

**IDENTITY, EQUITY, AND PERFORMANCE:
MATHEMATICS AND READING LITERACY**

IN

NOVA SCOTIA PUBLIC SCHOOLS

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***NOTE:** Although the data analyzed in this report was collected by the Nova Scotia Department of Education, the views expressed in this report are solely those of the author and may not represent those of the Nova Scotia Department of Education.

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Executive Summary

This report presents an analysis of the reading and mathematics performances of Nova Scotian public school students who identified themselves as African Nova Scotian, First Nations (primarily Mi'kmaq), Acadian, or of other European ancestry. The analysis combined information from the 2006-2007 Student Self-Identification Survey (administered to students served by Chignecto-Central Regional School Board, Strait Regional School Board, and Tri-County Regional School Board) with the performance data from the 11 provincial assessments administered by the Department of Education between 2003 and 2008. The main findings are:

- Sizable gaps characterize the performances of learners of different cultural heritage. On all assessments, learners of a European heritage obtained the highest average scores, were most likely to be in the top 25 percent of achievers, and least likely to find themselves in the bottom 25 percent. African Nova Scotian learners typically fared worst on the provincial assessments, followed by First Nations and then Acadian learners.
- The performance gaps in mathematics are of approximately the same magnitude as those found for reading. Further, the relative performances of African Nova Scotian, First Nations, Acadian, and learners of European descent are the same in mathematics as in reading, with the exception that First Nations and African Nova Scotian learners are approximately equal in their mathematics performance.
- The cultural identity performance gaps are manifest in grade 3—the earliest assessments available for this report. These gaps persist through the grade 9 assessment. However, there is no evidence to indicate that the performance gaps associated with cultural identity either increase or decrease over the school years.
- Trends in performance gaps associated with cultural identities are not the same for students of different cultural self-identities. Specifically, the performance gaps for Mi'kmaq and Acadian learners have been declining somewhat in recent years. In contrast, no secular trend was found for African Canadians.
- There are two additional indicators that African Nova Scotian and Mi'kmaq learners experience school difficulties: a) they are especially likely to be below grade for their age, and b) a higher proportion of them require test adaptations.
- Between the transition from elementary to high school, the rate of growth in reading performance is significantly higher for students of European descent than it is for those of other cultural identities. Acadian, African Nova Scotian, and Mi'kmaq learners appear to have the most limited reading performance gains.

Identity, Equity, and Performance: Mathematics and Reading Literacy in Nova Scotia Public Schools

Introduction

In its *Racial Equity Policy*, the Department of Education enunciated its commitment to “the fundamental principle that all Nova Scotians have a right to an equitable education that respects their first culture” (Nova Scotia Department of Education 2002:1). As one concrete step to implement the policies contained in that document, an Advisory Committee was established. Part of the functions of this committee is to “develop an information data and research base” that includes data on “the performances of learners in relation to factors such as race, socio-economic class, and gender” (Nova Scotia Department of Education 2002:3). The purpose of this report is to provide an analysis of literacy performances among African Nova Scotian, First Nations (primarily Mi’kmaq), and Acadian learners served by the Chicnecto-Central Regional School Board, Strait Regional School Board, and Tri-County Regional School Board in Nova Scotia. Note that the focus on learners from these three boards means that when the term “Acadian” is used in this report, it excludes those served by the Conseil scolaire acadien provincial.

Research Questions

Several research questions are addressed in this report:

- How do Nova Scotia public school students who identify themselves as African Canadian, First Nations, or Acadian perform on performance tests in reading and mathematics?
- Are there some groups with high relative risks of performing substantially below average? Conversely, are there some groups with high odds of performing especially well?
- Is there consistency in performance across the different performance domains?
- Are there any trends in performance for the different groups? That is, are any documented performance gaps between different population groups increasing or decreasing?
- Do performance gaps become more (or less) pronounced at different grade levels?

Literature review

Canadian students perform well on standardized achievement tests. Relative to the performance of students in 30 other countries that participated in the Program for International Student Assessment (PISA), Canadian students ranked second in reading and sixth in mathematics (Human Resources Development Canada, Council of Ministers of Education and Statistics Canada 2001). Between 2000 and 2003, their average mathematics achievement scores increased while that of reading remained virtually unchanged (updated tables from Statistics Canada and Council of Ministers of Education

Canada 2003). However, sizable provincial differences in achievement scores were also documented, with students in the Atlantic Provinces typically performing lower than those in other regions (Human Resources Development Canada, Council of Ministers of Education and Statistics Canada 2001; Thiessen 2008a; Willms 2004). Nova Scotian youth generally perform better than those in the other Atlantic provinces, especially after controlling for student intake characteristics over which schools have no control (Thiessen 2008a).

In the context of equity, a more important finding is that inequality in performance generally increases with lower average performance in jurisdictions, both internationally and inter-provincially. Provinces that do well on average also tend to have the smallest performance gaps between top- and bottom achievers (Human Resources Development Canada, Council of Ministers of Education and Statistics Canada 2001; Willms 2004). That is, in jurisdictions with higher average performance, parental socio-economic status (SES) tends to be a less important determinant of performance. This is perhaps one of the reasons why parental SES has a relatively strong influence on the performance scores of Nova Scotian youth compared to the Canadian average (Willms 2004).

Additionally, large gaps in performance among certain segments of Canadian youth have been identified that need to be understood and addressed. First, Aboriginal youth tend to perform below the Canadian average. In the 2003 International Adult Literacy Skills Survey (IALSS) data, Aboriginals in every province and territory scored lower than their non-Aboriginal counterparts in every skill domain (Human Resources and Skills Development Canada and Statistics Canada 2005). In New Brunswick, grade 6 First Nations youth scored 25 percent of a standard deviation below other students in mathematics achievement, and just over a third of a standard deviation below non-Aboriginal students in reading and writing performance (Ma and Klinger 2000). Although the mathematics gap disappeared once family SES was controlled, the gaps in reading and writing remained and were not much reduced in magnitude. In Alberta, Vandenberghe and Gierl (2001) found that the performance scores of grade 6 Aboriginals was consistently lower than that of non-Aboriginals. The authors tested whether these gaps might be due to biased test item functioning, but found no evidence to support such an interpretation.

Thiessen (2009) found that both African Canadian and First Nations high school students have lower marks and are more likely to have repeated a grade in elementary school than their counterparts of European descent. These factors are known to have strong and persistent effects on subsequent academic performance, effects that persist into adulthood (Burkam et al. 2004; Chen and Kaplan 2003). Thiessen (2009) also documented that African Canadian and First Nations youth were less likely to take university-preparatory classes. Such classes are strongly associated with reading and mathematics achievement scores, although the causal order remains contested. That is, does participation in university-preparatory classes increase one's subsequent academic performance, or does prior performance cause students to be placed into university preparatory classes, for example.

In the US, the academic performance of African Americans and Aboriginals is found to be consistently lower than that of European Americans (Ainsworth 2002; Downey, von Hippel and Broh 2004; Kao and Thompson 2003; Ream and Palardy 2008). These differences exist at entry into kindergarten, and the gaps increase over the first two years of schooling (Chatterji 2006). Ogbu (1992) distinguished between voluntary and involuntary minorities to account for the lower academic performances of African Americans. He notes that immigrants are voluntary minorities who usually emigrate to the host country in the hopes for a better life for themselves or their children. In contrast, historically African Americans constitute an involuntary minority who “could not (and still cannot) easily escape from their birth-ascribed membership in a subordinate and disparaged group by "passing" for White” (Ogbu 1992:9). As a result, Ogbu argues, they developed an oppositional identity that discourages academic success. Despite its appeal, systematic analyses in the US finds little support for any of the hypotheses derived from Ogbu’s explanation (Ainsworth-Darnell and Downey 1998; Morgan and Mehta 2004; Stoner-Eby 2002). In the Canadian context, the historical treatment of First Nations, particularly the introduction of the residential schools that systematically stripped these children of their language and culture, makes it appropriate to consider them an involuntary minority.

Racial and ethnic inequalities in academic performance can be traced to two sets of factors. The first consists of inequalities in parental economic, social, and cultural capital. The amounts of such capital are strongly associated with skill levels achieved by their children (Barr-Telford et al. 2003; De Broucker 2005; Drolet 2005; Finnie, Lascelles and Sweetman 2005; Ipsos-Reid 2001; Lambert et al. 2004; Looker 2002; Tomkowicz and Bushnik 2003). The importance of parental resources is underscored by the fact that large literacy gaps between many visible minority students and those of European ancestry have been documented at the beginning of kindergarten. The second is the schooling experience, including various forms of systemic racism (Black Learners Advisory Committee 1994; Dei 1996). Systemic racism arguments are strengthened by the fact that the achievement and performance gaps generally widen over the years of compulsory education (Aikens and Barbarin 2008; Burkam et al. 2004; Chatterji 2006; Moller et al. 2006; Tach and Farkas 2006).¹

Parental aspirations for their children’s education ranks as one of the most important determinants of young people’s academic performance and educational performance (Neuenschwander et al. 2007; Thiessen 2008b). It is on this attribute that African Canadian households differ from First Nations families. Four in five African Canadian students believe that post-secondary education (PSE) is very important to their parents. This is in stark contrast to First Nations youth, where only about half of them hold that view, while two-thirds of youth of European descent believe that their participation in PSE is very important to their parents (Thiessen 2009).

¹ While the racialized performance gaps increase over the school years, the precise role of schools in this dynamic remains contested. For example, Downey, von Hippel, and Brow (2004) document that the growth in achievement gaps occurs primarily (but not exclusively) during the summer months when students are not in school.

Data, measures, and methods

The analyses undertaken for this report combines information from two separate sources. The first source is the Student Self-Identification Survey (SSIS). Three school boards (Chignecto-Central Regional School Board, Strait Regional School Board, and Tri-County Regional School Board) agreed to participate in this pilot project undertaken by the Nova Scotia Department of Education. During the 2006-2007 school year, a one-page form asking students about their cultural identity and languages spoken at home was given to all students attending public schools in these three school boards. A total of 28,752 forms were returned, representing an overall response rate of 76 percent. The response rates for the three school boards were quite similar, ranging from a low of 74 percent in Chignecto-Central Regional School Board to a high of 79 percent in Tri-County Regional School Board.² The response rates varied more systematically at the school level. Among the 131 schools in these three school boards, the response rates were significantly higher in the smaller schools ($p < 0.05$).

The second source is the literacy and numeracy assessments undertaken by the Department of Education. From 2003 onwards, such assessments have been carried out in one or more of grades 3, 6, and 9. All students in public schools enrolled in these grades except those that have a documented Individual Program Plan (IPP) in English Language Arts or Mathematics (for the mathematics literacy assessment) are required to take these assessments. Data from the following 11 assessments were made available:

- Grade 3 Early Elementary Mathematics Literacy Assessment (EEMLA); 2007-2008.
- Grade 3 Early Language Literacy Assessment (ELLA); 2007-2008.
- Grade 6 Elementary Literacy Assessment (ELA); 2003-2007.
- Grade 9 Junior High Literacy Assessment (JHLA); 2007-2008.

The two data sources share a common student identification number. This feature made it possible to link the SSIS with the assessment data. Data for each type of assessment from multiple years of assessment were combined. That is, data from the five annual ELA assessments were combined, but kept separate from the ELLA assessments. Combining cohorts increases the stability of the estimates, since cultural identity information is available from only three school boards. It is known that mathematics and reading literacy have some distinct determinants (for example, females perform better in reading but males tend to be somewhat better at math), and since progression over different age groups is important to monitor, information from the four types of assessment is analyzed separately.

² The school board differences in response rates are not statistically significant at conventional levels.

Description of measures

Cultural identity

Information on student's cultural identity was obtained from the SSIS. To reflect the reality of multiple identities, learners (and/or their parents, depending on the student's age) were asked to check as many of the identities as they felt applied to them. While 16 cultural identities were listed on the form, the focus of this report is on three cultural groups: African, Mi'kmaq (combining on- and off-reserve), and Acadian. Their performance is compared with the remaining students, who were predominantly of European descent.³

The fact of multiple responses to the cultural identity question creates a definitional problem: how to classify learners with more than one identity. This problem was resolved by creating two definitions—inclusive and exclusive—of cultural identity. In the inclusive version, a learner is considered to have a particular cultural identity if they checked that identity on the SSIS form, regardless of whether they also checked other identities. In the exclusive definition, a learner is considered to have an African identity, for example, if they checked African but did not check Acadian or any of the First Nations identities. To maximize the number of usable cases, all findings in this report are based on the inclusive definition. However, a robustness test is conducted where the exclusive definition is used.

Information on cultural identity was not ascertained for a third of the learners.⁴ Of those who did provide information on their cultural identity, 743 (4%) checked an African identity, 687 (4%) claimed a Mi'kmaq identity, 5,042 (26%) considered themselves to have an Acadian heritage, and 15,118 (79%) claimed other identities, almost totally of European ancestry.

The large proportion of learners who failed to provide information about their cultural identity raises concerns about possible bias associated with missing information status. Most crucial is any difference on performance scores associated with whether the learner provided cultural self-identity information. As documented in Table 1, respondents who failed to complete the cultural identity questions score consistently lower on all performance assessments. This is not a surprising finding, since analyses of the PISA data show a strong negative relationship between achievement and non-response on questionnaire items; i.e., students who failed to answer questionnaire items tended to have lower mathematics achievement scores (Thiessen and Blasius 2009). The

³ Less than one percent of learners claimed Asian as their sole. These were combined with Europeans for two reasons. First, exploratory analyses documented that the reading performances of Asians are relatively similar, while their mathematics performances are somewhat superior, to those of European descent. Second, while respect for cultural diversity extends to all visible minorities and other population groups, the most pressing equity issues in Nova Scotia concern African, Mi'kmaq, and Acadian learners.

⁴ A small proportion (just under five percent) of the learners or their parents refused to participate in the SSIS. Most of the non-response occurred because the section on cultural identity was left blank. A missing value indicator for cultural identity was therefore created to maximize the number of usable cases and to minimize the bias in statistical estimations that could arise from such a large number of missing values.

implication of this finding is that to minimize the bias, a missing data indicator for cultural identity will need to be included in all multivariate performance models.

The SSIS questionnaire also asked about the language parents and learners spoke at home. English was spoken almost universally, and there were too few cases of other languages spoken to permit an assessment of the possible effects of speaking another language on performance scores.

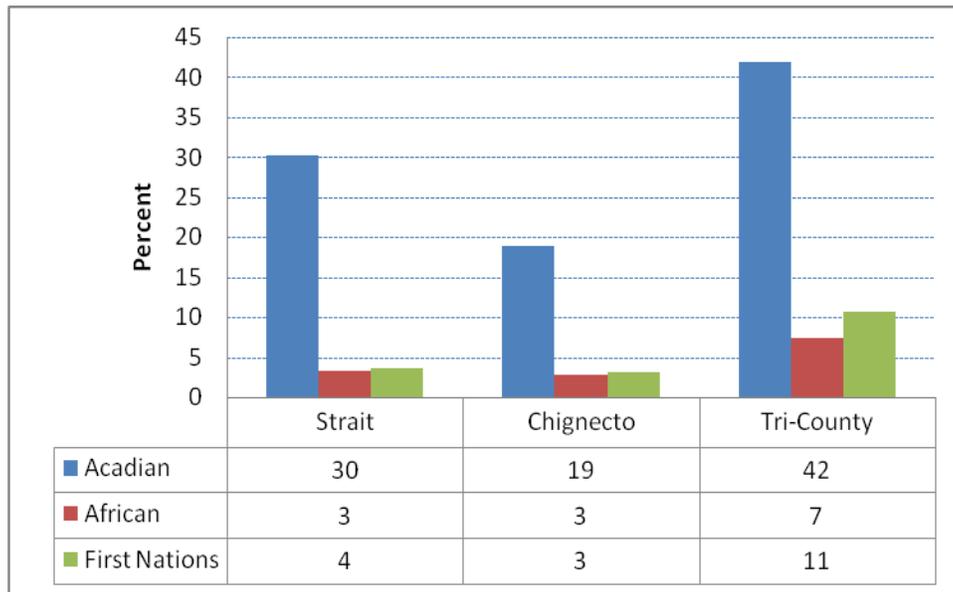
Table 1: Mean performance scores by whether cultural self-identity information was given

	Provided cultural self-identity information		
	Yes	No	Total
EEMLA			
Total math	516	496	510
Data and probability	503	494	500
Geometry	508	490	502
Measurement	510	493	505
Numbers	509	490	503
Operations	508	490	503
Patterns	510	494	505
Level 1	510	493	505
Level 2	509	489	503
Level 3	505	487	500
ELLA			
Total reading score	518	503	513
Literal comprehension in fiction genre	509	497	506
Interpretive comprehension in fiction genre	506	490	501
Literal comprehension in nonfiction/multimodal genre	508	497	505
Literal comprehension in nonfiction/multimodal genre	508	492	503
ELA			
Total reading	507	482	499
Literal and non-literal comprehension	506	483	499
Analysis, synthesis, and evaluation	506	484	499
JHLA			
Total reading	509	483	501
Literal and non-literal comprehension	510	484	502
Analysis, synthesis, and evaluation	511	489	504

Note: All performance differences by whether cultural identity information was provided are statistically significant ($p < 0.01$).

The distribution of cultural identities differs significantly by school board (Figure 1). The Tri-County Regional School Board has the highest proportion of learners of all four cultural identities; the Strait Regional School Board and Chignecto-Central Regional School Board have almost equal proportions of African Nova Scotian and Mi'kmaq learners, but the Strait Regional School Board serves substantially more students with an Acadian identity than does the Chignecto-Central Regional School Board.

Figure 1: Cultural identity by school board



Literacy performance

The main outcomes assessed in this report are the literacy performance scores on the four provincial assessments. Greater detail on the sub-components of the reading and mathematics literacy assessments is given in the findings relating to each type of assessment. Performance test scores are often standardized to a common scale with a mean of 500 and a standard deviation of 100. If the performance scores are approximately normally distributed, 67 percent of students should score between 400 and 600, and 95 percent of the students should score between 300 and 700. In recent test assessments the Department of Education has followed this practice of standardizing the test results to have a mean of 100 and a standard deviation of 500.⁵ However, this was not done for the ELA2003-2005 assessments. For ELA2003-04, the Department of Education converted the raw reading and the two cognitive level scores (Analysis and Comprehension) into a percentage correct measure. In 2004-2005, the raw reading score was scored out of 50 points, while the two cognitive level scores were scored out of 100. To make results comparable across domains, these scores were transformed to the common standard. Since each of the annual assessments were transformed to a mean of 500 and a standard deviation of 100, trends in student performance over the years cannot be detected.

Grade relative to age

As documented in the literature review, students who have been retained a grade have lower performance scores than other students. Information on grade retention is not available. However, the dates of administering the assessments are known for each year, with the precise date differing only by several days. Additionally, the date of birth is

⁵ Standardizing test scores in this way retains the rank order of all students' test results, as well as the overall shape of the distribution of scores.

known for each student. This makes it possible to compute the age of the student at the time of the assessment. The age of the student at assessment date was calculated as the difference between the date of assessment and the student's date of birth.

Information on the age of the student at the time of the assessment, in conjunction with whether their birthday was before or after October 1st, was used to create a measure of whether the student was behind, at, or ahead of grade for that age. During the years of the assessments, children were eligible to enroll in school if they were at least five years old on October 1st. For the ELA assessments that were administered to students in Grade 6 and that took place in early October, this means that if they were less than 11 years old on October 1st of the year in which they were assessed, they likely had skipped a grade. Conversely, if they were 12 or older, they were at least one year older than the modal age for students in that grade.⁶ A similar logic is used for the other assessments. The measure was trichotomized into below, at, or above grade for age.

Test adaptations

While learners with an IPP are exempt from taking the performance assessments, a minority of students required to take the assessments have one or more documented test adaptation requirements. These take the form of: 1) additional test time, 2) verbatim scribing, 3) alternate test setting, 4) alternate assessment format, 5) English-foreign language dictionary, 6) reading to students (only for writing tasks), and 7) assistive technology. The concept of test adaptations consists of a count of the number of adaptations required.

Analysis methods

Separate parallel analyses were conducted for each assessment type, starting with the earliest (grade 3) and concluding with the grade 9 JHLA. Separate analyses are dictated by one of the research goals, namely to assess whether gaps in performance between learners of different cultural identities diminish or are exacerbated between grades 3 and 9. While most of the data is cross-sectional, some students who completed the SSIS took both the ELA and JHLA. For this longitudinal component, it will be possible to assess whether the growth in performance between grades 6 and 9 differed between African Nova Scotian, Mi'kmaq, Acadian, and those of European ancestry.

Three identical types of statistical analyses are utilized for each of the assessment types. First some descriptive profiles are presented. These document the similarities and differences between learners of different cultural identities on several aspects of their school experiences, such as whether they: 1) have an IPP, 2) are at grade for their age, and 3) required any test adaptations.

⁶ The individual reasons for being older than the modal age is not known; for some it could be that their parents decided to withhold enrolling them for one or more years, while for others it may have been that they repeated a grade. The fact that the proportion of students who were behind grade for their age is substantially larger in high school than in elementary school suggests that, at least for the assessments conducted in high school, grade retention is the dominant reason for being behind grade for age.

Two types of multivariate analyses follow the profile analyses. The first type, known as ordinary least squares regression analysis, estimates the *average* performance of learners who differ on a variety of attributes such as cultural identity and gender.

Averages sometimes mask important differences. Especially important for the purposes of this report are factors that might operate differently at the top and bottom ends of the performance continuum—learners whose performance is substantially above average and those whose performance is so low that remedial efforts might be warranted. To assess these possibilities, performance scores were dichotomized at the top and bottom quartile. Multivariate logistic regression analysis is used to estimate the odds ratios of learners with certain characteristics being in the top 25 percent, and the relative risk of learners with the same characteristics being in the bottom quartile.

Findings

Early Elementary Mathematics Literacy Assessment (EEMLA)

The Early Elementary Mathematical Literacy Assessment is administered to students in grade three English and French Immersion programs. It is written one hour a day over three days. Extra time is built in for those students who may require it. The assessment is aligned with the *Atlantic Canada Mathematics Curriculum Grades P – 3* and all the questions were generated from that document. The assessment tasks include mental math, computation, and problem-solving. This provincial assessment was designed to gather valid, reliable, fair, and accurate information about the performance of individual students with the purpose of informing classroom instruction.⁷

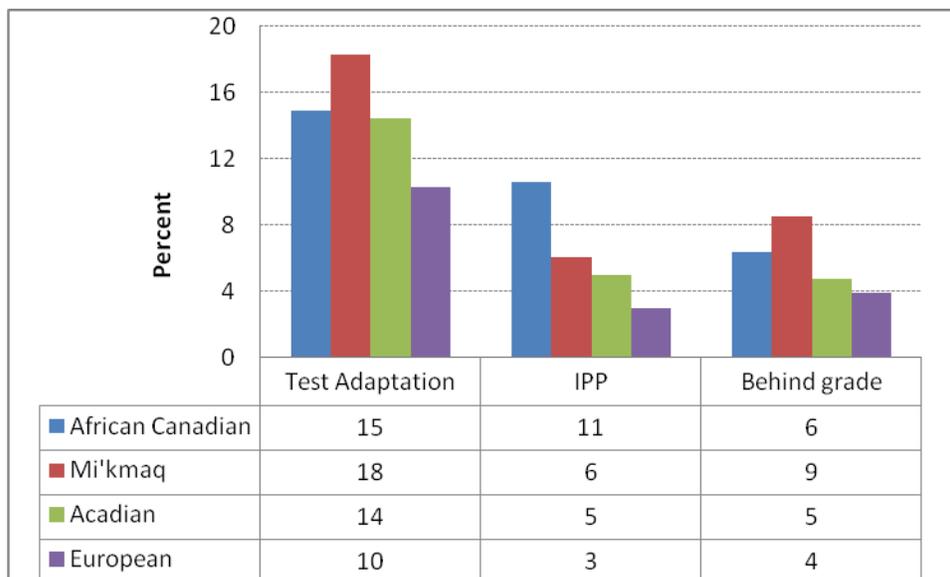
The assessments conducted in June of 2007 and 2008 were combined, giving a total sample size of 3,912 grade 3 students who took the assessment in the three school boards that participated in the pilot SSIS survey. Keeping in mind that multiple cultural identities were possible, the last row of Table 2 shows that fewer than 100 claimed African or Mi'kmaq as one of their identities. The small number of learners with these cultural identities limits the power of statistical tests to discern performance gaps for these two groups. For this reason, it is more important to focus on the patterns of the findings than on whether a given comparison is statistically significant. To participate in the SSIS, the grade 3 children had to take the one-page SSIS form home, have their parent complete the form and sign the consent to participate, and return it to the school. Perhaps because of their young age, cultural identity information was not obtained for over half (52%) of these students.

Three signs of possible early educational difficulties were available in the data set: requiring an assessment adaptation to write the EEMLA, having an IPP, and being behind grade for their age. As a first step for assessing the educational experiences of these students in relation to possible equity issues, Figure 2 gives the percentage of students of

⁷ Information concerning the EEMLA was obtained from the Department of Education assessment web site (<http://eemla.ednet.ns.ca/index.shtml>).

each cultural identity with these attributes.⁸ As the figure shows, European students were the least likely to require test adaptations, to have an IPP, or to be older than the modal age for that grade. Students who identified themselves as Acadian were second-lowest on all three indicators. Mi’kmaq youth were most likely to have required test adaptations and to be behind grade for their age, while African Canadians were the most likely to have an IPP.

Figure 2: Percent of EEMLA students who required an assessment adaptation, had an IPP, or were behind grade for their age, by cultural identity



Note: European students were significantly less likely ($p < 0.05$) to require test adaptations, to have an IPP, or to be behind grade for their age than were students of other identities

The results of the EELMA comprise both a total mathematics performance score, and scores on six specific components: data and probability, geometry, measurement, numbers, operations, and patterns. Additionally, the test items were differentiated into three levels. Table 2 provides the cultural identity profiles for all components of mathematics performance. Looking first at average (mean) performances, African Nova Scotians and Mi’kmaq learners are virtually indistinguishable on both overall mathematics performance and on each of the assessment components. They score about 20 points (a fifth of a standard deviation) below average. Learners identifying themselves as Acadian have approximately average mathematics performance scores. On both total performance and all components, their scores average higher than those of African Nova Scotian and Mi’kmaq learners. Students of European descent consistently have the highest average performance scores. That is, the rank-order for grade 3 mathematics performance is consistently:

$$\text{African} \approx \text{Mi'kmaq} < \text{Acadian} < \text{European}.$$

⁸ The proportion of learners having these three characteristics typically is smaller in the earlier grades.

The difference between the average performance of African Nova Scotian and Mi'kmaq learners at the one extreme and students of European descent on the other is approximately 45 performance points. This is the raw performance gap between learners of these identities. Keeping in mind that all performance scores were transformed to a mean of 500 and a standard deviation of 100, the mathematics performance gap between European and either African Nova Scotians or Mi'kmaq learners is the equivalent of 0.45 standard deviations, which is a considerable gap.

Table 2: Performance on EEMLA by cultural identity

Performance Score:	African			
	Canadian	Mi'kmaq	Acadian	European
Total	480	473	504	523
Data and probability	477	472	490	508
Geometry	475	457	495	514
Measurement	476	470	502	516
Numbers	475	470	498	515
Operations	477	475	499	515
Patterns	478	479	500	515
Level 1	482	469	502	516
Level 2	471	468	496	516
Level 3	470	464	490	513
Bottom quartile of mathematics literacy (%)	40	36	27	21
Top quartile of mathematics literacy (%)	19	12	24	29
Bottom quartile on all six mathematics components (%)	36	34	25	18
Top quartile on all six mathematics components (%)	18	12	22	27
N	82	77	770	2,115

Several important patterns become apparent when examining the top and bottom quartiles. A first pattern concerns the likelihood of doing well on different components of math, such as geometry or measurement. Since six distinct components formed the mathematics performance assessment, a count was made of the number of components on which a student was in the top (bottom) quartile. Comparing the percentages in the top or bottom quartile on the total with those in the top or bottom on all six components, reveals minor differences. For example, 29 percent of students of European descent scored in the top quartile of math, and almost the same percentage (27%) scored in the top quartile on all six mathematics components. The implication is that those who perform exceptionally well (or poorly) on one component tend to do well (or poorly) on all components.

A second pattern is that the magnitudes of the low- and high-end gaps differ between Mi'kmaq and African Nova Scotians. In the top quartile, the largest gap is between European and Mi'kmaq; learners with a European identity are more than twice as likely as Mi'kmaq youth to be in the top quartile ($29/11=2.64$). In contrast, the largest contrast at the bottom end is between European and African Nova Scotian, with African Nova

Scotians being almost twice as likely ($40/21=1.90$) as their European counterparts to perform in the lowest quartile.

Table 3 gives the results of ten ordinary least squares (OLS) multiple regression equations, with each column providing the results for a particular performance component (for example, column 1 gives the results for overall mathematics performance). In a multiple regression, a given outcome variable (in this case mathematics performance) is predicted on the basis of a number of independent variables included simultaneously. The second- to second-last rows of the table identify the independent variables.

Some guidelines will help in the interpretation of the numbers. First, the numbers associated with each of the independent variables represent the *net* performance points associated with a given factor, while the sign indicates the direction of the association. For example, the regression coefficient of -11 for female in the first column indicates that on average females are estimated to score 11 points lower than males, after adjusting for any other gender differences on the other independent variables. In contrast, learners who are at grade level for their age are estimated to score 33 performance points higher than those who are below grade for their age.

To incorporate information on cultural identity, it is necessary to have one group as the (omitted) reference group. In Table 3 and all subsequent multivariate analyses, European learners constitute the reference group.⁹ The first row of the table (labeled *Constant*) can be read as the estimated performance of European learners who had a score of 0 on all other variables: i.e., male Europeans who are at grade for age, provided information on cultural identity, and required no test adaptations are estimated to have scored 539 on the total mathematics performance assessment, 515 on probability, and so on.

The numbers associated with the cultural identity groups represent the net performance gaps between a given group and the (omitted) European reference group. As an example, African Nova Scotians are estimated to score 33 performance points lower than their European counterparts who have identical characteristics on all the other independent variables. This is ten performance points less than the raw gap documented in the first row of Table 2 ($523-480=43$). That is, adjusting for whether the learner is female, below grade, and number of test adaptations required accounts for 23 percent ($10/43=.23$) of the gap.

⁹ The reference group consists of those who did not identify themselves as African, First Nations, or Acadian. For the sake of brevity, this reference group is called European.

Table 3: EEMLA OLS regression coefficients

	Total	Probability	Geometry	Measurement	Numbers	Operations	Patterns	Level 1	Level 2	Level 3
Constant	539	515	523	532	536	526	527	532	530	523
African	-33	-24	-30	-31	-31	-28	-30	-24	-35	-33
Mi'kmaq	-37	-27	-47	-34	-33	-26	-26	-34	-34	-36
Acadian	-15	-16	-17	-9	-13	-11	-12	-8	-16	-19
Missing cultural identity	-23	-13	-23	-19	-21	-21	-18	-18	-23	-24
Female	-11		-1	-16	-21	-4	-9	-13	-10	-3
At grade for age	33	28	20	36	36	31	21	35	31	34
Test adaptations	-85	-51	-58	-74	-87	-83	-61	-90	-78	-66
Adjusted R ²	0.113	0.048	0.065	0.092	0.121	0.102	0.058	0.126	0.098	0.077

All performance gaps are statistically significant at the conventional level except some for gender. The gender gap is not significant for probability, geometry, operations and Level 3 components.

Comparing the cultural identity groups, the net performances of Mi'kmaq learners tends to be somewhat less than that of African Nova Scotian learners on all components of mathematics except operations and patterns. The performance of Acadian learners is consistently better than that of both Mi'kmaq and African Nova Scotian on the one hand, but between seven and 27 points lower than that of learners of European descent. Thus, the net rank-order typically is:

African < Mi'kmaq < Acadian < European.

The largest determinant of mathematics performance is connected with whether test adaptations were required. Requiring one or more adaptations is estimated to reduce mathematics performance by at least 50—and by as much as 90—points, depending on the specific component.

Congruent with other studies, males tend to perform somewhat better than females in most components of math. However, there is essentially no gender gap with respect to probability and geometry. The net effect of not providing information on cultural identity ranges between 13 and 24 points.

The final row of Table 3 (Adjusted R^2) indicates what proportion of the variance in performance scores is accounted for by the independent variables included in the regression equation. Between about five and 13 percent of the differences in student performance scores are “explained” by the variables available for this analysis.¹⁰ The reason these proportions are so low is because information on the variables known to be particularly influential for performance, such as student effort, educational aspirations, and parental socio-economic capital, is not available in this data set.

OLS is an appropriate statistical method only when the estimated outcome is measured in a continuous metric such as performance points. Dichotomous outcomes, such as whether a student performed in the top quartile, are typically analyzed using logistic regression instead. In most respects, it is similar to OLS, except that, in the example used here, logistic regression estimates the odds ratios of membership in the top quartile. In logistic regression, an odds ratio of 1.0 (colloquially referred to as “even odds”) implies that a person with a given characteristic has the same outcome odds as a person without that characteristic.

Odds ratios greater than 1.0 can be expressed as the percentage difference in odds. For example, the odds ratio for females being in the bottom quartile in overall mathematics performance is 1.33 (see Table 4). This means that the odds or likelihood of females scoring in the bottom quartile is 33 percent higher than for their male counterparts, net of all other factors included in the logistic regression equation. To express odds ratios smaller than 1.0 as a percentage, they must first be subtracted from 1.0. The odds ratio of females being in the top quartile of overall mathematics performance is 0.88. This means that females are 12 percent less likely than males to be in the top quartile ($1 - .88 = .12$).

¹⁰ Technically, to take advantage of certain mathematical properties, OLS uses the squared differences.

Table 4: Odds ratios for performing in the bottom and top quartiles of EEMLA

	Bottom quartile on...		Top quartile on...	
	Total score	All components	Total score	All components
Constant	.18***	.15***	.50***	.47***
African	2.22***	2.23***	.67	.66
Mi'kmaq	1.70*	1.79*	.37**	.40*
Acadian	1.32**	1.36**	.85	.80*
Missing cultural identity	1.48***	1.54***	.64***	.62***
Female	1.33***	1.33***	.88	.89
At grade for age	.48***	.47***	1.67*	1.49
Test adaptations	4.94***	5.07***	.15***	.15***
Nagelkerke R ²	0.117	0.123	0.074	0.071

*p < 0.05; **p < 0.01; ***p < 0.001. A significant difference in this table means that the odds ratio for that characteristic is significantly different from 1.0 (even odds).

The logistic regressions identify several features not apparent so far. First, African Nova Scotians are most over-represented in the bottom quartile, and substantially more likely than Mi'kmaq learners (odds ratios of 2.22 and 1.70 for African and Mi'kmaq learners, respectively). However, it is Mi'kmaq rather than African Nova Scotian learners who are least likely to populate the top quartile: Mi'kmaq learners have 63 percent (1-.37=.63) lower odds than Europeans of being in the top quartile, while African Nova Scotians have 33 percent lower odds.

Second, females are significantly over-represented in the bottom end of mathematics performance, but only mildly underrepresented at the top end. This gender pattern contradicts that found in a number of other studies (Benbow and Stanley 1980; Benbow and Stanley 1983; Lauzon 1999; OECD 2001; Penner 2003). That is, studies that find a gender difference in mathematics performance find the gender gap to be at the top of the continuum, rather than at the bottom.

Early Language Literacy Assessment (ELLA)

The Early Language Literacy Assessment (ELLA) is a provincial assessment administered for 90 minutes a day over three days near the end of September and beginning of October. The assessment is taken by all grade 3 public school English program students, with the exception of students with an Individual Program Plan (IPP) in English Language Arts. The purpose of the ELLA is to provide information about student performance, early in the school year, relative to the Early Stage Listening, Reading, and Writing outcomes of the Atlantic Canada English Language Arts Curriculum. The tasks of the ELLA include fiction and nonfiction listening and reading comprehension questions, as well as personal narrative and informational writing prompts.¹¹

¹¹ Information about ELLA was obtained from the assessment web page (<http://ella.ednet.ns.ca/>). Additional information is available at that site, especially under the *Documents and Resources* tab.

Comparing Figure 3 with Figure 2 reveals that substantially fewer grade 3 students required test adaptations in the reading than the mathematics assessment.¹² In the mathematics assessment, more than 10 percent of students in each of the cultural identity groups required at least one test adaptation, while for ELLA, less than five percent of European and Acadian students, compared to eight percent of African Nova Scotian and 14 percent of Mi’kmaq learners, required test adaptations. Similar to the EEMLA findings, learners of European ancestry were significantly less likely ($p < 0.05$) than those of other cultural identities to require a test adaptation, have an IPP, or find themselves behind grade for their age.

Figure 3: Percent of ELLA students who required an assessment adaptation, had an IPP, or were behind grade for their age, by population group

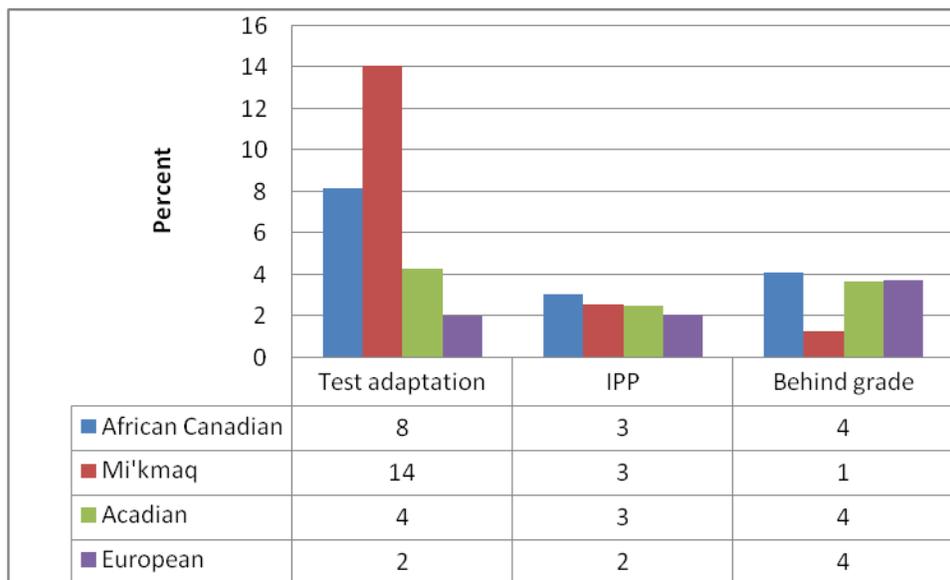


Table 5 reveals that African Nova Scotian learners scored relatively low on all aspects of reading. The total reading gap between learners of African and European descent is 46 performance points, which is approximately the same as was found for grade 3 mathematics performance. With some minor reversals, the rank order of cultural groups on the various components of reading tends to be:

$$\text{African Nova Scotian} \leq \text{Mi'kmaq} \leq \text{Acadian} < \text{European}.$$

This rank order is similar to that found for grade 3 math, except that there is a somewhat clearer tendency for Mi’kmaq learners to have slightly higher scores than African Nova Scotian learners. The rank orders for top and bottom quartiles mirror those found for overall performances.

¹²According to the Department of Education (personal communication), some schools do not begin to consider adaptations and IPPs until grade 3 is underway. Since the ELLA is administered in September/October of grade 3, there may not have been sufficient time to put required adaptations and IPPs into place. This could account for the lower proportions of learners with IPPs and test adaptations in the ELLA compared to the EEMLA.

Table 5: Performance on ELLA by cultural identity

	African	Mi'kmaq	Acadian	European
Total reading score	478	493	509	524
Total listening score	474	470	505	515
Literal comprehension in fiction genre	472	484	503	515
Interpretive comprehension in fiction genre	464	475	499	511
Literal comprehension in nonfiction/multimodal genre	471	495	502	513
Interpretive comprehension in nonfiction/multimodal genre	480	482	496	514
Bottom quartile in..	%	%	%	%
Reading	39	37	27	20
Literal comprehension in fiction genre	29	36	32	27
Interpretive comprehension in fiction genre	33	36	23	18
Literal comprehension in nonfiction/multimodal genre	44	41	31	27
Interpretive comprehension in nonfiction/multimodal genre	39	22	25	22
Top quartile in...	%	%	%	%
Reading	13	20	19	23
Literal comprehension in fiction genre	30	38	38	41
Interpretive comprehension in fiction genre	14	22	23	25
Literal comprehension in nonfiction/multimodal genre	4	14	13	15
Interpretive comprehension in nonfiction/multimodal genre	38	44	40	49
N	93	78	609	1,847

Note: All European coefficients except for literal comprehension in nonfiction/multimodal genre are statistically significant; i.e., the performance of learners with this identity differs collectively from those who do not claim this identity in having superior performance.

The net performance gaps (Table 6) yields similar relative performance rankings of learners from different cultural identities that were found for the unadjusted gaps (Table 5). African Nova Scotian learners consistently have the lowest scores while their European counterparts consistently perform best. Mi'kmaq learners tend to perform somewhat better than African Nova Scotians, and Acadian learners generally perform somewhat better still.

Overall, females obtain on average 25 more reading performance points than do males with the same characteristics. This advantage is greater than their grade 3 deficit in mathematics (which was 11 points). The greater female advantage in reading compared to their deficit in mathematics is congruent with results obtained in other studies (Goldsmith 2004; Human Resources Development Canada, Council of Ministers of Education and Statistics Canada 2001; Ma and Klinger 2000; OECD 2001).

Table 6: Unstandardized ELLA regression coefficients

	Total reading	Literal fiction	Interpretive fiction	Literal nonfiction	Interpretive nonfiction
Constant	516	509	501	510	509
African	-39	-36	-41	-37	-27
Mi'kmaq	-16#	-16#	-22	-7#	-20#
Acadian	-12	-10	-10	-9	-18
Missing cultural identity	-20	-16	-20	-14	-22
Female	25	22	30	13	22
At grade for age	38	34	33	36	30
Required test adaptation	-84	-90	-81	-59	-70
Adjusted R ²	0.092	0.087	0.079	0.043	0.059

Note: All parameter estimates are statistically significant ($p < 0.05$) except for those marked by #. Key: Total read = Total reading score; Literal fiction = Literal comprehension in fiction genre; Interpretive fiction = Interpretive comprehension in fiction genre; Literal nonfiction = Literal comprehension in nonfiction/multimodal genre; Interpretive nonfiction = Interpretive comprehension in nonfiction/multimodal genre.

Both whether a test adaptation was required and whether the learner was at grade level for age are strongly associated with all components of reading performance, perhaps even somewhat more strongly than they were for grade 3 mathematics performance.

The logistic regressions (Table 7) replicate the patterns from OLS. That is, the determinants of high (and low) achievers are much the same as those documented in Table 6. The only feature that stands out more clearly here is that the equations are much better for predicting membership in the bottom quartile than in the top quartile. This can be seen by comparing the model fit (Nagelkerke R^2) for the two sets of equations. The “explained variance” for predicting low performers is sometimes double that for predicting high performers. A similar tendency can be seen for predicting high and low achievers in mathematics (see Table 4).¹³ Note also that the equation for predicting high performance in literal comprehension of nonfiction/multimodal genre is particularly poor.

¹³ These patterns are not unexpected, since a main aim of these tests is to identify and attend to learning issues for low-performing students (Department of Education, personal communication).

Table 7: Odds ratios for performing in the bottom and top quartiles in ELLA

A) Bottom Quartile	Total reading	Literal fiction	Interpretive fiction	Literal nonfiction	Interpretive nonfiction
Constant	.29 ***	.25 ***	.44 ***	.31 ***	.24 ***
African	2.22 ***	1.95 **	1.94 **	2.17 ***	1.75 *
Mi'kmaq	1.74 *	1.92 *	1.50	.83	1.95 **
Acadian	1.40 **	1.30 *	1.19	1.13	1.51 ***
Missing cultural identity	1.72 ***	1.45 ***	1.41 **	1.32 **	1.65 ***
Female	.55 ***	.60 ***	.58 ***	.72 ***	.62 ***
At grade for age	.59 **	.50 ***	.59 **	.51 ***	.53 ***
Required test adaptation	5.15 ***	5.10 ***	3.64 ***	2.33 ***	3.93 ***
Nagelkerke R ²	.096	.086	.067	.036	0.073
B) Top Quartile					
Constant	.23 ***	.58 ***	.24 ***	.20 ***	.85 **
African	.56	.67	.54	.26 **	.70
Mi'kmaq	.61	.59 *	1.06	.86	.65
Acadian	.86	.91	.98	.89	.71 ***
Missing cultural identity	.80 *	.78 **	.76 **	.84	.67 ***
Female	1.73 ***	1.58 ***	1.77 ***	.87	1.48 ***
At grade for age	2.22 **	1.41	1.53	1.70	1.68 **
Required test adaptation	.34 ***	.28 ***	.32 ***	.58 *	.30 ***
Nagelkerke R ²	.040	.044	.042	.012	.049

Note: *p < 0.05; **p < 0.01; ***p < 0.001

Key: Total read = Total reading score; Literal fiction = Literal comprehension in fiction genre; Interpretive fiction = Interpretive comprehension in fiction genre; Literal nonfiction = Literal comprehension in nonfiction/multimodal genre; Interpretive nonfiction = Interpretive comprehension in nonfiction/multimodal genre.

Elementary Literacy Assessment (ELA)

The ELA was developed under the auspices of the Evaluation Services division of the Department of Education by elementary school teachers from all school boards in Nova Scotia.¹⁴ The assessment has been administered annually near the beginning of October of each year since 2003. All grade 6 students attending a public school in Nova Scotia participate in the assessment, except students with an Individual Program Plan (IPP) in English language arts.

The purpose of the ELA is to monitor the progress of individual students in meeting a representative number of reading, viewing and writing outcomes of the Atlantic Canada English Language Arts Curriculum. The assessment was developed by elementary school teachers, representing all school boards in Nova Scotia, under the direction of the Evaluation Services division of the Nova Scotia Department of Education. The assessment is scheduled to take 1.5 hours on each of four consecutive days. During the assessment, students read a variety of materials, and answer questions based on those readings. Reading materials include information texts, short stories, poetry, and visual

¹⁴ Information concerning the ELA was obtained from the Department of Education assessment web site (<http://ela.ednet.ns.ca/index.shtml#>).

media texts. Students also write a persuasive letter and a story. Elementary school teachers, again representing all school boards in Nova Scotia, score the assessments. Individual student results are distributed to parents/guardians through the school. The student results are intended to inform instruction and to develop effective support for the development of students' reading and writing skills generally.

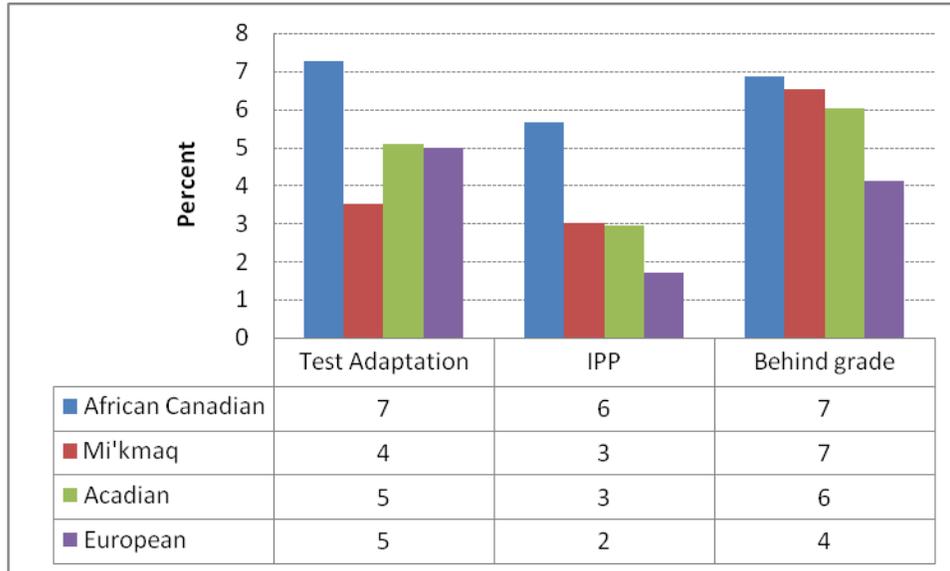
Aggregating the ELA across the assessment years resulted in a total of 9,199 grade 6 students available for the analyses in this section. About one in three students failed to provide information about their cultural identity. Of those who provided information, 248 considered themselves African Nova Scotian, 199 claimed a First Nations identity, 1,843 identified themselves as Acadian, while 4,940 had a European heritage.¹⁵

Figure 4 shows similarities and differences between learners of African, Mi'kmaq, Acadian, and European identity in whether they required any adaptations when taking the assessment, had a documented IPP in English Language Arts, or were behind grade for their age. Those who identified themselves as African Canadian were somewhat more likely than others to require a test adaptation, while Mi'kmaq students appeared even less likely than those of European descent to require adaptations. On average, just over one in every twenty students who took the ELA assessment required one or more adaptations.

Students who had a documented IPP in English Language Arts do not take the ELA assessments. At the same time, it is important to note that there are significant population group differences in the proportions requiring an IPP. Those who chose a European identity were significantly less likely to have an IPP than other groups. Likewise, those who identified themselves as African Canadian were significantly more likely than those of other cultural identities to have an IPP. The likelihood of a disability is known to increase with poverty (Wagner, Cameto and Guzmán 2003), and the population group differences in IPPs here may be a reflection of that. One implication of the population group differences in IPP is that population group performance differences in reading assessments are somewhat underestimated.

¹⁵ Since some students claimed multiple cultural identities, the combined numbers do not equal the sample size.

Figure 4: Percent of ELA students who required an assessment adaptation, had an IPP, or were behind grade for age, by cultural identity



Note: The percentage of students who have a documented IPP in English Language Arts is underestimated in this table since students with an IPP were excluded from the data base in ELA assessment years 2003 and 2004, while in subsequent years they were included but did not take the assessment.

In the last year of elementary school, relatively large and consistent gaps characterize the reading performances of learners with different cultural identities. Table 8 shows that African Nova Scotians have the lowest average reading performances and are most likely to score in the bottom quartile. A gap of 53 performance points separates African Nova Scotians from learners of European descent, and they are twice as likely as European Canadian learners to find themselves in the bottom quartile of reading achievers. The inequalities in grade 6 reading performance are similar (but clearer) to those found for grade 3 reading performance, namely:

$$\text{African} < \text{Mi'kmaq} < \text{Acadian} < \text{European}.$$

Table 8: ELA reading assessments by cultural self-identity

	Reading assessment score	Literal and non-literal comprehension	Analysis, synthesis, and evaluation	In bottom quartile of reading assessment (%)	In top quartile of reading assessment (%)
African	462	464	465	40	17
Mi'kmaq	468	468	471	34	15
Acadian	494	495	493	27	23
European	515	514	515	20	29

The net cultural identity performance gaps, although smaller than the unadjusted gaps, remain statistically significant and substantial (see Table 9). Additionally, this table shows that females perform at least 20 performance points higher than males, both

overall and in each of the two components (literal and non-literal comprehension, and analysis, synthesis, and evaluation). The coefficients for test adaptation requirements and being at grade for age are comparable to those reported for EEMLA and ELLA.

Table 9: Unstandardized regression coefficients for ELA assessments

	Reading Assessment	Literal and non-literal comprehension	Analysis, synthesis and evaluation
Constant	510	508	511
African	-44	-42	-41
Mi'kmaq	-42	-40	-39
Acadian	-18	-15	-19
Missing cultural identity	-31	-29	-30
Female	23	23	20
At grade for age	22	22	33
Required test adaptation	-106	-97	-103
Adjusted R ²	0.109	0.095	0.100

Note: All parameter estimates for all models are statistically significant ($p < 0.001$).

Table 10: Odds ratios for performing in the top and bottom quartile of ELA assessments

	Top quartile	Bottom quartile
Constant	.35	.27
African	.56	2.38
Mi'kmaq	.43	1.92
Acadian	.72	1.38
Missing cultural identity	.63	1.80
Female	1.52	.65
At grade for age	1.69	.54
Required assessment adaptation	.21	6.02
Nagelkerke R ²	0.051	0.100

Note: All parameter estimates for all models are statistically significant ($p < 0.001$).

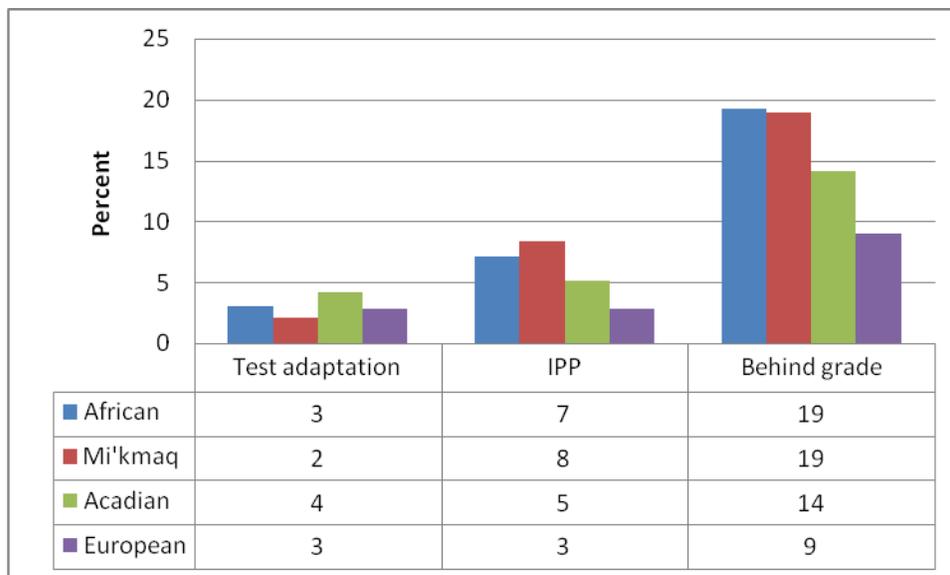
Junior High Literacy Assessment (JHLA)

Like the grades 3 and 6 literacy assessments, the purpose of the JHLA is to monitor the progress of individual students in meeting a representative number of reading and viewing and writing outcomes of the Atlantic Canada English Language Arts Curriculum. It was developed by junior high teachers, representing all school boards in Nova Scotia, under the direction of the Evaluation Services division of the Department of Education. Prior to 2008-2009, the JHLA was administered in late May to all grade 9 students in public schools in Nova Scotia, with the exception of students with an Individual Program Plan (IPP) in English language arts. Students read a variety of materials, and answered questions based on those readings. Materials included information texts, short stories, poetry or song lyrics, and visual media texts. Students also wrote an essay and a story. The results of the assessment are not used to determine whether a student is promoted or retained, or to decide whether a student graduates from high school. Rather, the individual student results are intended to inform instruction and make decisions about

interventions that would most effectively support the student’s development as a reader and writer.¹⁶

Less than five percent of students taking the JHLA required any test adaptations, and cultural identity differences in this regard are trivial (see Figure 5). As is to be expected, substantially greater proportions of students are behind grade for their age in junior high school than was found for grade 6 (and grade 6 students were somewhat more likely to be behind grade for their age than grade 3 students). What is more noteworthy, however, are the cultural identity differences: just under one in every five grade 9 Mi’kmaq and African Nova Scotian learners are behind grade for their age, compared to half that proportion among learners of European descent. Corroborating findings from the other assessments, learners of European heritage are the least likely to have an IPP, while their African and Mi’kmaq counterparts are the most likely to have an IPP.

Figure 5: Percent of JHLA students with test adaptations, IPP, or behind grade for age by cultural identity



With respect to average scores, Table 11 depicts the following inequalities:

$$\text{African} \leq \text{Mi'kmaq} < \text{Acadian} < \text{European}.$$

By grade 9, however, the top and bottom quartile performers differ in some respects. While African and Mi’kmaq learners are equally likely to find themselves in the bottom quartile Mi’kmaq youth are decidedly under-represented among top-quartile performers.

¹⁶Information about the JHLA was obtained and adapted from the assessment web site (<http://jhla.ednet.ns.ca/index.shtml>). Further details about the JHLA can be found there.

Table 11: JHLA performance by cultural identity

	African	Mi'kmaq	Acadian	European
Reading assessment score	473 **	474 **	501 *	518 ***
Literal and non-literal comprehension	480 *	478 *	502 *	518 ***
Analysis, synthesis, and evaluation	477 **	482 *	504	518 ***
In bottom quartile of...	%	%	%	%
Reading assessment	32	34	25 *	19 ***
Literal and non-literal comprehension	31 *	34 **	22	15 ***
Analysis, synthesis, and evaluation	33 *	33 *	23	18 ***
In top quartile of...	%	%	%	%
Reading assessment	20	14 **	28 *	32 ***
Literal and non-literal comprehension	23	13 **	25 **	29 ***
Analysis, synthesis, and evaluation	16	9 **	23	27 ***

*p < 0.05; **p < 0.01; ***p < 0.001. A significant difference in this table means that students who identified with a particular population group differ from those who did not identify with that population group.

Adjusting for the effects of the other independent variables does not change the rank order of the cultural identity groups (Table 12):

Table 12: Unstandardized regression coefficients for JHLA assessments

	Reading	Literal and Non-literal Comprehension	Analysis, Synthesis, and Evaluation
Constant	511	515	509
African	-35	-28	-32
Mi'kmaq	-31	-29	-25
Acadian	-18	-18	-14
Missing cultural identity	-30	-30	-25
Female	24	15	27
At grade for age	54	45	53
Required assessment adaptation	-96	-79	-94
Adjusted R ²	0.120	0.086	0.121

Note: All coefficients for all three performance models are statistically significant (p < 0.01).

Table 13: Odds ratios for performing in the bottom and top quartile of JHLA assessments

A) Bottom Quartile	Reading total	Literal and Non-literal Comprehension	Analysis, Synthesis, and Evaluation
Constant	.25 ***	.19 ***	.23 ***
African	1.68 *	1.96 **	2.01 **
Mi'kmaq	1.82 *	2.28 ***	1.94 **
Acadian	1.61 ***	1.45 **	1.41 **
Missing cultural identity	2.10 ***	2.07 ***	1.81 ***
Female	.61 ***	.70 ***	.56 ***
At grade for age	.37 ***	.45 ***	.33 ***
Assessment adaptation	5.57 ***	4.64 ***	6.97 ***
Nagelkerke R ²	.118	.092	.130
B) Top Quartile			
Constant	.39 ***	.38 ***	.28 ***
African	.58 *	.85	.61
Mi'kmaq	.38 **	.41 **	.31 **
Acadian	.70 **	.66 ***	.86
Missing cultural identity	.64 ***	.66 ***	.70 ***
Female	1.70 ***	1.28 **	1.68 ***
At grade for age	2.01 ***	1.98 ***	1.69 ***
Assessment adaptation	.34 ***	.33 ***	.29 ***
Nagelkerke R ²	0.061	0.041	.048

*p < 0.05; **p < 0.01; ***p < 0.001.

Trends in performance gaps

The ELA were the first assessments to be introduced in Nova Scotia and they were introduced during the 2003-2004 school year. Hence they are the only ones with a sufficiently long history to enable a tentative assessment of any secular trends in performance gaps between learners of different cultural identities. Since the relatively small number of learners in the SSIS sample who took the ELA in any given year, a two-year moving average was constructed to help smooth out sampling fluctuations. Additionally, the appropriate assessment is one that focuses on the net performance gaps, rather than the unadjusted gaps. Table 14 provides the OLS results, where each column combines the learners from two consecutive years of assessment.

Table 14: Unstandardized regression coefficients for ELA assessments by years of assessment

	2003-2004	2004-2005	2005-2006	2006-2007
Constant	516	510	508	505
African	-45	-36	-44	-46
Mi'kmaq	-47	-51	-40	-35
Acadian	-21	-19	-18	-17
Missing cultural identity	-38	-31	-28	-26
Female	19	26	22	23
At grade for age	32	21	34	42
Required assessment adaptation	-100	-109	-106	-111
N	3079	3357	3804	4342
Adjusted R ²	0.090	0.114	0.109	0.107

A comparison of the coefficients associated with each of the cultural identity groups shows two different patterns. Mi'kmaq and Acadian learners appear to be narrowing the gap in their performance relative to those of European descent. Part of that is due to the fact that there has been a modest decline of nine points over the years in the performance of European Canadian learners (see the first row in the table, which represents the estimated performance of European Canadian learners). In contrast, no secular trend is apparent among African Canadians.

Longitudinal change in reading performance

An important question concerns whether some learners progress more slowly than others in their academic performance. Fortunately, the available data contains almost 3,000 learners who took both the ELA and JHLA. This makes it possible to determine whether the rate of growth between the last year of elementary school and the last year of junior high school differs for learners of different cultural identities. Additionally, it permits an assessment of whether certain other groups, such as females, progress at a faster rate. In the regressions presented in Table 15, the attributes of learners in grade 6 are entered as predictors for estimating their reading performance in grade 9.

Table 15: Unstandardized regression coefficients for longitudinal estimation of reading performance

	Reading total	Literal and Non-literal Comprehension	Analysis, Synthesis, and Evaluation
Constant	183 ***	248 ***	240 ***
Grade 6 assessment	1 ***	1 ***	1 ***
African	-7	-8	-12
Mi'kmaq	-7	-10	-6
Acadian	-8 *	-11 **	-6
Missing cultural identity	-6	-11 ***	-5
Female	9 ***	1	16 ***
At grade for age	15 ***	14 **	19 ***
Test adaptation required	-23 ***	-23 ***	-24 ***
Adjusted R ²	0.489	0.357	0.375

Note: N = 2,913

*p < 0.05; **p < 0.01; ***p < 0.001

Several conclusions appear warranted from this analysis. First, African, Mi'kmaq, and Acadian learners have lower performance growth rates (between six and 12 points) than do learners of European ancestry.¹⁷ In the US, Burkam et al.(2004) documented the same pattern with respect to African Americans.

¹⁷ None of the performance growth rates of Mi'kmaq and African Nova Scotians relative to European learners are statistically significant by conventional standards, despite the fact that one of the African coefficients is larger than a statistically significant Acadian one. This is due to the fact that there are more Acadian than African Nova Scotians in the sample. It is also true that all three growth rates of those who identify themselves as having a European heritage are statistically significantly higher than those who do not take this identity.

Second, between grades 6 and 9 females' growth in abilities in analysis, synthesis, and evaluation outstrip those of their male counterparts by 16 performance points. At the same time, there is no gender difference with respect to growth in literal and non-literal comprehension. Finally, the relative performance of learners who were showing signs of difficulty in grade 6 (by being behind grade for their age and by requiring test adaptations) fell substantially farther behind by grade 9 than those of other students.

Discussion and conclusion

This paper documented sizable performance gaps between African Nova Scotian, Mi'kmaq, Acadian, and European Canadian learners.¹⁸ The cultural identity performance gaps were broadly consistent across performance domains (mathematics and reading) and across grades (grades 3 to 9), that typically conformed to the following inequalities:

$$\text{African} < \text{Mi'kmaq} < \text{Acadian} < \text{European}.$$

The cultural identity performance gaps in mathematics were of approximately the same magnitude as that for reading performance. Between 2003 and 2008, the grade 6 reading performance gaps between learners of different cultural identities decreased for Mi'kmaq and Acadian, but showed no secular trend for African Canadian learners. Additionally, the rate of reading performance growth between the end of elementary school and the beginning of senior high school was distinctly higher for learners of European heritage than it was for Mi'kmaq, Acadian and African Nova Scotian learners.

Several limitations characterize the analyses conducted for this report. First, most of the analyses are based on cross-sectional rather than longitudinal data. Hence differentiating between cohort and development effects remains somewhat problematic. Cohort effects refer to historical changes in such things as how school programs are implemented. Developmental (or maturational) effects refer to rates of cognitive development in each learner's biography. These two effects are sometimes confounded in this report. For example, while it is true that the magnitude of the performance gaps between learners of different cultural identities was roughly the same for learners in grades 3, 6, and 9, since different students were tested in these three grades, it would not be warranted to conclude that the rate of improvement over the school years was the same for all learners. The limited longitudinal data available for students between grades 6 and 9 revealed higher rates of performance growth for learners of European identity than for other learners between these two grades.

Second, information on what are known to be the most important determinants of reading and mathematics performance is not available for these students. The absence of such information can result in inappropriate (and sometimes invidious) comparisons being made. Indeed, this report runs that risk. Some would argue that the appropriate comparison would consist of cultural identity learners that have had identical advantages

¹⁸ Exploratory analysis was also conducted on those who identified themselves as Métis. There were only 48 students who defined themselves as solely Métis, and their performance typically was in-between those of First Nations and Acadian learners.

and disadvantages. Yet an equally compelling argument can be made that we live in a world in which the various groups have unequal opportunities and face diverse barriers. It is important to ascertain what effect that might have on such things as their academic performance. That is the viewpoint taken in this report. It should also be pointed out that statistical analyses are concerned with *average* rather than *individual* differences. Thus on average Mi'kmaq youth have lower performance scores than those of European ancestry, for example. At the same time, there are many individual Mi'kmaq learners whose performance scores are superior to some of their European counterparts.

Third, the performance gaps estimated here may be biased. This is because in about a third of the cases, information about cultural identity was absent. Only if the cultural identity information was missing at random would it not affect the performance gaps reported here. If the missing values were disproportionately drawn from Mi'kmaq and/or African Nova Scotian learners, then the performance gaps reported here probably constitute underestimates. If, on the other hand, it was primarily learners of European ancestry who failed to answer the cultural identity questions, then the estimated gaps presented in this report are too large. While it is not possible to determine the facts of the matter, other studies generally find that non-response is higher among young people from more disadvantaged backgrounds and lower among those of European heritage (Crosnoe and Huston 2007; Lee and Bowen 2006; O'Conner and McCartney 2007; Willms 2004). If that is also the case for this study, then the estimates presented constitute the lower bounds for the true cultural identity performance gaps.

Finally, the limited number of Mi'kmaq and African Canadian learners available for analyses in this report presents a severe limitation for exploring nuances in performance. While the overall patterns are clear and robust, caution must be exercised with respect to the details, especially those concerning performance on sub-components of the assessments, since these are also likely to have lower reliability than the overall measures.

The data available for this study do not permit an assessment of the reasons for the persistent performance gaps between learners of different cultural identities. Findings from other studies may help put some perspective on the findings presented here. First, less than one-fifth of the variation in performance scores is attributable to differences between schools (Thiessen 2008a; Willms 2004). Although most of the variation in performance scores can be traced to differences in parental resources and individual learner attributes, this does not deny the pernicious effects of systemic racism on all aspects of children's lives. Indeed, many would argue that the persistence of large disparities in resources between Mi'kmaq and African Canadian families on the one hand, and those of European descent on the other, constitutes in itself powerful evidence of systemic racism. In any event, two implications emerge from this report. First, achievement gaps likely exist prior to learners entering school (Farkas and Beron 2004). Second, schools have not adequately addressed the *persistence* of performance gaps, since over the course of public schooling, the racial gaps remain as wide as ever. Perhaps this report will act as one ingredient in ongoing discussions and deliberations on how schools can foster success among students of diverse cultural identities.

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