investigated preschool fadeout effects have also made similar comparisons, though with unique pre-K type contrasts, sample demographics, and geographic locations (Anderson et al., 2016; Bassok, 2010; Lipsey et al., 2017). Research on under-served communities is especially needed in the field, and the current project aims to contribute to this body of literature.

Future Work and Implications

Future work should perhaps explore school quality in a more well-rounded sense, since average student standardized test scores do not accurately capture other aspects of quality, such as teacher-child interactions, school climate, or direct measures of school quality. Results from the current study suggest that it is important for children to consistently be in a high-quality environment in elementary school if they are to gain the most from their education. Findings from the current study may also provide evidence to support the funding of public-school pre-K programs, since the pre-K advantage was still seen on some outcomes as late as eighth grade. Researchers might also investigate how the racial composition of schools and teachers is related to school quality and long-term ECE program effects (Card & Krueger, 1992; Conway-Turner, 2016; Hanushek, Kain, & Rivkin, 2009).

Table 1 Demographics by ECE type (*N* = 12,901 - 14,144)

	Demographic	Combined Pre-K	Fee-Supported	Title-1 Pre-K	CBC	FCC
Fifth Grade	**% Hispanic/Latinx**	53.1%	68.3%	47.2%	64.6%	55.9%
	% Black	36.1%	6.8%	48.9%	33.6%	43.0%
	% White/Other	10.9%	24.9%	3.8%	1.9%	1.1%
	% Male	49%	50.4%	48.0%	49.9%	49.2%
	% Free Lunch	63.4%	34.6%	80.3%	81.9%	86.3%
	% Reduced Lunch	10.7%	10.4%	9.4%	8.8%	7.7%
	%Non-FRL Status	25.9%	55.0%	10.2%	9.2%	6.0%
Eighth Grade	**% Hispanic/Latinx**	54.3%	66.5%	48.6%	65.9%	57.1%
	% Black	35.1%	7.0%	47.6%	32.2%	41.7%
	% White/Other	10.6%	26.6%	3.8%	1.9%	1.2%
	% Male	48.7%	51.0%	47.6%	49.7%	48.2%
	% Free Lunch	65.2%	38.0%	79.4%	81.5%	81.4%
	% Reduced Lunch	9.0%	10.3.0%	8.8%	7.7%	6.4%
	% Non-FRL Status	25.9%	51.7%	11.8%	10.8%	12.7%

Table 2 Standardized Test Administration by Academic Year and Cohort

	TEST					FCAT				FCAT 2.0					FSA	
	YEAR	'02-'03	'03-'04	'04-'05	'05-'06	'06-'07	'07-'08	'08-'09	'09-'10	'10-'11	'11-'12	'12-'13	'13-'14	'14-'15	'15-'16	'16-'17
A		Pre-K	K	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	
B			Pre-K	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	1st
C				Pre-K	K	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
D					Pre-K	K	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
E						Pre-K	K	1st	2nd	3rd	4th	5th	6th	7th	8th	9th

Table 3. Fifth Grade GPA of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* = 10,647 - 29,117)

Predictor	*β*	B	*SE*	R^2
Pre-K/CBC (*N*= 29,117)	0.15**	0.09	0.01	0.25
Title-1/CBC (*N*= 21,309)	0.06**	0.03	0.02	0.22
Pre-K/FCC (*N*= 19,032)	0.19**	0.11	0.07	0.29
Title-1/FCC (*N*= 11,224)	0.10	0.06	0.07	0.24
FCC/CBC (*N*= 10,647)	-0.04	-0.03	0.07	0.21
Cognitive Skills	0.23**	0.00	0.01	
White/Black	0.13**	0.30	0.01	
Hispanic/Black	0.21**	0.25	0.02	
Male	-0.16**	-0.19	0.01	
Free Lunch/Reduced Lunch	-0.11**	-0.14	0.01	
None/Reduced Lunch	0.09**	0.12	0.01	
Disability Status in 5th Grade	-0.17**	-0.27	0.01	

Note. * $p < .05$, ** $p < .01$.

Table 4 Fifth Grade FCAT Math Scores of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 29,117)	0.03**	0.03	0.01	0.19
Title-1/CBC (*N*= 21,309)	0.00	0.00	0.01	0.14
Pre-K/FCC (*N*= 19,032)	0.06	0.06	0.05	0.23
Title-1/FCC (*N*= 11,224)	0.04	0.03	0.06	0.16
FCC/CBC (*N*= 10,647)	-0.03	-0.03	0.06	0.14
Cognitive Skills	0.27**	0.01	0.00	
White/Black	0.36**	0.42	0.04	
Hispanic/Black	0.32**	0.36	0.02	
Male	0.16**	0.16	0.01	
Free Lunch/Reduced Lunch	-0.13**	-0.11	0.02	
None/Reduced Lunch	0.07**	0.12	0.03	
Disability Status in 5th Grade	-0.39**	-0.40	0.03	

Note. * $p < .05$, ** $p < .01$.

Table 5 Fifth Grade FCAT Reading Scores of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* = 10,647-29,117)

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 29,117)	0.03**	0.03	0.01	0.17
Title-1/CBC (*N*= 21,309)	-0.01	-0.01	0.01	0.12
Pre-K/FCC (*N*= 19,032)	0.03	0.03	0.05	0.20
FCC/Title-1 (*N*= 11,224)	0.00	-0.01	0.01	0.13
FCC/CBC (*N*= 10,647)	-0.01	-0.01	0.06	0.11
Cognitive Skills	0.19**	0.01	0.00	
White/Black	0.12**	0.46	0.01	
Hispanic/Black	0.18**	0.34	0.01	
Male	-0.02**	-0.04	0.01	
Free Lunch/Reduced Lunch	-0.07**	-0.14	0.01	
None/Reduced Lunch	0.08**	0.20	0.01	
Disability Status in 5th Grade	-0.20**	-0.51	0.01	

Note. * $p < .05$, ** $p < .01$.

Table 6 Odds Ratios of Elementary School Retention of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* = 10,818-29,395)

Predictor	β	B	*SE*	Odds Ratio
Pre-K/CBC (*N*=29,395)	-0.21	-0.46	0.02	0.63**
Title-1/CBC (*N*=21,570)	-0.10	-0.20	0.02	0.82**
Pre-K/FCC (*N*=19,145)	0.26	0.59	0.07	0.55**
Title-1/FCC (*N*=11,320)	0.17	0.36	0.08	0.70*
FCC/CBC (*N*=10,818)	0.08	0.17	0.08	1.18
Cognitive Skills	-0.03	-0.02	0.01	0.98**
White/Black	-0.06	-0.49	0.01	0.61**
Hispanic/Black	-0.10	-0.45	0.01	0.64**
Male	0.05	0.22	0.01	1.24**
Free Lunch/Reduced Lunch	0.10	0.48	0.02	1.62**
None/Reduced Lunch	-0.07	-0.38	0.02	0.69**
Disability Status in 5th Grade	0.29	1.65	0.01	5.19**

Note. * $p < .05$, ** $p < .01$.

Table 7 Eighth Grade GPA of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* = 7,110- 21,406)

Predictor	*β*	B	*SE*	R^2
Pre-K/CBC (*N*=21,406)	0.13**	0.09	0.02	0.16
Title-1/CBC (*N*=15,116)	0.01	0.01	0.02	0.13
Pre-K/FCC (*N*=19,021)	0.17**	0.12	0.06	0.19
Title-1/FCC (*N*=11,224)	0.06	0.04	0.05	0.15
FCC/CBC (*N*=7,110)	-0.09	-0.06	0.07	0.10
Cognitive Skills	0.16**	0.00	0.01	
White/Black	0.15**	0.39	0.01	
Hispanic/Black	0.20**	0.29	0.01	
Male	-0.16**	-0.22	0.01	
Free Lunch/Reduced Lunch	0.06**	0.15	0.01	
None/Reduced Lunch	0.15**	0.26	0.01	
Disability Status in 8th Grade	-0.05**	-0.09	0.01	

Note. * $p < .05$, ** $p < .01$

Table 8 Eighth Grade FCAT 2.0 Math Scores of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* = 10,647 - 29,106)

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*=29,106)	-0.01	-0.01	0.02	0.16
Title-1/CBC (*N*=21,309)	-0.05*	-0.04	0.02	0.12
Pre-K/FCC (*N*=19,021)	0.01	0.01	0.08	0.20
Title-1/FCC (*N*=11,224)	0.05	0.05	0.08	0.13
FCC/CBC (*N*=10,647)	0.01	0.01	0.08	0.11
Cognitive Skills	0.23**	0.01	0.01	
White/Black	0.13**	0.52	0.05	
Hispanic/Black	0.17**	0.35	0.03	
Male	0.04**	0.08	0.02	
Free Lunch/Reduced Lunch	0.05**	0.17	0.03	
None/Reduced Lunch	0.10**	0.26	0.03	
Disability Status in 5th Grade	-0.18**	-0.47	0.03	

Note. * $p < .05$, ** $p < .01$.

Table 9 Eighth Grade FSA Math Scores of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* =207-686)

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*=686)	0.11	3.11	0.02	0.11
Title-1/CBC (*N*=640)	0.02	0.52	0.09	0.08
Pre-K/FCC (*N*=253)	0.11	3.49	0.16	0.13
Title-1/FCC (*N*=207)	-0.06	-2.10	0.15	0.10
FCC/CBC (*N*=471)	0.13	3.69	0.08	0.11
Cognitive Skills	0.14**	0.15	0.05	
White/Black	0.47*	13.95	0.22	
Hispanic/Black	0.31*	9.18	0.08	
Male	-0.15*	-4.47	0.06	
Free Lunch/Reduced Lunch	-0.05	-1.55	0.13	
None/Reduced Lunch	0.36**	10.76	0.12	
Disability Status in 5th Grade	-0.38**	-11.14	0.08	

Note. * $p < .05$, ** $p < .01$

Table 10 Eighth Grade FCAT 2.0 Reading Scores of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* = 10,647 - 29,106)

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*=29,106)	0.03	0.03	0.02	0.19
Title-1/CBC (*N*=21,309)	-0.03	-0.03	0.02	0.14
Pre-K/FCC (*N*=19,021)	0.17^{+}	0.17	0.09	0.22
Title-1/FCC (*N*=11,224)	-0.12	-0.12	0.10	0.16
FCC/CBC (*N*=10,647)	-0.03	-0.16	0.02	0.12
Cognitive Skills	0.18**	0.01	0.01	
White/Black	0.14**	0.55	0.01	
Hispanic/Black	0.22**	0.46	0.01	
Male	-0.06**	-0.12	0.01	
Free Lunch/Reduced Lunch	0.05**	0.18	0.01	
None/Reduced Lunch	0.14**	0.36	0.01	
Disability Status in 5th Grade	-0.19**	-0.52	0.01	

Note. $^{+}$ $p < .10$, * $p < .05$, ** $p < .01$

Table 11 Eighth Grade FSA Reading Scores of Children who Attended Title-1 Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* = 309 - 917)

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*=917)	0.17**	5.11	0.06	0.25
Title-1/CBC (*N*=827)	0.12	3.45	0.06	0.21
Pre-K/FCC (*N*=399)	0.20	6.43	0.21	0.26
Title-1/FCC (*N*=309)	-0.15	-4.95	0.20	0.22
FCC/CBC (*N*=566)	-0.04	-1.11	0.24	0.18
Cognitive Skills	0.15**	0.16	0.01	
White/Black	0.55**	16.34	0.01	
Hispanic/Black	0.47**	14.16	0.01	
Male	-0.21**	-6.12	0.01	
Free Lunch/Reduced Lunch	0.09	2.71	0.01	
None/Reduced Lunch	0.40**	11.86	0.01	
Disability Status in 5th Grade	-0.59**	-17.46	0.01	

Note. * $p < .05$, ** $p < .01$

Table 12 Odds Ratios of Middle School Retention of Children who Attended Public-School Pre-Kindergarten, Center-based Care, or Family Childcare (*n* =10,818 - 29,384)

Predictor	*β*	B	*SE*	Odds Ratio
Pre-K/CBC (*N*=29,384)	-0.15	-0.29	0.05	0.75**
Title-1/CBC (*N*=21,570)	-0.03	-0.05	0.05	0.95
Pre-K/FCC (*N*=24,121)	-0.20	-0.40	0.18	0.51
Title-1/FCC (*N*=11,320)	-0.09	-0.17	0.19	0.85
FCC/CBC (*N*=10,818)	0.04	0.08	0.19	1.09
Cognitive Skills	-0.16	-0.01	0.04	0.99**
White/Black	-0.08	-0.59	0.05	0.56**
Hispanic/Black	-0.14	-0.57	0.03	0.57*
Male	0.20	0.78	0.03	2.19**
Free Lunch/Reduced Lunch	-0.17	-1.17	0.05	0.31**
None/Reduced Lunch	-0.11	-0.55	0.05	0.58**
Disability Status in 8th Grade	-0.04	-0.23	0.03	0.79

Note. * $p < .05$, ** $p < .01$

Table 13 Associations of ECE Type by School Quality of Fifth Grade GPA

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 28,668)	0.11*	0.06	0.05	
Title-1/CBC (*N*= 21,309)	0.09^{+}	0.05	0.05	
School Quality	0.08**	0.05	0.02	
Quality by Pre-K/CBC	0.02	0.01	0.01	0.26
Quality by Title-1/CBC	0.02	0.00	0.01	0.23
Cognitive Skills	0.22**	0.00	0.01	
Hispanic/Black	0.18**	0.21	0.02	
Male	-0.16**	-0.19	0.01	
Free Lunch/Reduced Lunch	-0.09**	-0.12	0.01	
None/Reduced Lunch	0.08**	0.11	0.01	
Disability Status in 5^{th} Grade	-0.17**	-0.26	0.01	

Note. * $p <$. 05, ** $p <$ .01

Table 14Associations of ECE Type by School Quality of Fifth Grade FCAT Math Scores

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 28,668)	0.03	0.03	0.04	
Title-1/CBC (*N*= 21,207)	0.11	0.10	0.04	
School Quality	0.14**	0.12	0.01	
Quality by Pre-K/CBC	0.01	0.01	0.01	0.21
Quality by Title-1/CBC	-0.03*	-0.02	0.01	0.16
Cognitive Skills	0.26	0.01	0.01	
Hispanic/Black	0.13**	0.25	0.01	
Male	0.09**	0.16	0.01	
Free Lunch/Reduced Lunch	-0.04**	-0.07	0.01	
None/Reduced Lunch	0.04**	0.10	0.01	
Disability Status in 5th Grade	-0.16	-0.40	0.01	

Note. * $p < .05$, ** $p < .01$

Table 15 Associations of ECE Type by School Quality of Fifth Grade FCAT Reading Scores

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 29,117)	-0.03	-0.03	0.04	
Title-1/CBC (*N*= 21,207)	0.02	0.02	0.04	
School Quality	0.13**	0.12	0.01	
Quality by Pre-K/CBC	0.03*	0.03	0.01	0.18
Quality by Title-1/CBC	0.00	0.00	0.01	0.14
Cognitive Skills	0.17**	0.01	0.01	
Hispanic/Black	0.12**	0.23	0.01	
Male	-0.02**	-0.04	0.01	
Free Lunch/Reduced Lunch	-0.05**	-0.10	0.01	
None/Reduced Lunch	0.07**	0.17	0.01	
Disability Status in 5th Grade	-0.20**	-0.51	0.01	

Note. * $p < .05$, ** $p < .01$.

Table 16 Associations and Odds Ratios of ECE Type by School Quality of Elementary School Retention

Predictor	β	B	*SE*	Odds Ratio
Pre-K/CBC (*N*= 28,836)	-0.17	-0.38	0.05	0.68**
Title-1/CBC (*N*= 21,375)	-0.12	-0.25	0.06	0.78*
School Quality	-0.10	-0.20	0.01	0.82**
Quality by Pre-K/CBC	-0.02	-0.05	0.02	0.96
Quality by Title-1/CBC	-0.01	-0.01	0.02	0.99
Cognitive Skills	-0.30	-0.02	0.01	0.98
Hispanic/Black	-0.05	-0.23	0.01	0.80**
Male	0.06	0.24	0.01	1.27**
Free Lunch/Reduced Lunch	0.09	0.42	0.02	1.52**
None/Reduced Lunch	-0.06	-0.31	0.02	0.74**
Disability Status in 5th Grade	0.28	1.65	0.01	5.22**

Note. * $p < .05$, ** $p < .01$.

Table 17 Associations of ECE Type by School Quality of Eighth Grade GPA

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 29,117)	0.04	0.03	0.05	
Title-1/CBC (*N*= 21,309)	0.02	0.01	0.05	
School Quality	0.08**	0.05	0.02	
Quality by Pre-K/CBC	0.03	0.02	0.01	0.15
Quality by Title-1/CBC	0.01	0.01	0.02	0.13
Cognitive Skills	0.16**	0.00	0.01	
White/Black	0.12**	0.31	0.01	
Hispanic/Black	0.16**	0.23	0.01	
Male	-0.17**	-0.24	0.01	
Free Lunch/Reduced Lunch	0.06**	0.14	0.01	
None/Reduced Lunch	0.14**	0.24	0.01	
Disability Status in 5th Grade	-0.05**	-0.09	0.01	

Note. * $p < .05$, ** $p < .01$.

Table 18 Associations of ECE Type by School Quality of Eighth Grade FCAT 2.0 Math Scores

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 28,526)	-0.01	-0.01	0.07	
Title-1/CBC (*N*= 21,704)	0.06	0.05	0.07	
School Quality	0.10**	0.10	0.02	
Quality by Pre-K/CBC	0.01	0.01	0.02	0.15
Quality by Title-1/CBC	-0.03	-0.02	0.02	0.11
Cognitive Skills	0.22**	0.01	0.01	
White/Black	0.11**	0.42	0.01	
Hispanic/Black	0.13**	0.27	0.01	
Male	0.04**	0.08	0.01	
Free Lunch/Reduced Lunch	0.04**	0.14	0.01	
None/Reduced Lunch	0.09**	0.22	0.01	
Disability Status in 5th Grade	-0.17**	-0.47	0.01	

Note. * $p < .05$, ** $p < .01$

Table 19 Associations of ECE Type by School Quality of Eighth Grade FSA Math Scores

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 677)	-0.19	-4.56	0.19	
Title-1/CBC (*N*= 631)	-0.17	-3.95	0.21	
School Quality	0.05	1.22	0.05	
Quality by Pre-K/CBC	0.14*	3.32	0.07	0.17
Quality by Title-1/CBC	0.11	2.54	0.09	0.13
Cognitive Skills	0.18**	0.16	0.04	
White/Black	0.38	9.08	0.25	
Hispanic/Black	0.28**	6.67	0.08	
Male	-0.13^{+}	-3.04	0.07	
Free Lunch/Reduced Lunch	-0.10	-2.31	0.16	
None/Reduced Lunch	0.36**	8.60	0.14	
Disability Status in 5th Grade	-0.42**	-10.11	0.08	

Note. $^{+}$ $p < .10$, *$p < .05$, ** $p < .01$.

Table 20 Associations of ECE Type by School Quality of Eighth Grade FCAT 2.0 Reading Scores

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*N*= 28,526)	-0.08	-0.08	0.06	
Title-1/CBC (*N*= 21,074)	-0.04	-0.04	0.06	
School Quality	0.10**	0.10	0.02	
Quality by Pre-K/CBC	0.04*	0.03	0.04	0.17
Quality by Title-1/CBC	0.01	0.01	0.02	0.13
Cognitive Skills	0.17**	0.01	0.01	
White/Black	0.11**	0.44	0.01	
Hispanic/Black	0.18**	0.36	0.01	
Male	-0.06**	-0.12	0.01	
Free Lunch/Reduced Lunch	0.04**	0.14	0.01	
None/Reduced Lunch	0.13**	0.32	0.01	
Disability Status in 5th Grade	-0.19**	-0.52	0.01	

Note. * $p < .05$, ** $p < .01$

Table 21 Associations of ECE Type by School Quality of Eighth Grade FSA Reading Scores

Predictor	β	B	*SE*	R^2
Pre-K/CBC (*n* = 907)	0.17	4.24	0.16	
Title-1/CBC (*n* = 817)	0.20	5.02	0.17	
School Quality	0.06^{+}	1.49	0.03	
Quality by Pre-K/CBC	0.03	0.64	0.06	0.32
Quality by Title-1/CBC	-0.00	-0.09	0.06	0.28
Cognitive Skills	0.19**	0.16	0.00	
White/Black	0.51**	13.05	0.13	
Hispanic/Black	0.47	11.85	0.06	
Male	-0.20**	-5.19	0.05	
Free Lunch/Reduced Lunch	0.06	1.64	0.14	
None/Reduced Lunch	0.40**	10.19	0.09	
Disability Status in 5th Grade	-0.63**	-16.05	0.08	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 22 Associations and Odds Ratios of ECE Type by School Quality for Middle School Retention

Predictor	β	B	*SE*	Odds Ratio
Pre-K/CBC (*N*= 28,526)	-0.25	-0.49	0.12	0.61**
Title-1/CBC (*N*= 21,074)	-0.27	-0.53	0.13	0.56*
School Quality	-0.12	-0.23	0.03	0.79**
Quality by Pre-K/CBC	0.04	0.07	0.04	1.07
Quality by Title-1/CBC	0.08	0.16	0.04	1.18*
Cognitive Skills	-0.17	-0.01	0.03	0.99**
White/Black	-0.06	-0.43	0.03	0.65^{+}
Hispanic/Black	-0.10	-0.42	0.03	0.66**
Male	0.20	0.77	0.02	2.17**
Free Lunch/Reduced Lunch	-0.15	-1.05	0.05	0.35**
None/Reduced Lunch	-0.08	-0.37	0.04	0.69*
Disability Status in 5th Grade	-0.04	-0.23	0.03	0.80^{+}

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 23 Associations of ECE Type by School Quality by Gender of Fifth Grade GPA (*n* =10,490-14,722)

	Females				Males			
Predictor	*β*	B	*SE*	R^2	*β*	B	*SE*	R^2
Pre-K/CBC (*n*=13,752-14,722)	0.11+	0.06	0.06		0.05	0.03	0.06	
Title-1/CBC (*n* =10,490-10,584)	0.14*	0.07	0.07		0.02	0.01	0.06	
School Quality	0.11**	0.06	0.02		0.08**	0.05	0.02	
Quality by Pre-K/CBC	0.02	0.01	0.02	0.22	0.04*	0.02	0.02	0.20
Quality by Title-1/CBC	-0.01	-0.01	0.02	0.17	0.02	0.01	0.02	0.17
Cognitive Skills	0.24**	0.00	0.01		0.23**	0.00	0.01	
Hispanic/Black	0.18**	0.19	0.02		0.16**	0.20	0.02	
Free Lunch/Reduced Lunch	-0.10**	-0.12	0.01		-0.09**	-0.12	0.01	
None/Reduced Lunch	0.08**	0.11	0.01		0.09**	0.14	0.01	
Disability Status in 5th Grade	-0.18**	0.32	0.01		-0.17**	-0.24	0.01	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 24 Associations of ECE Type by School Quality by Gender of Fifth Grade FCAT Math Scores (n = 10,490 – 14,722)

	Females				Males			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC	0.03^{+}	0.03	0.06		-0.05	0.04	0.05	
Title-1/CBC	0.12	0.10	0.07		0.05	0.05	0.05	
School Quality	0.15**	0.13	0.02		0.13**	0.12	0.02	
Quality by Pre-K/CBC	0.01	0.01	0.02	0.17	0.03*	0.03	0.01	0.18
Quality by Title-1/CBC	-0.02	-0.02	0.02	0.13	-0.01	-0.01	0.02	0.14
Cognitive Skills	0.27**	0.01	0.01		0.26**	0.01	0.01	
Hispanic/Black	0.10**	0.19	0.01		0.14**	0.28	0.01	
Free Lunch/Reduced Lunch	-0.05**	-0.11	0.01		-0.02	-0.03	0.01	
None/Reduced Lunch	0.05**	0.12	0.01		0.05**	0.12	0.01	
Disability Status in 5th Grade	-0.14**	-0.42	0.01		-0.17**	-0.39	0.01	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 25 Associations of ECE Type by School Quality by Gender of Fifth Grade FCAT Reading Scores (*n* = 10,490 – 14,722)

	Females				Males			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC	0.01	0.01	0.06		-0.11*	-0.11	0.05	
Title-1/CBC	0.08	0.07	0.06		-0.06	-0.05	0.05	
School Quality	0.15**	0.14	0.01		0.12**	0.12	0.01	
Quality by Pre-K/CBC	0.02	0.02	0.02	0.15	0.05**	0.05	0.02	0.12
Quality by Title-1/CBC	-0.01	-0.01	0.02	0.11	0.02	0.02	0.02	0.16
Cognitive Skills	0.19**	0.01	0.01		0.16**	0.01	0.01	
Hispanic/Black	0.11**	0.21	0.01		0.11**	0.23	0.01	
Free Lunch/Reduced Lunch	-0.06**	-0.12	0.01		-0.04**	-0.08	0.01	
None/Reduced Lunch	0.09**	0.20	0.02		0.07**	0.19	0.01	
Disability Status in 5th Grade	-0.16**	-0.49	0.01		-0.22**	-0.52	0.01	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 26 Associations and Odds Ratios of ECE Type by School Quality by Gender of Elementary School Retention (n = 10,490 – 14,722)

	Females				Males			
Predictor	β	B	*SE*	Odds Ratios	β	B	*SE*	Odds Ratios
Pre-K/CBC	-0.14	-0.30	0.08	0.74^{+}	-0.12	-0.25	0.07	0.78^{+}
Title-1/CBC	-0.10	-0.21	0.09	0.81	-0.06	-0.13	0.07	0.87
School Quality	-0.11	-0.24	0.02	0.79**	-0.09	-0.20	0.02	0.82**
Quality by Pre-K/CBC	-0.03	-0.06	0.03	0.95	-0.04	-0.08	0.02	0.92^{+}
Quality by Title-1/CBC	-0.01	-0.02	0.03	0.98	-0.10	-0.04	0.02	0.96
Cognitive Skills	-0.31	-0.02	0.02	0.98**	-0.29	-0.02	0.02	0.98**
Hispanic/Black	-0.03	-0.13	0.02	0.88*	-0.06	-0.25	0.01	0.78**
Free Lunch/Reduced Lunch	0.09	0.42	0.03	1.52**	0.08	0.40	0.02	1.50**
None/Reduced Lunch	-0.05	-0.29	0.03	0.75^{+}	-0.06	-0.33	0.02	0.72**
Disability Status in 5th Grade	0.28	2.01	0.01	7.45**	0.29	1.50	0.01	4.48**

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 27 Associations of ECE Type by School Quality by Gender of Eighth Grade GPA (*n* =10,568 - 14,670)

	Females				Males			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC	0.00	0.00	0.07		0.05	0.04	0.07	
Title-1/CBC	0.03	0.02	0.07		0.01	0.01	0.08	
School Quality	0.09**	0.06	0.02		0.08**	0.05	0.02	
Quality by Pre-K/CBC	0.05*	0.03	0.01	0.12	0.04^{+}	0.03	0.02	0.12
Quality by Title-1/CBC	0.02	0.01	0.02	0.09	0.01	0.00	0.02	0.08
Cognitive Skills	0.17**	0.00	0.01		0.16**	0.00	0.01	
Hispanic/Black	0.15**	0.21	0.01		0.17**	0.24	0.01	
Free Lunch/Reduced Lunch	0.06**	0.13	0.01		0.06**	0.15	0.01	
None/Reduced Lunch	0.14**	0.23	0.01		0.16**	0.28	0.01	
Disability Status in 8^{th} Grade	-0.09**	-0.19	0.01		-0.02	-0.04	0.01	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 28 Associations of ECE Type by School Quality by Gender of Eighth Grade FCAT 2.0 Math Scores (n = 10,490 –14,664)

	Females				Males			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC	-0.01	-0.01	0.10		-0.03	-0.03	0.09	
Title-1/CBC	0.06	0.06	0.10		0.05	0.05	0.10	
School Quality	0.10**	0.10	0.03		0.10**	0.10	0.03	
Quality by Pre-K/CBC	0.02	0.02	0.03	0.16	0.00	0.00	0.03	0.11
Quality by Title-1/CBC	-0.02	-0.02	0.03	0.11	-0.03	-0.03	0.03	0.14
Cognitive Skills	0.24**	0.01	0.02		0.21**	0.01	0.01	
Hispanic/Black	0.12**	0.25	0.02		0.14**	0.29	0.02	
Free Lunch/Reduced Lunch	0.04**	0.14	0.01		0.04**	0.12	0.01	
None/Reduced Lunch	0.12**	0.28	0.02		0.09**	0.22	0.02	
Disability Status in 8th Grade	-0.16**	-0.53	0.02		-0.17**	-0.42	0.02	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 29 Associations of ECE Type by School Quality by Gender of Eighth Grade FSA Math Scores of Children who Attended Public-School Pre-K or CBC (*n* = 264 - 396)

	Females				Males			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC	0.35	7.90	0.32		-0.48*	-12.01	0.24	
Title-1/CBC	0.64^{+}	14.23	0.36		-0.59*	-14.45	0.25	
School Quality	0.08	1.75	0.07		0.03	0.85	0.06	
Quality by Pre-K/CBC	-0.09	-2.04	0.12	0.18	0.26**	6.52	0.08	0.13
Quality by Title-1/CBC	-0.26^{+}	-5.87	0.15	0.16	0.29**	7.25	0.10	0.18
Cognitive Skills	0.01**	0.19	0.05		0.15**	0.14	0.04	
Hispanic/Black	0.30*	6.82	0.12		0.28**	6.94	0.09	
Free Lunch/Reduced Lunch	0.01	0.30	0.24		-0.15	-3.79	0.25	
None/Reduced Lunch	0.42^{+}	9.57	0.23		0.36*	8.91	0.17	
Disability Status in 8^{th} Grade	-0.54**	-12.27	0.16		-0.34**	-8.62	0.10	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 30 Associations of ECE Type by School Quality by Gender of Eighth Grade FCAT 2.0 Reading Scores of Children who Attended Public-School Pre-K or CBC (*n* = 10,475 – 14,664)

	Females				Males			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC	0.00	0.00	0.08		-0.18*	-0.18	0.09	
Title-1/CBC	0.05	0.04	0.09		-0.13	-0.13	0.09	
School Quality	0.12**	0.12	0.02		0.09**	0.09	0.02	
Quality by Pre-K/CBC	0.02	0.02	0.02	0.17	0.06*	0.06	0.03	0.16
Quality by Title-1/CBC	-0.01	-0.01	0.03	0.13	0.03	0.03	0.03	0.12
Cognitive Skills	0.19**	0.01	0.01		0.16**	0.01	0.01	
Hispanic/Black	0.19**	0.39	0.02		0.15**	0.32	0.02	
Free Lunch/Reduced Lunch	0.04**	0.13	0.01		0.04**	0.15	0.01	
None/Reduced Lunch	0.15**	0.35	0.02		0.13**	0.32	0.02	
Disability Status in 8th Grade	-0.16**	-0.52	0.02		-0.21**	-0.51	0.02	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 31 Associations of ECE Type by School Quality by Gender of Eighth Grade FSA Reading Scores of Children who Attended Public-School Pre-K or CBC (*n* = 351 - 519)

	Females				Males			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC	0.11	2.75	0.22		0.22	5.46	0.20	
Title-1/CBC	0.15	3.77	0.24		0.28	6.57	0.24	
School Quality	0.05	1.36	0.05		0.07^{+}	1.81	0.04	
Quality by Pre-K/CBC	0.05	1.14	0.08	0.37	0.01	0.18	0.08	0.26
Quality by Title-1/CBC	0.01	0.14	0.09	0.33	-0.03	-0.61	0.09	0.22
Cognitive Skills	0.23**	0.20	0.05		0.15**	0.13	0.04	
Hispanic/Black	0.49**	12.39	0.09		0.47**	11.81	0.08	
Free Lunch/Reduced Lunch	0.09	2.17	0.21		0.09	2.30	0.19	
None/Reduced Lunch	0.41**	10.52	0.11		0.42**	10.41	0.12	
Disability Status in 8th Grade	-0.82**	-20.82	0.11		-0.55**	-13.68	0.09	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 32 Associations and Odds Ratios of ECE Type by School Quality by Gender of Middle School Retention of Children who Attended Public-School Pre-K or CBC (*n* = 10,490 – 14,722)

	Females				Males			
Predictor	*β*	B	*SE*	Odds Ratios	*β*	B	*SE*	Odds Ratios
Pre-K/CBC	-0.45	-0.87	0.23	0.42*	-0.17	-0.32	0.15	0.73
Title-1/CBC	-0.20	-0.80	0.14	0.45	-0.18	-0.34	0.16	0.72
School Quality	-0.16	-0.31	0.06	0.73**	-0.10	-0.19	0.04	0.82**
Quality by Pre-K/CBC	0.08	0.15	0.08	1.16	0.02	0.03	0.05	1.03
Quality by Title-1/CBC	0.05	0.21	0.05	1.24	0.07	0.13	0.05	1.14
Cognitive Skills	-0.25	-0.02	0.05	0.98**	-0.12	-0.01	0.04	0.99**
Hispanic/Black	-0.10	-0.42	0.04	0.48*	-0.10	-0.42	.03	0.47**
Free Lunch/Reduced Lunch	-0.16	-1.09	0.12	0.34	-0.15	-1.02	0.06	0.36**
None/Reduced Lunch	0.03	0.16	0.05	1.17	-0.14	-0.65	0.05	0.52**
Disability Status in 8th Grade	-0.01	-0.08	0.04	0.93	-0.05	-0.22	0.03	0.80

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 33 Associations of ECE Type by School Quality by Ethnicity of Fifth Grade GPA of Children who Attended Public-School Pre-K or CBC (*n* = 8,387–17,168)

	Black/African American				Hispanic/Latinx			
Predictor	*β*	B	*SE*	R^2	*β*	B	*SE*	R^2
Pre-K/CBC	0.11^{+}	0.06	0.06		0.10	0.06	0.07	
Title-1/CBC	0.12^{+}	0.07	0.06		0.03	0.03	0.03	
School Quality	0.09**	0.05	0.02		0.11**	0.06	0.02	
Quality by Pre-K/CBC	-0.01	-0.01	0.02	0.16	0.03^{+}	0.02	0.02	0.20
Quality by Title-1/CBC	-0.03	-0.02	0.02	0.16	0.03	0.01	0.04	0.22
Cognitive Skills	0.23**	0.00	0.01		0.22**	0.00	0.01	
Male	-0.18**	-0.21	0.01		-0.16**	-0.18	0.01	
Free Lunch/Reduced Lunch	-0.11**	-0.19	0.02		-0.08**	-0.09	0.01	
None/Reduced Lunch	0.03*	0.07	0.01		0.09**	0.12	0.01	
Disability Status in 5th Grade	-0.11**	-0.18	0.01		-0.21**	-0.31	0.01	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 34 Associations of ECE Type by School Quality by Ethnicity of Fifth Grade FCAT Math Scores of Children who Attended Public-School Pre-K or CBC (*n* = 8,387 – 17,168)

	Black/African American)				Hispanic/Latinx			
Predictor	*β*	B	*SE*	R^2	*β*	B	*SE*	R^2
Pre-K/CBC (*n*=9,244-17,168)	0.01	0.01	0.06		-0.03	-0.03	0.06	
Title-1/CBC (*n* =8,387-12,087)	0.05	0.04	0.06		0.09	0.08	0.07	
School Quality	0.11**	0.10	0.02		0.17**	0.15	0.02	
Quality by Pre-K/CBC	0.01	0.01	0.02	0.13	0.03	0.02	0.02	0.15
Quality by Title-1/CBC	-0.00	-0.00	0.02	0.12	-0.02	-0.01	0.02	0.12
Cognitive Skills	0.25**	0.01	0.01		0.26**	0.01	0.01	
Male	0.06**	0.11	0.01		0.11**	0.19	0.01	
Free Lunch/Reduced Lunch	-0.05**	-0.12	0.02		-0.02^{+}	-0.04	0.01	
None/Reduced Lunch	0.01	0.05	0.02		0.06**	0.12	0.01	
Disability Status in 5th Grade	-0.17**	-0.44	0.02		-0.16**	-0.38	0.01	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 35 Associations of ECE Type by School Quality by Ethnicity of Fifth Grade FCAT Reading Scores of Children who Attended Public-School Pre-K or CBC (*n* = 8,387 – 17,168)

	Black/African American				Hispanic/Latinx			
Predictor	*β*	B	*SE*	R^2	*β*	B	*SE*	R^2
Pre-K/CBC (*n*=9,244-17,168)	-0.02	-0.01	0.06		-0.06	-0.06	0.04	
Title-1/CBC (*n* =8,387-12,087)	-0.01	-0.01	0.06		0.04	0.03	0.05	
School Quality	0.12**	0.11	0.02		0.16	0.15	0.01	
Quality by Pre-K/CBC	0.01	0.01	0.02	0.11	0.04**	0.04	0.01	0.14
Quality by Title-1/CBC	0.00	0.00	0.02	0.10	0.00	0.00	0.02	0.10
Cognitive Skills	0.17**	0.01	0.01		0.17**	0.01	0.01	
Male	-0.03*	-0.05	0.01		-0.02*	-0.03	0.01	
Free Lunch/Reduced Lunch	-0.06**	-0.16	0.02		-0.03**	-0.07	0.01	
None/Reduced Lunch	0.04*	0.13	0.02		0.07**	0.18	0.01	
Disability Status in 5th Grade	-0.19**	-0.48	0.02		-0.21**	-0.52	0.01	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 36 Associations and Odds Ratios of ECE Type by School Quality by Ethnicity of Elementary School Retention of Children who Attended Public-School Pre-K or CBC (*n* = 8,387 –17,168)

	Black/African American				Hispanic/Latinx			
Predictor	*β*	B	*SE*	Odds Ratios	*β*	B	*SE*	Odds Ratios
Pre-K/CBC (*n*=9,378-17,328)	-0.11	-0.22	0.07	0.80	-0.28	-0.60	0.08	0.55**
Title-1/CBC (*n* =8,521-12,247)	-0.05	-0.11	0.07	0.89	-0.16	-0.33	0.09	0.72^{+}
School Quality	-0.07	-0.14	0.02	0.87**	-0.11	-0.27	0.02	0.77**
Quality by Pre-K/CBC	-0.03	-0.07	0.03	0.94	0.00	0.00	0.02	1.00
Quality by Title-1/CBC	-0.03	-0.06	0.03	0.94	0.00	-0.28	0.03	1.01
Cognitive Skills	-0.32	-0.02	0.02	0.98**	-0.28	-0.02	0.02	0.98**
Male	0.09	0.38	0.01	1.46**	0.04	0.17	0.02	1.18**
Free Lunch/Reduced Lunch	0.08	0.46	0.02	1.58**	0.09	0.41	0.02	1.50**
None/Reduced Lunch	-0.04	-0.33	0.02	0.72^{+}	-0.05	-0.29	0.02	0.75**
Disability Status in 5th Grade	0.23	1.34	0.01	3.81**	0.32	1.86	0.01	6.45**

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 37 Associations of ECE Type by School Ethnicity by Gender of Eighth Grade GPA of Children who Attended Public-School Pre-K or CBC (*n* = 8,387 – 19,282)

	Black/African American				Hispanic/Latinx			
Predictor	*β*	B	*SE*	R^2	*β*	B	*SE*	R^2
Pre-K/CBC (*n*=9,310-19,282)	0.05	0.03	0.07		0.19*	0.13	0.08	
Title-1/CBC (*n* =8,387-12,686)	0.03	0.02	0.07		0.06	0.04	0.04	
School Quality	0.06**	0.04	0.02		0.10**	0.08	0.02	
Quality by Pre-K/CBC	0.00	0.00	0.02	0.09	0.01	0.00	0.02	0.14
Quality by Title-1/CBC	-0.02	-0.01	0.02	0.10	0.01	0.01	0.04	0.11
Cognitive Skills	0.17**	0.00	0.02		0.16**	0.00	0.01	
Male	-0.19**	-0.27	0.01		-0.16**	-0.22	0.01	
Free Lunch/Reduced Lunch	0.06**	0.17	0.01		0.06**	0.13	0.01	
None/Reduced Lunch	0.08**	0.19	0.02		0.16**	0.26	0.01	
Disability Status in 8th Grade	-0.01	-0.01	0.02		-0.07**	-0.12	0.01	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 38 Associations of ECE Type by School Quality by Ethnicity of Eighth Grade FCAT 2.0 Math Scores of Children who Attended Public-School Pre-K or CBC (*n* = 8,387 – 17,168)

	Black/African American				Hispanic/Latinx			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC (*n*=9,244-17,168)	0.02	0.02	0.09		0.00	0.00	0.13	
Title-1/CBC (*n* =8,387-12,686)	0.03	0.03	0.09		0.05	0.04	0.13	
School Quality	0.08**	0.07	0.03		0.11**	0.13	0.02	
Quality by Pre-K/CBC	-0.01	-0.01	0.03	0.13	0.00	0.00	0.03	0.15
Quality by Title-1/CBC	-0.01	-0.01	0.03	0.10	-0.02	-0.02	0.04	0.10
Cognitive Skills	0.18**	0.01	0.02		0.26**	0.01	0.01	
Male	0.03^{+}	0.06	0.02		0.04**	0.09	0.01	
Free Lunch/Reduced Lunch	0.05**	0.20	0.01		0.03**	0.10	0.01	
None/Reduced Lunch	0.03^{+}	0.11	0.02		0.11**	0.26	0.02	
Disability Status in 8th Grade	-0.24**	-0.64	0.02		-0.14**	-0.39	0.02	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 39 Associations of ECE Type by School Quality by Ethnicity of Eighth Grade FSA Math Scores of Children who Attended Public-School Pre-K or CBC (*n* = 264 – 408)

	Black/African American				Hispanic/Latinx			
Predictor	*β*	B	*SE*	R^2	*β*	B	*SE*	R^2
Pre-K/CBC (*n*=271-408)	0.40	11.85	0.36		-0.09	-2.68	0.23	
Title-1/CBC (*n* =264-369)	0.50	14.70	0.41		-0.09	-2.67	0.25	
School Quality	0.10^{+}	2.87	0.06		0.03	0.93	0.05	
Quality by Pre-K/CBC	-0.25	-7.35	0.20	0.08	0.13^{+}	3.77	0.07	0.13
Quality by Title-1/CBC	-0.32	-9.41	0.23	0.08	0.12	3.35	0.09	0.09
Cognitive Skills	0.14	0.14	0.10		0.13**	0.15	0.04	
Male	-0.20**	-6.00	0.09		-0.11	-3.29	0.08	
Free Lunch/Reduced Lunch	0.10	3.03	0.09		-0.11	-3.08	0.18	
None/Reduced Lunch	0.38	11.24	0.30		0.37**	10.66	0.14	
Disability Status in 8th Grade	-0.27*	-8.03	0.13		-0.44**	-12.73	0.09	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 40 Associations of ECE Type by School Quality by Ethnicity of Eighth Grade FCAT 2.0 Reading Scores of Children who Attended Public-School Pre-K or CBC (*n* = 8,387 – 17,168)

	Black/African American				Hispanic/Latinx			
Predictor	*β*	B	*SE*	R^2	*β*	B	*SE*	R^2
Pre-K/CBC (*n*=9,244-17,168)	-0.06	-0.05	0.09		-0.08	-0.08	0.09	
Title-1/CBC (*n* =8,387-12,686)	-0.02	-0.01	0.09		-0.07	-0.06	0.10	
School Quality	0.09**	0.08	0.02		0.14	0.14	0.02	
Quality by Pre-K/CBC	0.01	0.01	0.03	0.12	0.04	0.04	0.03	0.13
Quality by Title-1/CBC	-0.01	-0.01	0.03	0.10	0.02	0.02	0.03	0.11
Cognitive Skills	0.18**	0.01	0.02		0.17**	0.01	0.01	
Male	-0.04**	-0.07	0.02		-0.07**	-0.13	0.01	
Free Lunch/Reduced Lunch	0.04*	0.14	0.02		0.04**	0.13	0.01	
None/Reduced Lunch	0.10**	0.30	0.02		0.12**	0.30	0.01	
Disability Status in 8th Grade	-0.20**	-0.53	0.02		-0.19**	-0.51	0.02	

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 41 Associations of ECE Type by School Quality by Ethnicity of Eighth Grade FSA Reading Scores of Children who Attended Public-School Pre-K or CBC (*n* = 312 – 586)

	Black/African American				Hispanic/Latinx			
Predictor	β	B	*SE*	R^2	β	B	*SE*	R^2
Pre-K/CBC (*n*=323-586)	0.52	15.76	0.28		0.13	3.60	0.18	
Title-1/CBC (*n* =312-507)	0.60^{+}	18.05	0.32		0.17	4.72	0.19	
School Quality	0.05	1.37	0.05		0.06	1.74	0.04	
Quality by Pre-K/CBC	-0.22	-6.48	0.16	0.13	0.04	1.19	0.06	0.26
Quality by Title-1/CBC	-0.27	-8.27	0.19	0.12	0.02	0.50	0.06	0.22
Cognitive Skills	0.09	0.10	0.08		0.19**	0.18	0.04	
Male	-0.24**	-7.21	0.08		-0.22**	-6.06	0.06	
Free Lunch/Reduced Lunch	0.47**	14.30	0.19		-0.08	-2.11	0.16	
None/Reduced Lunch	0.54*	16.17	0.25		0.37**	10.39	0.10	
Disability Status in 8th Grade	-0.49**	-14.80	0.16		-0.65**	-17.96	0.08	

Note. $^{+}p < .10$, *$p < .05$, **$p < .01$

Table 42 Associations and Odds Ratios of ECE Type by School Quality by Ethnicity of Middle School Retention (*n* = 8,251 -19,382)

	Black/African American				Hispanic/Latinx			
Predictor	*β*	B	*SE*	Odds Ratios	*β*	B	*SE*	Odds Ratios
Pre-K/CBC (*n*=9,378-19,382)	-0.27	-0.92	0.12	0.40*	-0.04	-0.08	0.21	0.92
Title-1/CBC (*n* =8,521-12,853)	-0.21	-0.79	0.11	0.45*	-0.05	-0.10	0.22	0.90
School Quality	-0.08	-0.24	0.04	0.79*	-0.09	-0.21	0.04	0.81*
Quality by Pre-K/CBC	0.08	0.26	0.04	1.30^{+}	-0.03	-0.06	0.06	0.95
Quality by Title-1/CBC	0.07	0.26	0.04	1.30^{+}	0.03	-0.21	0.07	1.05
Cognitive Skills	-0.09	-0.01	0.03	0.99**	-0.14	-0.01	0.04	0.99**
Male	0.12	0.80	0.04	2.22**	0.19	0.76	0.03	2.13**
Free Lunch/Reduced Lunch	-0.81	-11.62	0.11	0.00**	-0.15	-0.95	0.05	0.39**
None/Reduced Lunch	0.01	0.06	0.02	1.06	-0.15	-0.69	0.05	0.50**
Disability Status in 8th Grade	-0.03	-0.32	0.02	0.73	-0.02	-0.09	0.03	0.92

Note. $^{+}p < .10$, $*p < .05$, $**p < .01$

Table 43. Effect Sizes of Pre-K vs. CBC contrast and Pre-K type by Quality interaction by Grade

	Outcome	Fifth Grade	Eighth Grade
Main Effects of Pre-k	GPA	0.15**	0.13**
	Math	FCAT Math 0.03**	FCAT 2.0 Math n.s. FSA Math n.s.
	Reading	FCAT Read 0.03**	FCAT 2.0 Read n.s. FSA Read 0.17**
	School Retention	-0.21**	-0.15**
Pre-K type by School Quality Interaction	GPA	0.02	0.03
	Math	FCAT Math 0.01	FCAT 2.0 Math 0.01 FSA Math 0.14*
	Reading	FCAT Read 0.03*	FCAT 2.0 Read 0.04* FSA Read 0.03
	School Retention	-0.17**	0.04

Note. n.s. = not significant, *$p < .05$, **$p < .01$

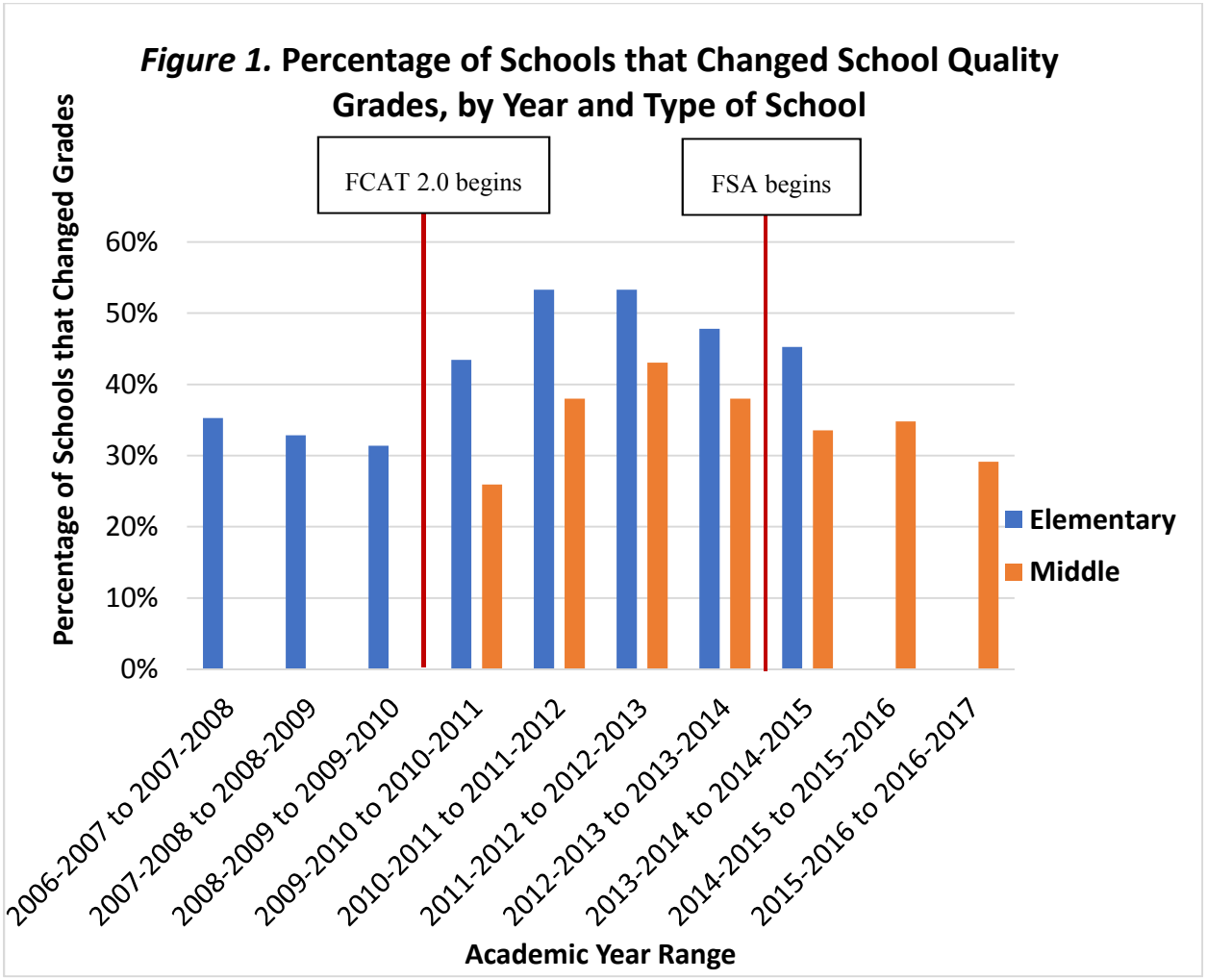
Figure 1. Percentage of Schools that Changed School Quality Grades, by Year and Type of School
FCAT 2.0 begins
FSA begins
Percentage of Schools that Changed Grades
60%
50%
40%
30%
20%
10%
0%
Elementary
Middle
2006-2007 to 2007-2008
2007-2008 to 2008-2009
2008-2009 to 2009-2010
2009-2010 to 2010-2011
2010-2011 to 2011-2012
2011-2012 to 2012-2013
2012-2013 to 2013-2014
2013-2014 to 2014-2015
2014-2015 to 2015-2016
2015-2016 to 2016-2017
Academic Year Range

Figure 1

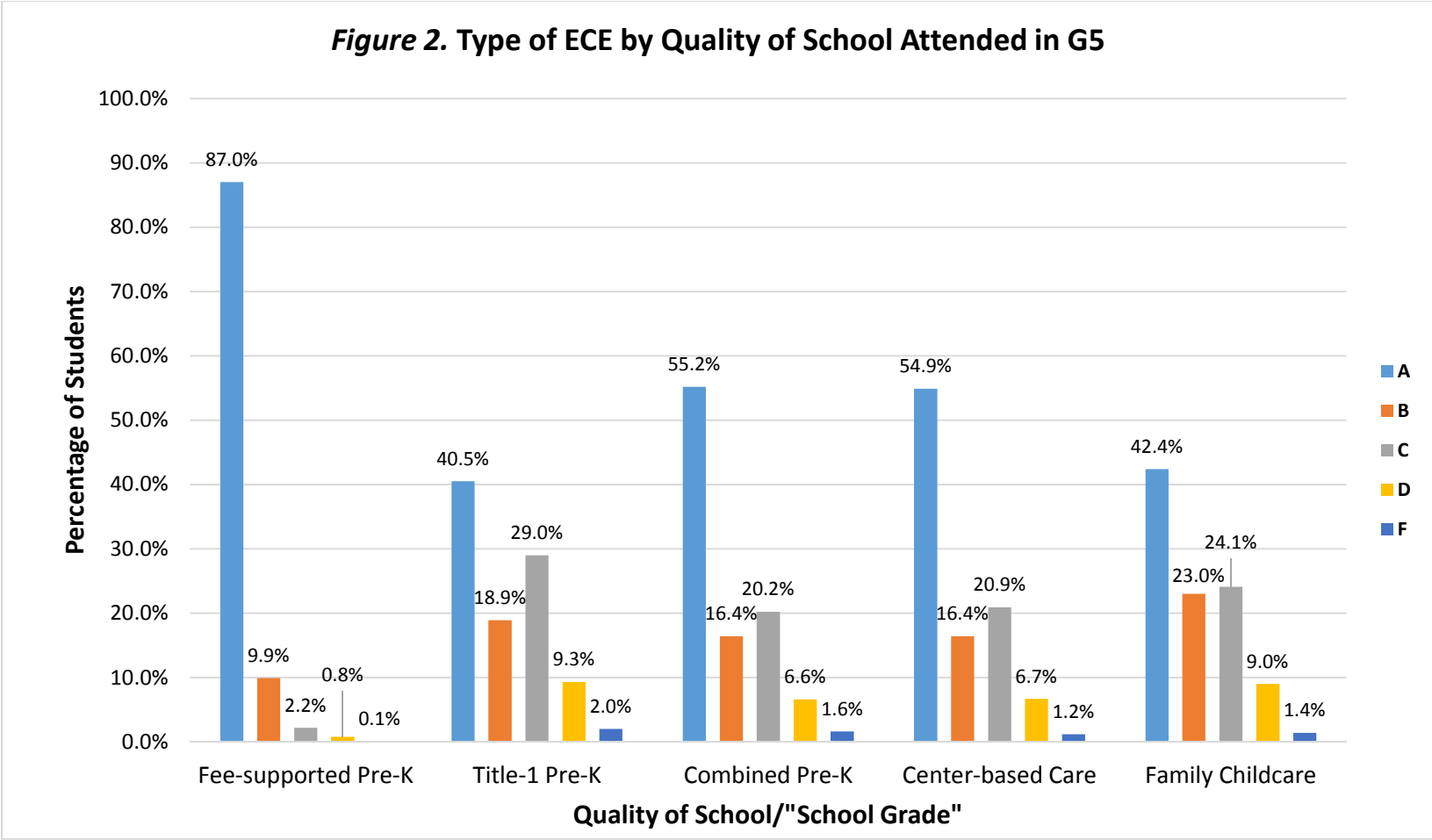
Figure 2. Type of ECE by Quality of School Attended in G5
Percentage of Students
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
87.0%
9.9%
2.2%
0.8%
0.1%
40.5%
18.9%
29.0%
9.3%
2.0%
55.2%
16.4%
20.2%
6.6%
1.6%
54.9%
16.4%
20.9%
6.7%
1.2%
42.4%
23.0%
24.1%
9.0%
1.4%
Fee-supported Pre-K
Title-1 Pre-K
Combined Pre-K
Center-based Care
Family Childcare
Quality of School/"School Grade"
A
B
C
D
F

Figure 2

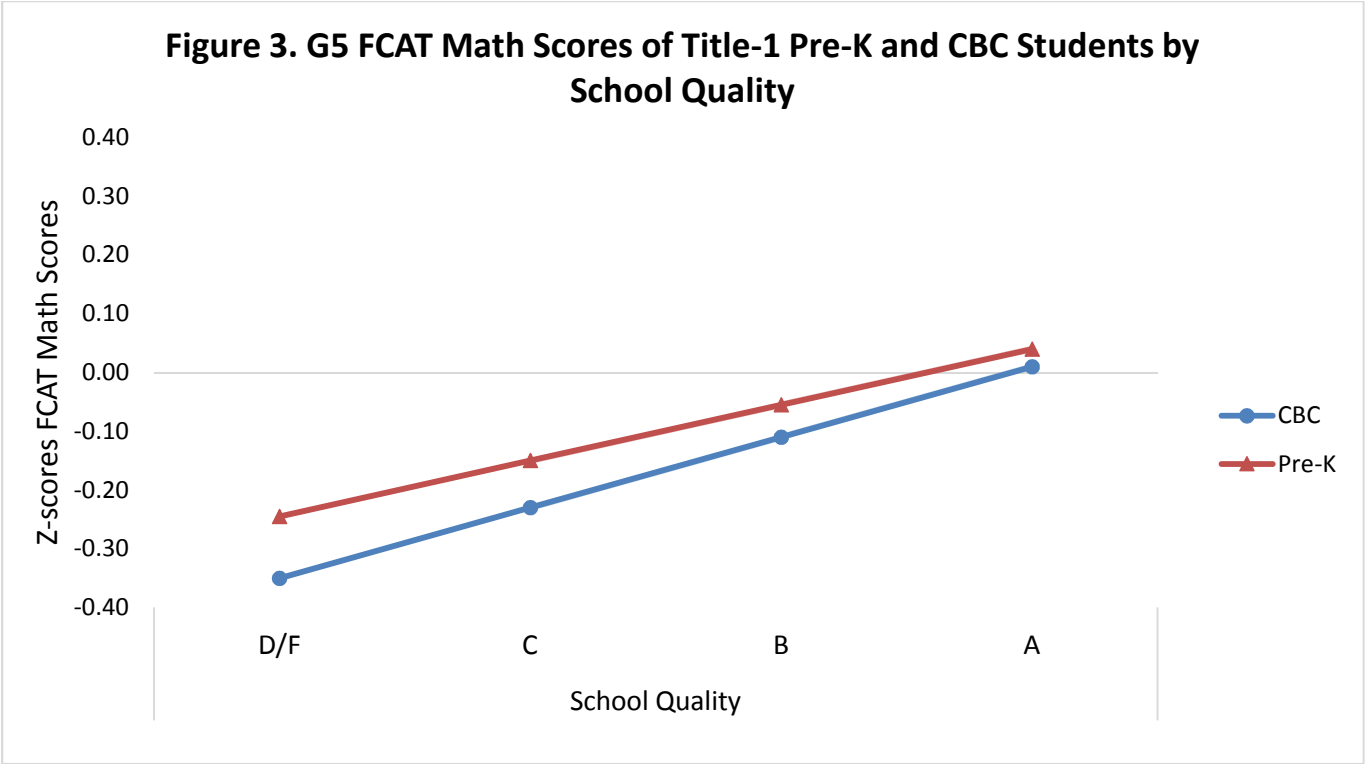
Figure 3. G5 FCAT Math Scores of Title-1 Pre-K and CBC Students by School Quality
Z-scores FCAT Math Scores
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 3

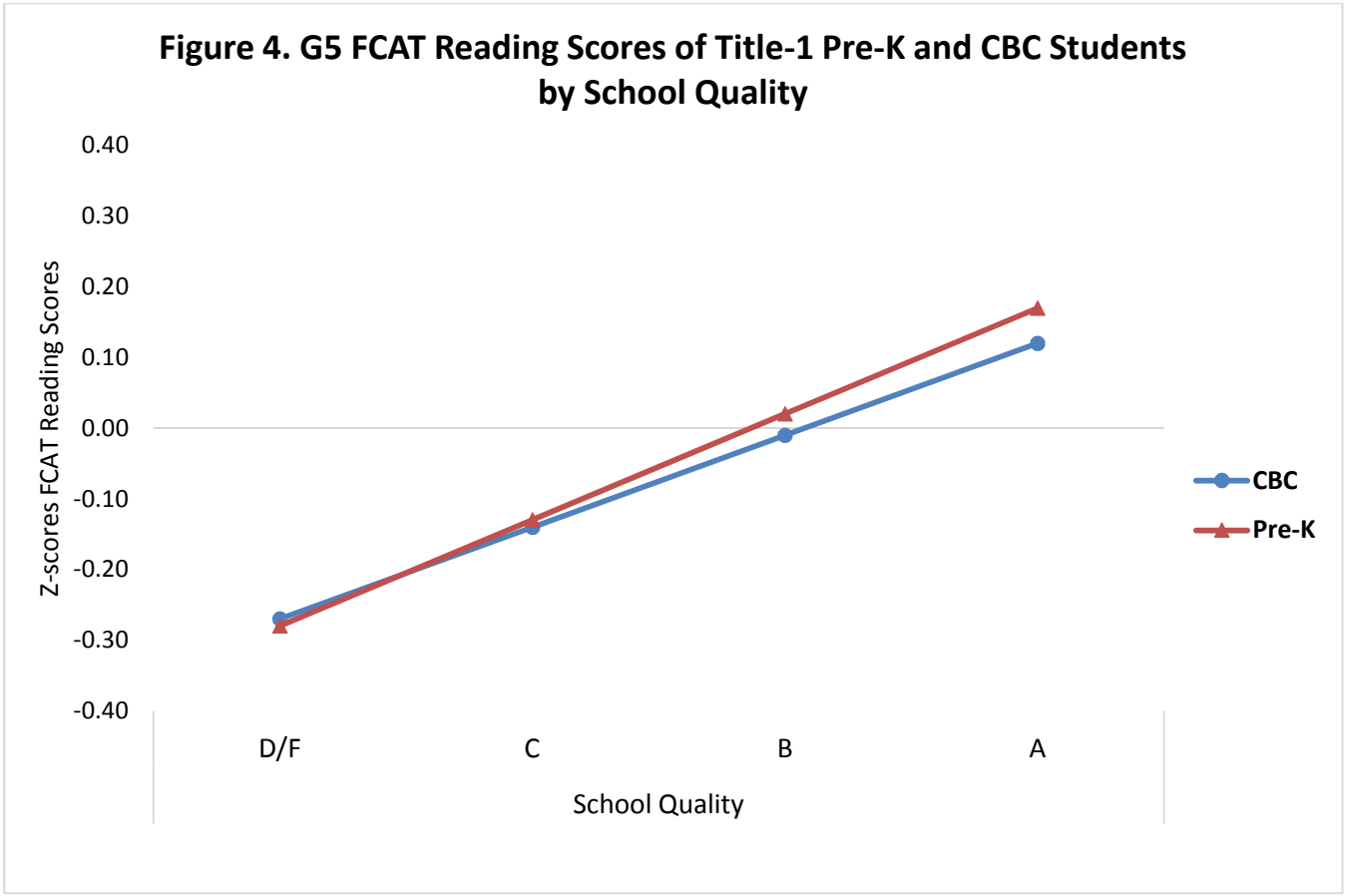
Figure 4. G5 FCAT Reading Scores of Title-1 Pre-K and CBC Students by School Quality
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
Z-scores FCAT Reading Scores
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 4

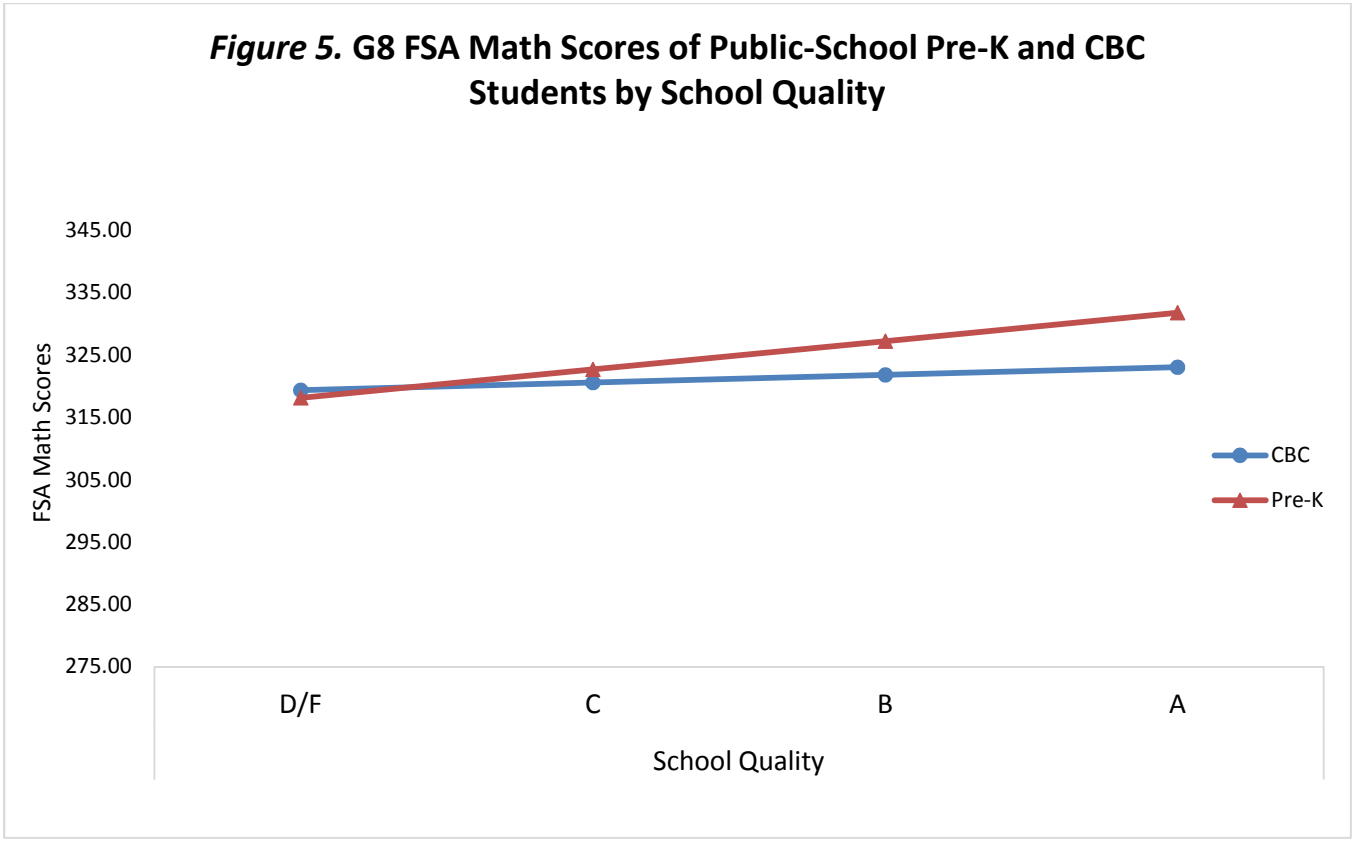
Figure 5. G8 FSA Math Scores of Public-School Pre-K and CBC Students by School Quality
345.00
335.00
325.00
315.00
305.00
295.00
285.00
275.00
FSA Math Scores
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 5

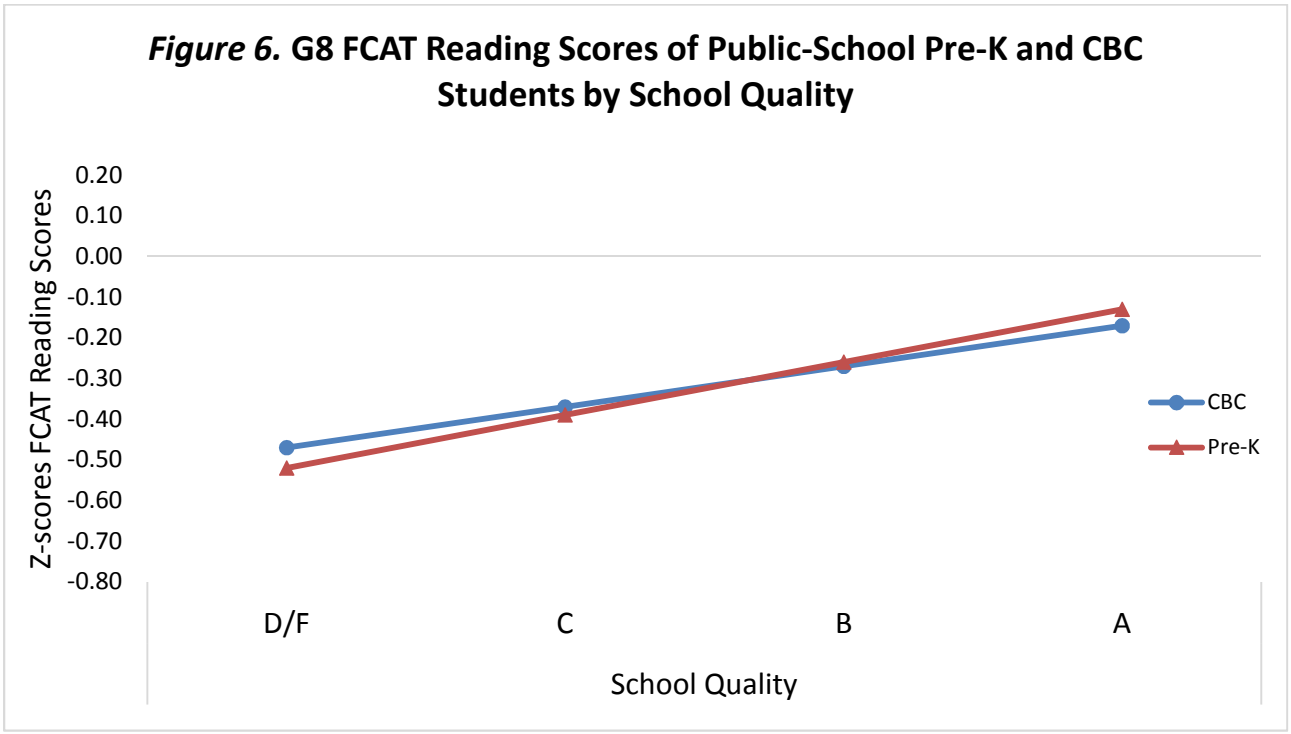
Figure 6. G8 FCAT Reading Scores of Public-School Pre-K and CBC Students by School Quality
Z-scores FCAT Reading Scores
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
-0.60
-0.70
-0.80
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 6

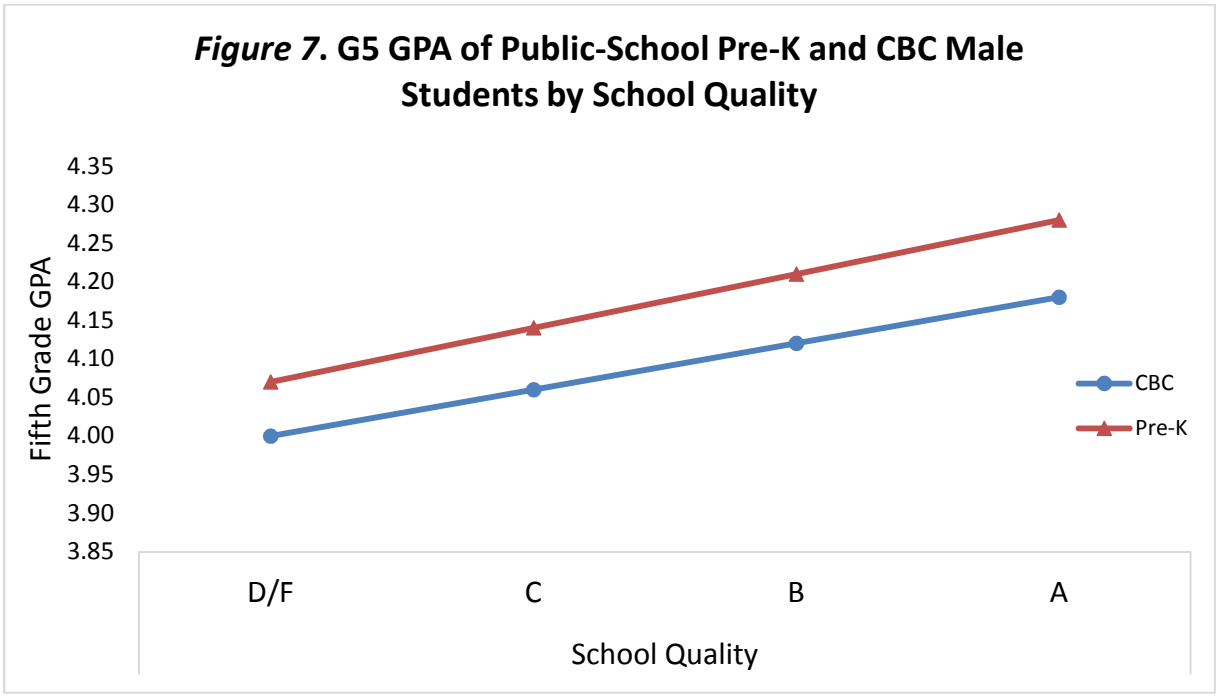
Figure 7. G5 GPA of Public-School Pre-K and CBC Male Students by School Quality
Fifth Grade GPA
4.35
4.30
4.25
4.20
4.15
4.10
4.05
4.00
3.95
3.90
3.85
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 7

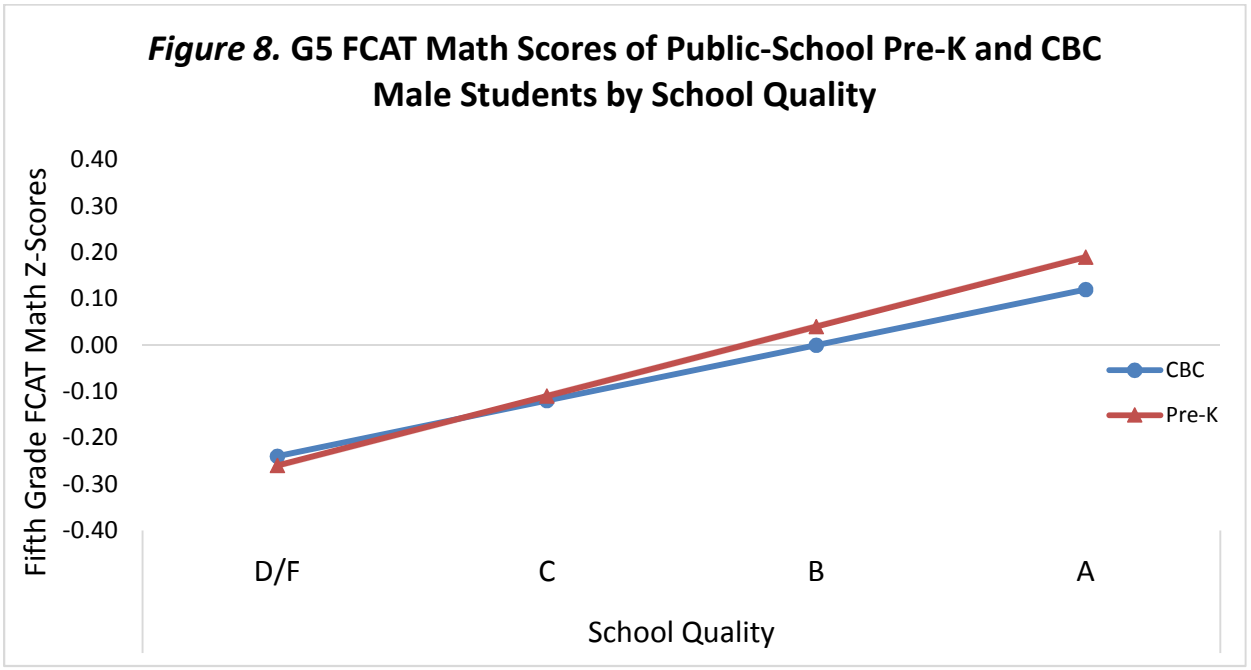
Figure 8. G5 FCAT Math Scores of Public-School Pre-K and CBC Male Students by School Quality
Fifth Grade FCAT Math Z-Scores
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 8

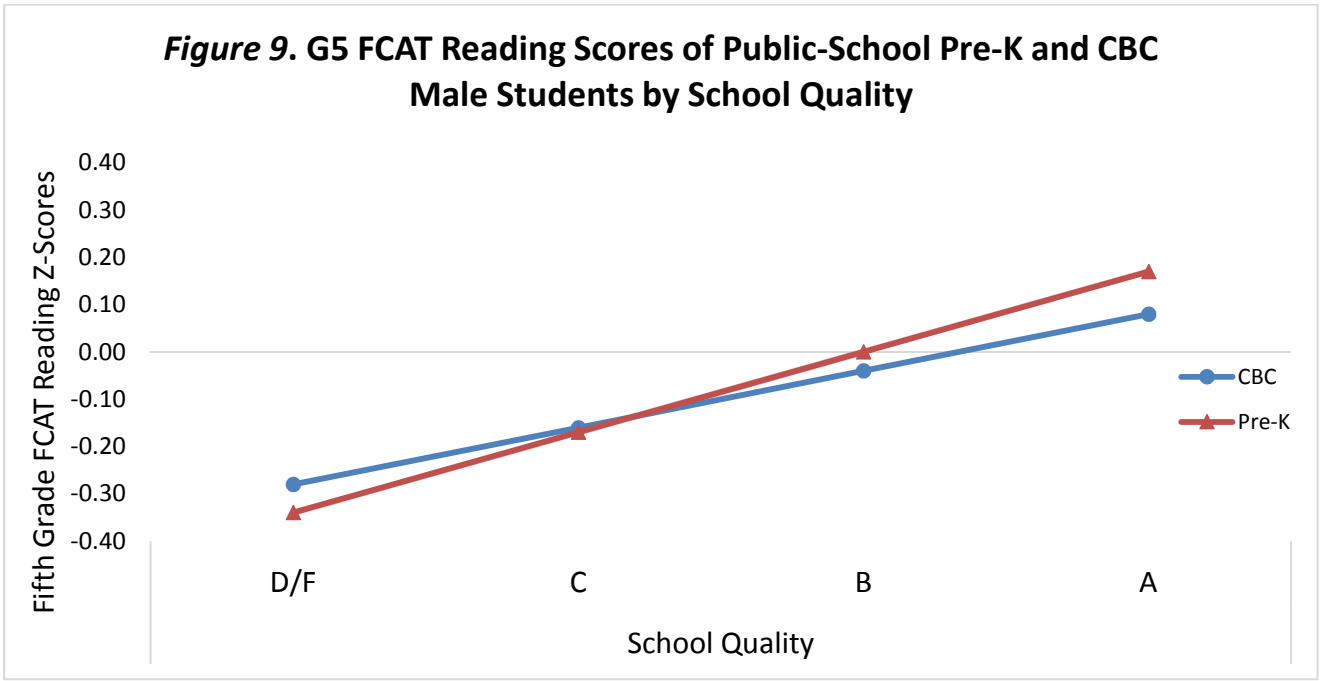
Figure 9. G5 FCAT Reading Scores of Public-School Pre-K and CBC Male Students by School Quality
Fifth Grade FCAT Reading Z-Scores
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 9

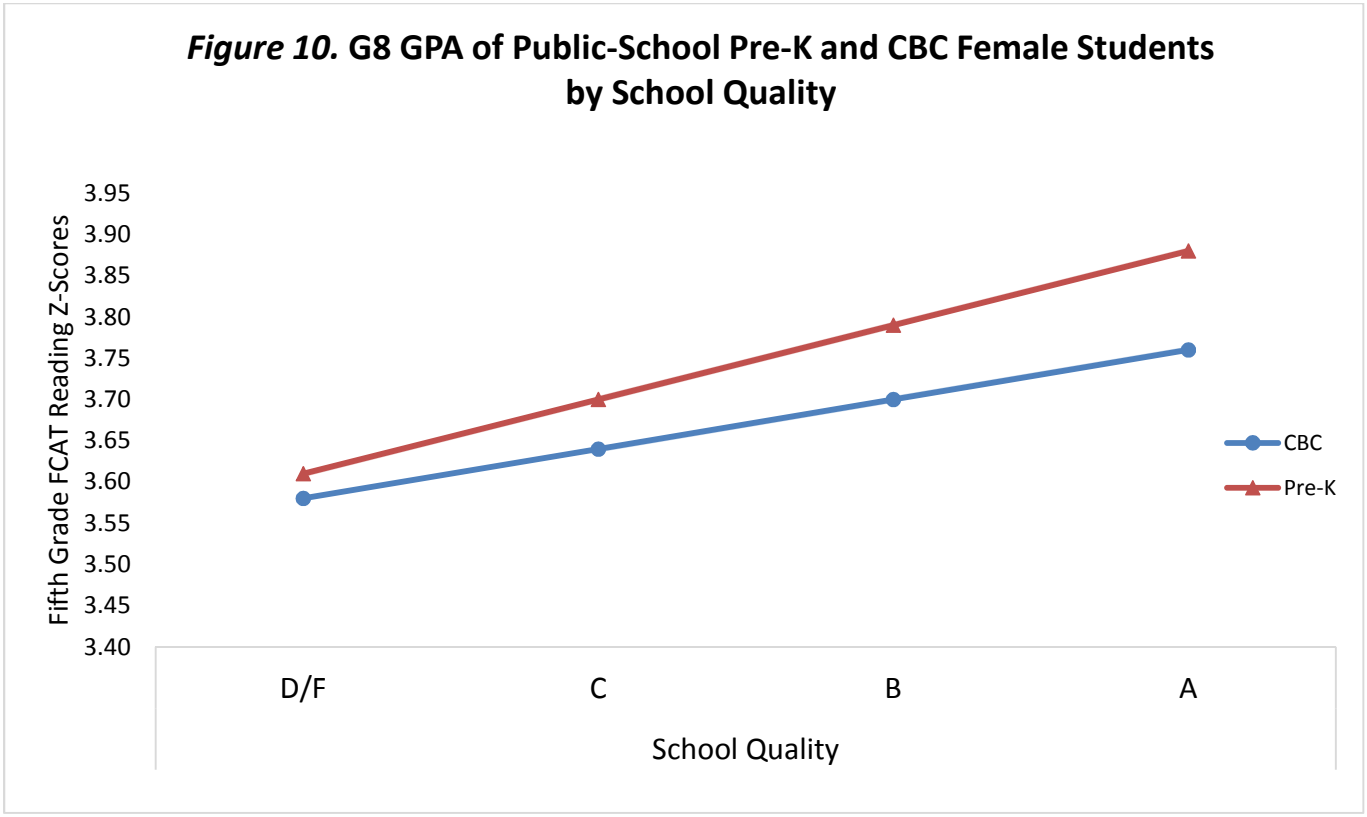
Figure 10. G8 GPA of Public-School Pre-K and CBC Female Students by School Quality
Fifth Grade FCAT Reading Z-Scores
3.95
3.90
3.85
3.80
3.75
3.70
3.65
3.60
3.55
3.50
3.45
3.40
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 10

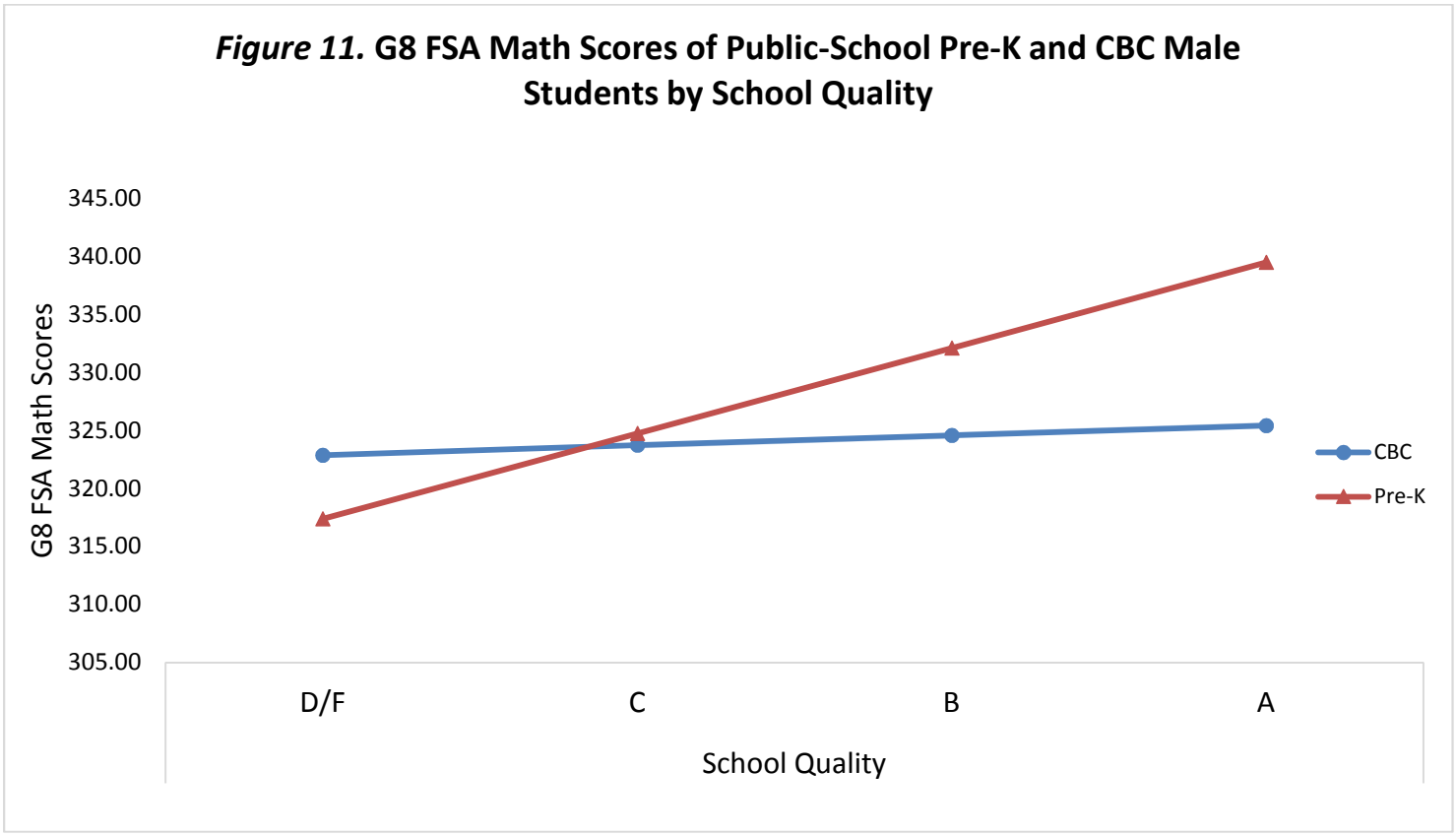
Figure 11. G8 FSA Math Scores of Public-School Pre-K and CBC Male Students by School Quality
345.00
340.00
335.00
330.00
325.00
320.00
315.00
310.00
305.00
G8 FSA Math Scores
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 11

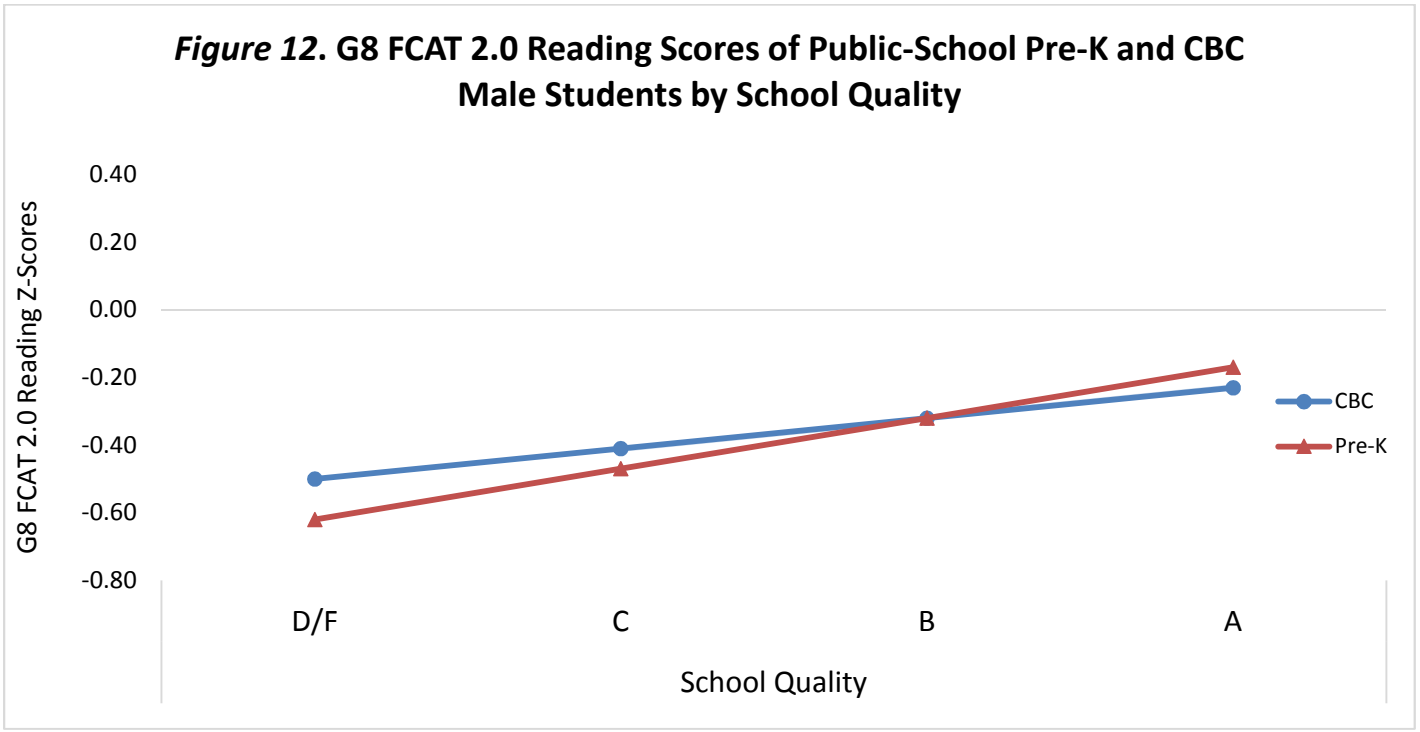
Figure 12. G8 FCAT 2.0 Reading Scores of Public-School Pre-K and CBC Male Students by School Quality
G8 FCAT 2.0 Reading Z-Scores
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
D/F
C
B
A
School Quality
CBC
Pre-K

Figure 12

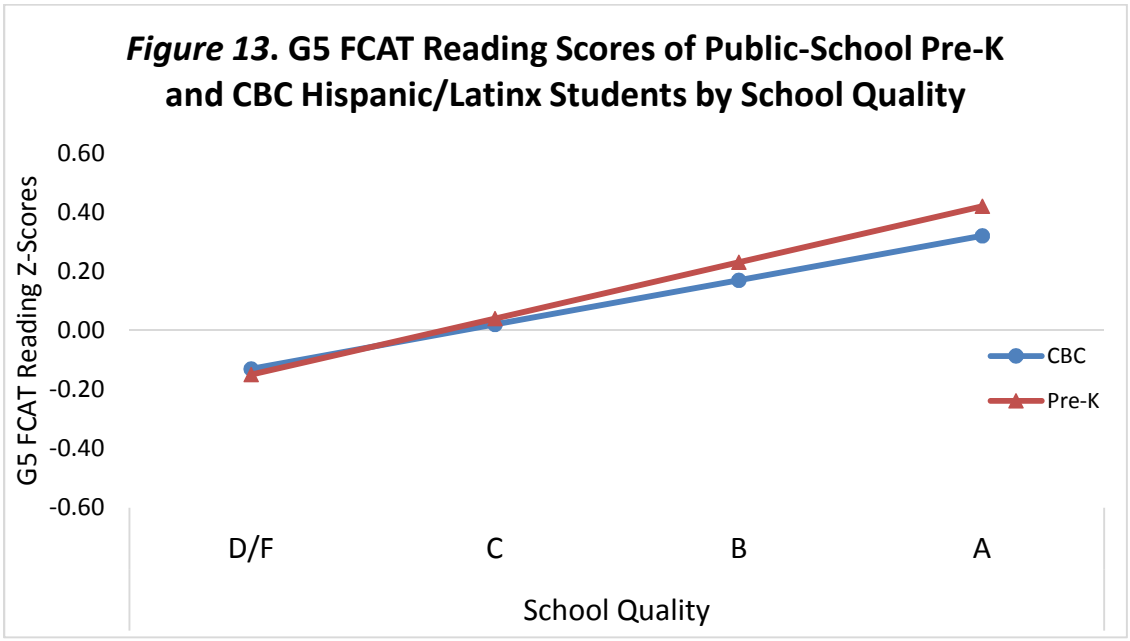
Figure 13. G5 FCAT Reading Scores of Public-School Pre-K and CBC Hispanic/Latinx Students by School Quality
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
G5 FCAT Reading Z-Scores
CBC
Pre-K
D/F
C
B
A
School Quality

Figure 13

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BIOGRAPHY

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