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A Missed Opportunity? Instructional Content Redundancy in Pre-K and Kindergarten

Lora Cohen-Vogel
University of North Carolina at Chapel Hill

Michael Little
North Carolina State University

Wonkyung Jang
Margaret Burchinal
Mary Bratsch-Hines
University of North Carolina at Chapel Hill

Policy observers have expressed concern over whether misalignment between pre-K and K–12 has negative consequences for children. This study considers students' exposure to redundant content across the pre-K and kindergarten years. Specifically, it asks, to what extent are skills and concepts taught in kindergarten redundant with skills and concepts taught in one state's public pre-K program, and for whom is redundancy most likely? Overall, findings from teacher surveys show that about 37% of the language, literacy, and math content covered in kindergarten is redundant with content covered in pre-K. The highest rates of redundancy seem to occur for basic (rather than advanced) content items, including the identification of letters and sight words. Moreover, children from families who live at or below the poverty line experience significantly higher rates of redundant content. Implications for policy, practice, and future research are discussed.

Keywords: *pre-kindergarten, kindergarten, early childhood education, education policy, curriculum*

High-quality prekindergarten programs (pre-K) have the potential to increase children's readiness for school and narrow achievement gaps (e.g., Bassok, 2010; Dodge et al., 2017; Gormley et al., 2005; Ladd et al., 2014; Magnuson & Shager, 2010; Magnuson & Waldfogel, 2005; Yoshikawa et al., 2016). Fueled by the evidence, policymakers across the United States have funded public pre-K (Cohen-Vogel, Sadler, Little, Merrill, & Curran, 2020; Merrill et al., 2020), and today, according to the National Institute for Early Education Research, 43 states have adopted programs that together enroll 34% of the nation's 4-year-olds (Friedman-Krauss et al., 2019). In many cases, however, the promising impacts on school readiness do not appear to reliably persist into elementary school—a pattern referred to as the *fade-out effect* (Bailey et al., 2017; Duncan & Magnuson, 2013; Farran & Lipsey, 2015; Hill et al., 2015; Magnuson et al., 2007; Phillips et al., 2017; Schweinhart et al., 1993).

Researchers are working to test various explanations for pre-K program fade-out (Burchinal et al., working paper). They include the "sustaining environments" explanation, positing that a child's schooling environment after program treatment is critical for the persistence of any effects (e.g., Duncan & Magnuson, 2013). Applied to early childhood education, this argument suggests that the persistence of pre-K program effects relies on subsequent educational experiences that are high quality and enriching. Other explanations suggest that impact persistence depends fundamentally on whether interventions target the right type of skills at the developmentally appropriate time (e.g., Bailey et al., 2017; Duncan & Magnuson, 2013).

Another explanation forwarded recently by Jenkins and Duncan (2017) and others (e.g., Bailey et al., 2017; Farran & Lipsey, 2015) suggests that the phenomenon of interest is not as much one of fade-out as "catch-up." Research suggests that basic academic skills develop rapidly in children at the point of exposure to formal education (e.g., Hill et al., 2008). The so-called fade-out effect of pre-K treatment, therefore, is explained by non–pre-K attenders exposed to educational content in early elementary school *catching up* with their peers who attended pre-K. As such, while academic

attainment outcomes may be positive and significant at the end of pre-K, they may be attenuated by first grade as children in comparison groups have had an opportunity in kindergarten to learn academic content and skills (e.g., Claessens et al., 2014; Engel et al., 2013).

Recent findings from our study of the publicly funded pre-K program in North Carolina revealed possible mechanisms related to the fade out/catch-up phenomenon. In a 2019 qualitative analysis of instructional guidance[1] in the state, we found evidence of strong horizontal alignment between the standards, curricula, and assessments in the NC Pre-K program but relatively weak vertical alignment (Cohen-Vogel, Sadler, Little, & Merrill, 2020). By horizontal alignment here, we mean the ways standards, curricula, and assessments align with one another *within* a grade; vertical alignment describes coherence *across* grade levels—specifically, how the instructional supports in pre-K align with those that govern kindergarten. The finding made us wonder: Could a lack of vertical alignment between the sectors that provide pre-K and kindergarten mean that children who attend the state's pre-K program are being subject to a similar curriculum again once they hit kindergarten, an idea we call *content redundancy*?

To find out, we set out to answer two research questions. The first is, "To what extent are skills and concepts taught in kindergarten redundant with skills and concepts taught in pre-K?" And, because we expected exposure to content, like many other resources and learning opportunities, to vary with student characteristics, the second asks, "For whom is redundancy most likely?"

To answer the research questions, we analyzed survey responses from teachers of young students we are tracking in a larger study of the malleable factors associated with early learning and achievement. Teacher surveys were administered during the spring of the 2016–2017 and 2017–2018 school years, when our student sample attended pre-K and kindergarten, respectively. The survey asked teachers about the content of what they teach and whether they consider it a major focus of the curriculum as a first step in understanding content coverage redundancy between the sectors that provide pre-K and kindergarten. Survey items addressed content coverage in seven domains—three focused on language and literacy and four focused on mathematics: (1) Language and Comprehension, (2) Mechanics of Reading, (3) Writing, (4) Numeracy, (5) Operations and Algebraic Thinking, (6) Measurement and Data, and (7) Geometry.

Why Study Content Redundancy?

While this study, constrained by our design for a larger project, neither investigates a causal link between content redundancy and fade-out nor unpacks whether and, in what circumstances, some redundancy may be advisable, it sets the stage for subsequent research to do so by describing content redundancy in instruction between pre-K and kindergarten. As the first of its kind, the study probes whether and how much redundancy exists between pre-K and kindergarten, in what subject area domains, and for whom.

Understanding content redundancy between the pre-K and kindergarten sectors is important for several reasons. First, as researchers working in the mise-en-scène of early childhood education policy, we regularly confront a "gut sense" among policymakers that something should be done to correct the "misalignment," "disconnect," or "instructional distance" between pre-K programs and early elementary school. Yet, when we look in the literature, we find position pieces (e.g., Bogard & Takanishi, 2005; Kagan et al., 2006) but relatively little in the way of empirical work examining the progression and overlap of instruction in the early years.

Second, our study begins a dialogue about how researchers can measure content redundancy between sectors. If content redundancy will, as we expect, occupy a central position in policy discussions around early learning, it is vital that we recognize its complexity and begin to develop various ways to measure it (Stipek et al., 2017). Specifically, we need to design and test measures that span multiple dimensions; dimensions might include, for example, reported versus observed redundancy, on one hand, and absolute versus benchmarked redundancy, on the other. Our study is not one of observed redundancy; nor does it employ measures of redundancy against some benchmark—by, for example, analyzing redundancy estimates against state content standards. Although doing so is beyond the scope of this study, we share ideas about how future projects might work to develop these kinds of alternate measures in the discussion section. In the current study, we look instead at teacher reports of the instructional content they cover in their classrooms and, in so doing, elevate the perceptions of practicing educators responsible for implementing the curriculum day to day. Arguably, it is educators themselves, rather than outside observers, who are best positioned to provide a full accounting of what they teach across an academic year.

Finally, beyond its contributions toward unpacking a new explanation for fade-out and promoting a conversation about redundancy metrics, our study represents an important conceptual advancement. Applying an equity lens, it investigates whether some groups of students are systematically exposed to more redundant content than are others. By doing so, it recognizes that unfavorable schooling outcomes derive from inequitable access to educational opportunities. There are larger, equity-focused questions to be asked about redundancy, including whether redundancy is largely driven by the need to cover skills and concepts for non–pre-K attenders. Here, our data permits us only to ask whether there are differences in content redundancy within pre-K attenders who, because of means-tested eligibility requirements, tend to vary less in terms of family income than the wider population. If,

even within this income-restricted population, substantial differences exist in instructional content, we need to understand which subgroups are more and less likely to be redundancy-exposed.

Literature Review

Researchers and long-time observers suggest that misalignment between the pre-K and K–12 sectors may lead to gaps or redundancies in the learning opportunities afforded to children as they transition from pre-K to kindergarten and that those gaps or redundancies may dampen the impact of pre-K on child outcomes over time (e.g., Abry et al., 2015; Cohen-Vogel, Sadler, Little, & Merrill, 2020; Kauerz, 2018; Little, 2020; Little et al., 2016; McCabe & Sipple, 2011; Vitiello et al., 2019). In a 2017 consensus statement, members of the Pre-kindergarten Task Force convened by the Brookings Institution explicitly warn that redundancy may contribute to fade-out: "Too much redundancy or lessons that are too advanced run the risk of inadvertently creating learning dead zones that interrupt educational progress and may squander Pre-K gains" (p. 25, Phillips et al., 2017). In other words, too much redundancy may stunt a child's progress in acquiring new knowledge and skills; at the same time, jumping ahead too fast may itself be a risk.

Despite these warnings about content redundancy from those working in the early education policy sector, there is a lack of empirical attention focused directly on the topic. We begin this section by reviewing the limited scholarship focused on redundancy between pre-K and kindergarten before moving on to cover research on higher grade levels that helps further inform the current study and ending with a brief review of what we know about disparate access to learning opportunities in early grades.

Content Coverage Redundancy: What Is Known, What Is Not?

The existing literature does not address redundancy in content coverage between pre-K and kindergarten directly. Instead of looking at the content delivered in pre-K and kindergarten classrooms, related studies have looked at content coverage in kindergarten against the *assessed skills* of children as they enter kindergarten. One of these studies used the Early Childhood Longitudinal Study, kindergarten Class of 1998–1999 (ECLS-K:1999) data set to examine the extent to which math content coverage in kindergarten was redundant with the skills children already demonstrated on a math assessment at the start of kindergarten (Engel et al., 2013). They found significant overlap. Specifically, they reported that teachers spend 13 days per month, on average, on content that children have already mastered, as measured by a kindergarten entry assessment.

A similar study using the same data set linked kindergarten content coverage (basic or advanced) in math and reading to assessed skills of children at the end of kindergarten for children who did and did not attend pre-K (Claessens et al., 2014). They found that children, regardless of pre-K attendance, benefited more from advanced content coverage in kindergarten. The implication of this finding for content redundancy is that children who benefit from pre-K do not benefit from basic instruction in kindergarten—instruction that is likely redundant with what they experienced in pre-K. Interestingly, the authors also found that children who did not attend pre-K also benefited from advanced content, rather than basic content, in kindergarten.

The two previous studies used data from the ECLS-K:1999. A recent update to this line of work used the newer ECLS-K:2011 coupled with the older version to describe how kindergarten mathematics content coverage has *changed over time* (Engel et al., 2016). The study authors found evidence that, on average, kindergarten teachers have shifted their instruction somewhat to teach more advanced mathematics content, but they still teach basic content more often than advanced content. A limitation of the ECLS-K data is that these data track children beginning in kindergarten and, thus, include teacher survey data on content coverage in kindergarten (and beyond), but not in pre-K. A key contribution of our study then is that we collect survey data on content coverage in *both pre-K and kindergarten.*

Beyond studies relying on the ECLS-K data to explore content coverage and redundancy, recent evidence from a large-scale randomized control trial of an early mathematics curriculum suggests that coordinated, nonredundant instruction is beneficial for student outcomes (Mattera & Morris, 2017). The study evaluated a pre-K mathematics curriculum, *Making pre-K Count*, and a follow-on intervention in kindergarten, *High 5s*. The pre-K treatment group was re-randomized to either receive the *High 5s* kindergarten follow-on, described as an aligned curriculum meant to sequentially build on the pre-K curriculum, or a business-as-usual condition. The study found that the benefits of the pre-K curriculum were most persistent and largest for the subset of students who had the *High 5s* kindergarten follow-on program. The findings from this randomized control trial seem to support the hypothesis that nonredundant, aligned instruction across the pre-K to kindergarten transition optimizes early learning gains.

Findings from a study of the sequencing of Head Start and pre-K between the ages 3 and 4 years may also provide some insights into the benefits of nonredundant instruction for gains in student learning (Jenkins et al., 2016; see Kalifeh et al., 2011, for evolution of the goals of Head Start). Researchers investigated whether students in Oklahoma who completed a year in Head Start at age 3 benefit more from an additional year of Head Start at age 4 or from switching to Oklahoma's public pre-K program at age 4. By using a regression discontinuity research design in tandem with propensity score weighting to adjust for selection

biases, Jenkins et al. (2016) found positive effects on prereading skills for students who switch into the public pre-K program compared with those who remain in Head Start; effects did not extend to prewriting or premath skills. Although the authors were not able to directly test which program elements of the public pre-K program in Oklahoma or the Head Start program are associated with the prereading effect, they hypothesized that factors related to redundancy and the sequencing of learning experiences likely play a key role. Specifically, they suggested that students who switch to the pre-K program are likely introduced to novel activities and materials, while those who remain in Head Start have a more redundant experience.

Additional research related to content redundancy comes from studies of higher grade levels. Arguably, research on content redundancy in the higher grades is more directly applicable to the present study because it describes the extent and nature of content redundancy between adjacent grades. These studies use a combination of textbooks, teacher logs, and survey data. Analyzing mathematics textbooks from kindergarten to ninth grade, Flanders (1987) found that the amount of new content to which students are exposed decreases as students progress through school. Specifically, the percentage of new content in math textbooks ranges from 40% to 70% in Grades 1 through 4, but declines steadily thereafter to 30% in Grade 8, suggesting that more new material is introduced in the earlier grades. The analysis only focused on the percentage of new material in textbooks, which may not be a valid proxy for teachers' actual instruction.

Polikoff (2012) provides a more recent and robust analysis of redundancy in mathematics instruction from kindergarten through Grade 8. Drawing on data from Surveys of Enacted Curriculum, a survey of teachers' self-reported instructional content coverage, Polikoff used data from more than 7,000 teachers to compare topics taught between consecutive grades within schools (see also Porter, 2002). Analysis revealed that teachers' instruction is highly redundant, with more than 60% of instructional time in each grade being spent on topics covered in previous grades. Teachers add topics in each grade at a faster rate than they were removed, leading to an accumulation of more redundancy in the later grades. Similar to Flanders's (1987) early findings, Polikoff showed that, across kindergarten through eighth grade, there is the least amount of redundancy between kindergarten and first grade. Specifically, he finds, 38% of topics covered in first grade are also covered by kindergarten teachers in the same grade. This figure increases for each passing grade level, plateauing around 50% between sixth and eighth grades. The study provides a near-grade benchmark (38%) to which we can compare our pre-K and kindergarten findings.

Understanding Variation: Content Redundancy and Student Subgroups

Though informative, none of the studies described above examines whether and how exposure to content redundancy varies by student subgroup. That is to say, the current literature does not build understanding around who receives high levels of redundant content and who does not. At the same time, an abundance of studies shows large gaps between student subgroups in terms of the instructional quality and support services they receive. Students of color, poor students, and others farthest from opportunity are less likely, for example, to have access to deeper learning (Noguera et al., 2015), quality teachers (e.g., Cohen-Vogel et al., 2013; Cohen-Vogel & Hunt, 2007; Lankford et al., 2002), gifted education/enrichment (e.g., Ford et al., 2008), and rigorous mathematics instruction (e.g., Leonard & Martin, 2013). In this context, we wondered whether content redundancy is more prevalent for minoritized students, poor students, and students from less-educated families, the same students for whom school transitions have been shown to be the most difficult (e.g., Duncan et al., 2007; Garcia, 2015; Lee & Burkman, 2002; Heckman & Kautz, 2012). Furthermore, we wondered about differences that may exist with regard to the type of redundancy to which subgroups of students are exposed. That is, are Black students more likely than White students to receive redundant instruction in mathematics, for example? Finally, any study of variation by student subgroups would be incomplete without attention to gender. Including gender as a variable makes sense in light of evidence showing that achievement varies between boys and girls at practically significant levels as students move through school. Reardon et al. (2019), for example, found that the average U.S. school district has a gender achievement gap of roughly 0.23 *SD* in English language arts that favors girls (see also Daly & Corcoran, 2019). In math, studies have found male-favoring gaps, with disparities in achievement and confidence developing by Grade 3 (e.g., Cimpian et al., 2016; Fryer & Levitt, 2010; Ganley & Lubienski, 2016; Robinson & Lubienski, 2011). In short, our analysis probes for any early gender differences in content exposure that may represent a key pathway through which later gender disparities occur.

Overall, the existing literature on redundancy in content coverage highlights the need for more study of the topic, particularly one that is focused on the pre-K to kindergarten transition and student subgroup variation. Previous studies have not directly looked at content redundancy in pre-K and kindergarten due to data limitations (the ECLS-K provides data from the kindergarten year forward), something that we overcome here with surveys fielded in *both* pre-K and kindergarten. From redundancy research in the higher grades, we learn that there is significant redundancy in content coverage in adjacent grades and that redundancy accrues over

time. We extend this literature by examining if the pattern of content redundancy extends to the pre-K and kindergarten years, despite a transition that bridges two sectors (preschool and K–12). Finally, we advance the research literature by not only documenting the extent of redundancy between pre-K and kindergarten but also examining how rates of redundancy vary based on student demographic characteristics.

Method

Data come from the ongoing Early Education in Rural North Carolina study, one of several projects in the Early Learning Network funded by the Institute of Education Sciences. The project follows a cohort of children who attended pre-K in the 2016–2017 academic year through fourth grade in six rural counties in North Carolina. The purpose of the larger project is to identify the factors that sustain children's early learning gains from pre-K into elementary school. It includes the collection of direct child assessments; classroom observations; parent, teacher, and principal surveys; as well as in-depth qualitative interviews. For the study reported here, we draw on teacher survey data collected in both the pre-K and kindergarten waves.

Setting

Our study of content redundancy in public pre-K and kindergarten is situated in the North Carolina context; a brief background is necessary for findings' interpretability.

Publicly Funded Pre-K in North Carolina. North Carolina became a recognized leader in early childhood policy in the 1990s with its Smart Start Initiative, a demonstration program in 18 of the state's 100 counties and the precursor to the statewide, publicly funded North Carolina Pre-kindergarten Program (NC Pre-K; Ladd et al., 2014). Today, NC Pre-K enrolls just shy of 25% of all 4-year-olds in North Carolina (total enrollment was 29,509 in 2018–2019; Friedman-Krauss et al., 2019). It is a targeted program, with eligibility limited to students with a family income under 75% of the state's median, a developmental delay/learning disability, a chronic health problem, and/or limited English proficiency. Program slots are provided in private licensed child care facilities, Head Start programs, and public schools, with approximately half provided in public school settings (Peisner-Feinberg & Schaaf, 2008). All providers must meet state-determined program standards and earn ratings under the state's star-rating Quality Rating and Improvement System.

Operating for a minimum of 6.5 hours a day for 10 months, NC Pre-K programs must adhere to the *state's early learning standards*—the North Carolina Foundations for Early Learning and Development (Foundations). The Foundations, developed from the National Education Goals Panel *Essential Domains of School Readiness*, focus on five developmental domains in early childhood education: (1) approaches to play and learning, (2) emotional and social development, (3) health and physical development, (4) language development and communication, and (5) cognitive development (https://ncchildcare.ncdhhs.gov/Home/DCDEE-Sections/North-Carolina-Pre-Kindergarten-NC-Pre-K). The Foundations, while similar to content standards common in K–12 education, are distinct in that they define the skills and abilities in terms of broad developmental continua from birth through Year 5 rather than discrete grade-based benchmarks. The Foundations stress that while development occurs in predictable patterns, an individual child's development process is often uneven across different stages and domains (See more about the Foundations at https://ncchildcare.ncdhhs.gov/Portals/0/documents/pdf/N/NC_Foundations.pdf?ver=2017-05-16-105950-953). In terms of professional qualifications, teachers in NC Pre-K classrooms must have a bachelor's degree and a state-issued Birth-through-kindergarten License or Preschool Add-on to their current license.

Public Kindergarten in North Carolina. In 2017–2018, North Carolina's K–12 system served 107,162 kindergarten students in its traditional public schools. Kindergarten in North Carolina is full-day and universal but not compulsory. Children are eligible to enroll in kindergarten if they reach the age of 5 by August 31 of the year they seek to enroll. Kindergarten is part of the K–12 public school system administered by the North Carolina Department of Public Instruction. In terms of qualifications, K–12 teachers in North Carolina are required to have a professional educator's license for the subject/grade level they teach.

The kindergarten standards come from the state's *Standard Course of Study* (*SCS*), which defines content standards for each grade to provide a uniform set of learning standards for every public school in North Carolina. The *SCS* was overhauled in recent years, with new standards implemented in 2012–2013. Currently, North Carolina's *SCS* consists of the Common Core State Standards in English language arts and mathematics and the North Carolina Essential Standards in all other subjects, which include arts education, healthful living, information and technology, science, and social studies. Local district leaders use the state standards to make decisions about the curriculum they deliver to students for every grade and subject; additionally, they may offer coursework that goes beyond the *SCS* content standards. There are no state-level curriculum requirements.

Data Collection

Sample. We randomly selected and recruited 63 NC Pre-K classrooms in six rural counties in central North Carolina. In each of these 63 classrooms, we recruited up to six children to include in the study through the fourth grade. The number of classrooms recruited per county was selected in proportion

to the number of NC Pre-K classrooms within that county; counties, in our sample, share borders with school districts. In Year 2 of the study, when the cohort of baseline Pre-K attenders was in kindergarten, we recruited a comparison group of children who did not attend NC Pre-K. We excluded these children from our present analysis because our interest here is in redundancy in content between pre-K *and* kindergarten. In pre-K, we had 63 teachers in our sample; in kindergarten, there were 145 teachers. The number of teachers in kindergarten is larger due to the dispersion of the initial pre-K sample (students we followed over time) into different kindergarten classrooms. The response rate among pre-K teachers was 92% and among kindergarten teachers was 81%. At the student level, our analytic sample included a total of 308 students. Our pre-K sample included 455 students. Our analytic sample is smaller due to attrition, lack of availability for follow-up in kindergarten, or the student was not a member of one of the three racial categories analyzed ($n = 3$). A comparison between the pre-K sample and our analytic sample revealed no statistically significant mean differences on any study measure (see online supplemental Appendix A).

Survey. We used a common set of items from both the pre-K and kindergarten teacher surveys in this analysis. The relevant survey items, derived from the Early Childhood Longitudinal Study, asked teachers to report the extent to which they covered skills in seven subdomains: Language and Comprehension, Mechanics of Reading, Writing, Numeracy, Operations and Algebraic Thinking, Measurement and Data, and Geometry. Across all subdomains, individual survey items listed 65 discrete skills. Example items included "Reading irregularly spelled words" and "Making, copying, or extending patterns." For each item, response options included (1) not taught because the skill is too basic, (2) not taught because the skill is too advanced, (3) taught in general instruction and is a major focus, (4) taught in general instruction and is a minor focus, (5) taught only to selected students who are struggling, and (6) taught only to selected students who are advanced.

Measures. For the measure of redundancy, we condensed the item response options into a binary indicator of whether or not the item was a "major focus of general classroom instruction." All other response options were coded as zero because teachers reported that either they were not taught as a part of general classroom instruction (e.g., taught only to selected students who are struggling) or they were a minor part of instruction (i.e., taught in general instruction and is a minor focus). Our goal was to capture content that was a major part of general classroom instruction. We used this modified specification of the redundancy measure, collected from both pre-K and kindergarten teachers, to construct measures of redundancy described in the Analysis section below.[2]

In addition to the redundancy measure, we included a range of student and family characteristics to examine the extent to which content coverage redundancy varies between different groups of students. Specifically, we included measures of student race/ethnicity, gender, maternal education, and family poverty. Information used to construct each of these measures was collected through parent surveys administered in the pre-K and kindergarten waves of data collection. The parent surveys were sent home by teachers and returned in sealed envelopes, which were then collected by trained data collectors when they visited classrooms to collect child assessment data.

Race/ethnicity was categorized as White, Black, or Hispanic. We coded students as Black if they had at least one parent who self-identified as Black. We did the same for Hispanic students. We coded students as White if all parents identified as non-Hispanic White. The reference category in our regression models is White students who are non-Hispanic. We explored variations of these variables in sensitivity analyses and found substantively similar findings. These included recoding students as Black if their parents indicated they were both Hispanic and Black and using all other students as the comparison group (as opposed to non-Hispanic White). A very small number of students ($N = 3$) identified as another race and were thus excluded from the analysis.

Student gender was similarly reported by parents and is a binary indicator where one represents male students and zero represents female students. We used a binary gender variable because parents were surveyed when children were 4 years old.

Maternal education was self-reported by mothers and categorizes education into two groups: less than a high school degree (0) and a high school degree or more (1). The original survey item included seven separate categories. We tested different specifications of categories and chose this binary specification because few respondents reported more than a high school degree. Results were consistent across the different specifications we explored.

Finally, our measure of family poverty was derived by a parent self-report of family income. We used the income data to construct a binary variable that indicates if the family income was at or below 100% of the federal poverty line (1 = *poor*) or not (0 = *not poor*). This variable uses federal income thresholds adjusted for the family size, as reported in the parent survey.

Descriptive statistics for these measures are provided in Table 1. Our sample of students is diverse in terms of race and ethnicity. The plurality of students in the sample are Hispanic (47%). Black students represent 32% of the sample and White students constitute 25% of the sample. Students in the sample are about equally distributed in terms of gender, with 51% identifying as female and 49% identifying as male. Twenty-six percent of students in the sample have mothers who completed less than high school degree, and

TABLE 1
Descriptive Statistics

Characteristic	Proportion	*SD*	Min	Max	*N*	Missing (%)
Race/ethnicity						
White	0.25	0.43	0	1	296	12 (3.8%)
Black	0.32	0.47	0	1	303	5 (1.6%)
Hispanic	0.47	0.5	0	1	308	0 (0%)
Gender						
Female	0.51	0.5	0	1	308	0 (0%)
Male	0.49	0.5	0	1	308	0 (0%)
Mother's education						
Less than a high school degree	0.26	0.44	0	1	307	1 (0.3%)
High school degree or more	0.74	0.44	0	1	307	1 (0.3%)
Poverty						
Income at or below 100% FPL	0.58	0.49	0	1	251	57 (18.5%)
Income above 100% FPL	0.42	0.49	0	1	251	57 (18.5%)

Note. $N = 308$. FPL = federal poverty line.

58% of students in the sample had family incomes that were at or below 100% of the federal poverty line.

Analysis

Our analysis of the teacher survey data proceeded in a manner consistent with our research questions. First, to document the extent to which skills and concepts taught in kindergarten were redundant with skills and concepts taught in pre-K, we created a child-level measure of redundancy using the binary teacher-level curricular content variables from pre-K and kindergarten. We considered a skill or concept to be redundant if it was a "major focus" in *both* pre-K and kindergarten. Figure 1 illustrates this process and the various response patterns possible with our data. There are four different response patterns possible, and only pattern D is considered to be redundant because the skill was reported to be a major focus in both pre-K and kindergarten. In patterns A, B, and C, the skill was not reported to be a major focus in *both* grades, even if it was a major focus in one of the two grades. This is our operationalization of content redundancy.

Having applied an indicator of content redundancy for each student-by-item observation, we then averaged the variable across students within items, within the two domains (i.e., Reading and Language, Mathematics) and seven subdomains, and across all items in aggregate. This allowed us to examine overall rates of redundancy (i.e., the proposition of skills or concepts taught as a major part of general classroom instruction in both pre-K and kindergarten) as well as how rates of redundancy varied between domains, subdomains, and items.

Next, we examined how rates of redundancy varied based on student characteristics. To do this, we estimated a series of regression models where the outcome was the proportion of redundant instruction and the predictors were the student demographic measures. We began by estimating simple bivariate models to ascertain the raw gaps in redundancy predicted by the student characteristics of interests—similar to research documenting unadjusted gaps in achievement between subgroups of students (Reardon, 2011). We then estimated multivariate regression models wherein all student characteristics were included contemporaneously to explore the degree to which differences were explained by the inclusion of covariates. This approach of estimating raw unadjusted differences as well as conditional differences is consistent with prior work documenting disparities in educational opportunities (e.g., Little et al., 2016; Pianta et al., 1999). All regression models included school district fixed effects to account for time-invariant differences between the six districts where our study took place (Wooldridge, 2016). All but one student in our sample attended kindergarten in the same district where they attended pre-K. The models also included random effects for pre-K ID and repeated kindergarten ID to adjust models for nonrandom clustering within each grade.

Results

Research Question 1: To what extent are skills and concepts taught in kindergarten redundant with skills and concepts taught in pre-K?

We summarize our findings for Research Question 1 in Figure 2. The *Y*-axis shows the percentage of skills and concepts that are redundant between pre-K and kindergarten. The *X*-axis shows different categories of the skills and concepts surveyed. From left to right, we first show a composite measure of "overall" redundancy across all 65 items. Then, we

Response Pattern	Major focus in Pre-K?	Major focus in kindergarten?	Redundancy Value
A	No	No	0
B	No	Yes	0
C	Yes	No	0
D	Yes	Yes	1

FIGURE 1. *Redundancy measure construction.*

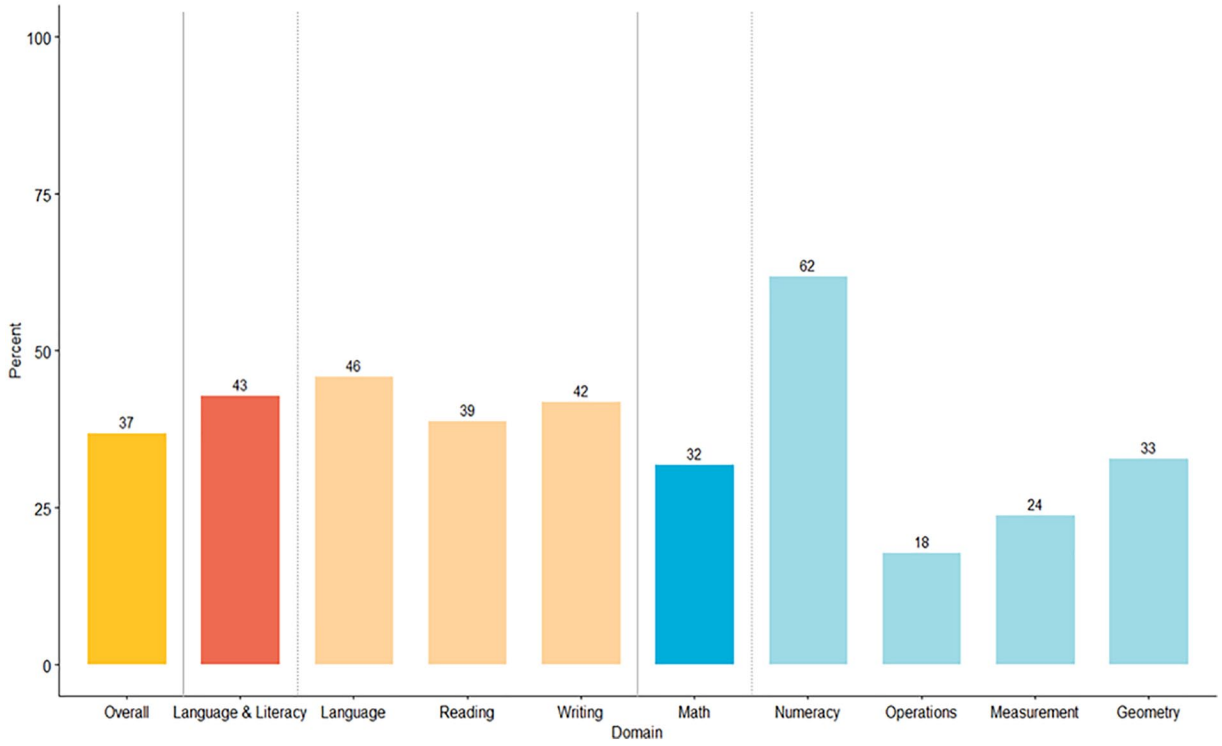

FIGURE 2. *Percentage redundant overall, by domain, subdomain.*

show the Language and Literacy domain followed by three associated subdomains. Finally, we show the Mathematics domain and four associated subdomains. In terms of overall redundancy, we find that 37% of the skills and concepts taught in kindergarten are redundant to those taught in pre-K.

Looking across the domains and subdomains, we find higher rates of redundancy between pre-K and kindergarten in the Language and Literacy domain (43%) than in the Mathematics domain (32%). Within the Language and Literacy domain, the variation among subdomains is relatively small, ranging from 39% (Mechanics of Reading) to 46% (Language and Comprehension). There is more variation among the Mathematics subdomains. The subdomain in Mathematics with the least redundancy is Operations and Algebraic Thinking (18%) and the subdomain with the most redundancy is Numeracy (62%).

In online supplemental Appendix C, we document rates of redundancy for each of the 65 skills and concepts surveyed individually along with the percentage of teachers who rated each skill and concept as a major focus in pre-K and kindergarten. While it was necessary to aggregate these items to summarize the overall picture of redundancy, there are some lessons to be learned by reviewing individual items. First, there is significant variation in terms of the redundancy observed for the 65 items. The mean rate of redundancy is 37% and the standard deviation is 24%. An examination of the extreme values that generate this variation—that is, values with very high and very low rates of redundancy—helps illuminate some distinctions among specific items (see online supplemental Appendix C).

We present the five most and least redundant items in Table 2. The five most redundant items are basic in nature

TABLE 2
Most and Least Redundant Skills and Concepts

Item	Percent redundant
Five most redundant skills/concepts	
Counting accurately to 20	87.14
Writing first name independently	84.89
Understanding correspondence between number and quantity	81.67
Matching small sets (up to 5 objects) with the corresponding numerals	78.46
Understanding conventions of print (left to right orientation, book holding)	75.24
Five least redundant skills/concepts	
Multiplying two one-digit whole numbers to find the product	0.96
Solving word problems by adding three numbers whose sum is 20 or less	0.96
Solving word problems involving quarters, dimes, nickels, and pennies	2.57
Measuring areas by counting unit squares (square centimeters, square inches, etc.)	2.57
Telling time	4.50

TABLE 3
Bivariate Associations Between Student/Family Characteristics and Redundancy

Characteristic	Composite redundancy	Language and literacy	Mathematics
Race			
Intercept	0.291*** (0.048)	0.321*** (0.055)	0.279*** (0.044)
Black	0.016 (0.016)	0.004 (0.019)	0.030^{+} (0.017)
Hispanic	−0.010 (0.014)	−0.021 (0.017)	0.001 (0.016)
Gender			
Intercept	0.290*** (0.047)	0.307*** (0.054)	0.294*** (0.042)
Male	0.001 (0.011)	0.015 (0.013)	−0.013 (0.012)
Mother's education			
Intercept	0.282*** (0.048)	0.301*** (0.055)	0.284*** (0.044)
HS or more	0.013 (0.014)	0.017 (0.016)	0.009 (0.015)
Poverty			
Intercept	0.276*** (0.047)	0.293*** (0.055)	0.278*** (0.043)
At or below 100% FPL	0.023* (0.012)	0.028* (0.014)	0.017 (0.013)

Note. $N = 308$. HS = high school; FPL = federal poverty line.
***$p < .001$. **$p < .01$. *$p < .05$. $^{+}p < .10$.

and frequently cited by teachers as important skills for school readiness (Bassok et al., 2016). For example, "Counting accurately to 20" and "Understanding conventions of print" are frequently included in kindergarten entry assessments, suggesting agreement that these skills are necessary for success in kindergarten. These same skills have also been characterized as "basic" in similar, published research (e.g., Claessens et al., 2014; Engel et al., 2013). Following the categorization from these prior studies, we find that the five least redundant items are advanced and highly discrete in scope. For example, the two least redundant items are "Multiplying two one-digit whole numbers to find the product" and "Solving word problems by adding three numbers whose sum is 20 or less."

Research Question 2: For whom is redundancy most likely?

We summarize our findings for Research Question 2 in Tables 3 and 4. Table 3 summarizes the bivariate models that regress each of the student/family characteristics on overall redundancy, Language and Literacy redundancy, and Mathematics redundancy. Table 4 shows results for these same three outcomes but includes all student/family characteristics in the regression simultaneously.

In terms of the bivariate models in Table 3, we find some statistically significant relationships for measures of race/ethnicity and poverty. In terms of race/ethnicity, we find that Black students are exposed to 3.0 percentage points more

TABLE 4
Multivariate Associations Between Student/Family Characteristics and Redundancy

Characteristic	Composite redundancy	Language and literacy	Mathematics
Intercept	0.267*** (0.050)	0.287*** (0.058)	0.267*** (0.047)
Race			
Black	0.013 (0.016)	0.001 (0.019)	0.026 (0.018)
Hispanic	−0.017 (0.016)	−0.030 (0.019)	−0.004 (0.018)
Gender			
Male	0.000 (0.012)	0.013 (0.013)	−0.013 (0.013)
Mother's education			
More than HS	0.011 (0.015)	0.015 (0.017)	0.007 (0.016)
Poverty			
At or below 100% FPL	0.032* (0.013)	0.040* (0.016)	0.024^{+} (0.014)

Note. $N = 308$. HS = high school; FPL = federal poverty line.
***$p < .001$. **$p < .01$. *$p < .05$. +$p < .10$.

redundant mathematics content, on average, than White students ($p < .10$). In terms of poverty, we find that students from households at or below 100% of the federal poverty line are exposed to 2.3 percentage points more redundancy overall, on average, than their peers above the poverty line ($p < .05$). This finding for overall redundancy appears to be concentrated in the language and literacy domain, where students from households at or below 100% of the federal poverty line are exposed to 2.8 percentage points more redundancy overall, on average, than their peers above the poverty line ($p < .05$). We find no differences in redundancy based on gender or maternal education.

Turning to Table 4, where we present the multivariate regression models, we no longer find that Black students are exposed to more redundant content in terms of Mathematics, but the associations for poverty remained and their magnitude increased. We find that students from families at or below 100% of the federal poverty line are exposed to 3.2 percentage points more redundancy overall, on average, than their peers from families above the poverty line. The association for poverty is more pronounced in the language and literacy domain (4.0 percentage points, $p < .01$) than the mathematics domain (2.4 percentage points, $p < .10$).

Discussion

Overall, findings from teacher surveys in six rural North Carolina districts show that about 37% of the language, literacy, and math content covered in kindergarten is redundant with content covered in pre-K. The highest rates of redundancy seem to occur for basic (rather than advanced) content items, including the identification of letters and sight words. Moreover, children from families who live at or below the poverty line experience significantly higher rates of redundant content. What are we to make of the findings?

Extent of Redundancy

Our 37% estimate of overall content redundancy between public pre-K and kindergarten aligns closely with previous studies of early grades in the K–12 sector—most notably, Polikoff's (2012) finding that 38% of topics covered by teachers in first grade were also covered in kindergarten. The finding suggests that considerable time in kindergarten classrooms is spent covering content previously taught to children enrolled in the NC Pre-K program, and that, consequently, this is not time spent on new and/or more advanced skills and concepts. Taken together with Polikoff's Kindergarten-Grade One finding, our pre-K–kindergarten finding should motivate future studies that follow students over multiple years, ensuring that the content already repeated between pre-K and kindergarten is not repeated again between kindergarten and first grade.

While it is valuable to know that almost 4 in 10 skills and concepts taught in public pre-K are taught again in kindergarten, the statistic alone should not inform an immediate change in policy or practice. Before changes are made to reduce content redundancy and improve the sequencing of learning experiences, more research is needed to better understand, first, the instructional practices related to the content domains and, second, what costs and/or benefits accrue to children exposed to redundant content.

Content Redundancy and Instructional Practice. First, research is needed that directly observes instruction across a large swath of early grade teachers, both to validate teacher self-reports (as captured in the survey) and to consider whether the instructional delivery of the skills and concepts in pre-K and kindergarten varies systematically in ways that expose children to different content across the 2 years. We are not talking explicitly about differences in teacher quality, per se (though the impact of individual teachers on student

learning is known to vary widely); instead, we are calling for systematic attention to between-grade differences in both the time spent on a skill or concept and student interactions with it. Take one highly redundant skill in our study, as an example: "understanding conventions of print (left to right orientation, book holding)." Future studies could use teacher logs, lesson plans, and observations to track minutes spent on teaching sets of skills, for example; they could also use existing measures and develop others to examine how those skills are taught in public pre-K and kindergarten classrooms. Does left to right orientation of print conventions, to continue the example, mean using a finger to point to text during shared, big book reading in public pre-K and something considerably extended, say, a discussion of global differences in print direction, in kindergarten? In short, more must be learned about what exactly is taught when pre-K and kindergarten teachers report teaching a skill.

The Open Question of "Optimal" Redundancy. Second, more must be learned about the impact of redundant content. Just because a specific skill or concept in pre-K is taught does not mean that learning occurs. In that sense, redundancy cannot simply be dismissed outright as a missed opportunity. It is possible, even likely, that some skills and concepts are learned only after students are given multiple opportunities to experience and practice them. Indeed, evidence of redundancy—far from revealing a previously unknown opportunity for new content delivery—might instead reflect intentional efforts on the part of schools and teachers to "re-teach" content in order to combat summer learning loss or examine how ready students are to learn advanced material (Atteberry & McEachin, 2016; Quinn et al., 2016; Quinn & Polikoff, 2017). Future studies, expanding on what's already known about the efficacy of curricular progression and sequencing, should systematically test whether and how much content redundancy may optimize learning during this early, formative stage of development. In light of previous research that suggests the pace of learning and learning loss vary by subject matter and topic, future work should be designed in ways that allow the answer to vary for different domains (e.g., Cooper et al., 1996).

Redundant for Whom?

Our findings that students' experiences with content redundancy depend on the demographic subgroups to which they belong have never before been documented. Consistently across models, findings imply that students from families living at or below the poverty line are more likely to be taught the same skills and concepts in pre-K and kindergarten than students from families living above the poverty line. The relationship is particularly strong in language and literacy. In the bivariate models, Black students are more likely to be taught the same mathematics skills and concepts in pre-K and kindergarten than non-Black students, but the finding does not hold when other demographic controls are added.

The poverty finding is notable because many public pre-K programs, including North Carolina's, are targeted. In North Carolina, as a reminder, eligibility is limited to students from families with incomes below 75% of the state's median,[3] a developmental delay/learning disability, a chronic health problem, and/or limited English proficiency. The historical rationale behind such programs was compensatory in nature; early programs funded by the federal government and, later by some states, were often described as attempts to reduce social inequalities and help ready underprivileged children for school[4] (Wrigley, 1989; Delaney & Neuman, 2018). So why are children from families at or below the federal poverty threshold who attend this state-funded, targeted pre-K program more likely to be exposed to redundant content in kindergarten than their nonpoor (but not necessarily economically thriving peers) who attended the same North Carolina program?

The data available to us do not provide answers. By way of possible explanations, perhaps the poorest pre-K attenders are systematically more likely to attend schools that deliver content in kindergarten at basic levels (content more likely to have been covered in pre-K). Or perhaps, within schools, the poorest pre-K attenders are more likely to be sorted into kindergarten classrooms where teachers teach basic content, as the result of implicit bias—the automatic, unconscious stereotypes that drive behavior. Studies show that teachers, on average, have lower academic expectations for poor students and students of color (Jacoby-Senghor et al., 2016; van den Bergh et al., 2010); as a result, teachers in classrooms and schools with larger proportions of these students engage in more didactic teaching (Stipek, 2004) and may also focus on more basic skills. Recent research by Papageorge et al. (2020) addresses the practical significance of low teacher expectations; situated in the K–12 space, the study found (1) that teacher expectations have a causal impact on students' educational attainment and (2) teacher expectations differ by racial groups in ways that disadvantage Black students. Another possibility is that teachers are responding instructionally to observed differences in student scores on the assessments they give at the start of school, such as Kindergarten Entry Assessments (KEAs). Used in 28 states, KEAs are tools administered at the beginning of kindergarten to provide educators with a snapshot of children's school readiness (Ackerman & Lambert, 2020; Little et al., 2020; Merrill et al., 2020); if the poorest students demonstrate lower skills as assessed on the KEA, then teachers with larger proportions of poor children in their classrooms may respond by focusing on more basic content.

Regardless of the reason, the subgroup differences reported here, especially if observed (or shown to be even

larger) in other contexts (e.g., studies that include private pre-K attenders), have considerable equity implications. If, for example, future studies find that content redundancy reduces learning gains in kindergarten and beyond, poor children—shown elsewhere to have unequal access to opportunities to learn—may be further disadvantaged.

Limitations

In addition to data limitations already covered in this section—the inability to examine between-grade differences in teacher time spent on/depth of content covered, the educational costs or benefits associated with redundant content, or reasons for exposure disparities between poor and nonpoor students—other study limitations exist. First, our measure of content redundancy itself is relatively simple. The measure relies on teacher reflections of what skills and concepts they covered as a major part of their instruction over the course of an academic year. Second, a first foray into these questions, the study uses data from a sample of rural school districts in North Carolina. We are unable here to examine whether the extent of redundancy and redundancy by domains as well as the disparity in exposure to redundant content that we document is representative of the state as a whole and states with similar, means-tested public pre-K, more generally. With interest now piqued, new research can begin to fill in these limits. For example, items that measure year to year content redundancy might be added to existing state and national survey assets; with follow-on data collection (observations, teacher logs, artificial intelligence–assisted technologies) with a subset of respondents. A priority area for future research is to explore whether (and how much) instructional content redundancy is linked to losses or gains in children's school readiness and achievement throughout elementary school.

Reducing Redundancies and Anticipating Implementation Barriers

Once more studies are conducted and evidence becomes available, various remedies exist to address redundant content and provide better sequenced and supported learning experiences for young students across the prekindergarten and K–12 sector divide. States might establish intra-agency governing councils to help reduce redundancies, where they are found to be harmful, and close the instructional distance. Those that already have councils might charge them with aligning curricular content across the pre-K–Grade 3 spectrum. Educators at state and district levels could design professional development opportunities that bring together pre-K and early elementary teachers to share lesson plans and portfolios of student work (Little et al., 2019; Cohen-Vogel, Sadler, Little, & Merrill, 2020). Subject area experts could be engaged to work with practicing educators to ensure all instructional programs set forth a progression of age-appropriate approaches that align evidence-based preliteracy and premath strategies for children aged birth through five with evidence-based strategies for students from kindergarten to Grade 3. The federal government could further incentivize states to enhance coordination through its Preschool Development Grant program, which prioritizes, among other things, children's transitions into elementary school.

But coordination is difficult even within sectors, and state and district partners need to anticipate threats to implementation. Coordination would be eased, of course, if all 4-year-olds attended prekindergarten. Today, about two thirds of the nation's 4-year-olds attend some form of preschool (U.S. Department of Education, 2020), defined as a group or class that provides educational experiences for children during the year or years preceding kindergarten, and only about one third attend state-funded prekindergarten (Friedman-Krauss et al., 2020). Unless federal or state governments invest in prekindergarten for all 4-year-olds, districts, schools, and kindergarten teachers will likely feel they need to set the instructional pace at a level that ensures all students, pre-K attenders and nonattenders alike, have mastered curricular objectives.

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ORCID iD

Michael Little https://orcid.org/0000-0001-9321-3088

Notes

1. By instructional guidance, we are referring to a combination of content standards, curricula, and assessments used in schools and pre-K centers and delivered in classrooms. Content standards describe what specific content groups of students should have learned by the end of a grade or course, curricula refer to the instructional materials students are exposed to, and assessments are tests aimed at evaluating the extent to which students have acquired skills and knowledge.
2. In addition to this primary measure of redundancy, we developed a second version of the redundancy measure that coded content as covered if it was either "taught in general instruction and is a *major focus*" or "taught in general instruction and is a *minor focus.*" We summarize those results in online supplemental Appendix B. The overall pattern of results is consistent with our primary measure.
3. According to the Census ACS 1-year survey, the 2019 median household income for North Carolina was $57,341. Seventy-five percent of that is approximately $43,000, or about

$17,000 higher than the federal poverty line for a family of four ($25,750), our definition of child poverty.

4. Government rhetoric, according to Wrigley (1989), also piqued interest among middle-class parents in preschool; soon, the stagnation of wages and women's rights increased demand from larger swathes of the American public. Today, publicly funded pre-K, whether universal or targeted, is often propelled as a strategy to reduce achievement gaps.

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Authors

LORA COHEN-VOGEL, PhD, is the Frank A. Daniels Jr. Distinguished Professor of Public Policy and Education at the University of North Carolina at Chapel Hill, where she focuses on bringing to scale programs that raise outcomes for historically underserved students.

MICHAEL LITTLE, PhD, is an assistant professor of educational evaluation and policy analysis at North Carolina State University, where he focuses on early childhood and early grade education policies and programs.

WONKYUNG JANG is a PhD candidate in the School of Education at the University of North Carolina at Chapel Hill, where he focuses on language and literacy development and learning during early childhood. He also pursues an MS in statistics en route to his PhD.

MARGARET BURCHINAL, PhD, is a research professor in the School of Education and Human Development at the University of Virginia, where is focuses on the impact of early care and education on development and learning for historically underserved children.

MARY BRATSCH-HINES, PhD, is the senior manager for research and evaluation at the University of Florida Lastinger Center for Learning, where she focuses on language and literacy professional development supports for early childhood and early elementary educators.