Native Hawaiian Students' Achievement Gap in Reading: A Longitudinal Study From Hawaii

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Abstract

The No Child Left Behind (NCLB) Act of 2001 helps to focus attention on ethnicity-related inequity in public education. However, its definition of ethnicity-related disadvantage is problematic in Hawaii for two main reasons. First, the historically disadvantaged Native Hawaiians are included in the Asian American and Pacific Islander (AAPI) category. In other words, their disadvantage is practically ignored for NCLB purposes. Second, NCLB relies on a simplistic difference in the proportion of proficient students between a minority group and the White peers, ignoring confounding factors such as social-economic inequities and differences in school qualities. Those concerns call for a more careful and more meaningful measure of ethnicity-related disadvantage for Hawaii. This paper reports a cross-classified multilevel analysis of the reading performance of Native Hawaiian students on the Hawaiian State Assessment (HSA) from grade 3 to grade 10. Achievement gaps between Native Hawaiians and their White peers were estimated at grades 8 and 10 respectively, with academic readiness statistically controlled for. Policy implications of ethnicity-related disadvantage thus measured are discussed.

Keywords: Native Hawaiian, reading achievement, Hawaii State Assessment, academic achievement gaps, longitudinal study

Many large-scale studies have shown the pernicious impact of race/ethnicity or poverty on academic achievement (e.g., Bali & Alvarez, 2003; Gertz, 1999; Moore, 2003; O'Conner & Miranda, 2002; Patton, 2003; Rathbun, West and Hausken, 2004); Saturnelli & Repa, 1995). Recent analyses of the Hawaiian State Assessment (HSA) have reported similar findings in Hawaii (Nochi, 2009; Uyeno, Zhang, & Chin-Chance, 2006; Zhang, 2009). Zhang's (2009) multilevel analysis showed that socioeconomic status had a consistent and negative effect at grades 3, 5, 8, and 10, based on the 2002 HSA. However, examining changes in the relationship between race or poverty and academic achievement requires longitudinal data. For example, three such studies have investigated the changes in the White-Hispanic achievement gaps in math and reading as the same cohort of students moved through elementary school and up to middle school (Borman, Stringfield, & Rachuba, 2000; Clotfelter, Ladd, & Vigdor, 2006; U.S. Department of Education, 2001).

Generally speaking, the NCLB has been successful in focusing attention on subgroups of minority students, except for the problematic Asian American and Pacific Islander (AAPI) category. In Hawaii's public schools, the four largest ethnicities are Native Hawaiian, Filipino, East Asian, and White. The four groups make up more than 90 percent of the student population. The inclusion of the Native Hawaiians in the AAPI category under the NCLB has disguised an obvious and serious problem in Hawaii. Furthermore, the ethnicity issue in Hawaii is confounded with socioeconomic status (SES). While ethnicity-related and SES-related disadvantages are supposed to be separate for NCLB purposes, neither measure is actually

specific to the intended disadvantage. The challenge therefore is to search for a more meaningful measure of ethnicity-related disadvantage for Hawaii.

To get a fair measure of ethnicity-related disadvantage at different stages of public education, one factor to be considered should be the students' academic foundation or readiness. Much research has documented the powerful impact of early academic success on future achievement. Singh and Zhang (2012) provided a summary table of a dozen large-scale cohort studies conducted between 2001 and 2011 that investigated how early reading competency influences future reading competency, with or without considering other SES factors. Recent studies in Hawaii have also shown a powerful impact of early success on future achievement, with early success considered in conjunction with poverty. Singh (2011, 2013) and Singh and Zhang (2012) reported that third-grade achievement is a predominant and stable predictor of future achievement above and beyond other factors such as SES and ethnic/cultural backgrounds. It seems that any estimation of the long-term impact of ethnicity/culture or poverty may be inaccurate if the level of foundational academics is overlooked. Academic readiness is related to ethnicity or SES status, but it is not a mere proxy. Recent research has yielded similar findings elsewhere. To cite one recent example, Montgomery County Public Schools, MD, recently identified the risk of dropping out of high school as early as first grade (West, 2013).

Gender has been found to influence academic performance in Hawaii, interestingly, in favor of girls (Brandon & Jordan, 1994; Brandon, Jordan, & Hammond, 1987; Reiss, 2005; Uyeno, Zhang & Chin-Chance, 2006).

The review above has highlighted the need to search for a measure of ethnicity-related disadvantage that is (a) meaningful in terms of the ethnic composition of Hawaii's public school population, and (b) distinct from confounding variables such as SES status, gender, and academic readiness. The clustering of students at grades 3, 8, and 10 into schools needed be taken into consideration, as well as the "cross-classified" structure of the HSA data at two levels (i.e., graduates from the same elementary school entering different middle schools, and graduates from the same middle school entering different high schools).

Research Questions

This study addressed two research questions:

1. How do Native Hawaiian students' reading performance compare to their White peers at middle school (grade 8), with grade 3 reading performance, SES, gender and school poverty statistically controlled for?

2. How do Native Hawaiian students' reading performance compare to their White peers at high school (grade 10), with grade 3 and grade 8 reading performance, SES, gender

and school poverty statistically controlled for? This model takes into account two levels of cross-classifications, the first from the 3rd to the 8th grade and the second from the 8th to the 10th grade.

The ethnicity-related disadvantage thus estimated was expected to be drastically different from the difference in mean, and, more important, more meaningful for accountability purposes across the elementary, middle, and high school years.

Data

The Hawaii Department of Education provided the HSA data of the grade 3 cohort in 2004 up to 2011. This investigation included only those students who had completed the HSA reading at grades 3, 8, and 10. We followed the 2004 third-grade cohort (N = 5,285), which consisted of the four largest ethnic groups in Hawaii's schools: East Asian (Chinese, Korean, and Japanese); Filipino; Hawaiian (Native Hawaiian and Part-Hawaiian); and White students. Those students were enrolled in 187 elementary schools, 65 middle schools, and 55 high schools.

English language learners were excluded from the analysis because there were too few of them in the Native Hawaiian and White groups to produce a reliable statistical effect. Students in special education were also not included in this analysis.

Descriptive statistics are reported in Table 1. Hawaiian and Filipino students made up about a third of the sample each. East Asians accounted for a little under a quarter, and Whites a little over 10 percent. Native Hawaiians currently constitute the largest ethnic group in Hawaii's public schools, and no ethnic group exceeds 50 percent.

Table 1 (see Appendix A)

Outcome variables

For Research Question 1, the outcome variable was the HSA reading score at grade 8. For Research Question 2, the outcome variable was the HSA reading score at grade 10.

The HSA reading is defined by six broad standards, of which three are assessed:

a) Comprehension processes (using strategies to construct meaning)
b) Conventions and skills (applying linguistic and textual conventions for comprehension)
c) Response (responding to a text from a personal, interpretive or critical stance)

The other three other broad standards are not covered by HSA:

a) Range (various types of readings)
b) Attitudes and engagement (confidence in and satisfaction with reading)

c) Diversity (thoughtfulness about and respect for multicultural readings)

HSA scores fall on a scale from 100 to 500 with the cut-off score for meeting proficiency set at 300 across subjects, grades, and years. HSA scores cannot be directly compared from one grade to another because of the resetting of standards between 2004 and 2011. HSA scores of different grades have not been vertically linked and therefore cannot be used for growth modeling.

Predictors

There were seven student-level predictors:

- HSA reading score at grade 3, school mean centered (HSA 3R)
- Gender, coded 1 for male, 0 for female
- Ethnicity converted into three indicator/dummy variables describing ethnicity: Hawaiian, Filipino and East Asian, with White as the reference group
- Eligibility for free or reduced price school lunch as an indicator of SES, coded 1 if eligible, 0 otherwise

Three school-level predictors were adopted, based upon the percentage of students in the school eligible for the school lunch program (SchSES-3 in elementary school, SchSES-8 in middle school and SchSES-10 in high school). School poverty levels were centered around the mean of all schools at each of the grades.

The data set had four levels with student characteristics at the individual level and school characteristics at three successive levels, elementary, middle, and high school. Cross-classification occurred in two transitions: first from the elementary to middle school and then from middle to high school.

Analysis

Version 9.12 of SAS was used for the analysis. The *restricted maximum likelihood* (REML) option was used for model fitting and parameter estimation. For the first research question, all seven student-level predictors were included. At the second level, SchSES-3 was included for elementary schools and SchSES-8 for middle schools. For the second research question, there was another level of cross-classification to capture the transition from grade 8 to grade 10. Therefore, SchSES-10 was added to the model.

The 11 predictors could yield an unwieldy number of alternative models. Subsequent model selection was guided by three criteria (Singh & Zhang, 2012):

a) Feasibility (to exclude models that did not converge or converged inappropriately)
b) Parsimony (to exclude trivial effects)
c) Generalizability (to allow an overall interpretation).

For details of the final models of choice, see Appendices 1 and 2 respectively. Same-level and cross-level interactions were found to be nonsignificant, probably due to insufficient cross-classifications given the island locations within the state. Consequently, interaction effects were removed from the initial models. The effects of the predictors in the final models were therefore additive, not multiplicative.

Results

Intercepts

The intercept in the multilevel models is the expected performance of a non-poor female White student in a school that has the average percentage of poor students. In the 8th grade, this score is expected to be 338.89 points (95% Confidence Limits (CL): 335.03, 342.50), and in the 10th grade, 328.88 points (95% CL: 325.18, 332.57), well above the cut-off of 300 for proficiency.

Table 2 (see Appendix A)

Unstandardized Coefficients

A 10-point advantage in grade three reading, all other factors being held constant, would result in a score 3.33 points higher at the 8th grade (95% CL: 3.16, 3.38) or 2.74 points higher at the 10th grade (95% CL: 2.64, 2.84). Early reading competency has proved to be a statistically significant and positive impact.

A male student is disadvantaged by 5.83 points at grade 8 (95% CL: 4.68, 6.99) and 1.23 points at grade 10 (95% CL: 0.21, 2.25) when other factors are held constant.

A poor student will score lower than a non-poor peer by 2.39 points at grade 8 (95% CL: 1.07, 3.72) and by 2.55 points at grade 10 (95% CL: 1.38, 3.72).

A 10 percent increase in the percentage of low SES students in an elementary school would lower a student's score by 2.24 points at grade 8 (95% CL: 1.78, 2.69) or by 2.00 points at grade 10 (95% CL: 1.60, 2.40). Once school poverty has been considered at the elementary level, middle or high school poverty does not seem to have an additional negative impact on reading achievement. This pattern, hitherto unknown, suggests that unlike the disadvantage in SES at the individual level, which has a persistent and negative effect, the impact of school-level poverty seems to be restricted to the elementary school. School SES ceases to be a significant factor in middle or high school. (We verified this finding in our current study by removing schSES-3 and we found that SchSES-8 and SchSES-10 still failed to reach significance.)

Now that the effects of the confounding variables have been examined, we can focus on ethnicity-related disadvantage. Other factors being equal, Native Hawaiian students suffer a disadvantage of 3.90 points at grade 8 (95% CL: 1.83, 5.97) and 6.90 points at grade 10 (95% CL: 5.07, 8.72) in comparison to their White peers. East Asian students, on the other hand, have an advantage of 4.93 points at grade 8 (95% CL: 2.73, 7.12) and 2.81 points at grade 10 (95% CL: 0.87, 4.76) against their White peers. While Filipino students do not have a statistically significant disadvantage at grade 8, they do have a clear disadvantage of 3.83 points at grade 10 (95% CL: 1.95, 5.71) against their White peers. It should be emphasized that those estimates have been arrived at as unique to ethnicity, with the confounding variables statistically controlled for. The inclusion of prior reading achievement as a confounding variable is particularly interesting because the unique effect due to ethnicity is now specific to the grade level. We have isolated ethnicity-related disadvantage at grade 8, with grade 3 reading statistically controlled for. Similarly, ethnic disadvantage at grade 10 has been estimated separately from the effect of prior reading achievement at grades 3 and 8.

While the types of models used in this research do not lend themselves to a straightforward interpretation of a R^2-type statistic, intuitively it may be helpful to illustrate for nontechnical audiences the strength of the models in explaining the variance in student reading scores. The multilevel models in our study accounted for about half of the total variance in student reading scores at the 8th grade (52%) and 10th grade (50%).

Standardized Coefficients

Each unstandardized estimate at the student level was standardized by the corresponding standard deviation of the entire cohort (Table 3). The negative impact of poverty increases by 25 percent from the 8th to the 10th grade. In contrast, the disadvantage of being Hawaiian seems to increase by 108% within the same two-year period, suggesting that the disadvantage of being Hawaiian increases much faster than being poor within the later stages of public education.

The effect of 3rd grade reading remains stable up to the 10th grade. The coefficient for gender is significant at both the 8th and 10th grades, favoring girls consistently. Its influence decreases by 74 percent from the 8th to the 10th grade. Being an East Asian carries a distinct advantage at the 8th grade over being White. Its influence decreases by 31 percent from the 8th to the 10th grade. Filipino students have a distinct disadvantage only at the tenth grade, being 15% of a standard deviation below their White peers.

Table 3 (see Appendix A)

Discussion

This paper is a rare example of a statewide cohort study that has isolated ethnic disadvantages among the AAPI subgroups at grades 8 and 10 respectively, over and beyond the influences of academic readiness, gender, and individual as well as school SES. In terms of reading performance at the 8th grade, East Asians outperform Whites, who are tied with Filipinos after adjusting for SES and followed by Hawaiians. At grade 10, East Asians and Whites are tied at the first place, followed by Filipinos and Hawaiians in that order.

After adjustments were made for the confounding variables, Native Hawaiians on average are behind their White peers by 3.90 points at grade 8 in reading. This may be interpreted as the negative impact of being Hawaiian during middle school. The usual measure, however, is a much bigger difference of 310.62 – 328.47 = -17.85 points (Table 1), which has included an accumulation of the effects of the other disadvantages, SES and academic, up to the 8th grade, a gross overestimation. Whether middle schools in Hawaii perpetuate ethnic disadvantage should be tied to the -3.90 coefficient for the Hawaiian-White contrast. Ideally, the coefficient is statistically nonsignificant, if not exactly 0. The same applies to ethnic disadvantage in grade 10 reading. The current coefficient for the Hawaiian-White contrast is -6.90, as opposed to the over-estimated difference of 304.48 – 323.76 = -19.28 points (Table 1). The value of -6.90 is the incremental ethnic disadvantage for Hawaiians between grades 3 and 10. In an ideal Hawaii high school, this coefficient should be 0 or at least statistically nonsignificant.

Grade 3 reading was treated as the academic readiness in this study because we do not have a statewide measure of academic readiness in literacy for preschool. If grade 1 reading were treated as measures of academic readiness, the same analytical approach could be used to measure different ethnic disadvantages within the AAPI category at any elementary grade. Regular hierarchical linear modeling (HLM) without cross-classification should work well for elementary schools, since very few students change schools in their early grades. Assuming the availability of data, the method demonstrated is feasible for any segment within the K–12 span.

The NCLB is fast approaching its reauthorization, but that does not eliminate the serious challenge in the historical disadvantage of Native Hawaiian students. To help Hawaii's public education system rise to the challenge, the following recommendations based upon the study, we feel, are worth considering:

a) Measure ethnicity-related disadvantages separately for the major subgroups within the AAPI category.
b) Estimate ethnicity-related disadvantages at the elementary, middle, and high grade intervals separately so that administrators, teachers, and staff can focus on stage-specific targets.
c) Include academic readiness in the model as a causal factor to allow the ethnic disadvantage estimates to be adjusted in consideration of academic readiness. This is our attempt to respond

to a common criticism of the fairness or usefulness of the NCLB accountability actions that ignore student preparedness.
d) Tentatively publicize the Hawaiian-White gap of -3.90 points (as opposed to -17.48) at grade 8 and the gap of -6.90 points (as opposed to –19.28) at grade 10, and ask administrators, teachers, and staff whether and how they feel such gaps may be closed within a reasonable number of years.

Limitations

The estimates of the Hawaiian-White gaps need be verified with other cohorts in order to determine whether the preliminary estimates are stable enough to guide policy deliberations. Even if the estimates should prove to be credible, they would only serve as a systemwide picture. This approach is not likely to be applicable down to the level of individual teachers or principals. As of now, we have yet to find a way to determine to what extent the cross-classified model may account for the total variability in the actual HSA scores. We look forward to suggestions of how to get an overall predictive accuracy for the models.

Another limitation is that although the dichotomous coding of SES is consistent with the NCLB guidelines, it is probably not an informative or precise measure. The percentage of students eligible for the school lunch program tends to decline as students grow older in Hawaii. It is not clear whether the decline is due to increased family income or increased stigma associated with poverty. We assumed that the grade 3 SES status was stable across the years, but some students might have changed in SES.

The ultimate question is how to conceptualize, not how to measure, ethnicity-related disadvantage. Thirty years after *A Nation at Risk*, we still do not have a consensus on how to isolate ethnicity-related gaps in achievement. And the NCLB Act of 2001 has fallen short of its objectives largely because, in our opinion, the way such disadvantages are defined has discouraged rather than stimulated reformers in the public education system. Our approach is quantitative but we hope it will contribute to the wider theoretical discussion on what is and is not ethnicity-related disadvantage, whether or not certain causal factors should be taken into consideration in estimating ethnicity-related disadvantage, and how to link up pragmatic accountability actions with a psychometric measure to effect systemic rejuvenation. We hope the reader can see our effort to reconceptualize in this paper.

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Appendix A: Tables

Table 1: Descriptive Statistics for the 2004-2011 Cohort

	East Asian			Filipino			Hawaiian			White			Total		
Grade	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
3	1188	328.84	55.99	1642	299.08	54.12	1841	283.19	53.26	614	323.45	57.37	5285	303.07	57.65
8	1188	337.22	29.63	1642	322.98	27.28	1841	310.58	37.71	614	328.47	28.98	5285	322.50	29.93
10	1188	328.82	25.09	1642	313.71	22.27	1841	304.48	24.37	614	323.76	26.70	5285	315.07	26.00

Note: Descriptive statistics are based on the subgroups of the AAPI students and White students who took the HSA at grades three, eight, and ten.

Table 2: Hierarchical Linear Model Results

	Final Models	
Year	2009	2011
Grade	8	10
Fixed Effect	Coefficients	Coefficients
N	5285	5285
Intercept	338.89*** (1.94)	328.88*** (1.86)
HSA 3R	0.33*** (0.01)	0.27*** (0.01)
Gender	-5.83*** (0.59)	-1.23* (0.52)
Hawaiian	-3.90*** (1.05)	-6.90*** (0.93)
Filipino	0.81n.s.	-3.83*** (0.96)
East Asian	4.93*** (1.12)	2.81** (0.99)
SES	-2.39*** (0.68)	-2.55*** (0.60)
SchSES-3	-0.22*** (0.02)	-0.25*** (0.)
SchSES-8	-0.03n.s. (0.02)	-0.05n.s. (0.03)
SchSES-10	N.A.	0.07n.s. (0.04)
Random Effect	Variance Components	Variance Components
μ_{0j}	13.08*** (3.57)	10.12*** (2.68)
μ_{0k}	15.68*** (3.57)	0.06 (2.11)
μ_{0l}	N.A.	11.99** (4.55)
Residual	436.59*** (8.67)	342.55*** (6.81)
R^2	0.52	0.50

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$, n.s. not significant, N.A. not applicable. Numbers in parentheses are standard errors.

Table 3: Standardized Coefficients

Predictor	Standardized Coefficients		Percentage change
	Grade 8	Grade 10	
HSA 3R	0.01	0.01	0%
Gender	-0.19	-0.05	74%
Hawaiian	**-0.13**	**-0.27**	**108%**
Filipino	n.s.	-0.15	N.A.
East Asian	0.16	0.11	31%
SES	**-0.08**	**-0.10**	**14%**

Female students' advantage over their male counterparts appears to have decreased by 74%. East Asian students' advantage over their White peers appears to have decreased by 31%. Native Hawaiian students' disadvantage seems to have increased by 108% from the 8th grade to the 10th grade against their White peers. The disadvantage of free or reduced price lunch status seems to have increased by 14% over the same two year period.

Appendix B: Detailed Specifications for Model 1

Level 1 $$Y_{i(jk)} = \beta_{0(jk)} + \beta_{1(jk)}\,\text{HSA 3R})_i + \beta_{2(jk)}\,\text{SES})_i + \beta_{3(jk)}(\text{East Asian})_i + \beta_{4(jk)}\,\text{Filipino})_i + \beta_{5(jk)}\,\text{Hawaiian})_i + \beta_{6(jk)}\,\text{Gender})_i + r_{i(jk)}$$

Level 2 $$\beta_{0(jk)} = \gamma_{00} + \gamma_{01}(\text{SchSES-3})_j + \gamma_{02}(\text{SchSES-8})_k + \mu_{0j} + \mu_{0k}$$

$$\beta_{1(jk)} = \gamma_{10}$$
$$\beta_{2(jk)} = \gamma_{20}$$
$$\beta_{3(jk)} = \gamma_{30}$$
$$\beta_{4(jk)} = \gamma_{40}$$
$$\beta_{5(jk)} = \gamma_{50}$$
$$\beta_{6(jk)} = \gamma_{60}$$

Reduced $$Y_{i(jk)} = \gamma_{00} + \gamma_{10}(\text{HSA 3R})_i + \gamma_{20}(\text{SES})_i + \gamma_{30}(\text{East Asian})_i + \gamma_{40}(\text{Filipino})_i + \gamma_{50}(\text{Hawaiian})_i + \gamma_{60}(\text{Gender})_i + \gamma_{01}(\text{SchSES-3})_j + \gamma_{02}(\text{SchSES-8})_k + \mu_{0j} + \mu_{0k} + r_{i(jk)}$$

Where i = i^{th} student

j = j^{th} elementary school

k = k^{th} middle school

$Y_{i(jk)}$ = Grade 8 HSA score of the i^{th} student from the j^{th} elementary school and the k^{th} middle school

Appendix C: Detailed Specifications for Model 2

Level 1 $Y_{i(jkl)} = \beta_{0(jkl)} + \beta_{1(jkl)}(\text{HSA 3R})_i + \beta_{2(jkl)}(\text{SES})_i + \beta_{3(jkl)}(\text{East Asian})_i + B_{4(jkl)}(\text{Filipino})_i + \beta_{5(jkl)}(\text{Hawaiian})_i + \beta_{6(jkl)}(\text{Gender})_i + r_{i(jkl)}$

Level 2 $\beta_{0(jkl)} = \gamma_{00} + \gamma_{01}(\text{SchSES-3})_j + \gamma_{02}(\text{SchSES-8})_k + \gamma_{03}(\text{SchSES-10})_l + \mu_{0j} + \mu_{0k} + \mu_{0l}$

$\beta_{1(jkl)} = \gamma_{10}$

$\beta_{2(jkl)} = \gamma_{20}$

$\beta_{3(jkl)} = \gamma_{30}$

$\beta_{4(jkl)} = \gamma_{40}$

$\beta_{5(jkl)} = \gamma_{50}$

$\beta_{6(jkl)} = \gamma_{60}$

Reduced $Y_{i(jkl)} = \gamma_{00} + \gamma_{10}(\text{HSA 3R})_i + \gamma_{30}(\text{SES})_i + \gamma_{40}(\text{East Asian})_i + \gamma_{50}(\text{Filipino})_i + \gamma_{60}(\text{Hawaiian})_i + \gamma_{70}(\text{Gender})_i + \gamma_{01}(\text{SchSES-3})_j + \gamma_{02}(\text{SchSES-8})_k + \gamma_{03}(\text{SchSES-10})_l + \mu_{0j} + \mu_{0k} + \mu_{0l} + r_{i(jkl)}$

Where
- i = i^{th} student
- j = j^{th} elementary school
- k = k^{th} middle school
- l = l^{th} high school
- $Y_{i(jkl)}$ = Grade 10 HSA score of the i^{th} student from the j^{th} elementary school, the k^{th} middle school, and the l^{th} high school