An Examination of Advanced Placement (AP) Course Taking and College-Going in Nebraska

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Abstract
This study examines the relationship between high school students' participation in Advanced Placement (AP) courses and college-going in Nebraska. Using a series of logistic regression models and propensity score matching method, results of this quasi-experimental study indicate that students who participate in AP courses have significantly higher odds of going on to college compared to those who do not participate in AP courses. Other demographic variables such as gender, race/ethnicity, immigration status, and NeSA performance are also tested as covariates in the statistical models. Findings from this study may be used to provide information to assist Nebraska policy-makers in making decisions with regards to AP programs and to better prepare Nebraska students for post-secondary education.

Keywords: *College-going; Advanced Placement; NeSA; College and Career Ready; Assessment; Transitions*

Research Background and Objective
Nebraska's education policy-makers and school districts are interested in preparing Nebraska students for post-secondary education, and in ensuring that students are competitive nationally. Students' academic performance and readiness for college when they leave high school are commonly recognized as strong predictors of college completion rates (Adelman, 1999).

One of the investments many states have adopted is the Advanced Placement (AP) courses and exams. The Advanced Placement (AP) program is designed to provide high school students with the opportunity to dive into college-level material and to earn college credits. AP can also serve an important role in the college admission process, as more and more colleges look at students' AP activities during the admission process (Klopfenstein and Thomas, 2009).

However, research findings investigating the relationship between AP programs and college success are mixed. Santoli (2002) discovers that AP enrollment is positively associated with college enrollment rates, indicating that students with AP experience are more likely to enroll in post-secondary education. Speroni (2007) also finds a positive relationship between AP course enrollment and college access and success. Sadler and Tai (2007) discover that students who pass AP exams earn higher scores for college science classes, but the score differences depend more on students' demographics and high school coursework than AP course enrollment. According to Geiser and Stantelices (2004), only students who receive qualifying scores on the AP exams receive AP advantages in college; merely participating in AP programs do not confer college advantages. Therefore, the Data, Research and Evaluation team seeks to **investigate the effects of AP enrollment on the college-going behavior of Nebraska students.** More specifically, this study aims to answer the following research questions:

1) Is there a difference in college-going behavior between Nebraska students with AP course experience and Nebraska students without AP course experience?

2) Is there a relationship between AP enrollment and college-going behavior when accounting for other variables such as gender, race/ethnicity, immigration status, family income, etc.?

Research Design and Methods

Overview

This quasi-experimental study uses student-level data for Nebraska public high school students from the combined cohorts of 2011 – 2015. Specifically, demographic data, AP course enrollment data, and college enrollment data are employed. These data are drawn from two sources:

1. The Nebraska Student and Staff Record System (NSSRS) at NDE
2. The National Student Clearinghouse (NSC).

Unique student identifiers are used to match students between the two datasets. If a student does not have college enrollment records in the NSC data, it is assumed that the student did not go to college during the time at which the NSC data was last updated and obtained for this study.

Sample

To answer the aforementioned research questions, Nebraska high school students who belong to the 2011 – 2015 cohorts are selected as the population under investigation. Primarily, these cohorts are selected due to the availability of AP enrollment data and post-secondary education data. The Nebraska Department of Education did not start to collect AP-related data until the 2010-11 school year, and the NSC database of AP-enrolled students was last updated in April 2016.

Dependent Measure

The main goal of this study is to assess the impact of AP enrollment on college-going behavior. Therefore, whether a student enrolled in college or not is selected as the dependent variable for this study. This variable is binary, coded "yes" where a student is enrolled in a post-secondary institution; otherwise, it is coded "no."

Treatment Condition

This study focuses on the treatment condition of whether a student enrolled in an AP course or not. The treatment condition is obtained from the Nebraska Student and Staff Record System (NSSRS) at the Nebraska Department of Education. Specifically, if a student enrolled in at least one AP course during his or her high school education, he/she is flagged "yes" for AP enrollment. Conversely, if a student never enrolled in AP courses during his or her high school education, he/she is flagged "no" for AP enrollment. Descriptive statistics of AP enrollment status for all students in this study are presented in Table 1.

Table 1. Treatment condition for all students in the study.

Treatment Condition	N	Percentage (%)
AP Enrollment	19,855	15.88
Non-AP Enrollment	105,178	84.12
Total	125,033	100

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Covariates

There are a total of thirteen covariates included in this study. These covariates are related to students' demographics and performance on state assessments. Male students are coded as 0 in this study, and female students are coded as 1. There are six race/ethnicity categories: Whites are coded as 1, Hispanics are coded as 2, Blacks or African Americans are coded as 3, Asians or Pacific Islanders are coded as 4, American Natives are coded as 5, and students with multiple races are coded as 6. Students' household income status is also included as a covariate; this status is approximated by students' participation in the Free or Reduced Lunch program. These three variables are selected as covariates due to research findings on differences in college access across gender, race, and household income level (Martinez and Klopott, 2005; Beattie, 2002; Davis & Guppy, 1997).

Immigrant status, single parent status, homeless status, and LEP participation status are also included in the study as covariates. These variables are coded as binary variables with 0 indicating non-participation and 1 indicating participation. These variables are included based on research findings that indicate students who come from immigrant families and who belong to a lower socioeconomic status access college at lower rates (Kanno, 2010; Hurtado et. al., 1997).

Additionally, students' learning ability and test performance are known to be related to college access (Burdman, 2005; Perna, 2005). As such, special education status, gifted participation status, dual credit status, and NeSA performance in Reading, Science, and Math are included as covariates to control for student variation. The NeSA performance variables have 4 levels: 0 indicates a student did not take the assessment, 1 represents the student performed below standards, 2 represents a student met standards, and 3 represents a student exceeded standards.

Covariates are selected based on availability and observed differences among sub-groups on school performance and college outcomes. Only the latest variable information is included in this study. For example, if a student participated in LEP during grades 10 and 11 but he did not participate in LEP during grade 12, the student receives a "no" for LEP participation in the dataset used for this study. Table 2 shows the descriptive statistics of the treatment variable, dependent variable, and covariates.

Table 2. Sample sizes of each covariate by group and treatment condition.

Covariate	Level	N (%)		
		Non-AP Enrollment	AP Enrollment	Total
Gender	Male	55,367 (52.64)	8,775 (44.20)	64,142 (51.30)
	Female	49,811 (47.36)	11,080 (55.80)	60,891 (48.70)
Race/Ethnicity	White	74,494 (70.83)	14,931 (75.20)	89,425 (71.52)
	Hispanic	16,328 (15.52)	2,342 (11.80)	18,670 (14.93)

Covariate	Level	Non-AP Enrollment	AP Enrollment	Total
	Black or African American	7,449 (7.08)	1,000 (5.04)	8,449 (6.76)
	Asian or Pacific Islander	2,335 (2.22)	791 (3.98)	3,126 (2.50)
	American Native	1,907 (1.81)	102 (0.51)	2,009 (1.61)
	Multiple Races	2,665 (2.53)	689 (3.47)	3,354 (2.68)
Household Income Status	Non-Low Income	65,674 (62.44)	15,078 (75.94)	80,752 (64.58)
	Low Income	39,504 (37.56)	4,777 (24.06)	44,281 (35.42)
Immigrant Status	Non-Immigrant	100,029 (95.10)	18,951 (95.45)	118,980 (95.16)
	Immigrant	5,149 (4.90)	904 (4.55)	6,053 (95.16)
Gifted Participation Status	Non-Gifted	93,673 (89.06)	12,183 (61.36)	105,856 (84.66)
	Gifted	11,505 (10.94)	7,672 (38.64)	19,177 (84.66)
Single Parent Status	Not a single parent	103,356 (98.27)	19,734 (99.39)	123,090 (98.45)
	Single parent	1,822 (1.73)	121 (0.61)	1,943 (1.55)
LEP Participation Status	Non-LEP	102,126 (97.10)	19,786 (99.65)	121,912 (97.50)
	LEP	3,052 (2.90)	69 (0.35)	3,121 (2.50)
Special Education Status	Non-Special Education	90,585 (86.13)	19,344 (97.43)	109,929 (87.92)
	Special Education	14,593 (13.87)	511 (2.57)	15,104 (12.08)
Homeless Status	Non-Homeless	103,878 (98.76)	19,750 (99.47)	123,628 (98.88)
	Homeless	1,300 (1.24)	105 (0.53)	1,405 (1.12)
Dual Credit Status	Did not earn dual credit	94,768 (90.10)	15,581 (78.47)	110,349 (88.26)
	Earned dual credit	10,410 (9.90)	4,274 (21.53)	14,684 (11.74)
NeSA Reading Performance Level	Did not Take	21,830 (20.76)	448 (2.26)	22,278 (17.82)
	Below Standards	29,763 (28.30)	2,259 (11.38)	32,022 (25.61)
	Meets Standards	36,536 (34.74)	7,950 (40.04)	44,486 (35.58)
	Exceeds Standards	17,049 (16.21)	9,198 (46.33)	26,247 (20.99)
NeSA Science Performance Level	Did not Take	59,249 (56.33)	3,071 (15.47)	62,320 (49.84)
	Below Standards	15,694 (14.92)	1,743 (8.78)	17,437 (13.95)
	Meets Standards	25,609 (24.35)	10,828 (54.54)	36,437 (29.14)
	Exceeds Standards	4,626 (4.40)	4,213 (21.22)	8,839 (7.07)
NeSA Math Performance Level	Did not Take	41,597 (39.55)	503 (2.53)	42,100 (33.67)
	Below Standards	30,807 (29.29)	3,634 (18.30)	34,441 (27.55)
	Meets Standards	21,288 (20.24)	7,400 (37.27)	28,688 (22.94)
	Exceeds Standards	11,486 (10.92)	8,318 (41.89)	19,804 (15.84)

Analytic Approach

In general, students are not randomly selected to enroll in AP courses; thus, students who choose to enroll in AP courses may be systematically different from students who do not choose to enroll in AP courses, especially in post-secondary education behaviors and activities. As a result of this self-selection (instead of random assignments) into either AP enrollment category, there may be biases if the full sample of students is analyzed to test the impact of AP enrollment on college-going. One of the statistical methods used to ameliorate these biases is propensity score matching (PSM). PSM (Rosenbaum & Rubin, 1983) is a two-step statistical method: step one is to estimate a propensity score for each respondent in the full sample based on selected variables related to the treatment and the outcome; step two is to match respondents based on the calculated propensity scores, and only compare those with similar propensity scores. Propensity score matching methods are widely used to remove possible systematic differences and to ensure equivalencies between the control group and the treatment group in a non-randomized experiment.

In this study, both the simple logistic regression model (using AP enrollment status only as a single predictor) and the multiple logistic regression models (using all the listed covariates) are built on the full sample first. This is conducted to fit a model that best describes the relationship between AP enrollment and college-going. Propensity scores are then calculated based on the thirteen covariates found from the full logistic regression model in step one. The simple logistic model and the full logistic models are then both re-run on the new sample after matching (i.e., matched sample) based on the propensity scores. A simple one-to-one nearest neighbor matching without replacement is performed. The differences in model fit between the simple logistic regression model and the full logistic regression model are tested for both the full sample and the matched sample.

Results

The propensity score matching method reduces prior differences among student subgroups that could potentially explain the outcome variable. For instance, there is a significant difference in college-going behavior between Native American students who are enrolled in AP courses and Native American students who are not enrolled in AP courses ($\chi^2(1) = 50.17$, $p = 0.00$) in the full sample. After the matching process, this difference no longer holds (($\chi^2(1) = 1.81$, $p = 0.179$). A majority of the differences among student subgroups are reduced using the propensity score matching method, thereby increasing the equivalence in student subgroups comparisons for both treatment conditions.

Table 3 displays the difference in sample sizes before and after the matching process. The new matched sample produces an equal proportion of students who did and did not enroll in AP courses. Students in the new matched sample from the non-AP enrollment group are matched with characteristics of the students from the AP enrollment group, such as gender, race, household income, etc. The new matched sample is more balanced than the full sample. The quality of the matching procedure can be visually depicted in Figure 3, found in the Appendix.

Table 3. Sample sizes before and after matching on propensity scores.

Sample	**Non-AP Enrollment N (%)**	**AP Enrollment N (%)**	**Total N (%)**
Full Sample (before matching)	105,178 (84.12)	19,855 (15.88)	125,033 (100)
Matched Sample (after matching)	19,855 (50)	19,855 (50)	39,710 (100)

As shown in Table 4, the difference between AP and non-AP enrolled students in terms of college-going behavior is reduced for the matched sample. For the full sample, 86% of AP students are in college, and 56% of non-AP students end in college. For the matched sample, 86% of AP students are in college, and 78% of non-AP students end in college. However, the reduced difference of college-going between AP and non-AP students is still statistically significant for the matched sample ($\chi^2(1) = 479.84$, $p <. 001$). Figure 1 presents the difference in college-going visually.

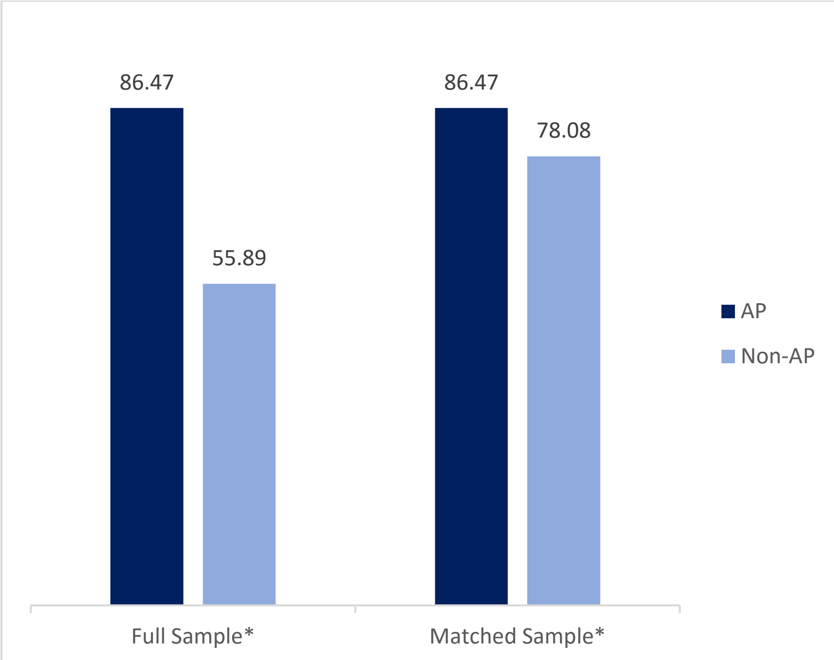
Table 4. Test of differences in college-going on full and matched samples.

	Full Sample			**Matched Sample**		
N (%)	**Not College-Going**	**College-Going**	**Test Statistic**	**Not College-Going**	**College-Going**	**Test Statistic**
Treatment Condition						
Non-AP Enrollment	46,399 (44.11)	58,779 (55.89)	6,600 (a)*	4,353 (21.92)	15,502 (78.08)	479.84 (a)*
AP Enrollment	2,686 (13.53)	17,169 (86.47)		2,686 (13.53)	17,169 (86.47)	

*p < 0.05

Note. a = Chi-square value

Figure 1. Differences in college-going on full and matched samples.



*$p < 0.05$

A series of logistic regression models are built to assess the impact of AP enrollment on college-going behavior. First, a simple logistic regression model is built to examine the effect of only the treatment, AP enrollment, on the dependent variable. Subsequently, the model is further specified to include the 13 covariates discussed previously. This latter model – referenced as the complete model – attempts to account for the effects of other variables in addition to the treatment of being enrolled in AP or not. The complete model also accounts for interactions between: 1) gender and race, and 2) race and household income. It is important to control for these interactions since the effect of race/ethnicity on college outcomes has been found to be differential across socioeconomic status (Black & Sufi, 2002), and across gender (Barajas & Pierce, 2001; Strayhorn, 2010). The two models described are built for both the full sample and the matched sample, and results are displayed in Table 5 and Table 6, respectively.

Table 5. Regression analyses on the full sample, with college-going as the outcome.

Independent Variable	Odds Ratio	SE	95% CI	Log Likelihood [Likelihood Ratio x^2 (p)]	N
Simple Model					
AP Enrollment	5.05*	0.11	[4.84, 5.26]	-80042.15 [7431.56 (0.00)]	125,033
Constant	1.27	0.01			

Independent Variable	Odds Ratio	SE	95% CI	Log Likelihood [Likelihood Ratio x² (*p*)]	N
Complete Model					
AP Enrollment	2.05*	0.05	[1.95, 2.16]	-58331.03 [50853.79 (0.00)]	125,033
Female (Male)	1.57*	0.13	[1.33, 1.85]		
Race/Ethnicity (White)					
Native American	0.43*	0.05	[0.34, 0.54]		
Asian or Pacific Islander	0.91	0.07	[0.78, 1.07]		
Black or African American	0.76*	0.04	[0.68, 0.84]		
Hispanic	0.58*	0.02	[0.54, 0.63]		
Two or More Races	0.76*	0.06	[0.65, 0.88]		
Low Income (Non-Low Income)	0.92	0.08	[0.78, 1.09]		
Dual Credit (Not Dual Credit)	2.22*	0.06	[2.10, 2.35]		
Gifted (Not Gifted)	1.76*	0.05	[1.66, 1.86]		
Single Parent (Not Single Parent)	0.54*	0.03	[0.48, 0.60]		
Immigrant (Non-Immigrant)	0.80*	0.03	[0.74, 0.86]		
LEP (Non-LEP)	0.70*	0.04	[0.63, 0.79]		
Special Education (Not SPED)	0.50*	0.01	[0.48, 0.53]		
Homeless (Not Homeless)	0.85*	0.06	[0.74, 0.97]		
NeSA Math (Meets Standards)					
Did Not Take	0.95	0.03	[.90, 1.01]		
Below Standards	0.55*	0.01	[.53, .57]		
Exceeds Standards	1.42*	0.04	[1.33, 1.50]		
NeSA Science (Meets Standards)					
Did Not Take	1.48*	0.03	[1.42, 1.55]		
Below Standards	0.88*	0.02	[0.84, 0.92]		
Exceeds Standards	0.83*	0.03	[0.77, 0.90]		
NeSA Reading (Meets Standards)					
Did Not Take	0.03*	0.00	[0.03, 0.03]		
Below Standards	0.62*	0.01	[0.60, 0.65]		
Exceeds Standards	1.08*	0.03	[1.03, 1.13]		
Race/Ethnicity × Income (White × Non-Low Income)#					
Native American × Low Income	1.01	0.15	[.75, 1.35]		
Asian or Pacific Islander × Low Income	2.14*	0.28	[1.66, 2.77]		
Black or African American × Low Income	1.62*	0.17	[1.32, 1.98]		
Hispanic × Low Income	1.29*	0.12	[1.07, 1.54]		
Two or More Races × Low Income	{*omitted*}				
Race/Ethnicity × Gender (White × Male)#					

Independent Variable	Odds Ratio	SE	95% CI	Log Likelihood [Likelihood Ratio x² (*p*)]	N
Native American					
× Female	0.77	0.11	[0.58, 1.03]		
Asian or Pacific Islander					
× Female	0.76*	0.10	[0.59, 0.97]		
Black or African American					
× Female	0.94	0.09	[0.77, 1.15]		
Hispanic					
× Female	0.94	0.09	[0.79, 1.13]		
Two or More Races					
× Female	{*omitted*}				
Constant	2.75	0.06			

*$p < 0.05$

Note. # The values displayed for the interaction terms are the differences in the odds ratios between two groups (Low Income and Non-Low Income, or Female and Male), for each race/ethnicity subgroup. Please refer to the Appendix for figures on the interaction terms.

Results in Table 5 display the odds ratio of going on to college for the full sample. For the simple model, the odds of going on to college are 5.05 times greater for students who enrolled in AP courses compared to those who did not enroll in AP courses (p<0.001). However, after accounting for the other covariates included in the complete model, the odds of going on to college are reduced to 2.05 times greater for those students who enrolled in AP courses versus those who did not enroll in AP courses (p<0.001).

Holding all other covariates in the model constant, females have higher odds of going on to college compared to males (odds ratio = 1.57, p<0.001). Compared to White students, Native American students have smaller odds of going on to college (OR = 0.43, p<0.001), Black or African American students have smaller odds of going to college (OR = 0.79, p<0.001), Hispanic students have smaller odds of going to college (OR = 0.58, p<0.001), and students with multiple races also have smaller odds of going to college (OR = 0.76, p<0.001). However, no difference is detected between White students and Asian or Pacific Islander students (OR = 0.91, p=0.268).

Overall, students from disadvantaged backgrounds have lower odd of going on to college versus their peers with presumably more advantage. No significant difference is detected in the odds of going to college for students from low-income and non-low income households (OR = 0.92, p = 0.268). Students who earned dual credit have greater odds of going on to college compared to those who did not earn dual credit during high school (OR = 2.22, p<0.001). Students who participate in a gifted program have greater odds of going on to college compared to those not participating in gifted education (OR = 1.76, p<0.001). Single parent students have lesser odds of going on to college compared to students who are not single parents (OR = 0.54, p<0.001). Immigrant students have lesser odds of going on to college compared to students who are not immigrants (OR = 0.80, p<0.001). LEP participants have lower odds of going on to college compared to non-LEP participants (OR = 0.70, p<0.001). Special education students have lower odds of going on to college compared to non-special education students (OR = 0.50, p<0.001). Homeless students also have lower odds of going on to college compared to students who are not homeless (odds ratio = 0.85, p<0.001).

Among the three NeSA tested subjects included in the complete model, Math performance is the strongest predictor of college-going. Students exceeding Math standards have greater odds of going on to college compared to those who meet standards (OR =1.42, p<0.001). Similarly, students who exceed standards on the Reading assessment have greater odds of going on to college compared to those meeting standards (OR = 1.08, p = 0.003). This pattern does not hold for performance on the NeSA Science assessment, however (OR = 0.83, p <0.001). The results indicate that the odds of going on to college for students who exceed standards on the Science assessment are lower compared to those who meet the Science assessment standards.

Table 6. Regression analyses on the matched sample, with college-going as the outcome.

	Independent Variable	**Odds Ratio**	**SE+**	**95% CI**	**Log Likelihood [Likelihood Ratio x² (*p*)]**	**N**
Simple Model						
	AP Enrollment	1.79*	0.05	[1.70, 1.89]	-18311.22 [483.65 (0.00)]	39,710
	Constant	3.56	0.06			
Complete Model						
	AP Enrollment	1.93*	0.06	[1.83, 2.05]	-15691.64 [5722.81 (0.00)]	39,710
	Female (Male)	1.72*	0.24	[1.31, 2.25]		
	Race/Ethnicity (White)					
	Native American	0.29*	0.08	[0.16, 0.51]		
	Asian or Pacific Islander	1.21	0.17	[0.92, 1.58]		
	Black or African American	0.79*	0.09	[0.64, 0.98]		
	Hispanic	0.64*	0.05	[0.55, 0.74]		
	Two or More Races	0.69*	0.08	[0.55, 0.86]		
	Low Income (Non-Low Income)	0.68*	0.09	[0.52, 0.89]		
	Dual Credit (Not Dual Credit)	2.03*	0.08	[1.87, 2.20]		
	Gifted (Not Gifted)	1.41*	0.05	[1.31, 1.52]		
	Single Parent (Not Single Parent)	0.40*	0.06	[0.30, 0.53]		
	Immigrant (Non-Immigrant)	0.73*	0.05	[0.64, 0.84]		
	LEP (Non-LEP)	0.90	0.18	[0.60, 1.34]		
	Special Education (Not SPED)	0.46*	0.03	[0.40, 0.53]		
	Homeless (Not Homeless)	0.81	0.13	[0.59, 1.11]		
	NeSA Math (Meets Standards)					
	Did Not Take	0.64*	0.12	[0.43, 0.93]		
	Below Standards	0.52*	0.02	[0.48, 0.57]		
	Exceeds Standards	1.51*	0.06	[1.39, 1.63]		
	NeSA Science (Meets Standards)					

Independent Variable	Odds Ratio	SE+	95% CI	Log Likelihood [Likelihood Ratio x² (*p*)]	N
Did Not Take	1.66*	0.08	[1.52, 1.83]		
Below Standards	0.85*	0.04	[0.77, 0.94]		
Exceeds Standards	1.05	0.05	[0.95, 1.15]		
NeSA Reading (Meets Standards)					
Did Not Take	0.08*	0.02	[0.06, 0.12]		
Below Standards	0.72*	0.03	[0.66, 0.79]		
Exceeds Standards	1.04	0.04	[0.97, 1.12]		
Race/Ethnicity × Income (White × Non-Low Income)#					
Native American × Low Income	1.97*	0.67	[1.01, 3.84]		
Asian or Pacific Islander × Low Income	2.24*	0.50	[1.45, 3.46]		
Black or African American × Low Income	1.73*	0.31	[1.22, 2.47]		
Hispanic × Low Income	1.59*	0.25	[1.17, 2.16]		
Two or More Races × Low Income	{*omitted*}				
Race/Ethnicity × Gender (White × Male)#					
Native American × Female	0.81	0.28	[0.42, 1.58]		
Asian or Pacific Islander × Female	0.60*	0.13	[0.40, 0.91]		
Black or African American × Female	0.97	0.17	[0.68, 1.38]		
Hispanic × Female	0.86	0.13	[0.64, 1.17]		
Two or More Races × Female	{*omitted*}				
Constant	2.86	0.11			

$^{*}p < 0.05$

Note. # The values displayed for the interaction terms are the differences in the odds ratios between two groups (Low Income and Non-Low Income, or Female and Male), for each race/ethnicity subgroup. Please refer to the Appendix for figures on the interaction terms. + The standard error does not take into account that the propensity score is estimated, thus rendering limited reliance on its interpretation.

Table 6 shows the results of the logistic regression models for the matched sample. The simple model reveals that enrolling in AP courses significantly increases the odds of a student going on to college. More specifically, the odds of going on to college is 1.79 times higher for students who enrolled in AP courses compared to those who did not enroll in AP courses (p<0.001). After accounting for the effects of additional covariates included in the complete model, the odds of going on to college increases to 1.93 times for students who enrolled in AP courses compared to students not enrolling in AP courses (p<0.001). This reveals that the effect of AP enrollment on college going is even more pronounced after accounting for student subgroup differences.

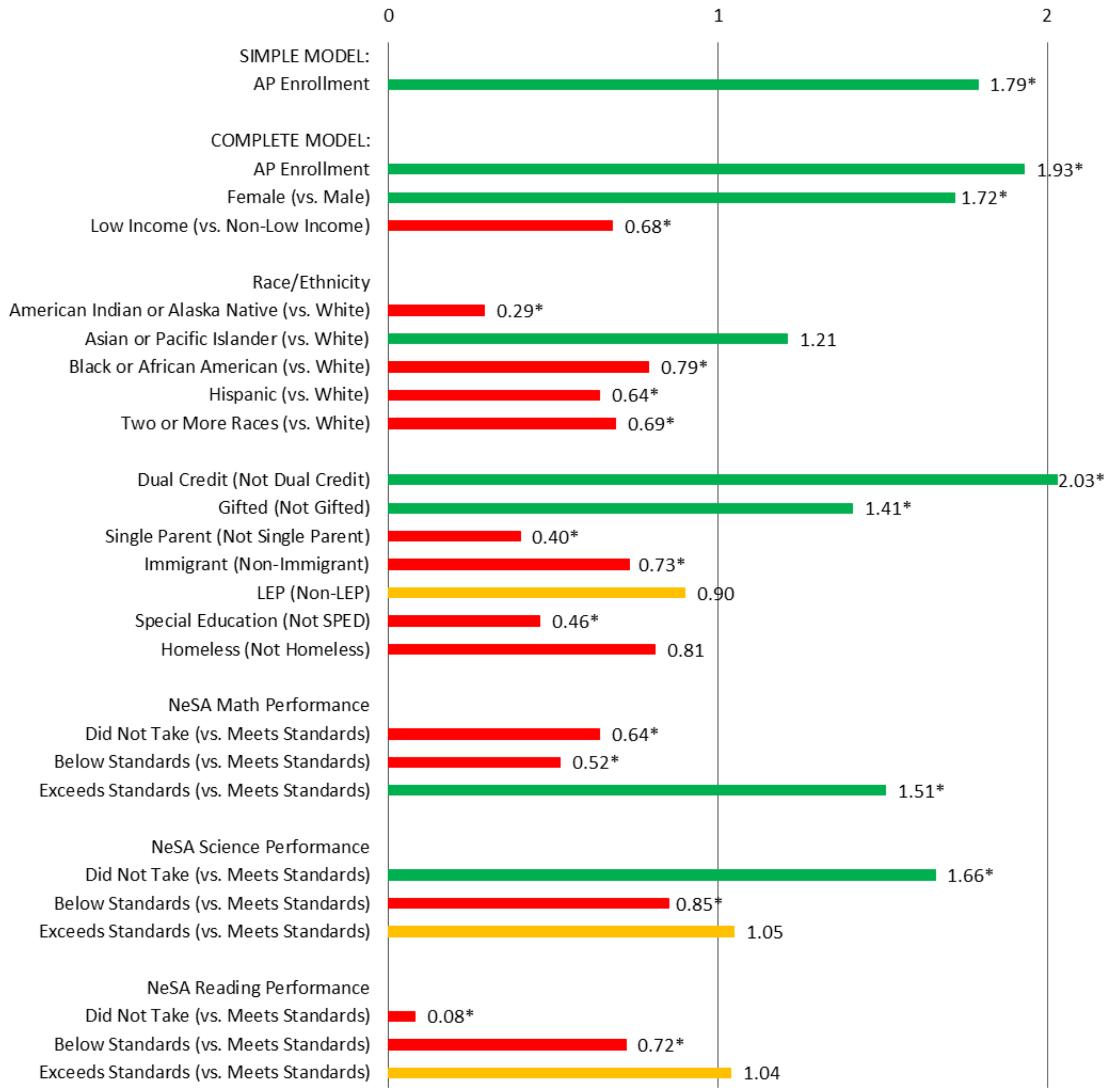
When holding all other covariates in the model constant, females have higher odds of going to college compared to males (OR = 1.72, $p<0.001$). Compared to White students, Native American students have lower odds of going to college (OR = 0.29, $p<0.001$), Black or African American students have lower odds of going to college (OR = 0.80, $p=0.03$), Hispanic students have lower odds of going to college (OR = 0.64, $p<0.001$), and students with multiple races also have lower odds of going to college (OR = 0.69, $p<0.001$). However, there is no significant difference between White students and Asian or Pacific Islander students in terms of college-going (OR = 1.21, $p=0.171$).

Similar to the regression results drawn for the full sample, regression on the matched sample shows that students from disadvantaged backgrounds have smaller college-going odds than their more advantaged counterparts. The odds for low-income students to go to college are lower than non-low income students (OR = .68, $p=0.005$). Students who earned dual credits have higher odds of going to college compared to those who did not earn dual credit during high school (OR = 2.03, $p<0.001$). Students who are gifted participants have higher odds of going to college compared to students who are not gifted participants (OR = 1.41, $p<0.001$). Students who are single parents have lower odds of going to college compared to students who are not single parents (OR = 0.40, $p<0.001$). Immigrants have lower odds of going to college compared to students who are not immigrants (OR = 0.73, $p<0.001$). Special education students have lower odds of going to college compared to non-special education students (OR = 0.50, $p<0.001$). There is no significant different between homeless students and non-homeless students in terms of college-going (OR = 0.81, $p=0.198$). There is also no significant difference between LEP participants and non-LEP participants in terms of college-going (OR = 0.90, $p=0.604$).

For the three NeSA tests on different subjects, Math performance is still the strongest predictor of the odds of going to college. Those who exceed standards on the NeSA Math have an odd of going on to college that is 1.51 times higher ($p<0.001$) compared to those who meet standards. However, students who exceed standards on the NeSA Reading have no difference in the odds of going to college compared to students who meet NeSA Reading standards (OR = 1.04, $p=0.29$). Similarly, there is no significant difference between students who meet standards and exceed standards on the NeSA Science in terms of college-going (OR = 1.05, $p=0.35$).

A comparison of the magnitude of the odds ratios predicting college-going for the matched sample is shown in Figure 2. As a guide, the longer the bar, the greater the odds is of going on to college. Figure 2 reveals that earning dual credit and AP enrollment are strongly and significantly associated with increased college-going; specifically, for those who earn dual credit and enroll in AP compared to those who do not earn dual credit and do not enroll in AP coursework.

Figure 2. Odds ratios of college-going for the matched sample.



$*p < 0.05$

Note. The value of 1 signifies equal odds of going on to college, i.e. the closer the odds ratio is to 1, the lesser the difference in the college-going odds between the 2 comparison groups. Green bars represent larger odds, orange bars represent equal odds, and red bars represent smaller odds.

Discussion

Analyses from both the full sample and the matched sample suggest that students have significantly higher odds of going on to college if they enroll in any AP course during high school. The difference between the proportion of students in the control group (non-AP students) who go on to college and the proportion of students in the treatment group (AP students) who go on to college changes from 31% for the full sample to 8% for the matched sample. This indicates that the propensity score matching method creates more homogeneity between the control group and the treatment group on key demographic variables. Thus, comparisons based on the matched sample ought to be more precise than comparisons using the full sample.

The complete model reveals that the impact of AP enrollment during high school on student college-going behavior is significant even after accounting for a series of covariates that are associated with the outcome variable (college-going) and the treatment variable (AP enrollment). Accounting for these additional covariates, students who are enrolled in AP courses have greater odds of going on to college than students who are not enrolled in AP courses. The complete model also suggests that students who earn dual credit have higher odds of going on to college compared to those not earning dual credit. Further research may be warranted to examine the impact of earning dual credit on post-secondary matriculation, and can be looked at in tandem with this study.

Additionally, after controlling for the interaction effect of race and household income levels, the main effect of race and household income levels are still significant. This indicates that students from low-income households have lower odds of going on to college, accounting for racial differences and the interaction effect of race and household income levels. Similarity, students from racial minority groups (except for Asians or Pacific Islanders) have lower odds of going on to college compared to white students after accounting for household income differences, and the interaction effect of race and house income level. The interaction term included in the model also indicates that the college-going odds for all minority students differ significantly from the college-going odds for White students across income levels.

Whether a student exceeds NeSA Math standards is a significant predictor of the student's odds of going on to college. Students who perform below NeSA standards are significantly less likely to go on to college compared to those who only meet standards for all three NeSA subjects. These findings suggest that additional efforts should focus on supporting students in meeting NeSA standards. Interestingly, students who do not take the NeSA Science have higher odds of going on to college compared to students who meet standards on the NeSA Science. This could mean that there may be a systematic difference in students who choose to opt out of taking the NeSA Science, and this effect should be investigated further.

Broader Impacts

There are some limitations to this study. While a series of covariates are used for both propensity score matching and for building the logistic regression models, this does not necessarily mean that we are able to capture all of the possible confounding variables that create variations in the outcome. There could be other variables related to both the treatment condition and outcome variable, such as parents' education level, parents' occupations, students' attitude towards the school and the like that are not accounted for in this work.

Students' demographic backgrounds are consistently found to impact students' college-going odds, according to the findings in this study. This study finds that that racial minority students and students who come from lower-income households have significantly lower odds of going on to college. AP enrollment is found to impact the college going rates, after controlling for demographic background differences. Thus, continued efforts should be made towards providing AP opportunities and support for students from less advantaged backgrounds to reduce college access and enrollment gaps.

Continued efforts should also be focused on students' NeSA performance. Even though the performance of exceeding standards appears to have mixed effects on different subject areas, scoring below NeSA performance standards shows a consistent and significant negative impact on students' odds of going on to college compared to meeting standards for all three NeSA subjects. Nebraska educators should continue to focus on enabling more students who score below NeSA performance standards to meet those standards to increase their odds of college-going.

In sum, students who enroll in AP courses have greater odds of going on to college compared to those who do not enroll in AP courses. The results presented in this study suggest that educators and policy-makers alike should continue their efforts to support AP programs as a means of encouraging post-secondary matriculation.

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Appendix

This section contains the tables and figures alluded to in the text of this study. Information on the data files requested from various sources is also provided here.

Tables and Figures

Table 8. Difference in college-going between those who are AP enrolled and those who are not AP enrolled.

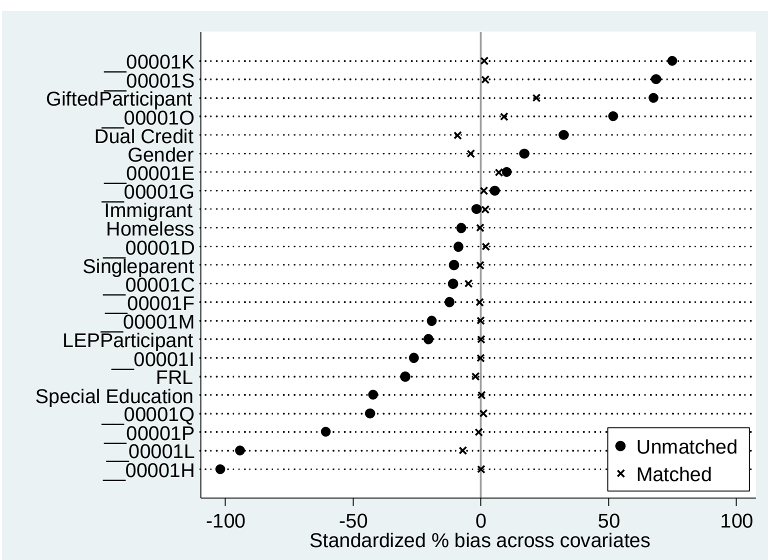
Sample	N	Difference in College-Going (%)
Full Sample	125,033	30.59
Matched Sample	39,710	8.40

Table 9. Fit statistics for the logistic regression models predicting college-going.

	Full Sample		Matched Sample	
Fit Statistic	Simple Model	Complete Model	Simple Model	Complete Model
Likelihood Ratio	43422.24*		5239.15*	
Area under ROC curve#	0.586	0.848	0.572	0.760
McFadden's R^2 #	0.044	0.304	0.013	0.154
AIC+	1.280	0.934	0.922	0.793
BIC+	-1.307e+06	-1.350e+06	-383859.808	-388558.906

Note. * = The complete model fits better, # = Larger values indicate better fit, + = Smaller values indicate better fit

Figure 3. Quality of matching among the covariates.



Note. The unmatched sample refers to the full sample, prior to matching. The closer the marker is to 0%, the smaller the bias for each covariate group.

Figure 4. Odds ratios of college-going for the matched sample, with 95% confidence intervals.

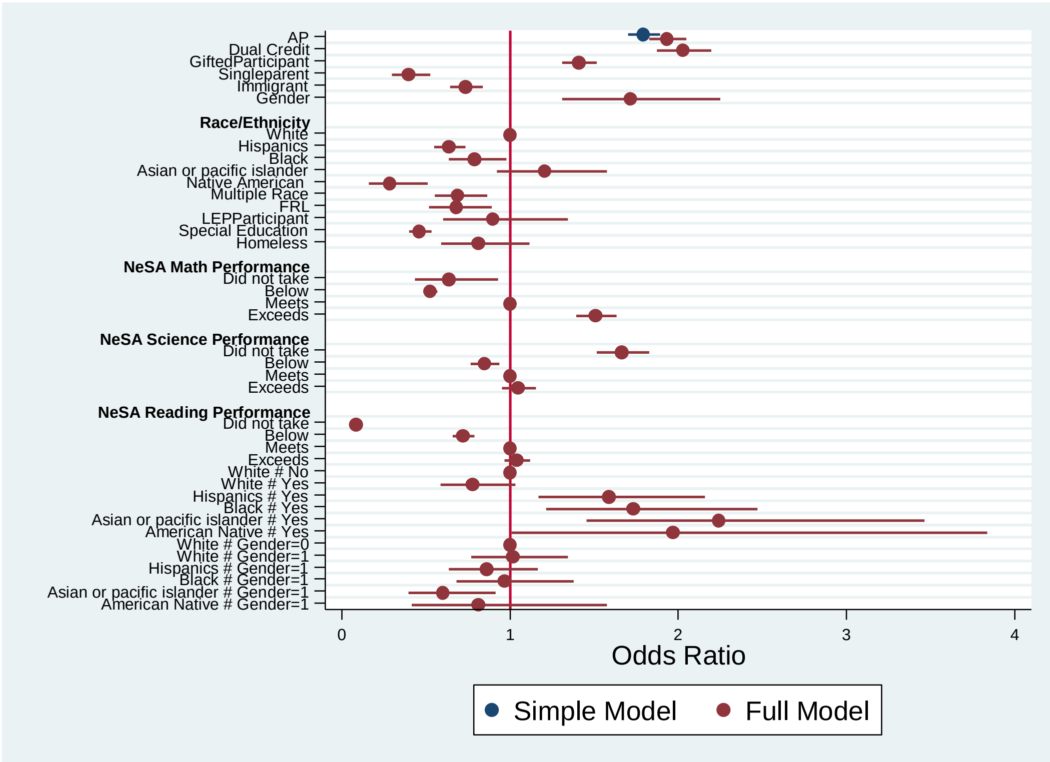


Figure 5. The college-going log odds of each race/ethnicity subgroup, for each level of household income status.

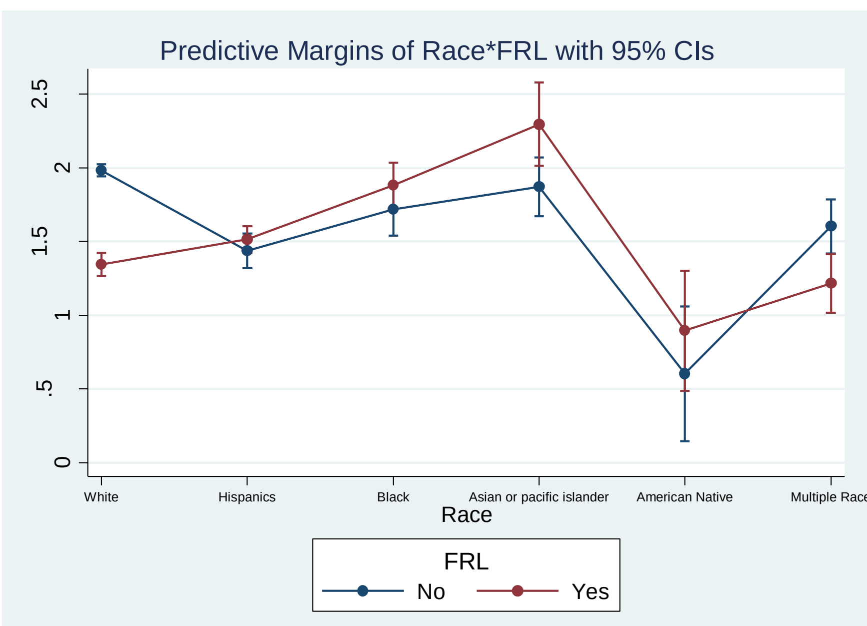
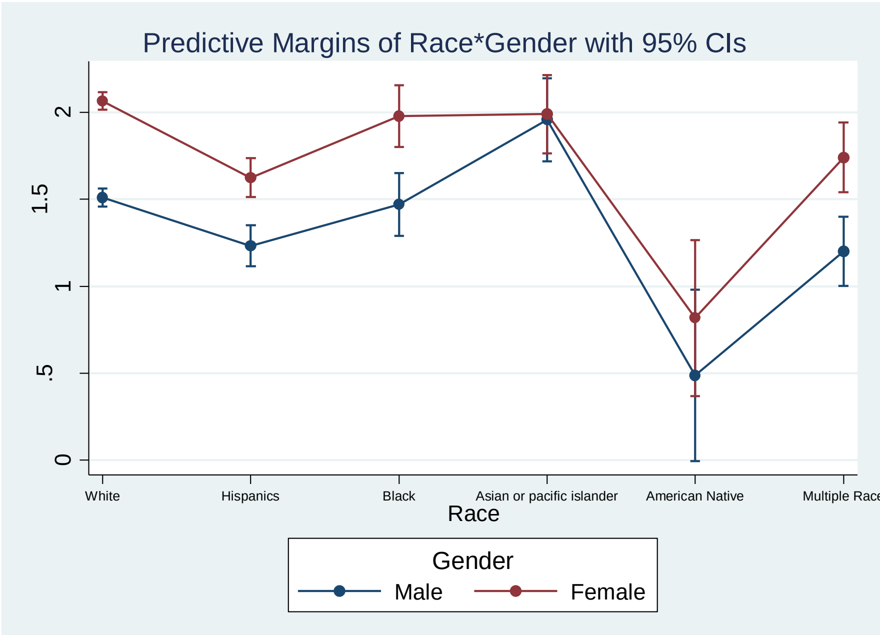


Figure 6. The college-going log odds of each race/ethnicity subgroup, for each gender.



Data for the AP Project

Data from NSSRS	Data from NSC
NDE student ID	College Code/branch
Cohort Year	College Name
High School Graduation Date	College State
Student Name	College Graduation Date
Birth Date	2 or 4 Year
Gender	Public/Private
Race; Ethnicity	Enrollment Status
Student as a single parent	Graduated
Immigrant indicator	Degree Title
Gifted	Record Found
FRL	Search Date
LEP Participation Status	Enrollment Begin
Special Education Status	Enrollment End
Homeless Status	Graduation Date

High School Drop Out	Degree Major 1
High School Name	College Sequence
Reason Not tested for NeSA	NDE student ID
NeSA Math Score	
NeSA Science Score	
NeSA Reading Score	
NeSA Math Performance Level	
Data from NSSRS	**Data from NSC**
NeSA Science Performance Level	
NeSA Reading Performance Level	
Attendance Rate 12th Grade	
Attendance Rate 11th Grade	
Whether Student Enrolled in AP Courses or Not During High School	
Number of AP Courses 9th grade	
Number of AP Courses 10th grade	
Number of AP Courses 11th grade	
Number of AP Courses 12th grade	
Average AP Letter Grade 9th grade	
Average AP Letter Grade 10th grade	
Average AP Letter Grade 11th grade	
Average AP Letter Grade 12th grade	
Dual Enrollment 0 vs (1,2)	
Dual Credit - Coded as (0,2) vs. 1	
Dual Credit	
If a student went to college after high school	