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A Meaningful Measure of Homeschool Academic Achievement: Statistical Analysis of Standardized Test Performance in Alaska Public Correspondence Schools

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Abstract *Non-traditional education has a long history in Alaska, where publicly-funded correspondence programs educate a large portion of the state's children. Publicly-available data from these correspondence schools allows a state-wide comparison between the standardized test scores of traditional and correspondence students. We found that there was no overall difference between the scores of traditional and correspondence students. However, correspondence students who were Caucasian, non-disabled, and non-economically disadvantaged scored significantly lower than their counterparts in traditional school, while correspondence students of color, disabled correspondence students, and low-income correspondence students scored significantly higher than their peers in traditional school. Correspondence students in nearly every demographic category scored significantly lower than traditional students in math. We argue that these findings have important implications for homeschooling policy.*

Keywords Alaska, homeschooling, correspondence schools, statistics, standardized test, assessment, academic achievement, K-12 education, school choice

Introduction

The modern homeschooling movement began in the 1970s; today, an estimated 1.7 million children are being homeschooled in the United States (National Center for Education Statistics, 2017a). While homeschooling has grown in popularity over the past forty years, there is little representative research on how homeschooled children in the United States fare academically, particularly with regard to the relationship between demographic factors and academic success. Because many

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states do not collect data on homeschooled students and those that do rarely compile testing data at the state level, much existing research on homeschool academic outcomes suffers from poor survey design and sample bias (Kunzman & Gaither, this volume, pp. 269-281). Alaska's public correspondence programs present a unique opportunity to study the academic outcomes of non-traditional education. In Coleman and McCracken (this volume), we argue that Alaska's correspondence school programs meet the definition of homeschooling. In the present study, we examine the test scores of students enrolled in these correspondence programs with the intention that our findings may be applied to fill a gap in the literature on homeschooling's academic outcomes.

Kunzman & Gaither's (this volume) literature review noted three main themes in the extant literature on homeschool academic achievement. First, homeschooling as an educational method has a fairly small impact on academic achievement when there is control for demographic factors. Second, family demographics have a very large impact on the academic outcomes of homeschooling. Third, homeschooled students appear to over-perform their traditionally educated peers in verbal ability, while underperforming in math (Kunzman & Gaither, this volume, p. 252). Indeed, studies of homeschooled students' choice of major in two private colleges suggest that this "math gap" may affect students' career choices: in each study, homeschooled students were less likely than their traditionally schooled peers to pursue majors in STEM fields (Phillips, 2010; Wheaton, 2010). Kunzman & Gaither's (this volume) findings indicate a need for further research on the relationship between demographic factors and homeschooling's academic outcomes, as well as on the comparative effectiveness of homeschooling for teaching different academic subjects.

Representative research on homeschooled students' academic performance has been hampered by the lack of data collected on homeschooled students in most states. In the handful of states that require all of their homeschooled students to be tested, students' scores are not collected or reported in any meaningful fashion. The vast majority of homeschooled students live in states that do not require testing; in these states, those students whose parents voluntarily have them tested are likely those least at risk of educational neglect (Coalition for Responsible Home Education, n.d.; Huseman, 2015; Wixom, 2015).

Previous studies of homeschool academic achievement have addressed this lack of available data in creative ways. Several researchers have examined self-selected samples of homeschooled students' standardized test scores and compared

these scores with national norms (e.g., Ray, 2010; Rudner, 1999); the nature of these samples means that they are not likely to be representative of homeschoolers as a whole. A few studies have tested demographically matched pairs of homeschooled and traditionally educated students, simultaneously eliminating the self-selection problem while limiting external validity (e.g., Duvall, Ward, Delquadri & Greenwood, 1997; Martin-Chang, Gould & Meuse, 2011). Studies comparing college students who were formerly homeschooled with their traditionally educated peers (e.g., Bennett, Edwards & Ngai, 2018; Yu, Sackett & Kuncel, 2016) are by definition not representative of students who do not attend college. Occasionally, researchers have had access to test scores for all homeschooled students in a state (e.g., Wartes, 1988). Arkansas published publicly available testing data for homeschooled students each year from 2003 to 2014; homeschooled students in that state tended to score around the 60th percentile on nationwide norms, with higher scores in reading and vocabulary and lower scores in spelling and math (Arkansas Department of Education, 2019). While these scores are representative of homeschooled students in these states, no attempt has been made to match these scores with those of demographically similar students who attend traditional school. As a result, it cannot be determined how much (if any) of these students' higher than average scores can be attributed to homeschooling rather than to their demographic factors.

One state, Alaska, presents a unique opportunity to gain insight into homeschooled students' academic achievement. Due to its unique educational history (Coleman & McCracken, this volume), Alaska is home to many popular "correspondence" programs which enroll thousands of Alaska students. These programs, which have been operating in some form since the 1930s, were redesigned in the late 1990s to meet the needs of modern homeschooling families. These programs typically allow parents to select their own curriculum and educate their children independently at home while providing families with around $2,000 per child in reimbursements for approved educational expenses (Alaska Department of Education and Early Development, 2019; McKittrick, 2016). Due to the publicly funded nature of these programs, enrolled students are tested annually; the Alaska Department of Education and Early Development (DEED) publishes the results for each school.

Several small-scale studies of Alaska correspondence students' academic performance echo many of the national trends in homeschooling research. In the early 1980s, Alaska administered the California Achievement Test and the

Scientific Research Associates test to various groups of students. They found that students enrolled in Central Correspondence Study, the state correspondence program, performed above their traditionally educated peers in both reading and math, but that there was a significant math gap for the higher grades (Folle, 1986). In a comparison of the test scores of students enrolled in Kodiak Island Borough's correspondence program AKTEACH with the scores of students in Kodiak's traditional public schools, Cavan (2017) found that correspondence students were more likely to outperform traditional students in reading than in math.

This study will present a statistical analysis of standardized test performance in Alaska correspondence schools with the purpose of contributing to the literature on the academic outcomes of homeschooling. It will endeavor to answer the following questions: how do Alaska correspondence students perform academically with respect to their traditionally educated peers? How is this performance affected by demographic factors? How do students enrolled in Alaska's correspondence programs compare to homeschoolers nationwide, and how do our findings apply to homeschooling as a whole?

Methods

The state of Alaska requires school districts to administer standardized tests to all students. Alaska correspondence school students are not exempt from this requirement and therefore must participate in these state-mandated assessments. The Alaska DEED posts the results of recent assessments on its website at https://education.alaska.gov/assessments/results; results are reported by state, by district, and by school. Older data may no longer be accessible. The Alaska DEED was not able to make available any data other than what is posted publicly on the website. By identifying which schools were correspondence schools, we were able to compare the standardized test scores of correspondence students to the scores of traditionally educated students. We combined the data from all the correspondence schools to create correspondence school subtotals and subtracted these from the state totals; this allowed us to create traditional school subtotals which we then compared with the correspondence school subtotals.

Schools

We compiled data from 38 Alaska correspondence schools. A list of these schools is presented in Appendix A. Schools were selected based on whether they ever appeared on the Alaska DEED Correspondence School Directory during the years

for which data was analyzed (2002-2014).[1] Some correspondence schools that operated during this period were not included in the directory every year; however, some of these schools submitted student testing data which is available on the DEED website even in years they did not appear in the directory. This data was included in our analysis. It is unclear what requirements a correspondence school had to meet in order to appear in the directory in a given year, although it is likely that schools appearing in the directory were designated as those receiving only 80% of the total student allotment (see Coleman & McCracken, this volume). Due to the difficulty of accessing complete lists of correspondence schools for the years under study, it is possible that some correspondence schools may have been included in the traditional school subtotal.

Testing data is not available for a few correspondence schools that listed enrolled students during the years in question. Enrollment totals for each school are available at https://education.alaska.gov/stats/. This gap in data may be explained if the schools did not submit test scores for these years, or if the DEED did not post the test scores that were submitted. For example, the HomeBRIDGE program in Juneau Borough district listed 101 enrolled P-12 students in the 2007-2008 school year; requesting their SBA scores through the DEED website produced a site error. Another example is the Chatham Correspondence program in the Chatham district, which listed two enrolled SBA-eligible students for the 2006-2007 school year; requesting their scores through the DEED website produced an empty page, perhaps because the students were withdrawn before taking the assessments.

Together these unavailable scores account for an average of 0.1% of enrolled correspondence students per year.

Assessment Measures

We analyzed testing data from two standardized tests. The largest source of testing data, the Standards Based Assessment (SBA), was administered every year in the spring from 2005 to 2014. SBA reading, writing, and math assessments were

[1] A current version of this directory is available at https://education.alaska.gov/Alaskan_Schools/corres/. Previous versions of the directory were either accessed through the Internet Archive at https://archive.org/web/ (2006 to 2014), or received via email from Paul R. Prussing, Director, Division of Student Learning, Alaska Department of Education & Early Development (2002 to 2006).

administered each of those years to all Alaska public school students, including correspondence students, in grades three through 10 (the SBA was not administered to 10th graders until spring 2006). The SBA test was designed to be a criterion-based assessment aligned with the Alaska Grade Level Expectations for each grade; assessment items were developed and reviewed by Alaska educators and by experienced item writers and underwent repeated field-testing over the years the test was administered (Data Recognition Corporation, 2013b).

Another test, the High School Graduation Qualifying Examination (HSGQE), was administered every year in the spring from 2003 to 2014. HSGQE reading, writing, and math assessments were administered each of those years to all Alaska public school students, including correspondence students, in 10th grade. A HSGQE retest was also administered each year to students in 11th or 12th grade who had not yet attained a passing score. The HSGQE was designed to "determine student competency" and was intended to "reflect the essential skills that students should know as a result of their public school experience" (Data Recognition Corporation, 2013a).

As specified by Alaska Administrative Code, each school district designated school test centers where the tests would be administered and District Test Coordinators (DTCs) to oversee the administration. DTCs were district employees who held a current Alaska teaching certification. Prior to test administration, DTCs received training from the Alaska DEED and the test developers and signed a Test Security Agreement stating that they would keep testing materials secure and follow standardized testing procedures. These procedures included designating a district-employed certified teacher as Associate (Building) Test Coordinator (ATC) at each additional school test center in the district. DTCs and ATCs oversaw the test personnel—school district employees who actually administered the test—in each school test center. Test personnel who administered the HSGQE were required to be certified teachers, while test personnel who administered the SBA were not. Test personnel were assigned to 30 students or less and signed a Test Security Agreement stating they would not read any test questions aloud. At the discretion of the DTC, correspondence students were permitted to take tests at a school test center in a district where they were not enrolled. All districts in the state were required to administer the SBA test during a designated two-week testing window; students were required to take the tests in this order: reading, writing, math. All HSGQEs were administered to students across the state on the same three days; these tests were also administered in the order: reading, writing, math (Alaska

Department of Education and Early Development, 2012; Alaska Department of Education and Early Development, 2013b; Data Recognition Corporation, 2013a; 2013b; 2013c). These were the testing procedures in 2013; they are assumed to have been similar across the years under study.

Variables

Within a given test, school, grade level, and subject, the DEED reports score totals and, according to the terminology used in its data reporting manual, further divides student scores by gender, race/ethnicity, disability status, economic status, migrant status, and limited English proficiency status. The latter two variables were eliminated from our analysis due to limited data. According to the DEED's data reporting codes, gender is divided into male and female categories.

Race/ethnicity is divided into six categories: African American, Alaska Native/American Indian, Asian/Pacific Islander, Caucasian, Hispanic, and Two or More Races. The race/ethnicity categories underwent revision over the years under analysis. From spring 2006 to spring 2007, the Two or More Races category was called Mixed Ethnicity. From spring 2003 to spring 2005, the six categories were African American, Alaska Native, American Indian, Asian/Pacific Islander, Caucasian, and Hispanic. Our analysis accounted for these changes by grouping together Alaska Native and American Indian categories during the years they were separate and leaving the sixth category blank for those years.

Disability status is divided into Disabled and Non-Disabled. During the years in question, disabled children were defined first as those who are "receiving special education and related services according to an Individualized Education Program (IEP)" (Alaska Department of Education and Early Development, 2004), and later as those "who are being served under the IDEA, Part B program" (Alaska Department of Education and Early Development, 2006).

Income status is divided into Low Income/Economically Disadvantaged and Not Economically Disadvantaged. Economically Disadvantaged children are defined as those who "receive public assistance (TANF) and or are eligible to participate in the Free and Reduced Lunch Program (NSLA)" (Alaska Department of Education and Early Development, 2004). To be eligible for NSLA, a child's family had to earn 185% of the federal poverty level or less (Alaska Department of Education and Early Development, 2013a).

Data Reporting and Extrapolation

During the years in question (2003-2014), student scores for the SBA and HSGQE assessments were reported as pass rates; that is, Alaska reported 1) the number of students enrolled in a category; 2) the percent of students in that category who participated in the assessment; 3) the number of students in that category who achieved a score of proficient or above; and 4) the number of students in that category who scored below the proficiency standard.

Legal concerns about student privacy due to the Family Educational Rights and Privacy Act of 1974 (FERPA) led Alaska to impose two degrees of censorship when reporting assessment data. If the number of students who achieved either proficiency level (proficient or not proficient) was less than three, the exact figure for both levels was censored and percentage ranges were reported instead. If fewer than five students total participated in the assessment in any one category, both figures and percentages were censored (Alaska Department of Education and Early Development, 2003). Appendix B shows an example printout of the data, where five of six enrolled Alaska Native and American Indian students (83.33%) in grade 10 at Connections Homeschool participated in the SBA reading assessment in 2008. Alaska reports that 60% or more of them achieved a score of proficient, but the exact figure is censored; it could be three, four, or five. The example printout also shows that one enrolled African American student participated in the assessment; their score is not reported in any way. Because many correspondence schools enroll small numbers of students, this privacy shield limited the data that could be used for our analysis.

We were able to reconstruct much of the data using two methods. First, in variable categories coded as binary (gender, disability, and socioeconomic status), if one variable value reported exact figures, the other could be calculated easily by subtracting from the total. This method was frequently unavailable for the ethnicity variable; as a result, our results for the binary Caucasian vs. combined non-Caucasian categories are more reliable than any particular non-Caucasian ethnicity category by itself. The second method we used to reconstruct the data was probabilistic. We considered the set of cases where exact pass rate was censored but percentage pass rates were available—that is, when there were five or more participants but one of the cells contained a 0, 1, or 2. We assumed a priori that the average of all these censored cells across the data was 1. Then, we assumed that the other cell had an average value of n - 1, where n is the number of participants. Each censored cell was filled in with these average values. The purpose of this data

reconstruction was to ensure that extreme values—very high and very low student performance within a category—were not excluded from our analysis. Due to time constraints we were not able to perform a statistical measure of robustness; this would be a potential direction for future research. The data we used for our analysis is available by request, both with and without this probabilistic reconstruction. All data reported here includes the probabilistic reconstruction.

Statistics

For our statistical analysis of the assessment data, we used a between-subjects model where each case was coded as a particular assessment, year administered, grade level of participants, subject area, and with all analyses other than the overall total, we added a demographic variable (either gender, ethnicity, disability, or socioeconomic status). Unfortunately the structure of the data made it impossible to analyze multiple demographic variables at a time. There were two dependent variables: pass rate, which was calculated by dividing the number of students in a category who scored proficient or above by the number of students in that category who participated in the assessment; and opt out rate, which was calculated by dividing the number of students in a category who participated in the assessment by the number who were enrolled in that category.

In the analysis of the HSGQE test, some average pass rates for 11th and 12th grade were missing due to the smaller number of students taking those assessments. The missing pass rates were filled in with the average pass rate across the other years for the same variable.

There were significant heteroscedasticity problems in the data; for example, the O'Brien Test for heterogeneity of variances (O'Brien, 1981) on the SBA data was significant for pass rate by school type, $F(1, 472) = 73.50$, $p < .001$. The heteroscedasticity was robust against transforms, so instead of using ANOVAs we compared traditional and correspondence students' pass rates using Welch's Test for unequal variances.

Results

Assessment Results: SBA

As Table 1 shows, we found no significant effect of school type on the overall SBA scores of Alaska students. However, we did find a significant effect of school type on scores when they were divided by subject and by gender. Correspondence students scored significantly higher than traditional students in reading and writing, but significantly lower in math. Male correspondence students scored significantly higher overall than male traditional students. There was no significant difference in female students' overall scores by school type.

There was no significant difference between the scores of correspondence and traditional students who were African American or Hispanic. Alaska Native/American Indian correspondence students scored significantly higher than their traditional counterparts, as did Asian/Pacific Islander correspondence students. Caucasian correspondence students scored significantly lower than their traditional counterparts, as did correspondence students of Two or More Races. When the scores of all non-Caucasian groups were combined, non-Caucasian correspondence students were significantly more likely to be proficient overall than non-Caucasian traditional students.

Economically disadvantaged correspondence students scored significantly higher than economically disadvantaged traditional students, while correspondence students who were not economically disadvantaged scored significantly lower than their traditional counterparts. Disabled correspondence students scored significantly higher than disabled traditional students, while correspondence students who were not disabled scored significantly lower than their traditional counterparts.

Table 1: SBA pass rate by school type (grades 3-10; 2005-2014)

	Correspond-ence students	Tradition-al students	Differ-ence	Welch's Test
Overall	75.38	74.29	1.09	$F(1, 367.89) = 2.07$, $p = .15$
Subject				
Reading	86.09*	79.40	6.69	$F(1, 154.80) = 207.48$, $p < .001$
Writing	76.60*	74.21	2.39	$F(1, 140.13) = 26.54$, $p < .001$
Math	63.44	69.25*	-5.81	$F(1, 155.94) = 42.93$, $p < .001$
Grade				
3rd	75.23	77.18	-1.95	$F(1, 38.02) = 3.11$, $p = .09$
4th	74.95	76.76	-1.81	$F(1, 35.74) = 1.62$, $p = .21$
5th	75.69	75.77	-0.08	$F(1, 40.91) < .01$, $p = .96$
6th	75.00	72.99	2.01	$F(1, 39.17) = 1.33$, $p = .26$
7th	76.31	72.51	3.80	$F(1, 43.94) = 3.07$, $p = .09$

8th	78.25	74.74	3.51	$F(1, 48.05) = 2.26$, $p = .14$
9th	74.10	71.68	2.42	$F(1, 44.98) = .61$, $p = .44$
10th	73.28	72.47	0.81	$F(1, 40.39) = .08$, $p = .77$
Gender				
Male	72.55*	70.67	1.88	$F(1, 384.33) = 7.33$, $p < .01$
Female	78.23	78.11	0.12	$F(1, 375.37) = .02$, $p = .89$
Race				
African American	68.29	64.93	3.36	$F(1, 201.98) = 2.23$, $p = .14$
Alaska Native / American Indian	61.77*	53.95	7.82	$F(1, 324.59) = 55.54$, $p < .001$
Asian / Pacific Islander	80.05*	73.17	6.88	$F(1, 220.22) = 27.46$, $p < .001$
Caucasian	77.53	84.92*	-7.39	$F(1, 359.76) = 106.06$, $p < .001$

Hispanic	74.33	72.46	1.87	$F(1, 253.13) = 1.51$, $p = .22$
Two or More Races	70.12	75.68*	-5.56	$F(1, 178.05) = 6.82$, $p = .01$
All non-Caucasian	66.73*	63.04	3.69	$F(1, 348.69) = 15.12$, $p < .001$
Socioeconomic Status				
Low Income/ Economically Disadvantaged	68.20*	61.58	6.62	$F(1, 379.01) = 48.89$, $p < .001$
Not Economically Disadvantaged	78.24	84.08*	-5.84	$F(1, 369.61) = 68.11$, $p < .001$
Disability Status				
Disabled	40.38*	36.89	3.49	$F(1, 414.89) = 8.91$, $p < .01$
Not Disabled	77.52	79.98*	-2.46	$F(1, 362.95) = 10.74$, $p < .01$

* indicates the figure in this column is significantly higher, $p < .05$

However, it is difficult to draw definitive comparisons between traditional and correspondence students because these groups did not actually take the SBA at the same rate. Though all public school students are required to take the SBA, we found that in every category, correspondence students opted out of the test at a significantly higher rate than traditional students. Correspondence students opted out overall at a rate of 7.32% (compared with 2.18% of traditional students) and correspondence students' opt-out rate across demographic categories ranged from 4.94% to 14.6%, while traditional students' opt-out rate across demographic categories ranged from 1.51% to 5.78%. Correspondence students were more than three times as likely as traditional students to opt out of the reading, writing, and math assessments. Opt-out rates for both groups of students increased rapidly after 7th grade, but they increased more rapidly for correspondence students than for traditional students, reaching a 10th grade high of 14.6% for correspondence students and 4.65% for traditional students. Two groups with notably high opt-out rates were Alaska Native / American Indian correspondence students (10.09% opted out, as opposed to 3% of Alaska Native / American Indian traditional students) and disabled correspondence students (11.49% opted out, as opposed to 5.98% of disabled traditional students).

The effect of school type on students' SBA performance differed depending on the academic subject (Tables 2-4). Both non-Caucasian and economically disadvantaged correspondence students scored significantly higher than non-Caucasian and economically disadvantaged traditional students in reading and writing, but significantly lower in math. Similarly, disabled correspondence students scored significantly higher than disabled traditional students in reading and writing, but there was no significant difference between their math scores. Caucasian correspondence students scored significantly lower than Caucasian traditional students in every subject. Correspondence students who were not economically disadvantaged scored significantly lower than traditional students who were not economically disadvantaged in writing and math, but there was no difference between their scores in reading. Correspondence students who were not disabled scored significantly higher than their traditional counterparts in reading and significantly lower in writing and math.

Table 2: SBA Reading test pass rate by school type (grades 3-10; 2005-2014)

	Corres-pondence students	Trad-itional students	Differ-ence	Welch's Test
Reading Overall	86.09*	79.40	6.69	$F(1, 154.80) = 207.48$, $p < .001$
Gender				
Male	83.27*	75.89	7.38	$F(1, 145.02) = 184.72$, $p < .001$
Female	88.72*	83.15	5.57	$F(1, 155.14) = 162.02$, $p < .001$
Race				
Cauc-asian	87.63	89.64*	-2.01	$F(1, 121.93) = 23.91$, $p < .001$
All non-Caucasian	80.07*	68.59	11.48	$F(1, 150.36) = 242.54$, $p < .001$
Socioeconomic Status				
Low Income/ Economically Disad-vantaged	81.40*	67.63	13.77	$F(1, 154.21) = 373.11$, $p < .001$

Not Economically Disadvantaged	87.99	88.55	-0.56	$F(1, 141.10) = 1.90$, $p = .17$
Disability Status				
Disabled	52.25*	42.70	9.55	$F(1, 116.69) = 59.76$, $p < .001$
Not Disabled	88.11*	85.04	3.07	$F(1, 150.55) = 46.84$, $p < .001$

* indicates the figure in this column is significantly higher, $p < .05$

Table 3: SBA Writing test pass rate by school type (grades 3-10; 2005-2014)

	Correspondence students	Traditional students	Difference	Welch's Test
Writing Overall	76.60*	74.21	2.39	$F(1, 140.13) = 26.54$, $p < .001$
Gender				
Male	70.71*	68.04	2.67	$F(1, 146.60) = 21.02$, $p < .001$
Female	82.53*	80.73	1.80	$F(1, 121.42) = 15.82$, $p < .001$

Race				
Cauc-asian	78.78	85.09*	-6.31	$F(1, 114.92) = 167.84$, $p < .001$
All non-Caucasian	67.77*	62.66	5.11	$F(1, 133.43) = 52.15$, $p < .001$
Socioeconomic Status				
Low Income / Econ-omically Disad-vantaged	69.52*	61.12	8.40	$F(1, 144.50) = 128.82$, $p < .001$
Not Econ-omically Disad-vantaged	79.46	84.30*	-4.84	$F(1, 137.22) = 107.71$, $p < .001$
Disability Status				
Disabled	40.42*	36.38	4.04	$F(1, 149.14) = 5.65$, $p = .02$
Not Disabled	78.84	79.93*	-1.09	$F(1, 122.49) = 5.48$, $p = .02$

* indicates the figure in this column is significantly higher, $p < .05$

Table 4: SBA Math test pass rate by school type (grades 3-10; 2005-2014)

	Corres-pondence students	Trad-itional students	Differ-ence	Welch's Test
Math Overall	63.44	69.25*	-5.81	$F(1, 155.94) = 42.93$, $p < .001$
Gender				
Male	63.67	68.07*	-4.40	$F(1, 153.83) = 28.27$, $p < .001$
Female	63.44	70.44*	-7.00	$F(1, 151.15) = 49.17$, $p < .001$
Race				
Cauc-asian	66.17	80.04*	-13.87	$F(1, 155.99) = 273.42$, $p < .001$
All non-Caucasian	52.36	57.88*	-5.52	$F(1, 147.58) = 20.97$, $p < .001$
Socioeconomic Status				
Low Income/ Econo-mically Disadvanta-ged	53.70	55.98*	-2.28	$F(1, 150.03) = 4.15$, $p = .04$

Not Economically Disadvantaged	67.26	79.40*	-12.14	$F(1, 155.93) = 173.29$, $p < .001$
Disability Status				
Disabled	28.47	31.59	-3.12	$F(1, 155.11) = 2.73$, $p = .10$
Not Disabled	65.61	74.97*	-9.36	$F(1, 155.90) = 115.10$, $p < .001$

* indicates the figure in this column is significantly higher, $p < .05$

Assessment Results: HSGQE

As Table 5 shows, there was no statistical difference between the HSGQE pass rates of correspondence and traditional students in 10th grade, when most students take the test. Correspondence students were significantly more likely than traditional students to pass when they took the retest in 11th or 12th grade, and, as a result of this, correspondence students were significantly more likely to pass overall. This pass rate may be related to the fact that correspondence students were more than twice as likely as traditional students to miss the first administration of the HSGQE in 10th grade; opt-out rates for the 10th grade HSGQE were 17.34% for correspondence students and 7.54% for traditional students. Perhaps, in the absence of institutional pressure to take assessments at the same time as their peers, some of these correspondence students are intentionally delaying assessment by a year in order to be better prepared.

Table 5: HSGQE pass rate by school type (grades 10-12; 2003-2014)

	Corres-pondence students	Trad-itional students	Differ-ence	Welch's Test
Overall	63.86*	54.04	9.82	$F(1, 212.77) = 14.91$, $p < .001$
Grade				
10th	78.88	78.32	0.56	$F(1, 64.36) = .10$, $p = .75$
11th	55.85*	42.13	13.72	$F(1, 57.96) = 21.31$, $p < .001$
12th	56.85*	41.65	15.20	$F(1, 56.33) = 18.49$, $p < .001$

* indicates the figure in this column is significantly higher, $p < .05$

Table 6 below shows that there was no significant difference between the HSGQE pass rates of 10th grade correspondence and traditional students in reading or in writing. However, traditional students were significantly more likely to pass the math assessment. There were no significant differences between the school types in HSGQE pass rate by gender or by disability. Only grade 10 scores are shown due to the small number of students participating in re-tests or make-up tests in higher grades.

Traditional students who were Caucasian or Two or More Races were significantly more likely to pass than their counterparts in correspondence schools. However, African American correspondence students were significantly more likely to pass than African American traditional students. Findings about children of color should be interpreted with caution due to the large amount of missing ethnicity data.

Traditional students who were not economically disadvantaged were significantly more likely to pass the HSGQE than correspondence students who

were not economically disadvantaged. By contrast, low income correspondence students were significantly more likely to pass than low income traditional students.

Table 6: HSGQE pass rate by school type (grade 10; 2003-2014)

	Corres-pondence students	Trad-itional students	Differ-ence	Welch's Test
Subject				
Reading	86.38	80.16	6.22	$F(1, 21.57) = 4.32$, $p = .05$
Writing	78.34	78.91	-0.57	$F(1, 21.45) = .04$, $p = .84$
Math	71.92	75.91*	-3.99	$F(1, 21.92) = 5.29$, $p = .03$
Gender				
Male	76.36	75.07	1.29	$F(1, 52.62) = .37$, $p = .54$
Female	82.45	81.78	0.67	$F(1, 54.43) = .11$, $p = .74$
Race				
African American	78.78*	65.87	12.91	$F(1, 52.76) = 10.59$, $p < .01$
Alaska	65.03	61.34	3.69	$F(1, 62.72) = 1.85$, $p = .18$

Native / American Indian				
Asian / Pacific Islander	81.66	74.88	6.78	$F(1, 42.46) = 2.91$, $p = .10$
Cauc-asian	81.79	87.21*	-5.42	$F(1, 58.81) = 12.32$, $p < .01$
Hispanic	74.53	73.13	1.40	$F(1, 42.88) = .10$, $p = .75$
Two or More Races	65.81	79.42*	-13.61	$F(1, 29.05) = 7.70$, $p = .01$
All non-Caucasian	69.00	67.05	1.95	$F(1, 61.52) = .54$, $p = .47$
Socioeconomic Status				
Low Income / Econ-omically Disad-vantaged	72.67*	64.95	7.72	$F(1, 56.18) = 9.19$, $p < .01$

Not Economically Disadvantaged	81.64	85.86*	-4.22	$F(1, 52.39) = 6.72$, $p = .01$
Disability Status				
Disabled	44.16	38.34	5.82	$F(1, 47.87) = 2.75$, $p = .10$
Not Disabled	81.55	84.03	-2.48	$F(1, 49.72) = 2.09$, $p = .16$

* indicates the figure in this column is significantly higher, $p < .05$

Discussion

Taken together, our findings suggest that Alaska correspondence students who are demographically privileged—those who are Caucasian, lack disabilities, and are economically stable—are underperforming with respect to their counterparts who attend traditional school. On the other hand, we found that Alaska correspondence students who lacked privilege in some way—in terms of race, socioeconomic status, or disability—were better equipped than their counterparts in traditional school to succeed in reading and writing. Disadvantaged correspondence students did underperform slightly in math relative to their peers who attended traditional schools; however, this underperformance was far smaller than that of demographically privileged correspondence students relative to their traditionally educated peers. In other words, correspondence education in Alaska is correlated with a decrease in the width of the achievement gap between children with advantages and children without them, bringing both of them closer to the middle.

Another major finding of our study was strong evidence of a math gap between correspondence and traditional students in Alaska. While some studies of homeschooling have found that homeschooled students scored higher in math than the national average (Ray, 2010; Rudner, 1999), we found that Alaska

correspondence students scored significantly lower in math than their traditional counterparts in almost every demographic category. Disadvantaged correspondence students in our study also scored lower in math than disadvantaged traditional students, even though the gaps between the school types were much smaller for children of color, disabled children, and low income children than for their privileged peers. Kunzman and Gaither (this volume) speculate that "the conversational learning style common to homeschooling and the widely-observed phenomenon that homeschoolers often spend significant time being read to or reading all contribute to their impressive verbal scores, while math is not given the same priority" (Kunzman & Gaither, this volume, p. 271). Other studies have shown that parents have more negative feelings about math than about language; believe math is less important for children to learn than language; and spend less time on home instruction in math than language (Cannon & Ginsburg, 2008). Our findings suggest Alaska's correspondence programs are less effective than traditional schools at fostering math skills and that parents and policymakers should do more to ensure that correspondence students are receiving an adequate education in math.

One possible interpretation of our overall findings is that correspondence programs like Alaska's may eliminate many of the academic benefits of school attendance for privileged children. Approximately 21% of all variation in student achievement is attributable to school-level factors (rather than student- or family-based factors) (Goldhaber, 2002). Some of these factors which have been shown to increase academic achievement include: teacher quality and experience (Rice, 2003; Rivkin, Hanushek, & Kain, 2005; Stronge, 2010); positive peer relationships, especially group memberships (Gifford-Smith & Brownell, 2003; Stewart, 2008; Wentzel & Caldwell, 1997); and school administration, resources, and environment (Bryk & Schneider, 2002; Eccles, 2004; Johnson, 2009; Kraft, Marinell, & Yee, 2016; Stewart, 2008). There is evidence that these beneficial factors may be disproportionately available to demographically privileged students (Hanushek, Kain, & Rivkin, 2004; Simon & Johnson, 2015). Thus, when Caucasian, non-disabled, and non-poor children are educated in an environment outside of a traditional school, they lose access to these achievement-boosting privileges.

Another possible interpretation of our findings is that disadvantaged children in Alaska experience an academic benefit from the protection from negative school experiences that a non-traditional educational environment can offer. Bullying has been shown to negatively affect academic achievement (Glew, Fan, Katon, Rivara

& Kernic, 2005; Nakamoto & Schwartz, 2010), as has stigma resulting from membership in a marginalized group (Major & O'Brien, 2005; Sherman et al., 2013; Steele, 1997). Many studies have demonstrated that negative school experiences impact the educational attainment of students who belong to disadvantaged groups (Croizet & Claire, 1998; Greenbaum, Graham & Scales, 1995; McLoyd et al., 2009; Wong, Eccles & Sameroff, 2003). Outside the traditional school environment, these children may have the opportunity to develop a more positive self-image and to experience less stress (Duvall, Delquadri, & Ward, 2004; Fields-Smith & Williams, 2009; James, 2007; Kidd & Kaczmarek, 2010; Mazama & Lundy, 2012; Rozon, 2000a; 2000b).

In addition, differences in Alaska parents' motivations for choosing a correspondence program over a traditional school may have different effects on privileged and disadvantaged children. Both researchers (Aurini & Davies, 2005; Groover & Endsley, 1988; Guterman & Neuman, 2017) and practitioners (Arnall, 2015; Wessling, 2013) have linked specific motivations for or styles of non-traditional education to particular parental personality traits and parenting styles. Research has shown that parenting styles influence children's academic achievement (Spera, 2005; Turner, Chandler, & Heffer, 2009). If the educational choices of parents of disadvantaged children were more likely to be motivated by "pragmatic" factors (Coleman, 2010) like protection from bullying and discrimination, while parents of privileged children were more likely to be "ideologues" or "pedagogues" as defined by Van Galen (1991), we might expect these different motivations to produce different academic results.

Some researchers have suggested that the high test scores found in many studies of homeschooled students may be related to these students' demographic factors and the level of parental involvement, rather than being the product of homeschooling per se (Barwegen, Falciani, Putnam, Reamer, & Stair, 2004; Belfield, 2005; Rudner, 1999). It is possible that the academic achievement of the disadvantaged correspondence students in our study was due to parental involvement or demographic factors that were not measured, rather than due to educational method.

Another theory that may explain our findings is that disadvantaged children who enroll in Alaska correspondence schools may be a self-selected group who are demographically distinct from disadvantaged children who attend traditional schools. For example, economically disadvantaged students who are homeschooled differ from economically disadvantaged students who attend traditional public

schools in several notable ways. While homeschooled children are more likely than other children to live in families at or below 200% of the poverty line, they are also more likely than other children to have a parent with a bachelor's degree or above (National Center for Education Statistics, 2017b). A large number of homeschooling families give up an income so that one parent can stay at home; homeschooling families also have a larger than average number of children. These factors may cause a family to fall below the federal poverty line while other measures of socioeconomic status, such as education and occupation, may reflect a middle class status. It is perhaps not surprising, given this, that low-income families that homeschool are clustered closer to 200% of the poverty line than are other low-income families (National Center for Education Statistics, 2017a). Similar self-selection effects may apply to children of color and children with disabilities; however, the lack of available information on these groups makes it difficult to speculate on what these differences might be.

While disadvantaged correspondence students in our study earned higher test scores than their traditionally-educated peers, the possibility that Alaska correspondence students are a self-selected group inspires one major note of caution. Because disadvantaged families that choose to enroll their children in correspondence schools may be different from other disadvantaged families in ways not measured in the broad demographic categories included in the data, our findings should *not* be taken to suggest that parents of disadvantaged children *should* enroll their children in correspondence programs like Alaska's in order to improve their academic achievement. Our data merely shows a correlation between school type and academic achievement for disadvantaged students in Alaska, but the interpretation of that correlation may very well be that students who are the most well-equipped to succeed in the correspondence programs are the ones who are currently enrolled, or that a third variable is influencing the results. A more detailed quasi-experimental design would be necessary to hypothesize a causal relationship.

Two major caveats pertain to the internal validity of our work. First, correspondence students in every demographic category were significantly more likely than traditional students to opt out of or simply be absent from the required state assessments. The increase in standardized testing across the United States in the past few decades has led to an increased number of parents who desire to opt their children out of testing (Crowder & Konle, 2015). In some states, opt-outs are explicitly allowed by state law or permitted by department of education policy, while in other states, opt-outs are explicitly prohibited by law and constitute a form

of truancy. It is unclear what Alaska's position on opt-outs is (Aragon, Rowland, & Wixom, 2015). Several studies have shown a relationship between school attendance and academic performance; students who are habitually truant generally have decreased academic achievement, along with a host of other negative outcomes (Gottfried, 2010; Musser, 2011; Sutphen, Ford, & Flaherty, 2010). However, several anecdotal reports of standardized testing opt-outs identify this choice as popular with parents of typically high-achieving children (Rotherham, 2015; Strauss, 2015). This discrepancy makes it difficult to predict whether the correspondence students in our data who opted out of the state assessments were more likely to be high-achieving or low-achieving students. One piece of evidence is that correspondence students were increasingly more likely to opt out of the SBA in higher grades, indicating that there may be a larger portion of academically struggling students among testing opt-outs. However, the uncertainty of this finding makes it difficult to make definitive statements comparing the scores of correspondence students to the scores of traditional students in Alaska.

Relatedly, standardized tests may not be the best way to assess student preparedness. A considerable body of literature exists to demonstrate that standardization in education negatively affects teaching and learning (Herman & Golan, 1993; Kohn, 2000; McNeil, 2000; Wolf, Bixby, Glenn, & Gardner, 1991) as well as magnifying existing inequalities of race and class (Au, 2009; Ellis, 2008). Standardization by necessity collapses individual and local differences in students' abilities. Many homeschooling parents explicitly aim to provide instruction that is individualized and tailored to each student (McKittrick, 2016; Thomas, 2016); some choose not to conduct standardized testing, not viewing it as valuable (Kirschner, 2008); and some view the goals of education differently from traditional school-based educators (Neuman & Guterman, 2016). This literature indicates the possibility that the Alaska correspondence students in our study may have accrued skills and experiences that are not reflected in their standardized test scores.

In Coleman & McCracken (this volume), we argue that the students in Alaska's correspondence programs should be considered to be homeschooled. A few major caveats pertain to the application of our findings to homeschooled students as a whole, however. First, correspondence students in Alaska may not be representative of all homeschooled students in Alaska. Neither families operating under the state's extremely minimalistic homeschooling statute nor families who enroll their children in correspondence programs represent a random selection of the homeschool population: independent homeschooling families' choice of educational

method is motivated primarily by ideological reasons (Coleman & McCracken, this volume), while families of correspondence students have chosen to opt in to a program that proves them with access to resources and reimbursement for educational expenses in exchange for public accountability. Therefore the results we found may not be applicable to Alaska's independent homeschooling families. Second, the demographics of Alaska correspondence students differ somewhat from the national population of homeschooled students, particularly in terms of race and level of district support (see Appendix C); they may also differ on average in terms of parental motivation. These caveats indicate that caution is warranted in applying our findings to the homeschool population as a whole.

Despite these caveats, our findings have important implications for homeschooling policy. Notwithstanding the prevailing narrative of homeschoolers' high academic achievement (e.g., Home School Legal Defense Association, 1999; Ray, 2017; Weller, 2015), our findings suggest that homeschooling may in fact have a negative impact on the academic achievement of children who are Caucasian, economically stable, or non-disabled, and that it may be a disadvantageous educational choice for this group. On the other hand, homeschooling may have a positive effect on the reading and writing abilities of children of color, children from low-income families, or disabled children, on the condition that their parents freely choose homeschooling, that they receive monetary and pedagogical support from the state, and that they are held accountable by a reasonable degree of state oversight including regular assessments. The availability of state funding for homeschooling may benefit disadvantaged students in a way that it doesn't help privileged students, who likely already have access to funds for educational expenses. Finally, our findings provide further support for the idea that homeschooling negatively affects math achievement and suggest that this applies to privileged and disadvantaged children alike, indicating that parents and policymakers should provide more support for homeschooled students' math attainment.

Our findings also suggest that states and districts should do more to collect standardized testing data from homeschooled students in such a way that it can be effectively compared with testing data from traditionally educated students. The example of Alaska suggests a relationship between educational method, demographics, and academic outcomes which must be confirmed using a representative sample of homeschooled students nationwide. States and districts should also analyze the data they do have, as this may provide information that is

relevant to the creation of homeschooling policies that protect children from negative academic outcomes. Finally, parents should take these findings into account when choosing an educational method that will be most beneficial to their children.

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Appendix A

#	School Name	District
1	Alaska REACH Academy	Alaska Gateway
2	Aleutians Correspondence Education	Aleutians East Borough
3	Family Partnership Charter School	Anchorage
4	Frontier Charter School	Anchorage
5	Chatham Correspondence	Chatham
6	FOCUS Homeschool	Chugach
7	Upstream Learning	Copper River
8	Innovative Learning Program	Cordova City
9	PACE Correspondence	Craig City
10	Delta Cyber School	Delta/Greely
11	Delta/Greely Homeschool	Delta/Greely
12	Denali PEAK	Denali Borough
13	Dillingham Correspondence	Dillingham City
14	Fairbanks BEST	Fairbanks North Star Borough
15	IDEA Homeschool	Galena City
16	Haines Home School	Haines Borough
17	Totem Correspondence	Hydaburg City

18	Distance Learning Center	Iditarod Area
19	HomeBRIDGE	Juneau Borough
20	Connections Homeschool	Kenai Peninsula Borough
21	Fast Track	Ketchikan Gateway Borough
22	Tongass School of Arts and Sciences	Ketchikan Gateway Borough
23	AKTEACH	Kodiak Island Borough
24	Lakeview Home School	Lake and Peninsula Borough
25	Horizon Charter School	Matanuska-Susitna Borough
26	Mat-Su Central School	Matanuska-Susitna Borough
27	Twindly-Bridge Charter School	Matanuska-Susitna Borough
28	CyberLynx Home School Program	Nenana City
29	Extensions Correspondence Program	Nome Public
30	NWABSD Homeschool	Northwest Arctic Borough
31	REACH Homeschool Support Program	Sitka Borough
32	SE Island Correspondence	Southeast Island
33	Yukon River Academy Correspondence	Tanana
34	Alaska Virtual Academy	Wrangell City
35	LEAD Correspondence	Yakutat City

36	Yukon Flats Distance Education Program	Yukon Flats
37	Raven Homeschool	Yukon-Koyukuk
38	Alyeska Central School	Yukon-Koyukuk (prev. Alyeska Central)

Appendix B

SPRING 2008 Standards Based Assessment
Kenai Peninsula Borough School District - Connections
Total Numbers and Percentages of Students
Scoring Above and Below Proficiency

		Grade 10						
		Advanced/Proficient		Below/Not Proficient				
Subject	Test Year	Count	Percentage[1]	Count	Percentage[1]	Enrollment	Participation Rate	
READING	2008	69	86.3%	11	13.8%	87	91.95%	Groups
WRITING	2008	60	75.0%	20	25.0%	87	91.95%	Groups
MATHEMATICS	2008	36	45.6%	43	54.4%	87	90.80%	Groups
SCIENCE	2008	41	68.3%	19	31.7%	87	68.97%	Groups

** Results cannot be published without releasing personally identifiable information.*
[1] Percent Proficient and Percent Not Proficient rates only include students that participated in the exams.

Connections Results by Race/Ethnicity

Grade 10						
READING	Proficient		Not Proficient		Enrollment	Participation Rate
	Count	Percentage[1]	Count	Percentage[1]		
Ethnicity						
Alaska Native and American Indian	*	60% or more	*	40% or fewer	6	83.33%
Asian/Pacific Islander	*	*	*	*	1	100.00%
African American	*	*	*	*	1	100.00%
Caucasian	63	86.3%	10	13.7%	79	92.41%
Gender						
Female	42	82.4%	9	17.6%	54	94.44%
Male	*	90% or more	*	10% or fewer	33	87.88%
Special Populations						
Disabled	7	63.6%	4	36.4%	11	100.00%
NonDisabled	62	89.9%	7	10.1%	76	90.79%
Low Income	*	80% or more	*	20% or fewer	21	85.71%
Not Low Income	53	85.5%	9	14.5%	66	93.94%
Migrant	*	*	*	*	4	75.00%

** Results cannot be published without releasing personally identifiable information.*
[1] Percent Proficient and Percent Not Proficient rates only include students that participated in the exams.

Appendix C

Correspondence students and traditional students who took the required assessments had distinct demographic profiles. As Tables 7 and 8 show, correspondence students who took the SBA and HSGQE tests were significantly more likely to be female than their traditional counterparts, but significantly less likely to be non-Caucasian, low income, and disabled.

Table 7: SBA demographics by school type (grades 3-10; 2005-2014)

Percentage (%)	Correspondence students	Traditional students	Difference	Welch's Test
Female	49.85*	48.52	1.33	$F(1, 252.28) = 62.85$, $p < .001$
Non-Caucasian	19.77	49.02*	-29.25	$F(1, 393.67) = 12926.03$, $p < .001$
Low Income	26.84	44.11*	-17.27	$F(1, 471.15) = 1133.68$, $p < .001$
Disabled	6.03	13.94*	-7.91	$F(1, 404.37) = 3773.14$, $p < .001$

* indicates the figure in this column is significantly higher, $p < .05$

Table 8: HSGQE demographics by school type (grade 10; 2003-2014)

Percentage (%)	Correspondence students	Traditional students	Difference	Welch's Test
Female	54.01*	49.02	4.99	$F(1, 67.47) = 239.93$, $p < .001$
Non-Caucasian	22.14	45.20*	-23.06	$F(1, 70.00) = 607.73$, $p < .001$
Low Income	26.32	35.50*	-9.18	$F(1, 66.85) = 43.63$, $p < .001$
Disabled	5.59	11.44*	-5.85	$F(1, 42.49) = 1230.62$, $p < .001$

* indicates the figure in this column is significantly higher, $p < .05$

This data suggests that Alaska parents are more likely to choose to homeschool children who are female, Caucasian, and able-bodied, and to homeschool when the family is not experiencing economic hardship.

Table 9 below shows the percentage distribution of homeschooled students by race/ethnicity in the US and Alaska.

Table 9: Percentage distribution by race/ethnicity for homeschooled students in the US and Alaska, 2011-2012

Race/Ethnicity	**United States**[2]	**Alaska**[3]
Caucasian	68	78
Black	8	2
Hispanic	15	3
Asian/Pacific Islander	4	3
Other	5	13

[2] Nationwide percentages were drawn from Redford, Battle, and Bielick (2017). Student ethnicities were reported in the following categories: White, non-Hispanic; Black, non-Hispanic; Hispanic; Asian or Pacific Islander, non-Hispanic; and Other, non-Hispanic, which includes "children who were multiracial and not of Hispanic ethnicity, or who were American Indian or Alaska Native, or who were not Hispanic, White, Black, Asian, or Pacific Islander" (Redford et al., 2017, p. 10).

[3] Alaska percentages were calculated by adding the ethnicity totals of 2011-2012 enrolled students from the 38 correspondence schools identified in Appendix A, and dividing it by the total number of enrolled correspondence students that year. Student races were reported in the following categories: Alaska Native; American Indian; Asian; Black; Hispanic; 2 or more races; Islander; and White. Asian and Islander totals were summed to correspond to the NCES category; and Alaska Native, American Indian, and 2 or more races totals were summed to correspond to the NCES category (Alaska Department of Education and Early Development, 2016).

Table 9 shows that Alaska's correspondence students are more likely to be Caucasian (by 10 percentage points) than homeschooled students as a whole in the U.S., and less likely to be Black, Hispanic, or Asian/Pacific Islander. Alaska correspondence students are also more likely to be multiracial, Alaska Native, or American Indian (by eight percentage points) than U.S. homeschooled students as a whole.

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