Research and Evaluation Office

Using Education Data to Predict Juvenile Justice Involvement among Oregon Students

This research was conducted for OYA by:

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The mission of the Oregon Youth Authority
is to protect the public and reduce crime by holding youth offenders accountable and providing opportunities for reformation
in safe environments

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Executive Summary

Oregon's feeder system research uses individual and family-level records from partnering social service agencies and the state department of education to identify factors that contribute to the risk of juvenile justice involvement. Previous feeder system analyses demonstrated that there are opportunities to intervene in the lives of youth who are at risk for juvenile justice involvement through their childhood contact with other social service agencies. Prior analyses further recognized that youth in foster care and those undergoing treatment for mental health and drug and alcohol addiction might be best targeted for enhanced intervention. Findings from each analysis suggested that young people who are at risk may be identifiable by assessing certain characteristics and historical service patterns. The following is a report of an analysis meant to supplement previous feeder system work by examining predictors of future juvenile justice involvement found within Oregon students' education records.

Education records were compiled from multiple school years (2007-2008 through 2011-2012) and linked with county juvenile probation and Oregon Youth Authority (OYA) commitment records (June 2009 through July 2013). Analyses were conducted among students by grade level from 5th through 10th grade. Models were estimated to predict either county probation or OYA commitment from key demographics, social determinants, and educational factors.

Results indicated that statistical models were very similar across all grade levels within each juvenile justice outcome of interest. In all models, certain demographic factors and social determinants were significantly related to the probability of future juvenile justice involvement. Male students were significantly more likely than female students to experience both county probation and OYA commitment. Compared to White students, the probability of OYA commitment was significantly higher for Native American/Alaska Native, Black/African American, and Hispanic/Latinx students. Native American/Alaska Native students were also significantly more likely than White students to experience county juvenile probation. Students whose education records indicated economic disadvantage (i.e., enrollment in free/reduced-price lunch) had a higher probability of county probation and OYA commitment relative to students without this disadvantage. Students with a documented disability/special education marker were more likely than their non-disabled peers to experience OYA commitment but not county probation.

All models also indicated that exclusionary discipline experiences (i.e., suspensions and expulsions), changing schools mid-year, below-standard performance on reading and math tests, and chronic absenteeism were related to students' future juvenile justice system involvement. The probability of county probation and OYA commitment grew significantly with each increase in the average number of discipline events in a students' academic record. Changing schools mid-year was significantly related to county probation and OYA commitment, although the association with OYA commitment was exceptionally strong. Below-standard performance on math and reading tests also increased the probability of county probation and OYA commitment, as did being absent for 10% or more school days in a year (i.e., chronic absenteeism).

Future analyses should consider measuring student strengths and protective factors to help with model estimation and interpretation and to inform interventions. Future work should also examine the utility of the models among specific groups of students (e.g., students of color and students with disability(ies)) and explore the reason for differences in the likelihood of juvenile justice involvement based on students' race/ethnicity, economic circumstances, and disability status.

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Introduction

Oregon's juvenile justice system is made up in part by 36 independent county juvenile departments and the Oregon Youth Authority (OYA), the state's juvenile justice agency. Both OYA and county juvenile departments provide services to youth offenders to reduce the likelihood of subsequent criminal activity and further escalation into the adult criminal justice system. Unfortunately, young people become involved with county and state juvenile justice services as a result of delinquent activity and, in some cases, victimization[1]. In ideal circumstances, a young person's risk for this type of behavior could be identified earlier and their involvement with the juvenile justice system could be prevented. Indeed, many young people who become involved with juvenile justice services are considered high risk by others at various stages in their lives including school teachers, social workers, law enforcement, and community-based service providers. In a similar way, researchers have been using data to identify factors that contribute to the risk of juvenile justice involvement in Oregon before youth enter the system. This "feeder system" research uses individual and family-level records from partnering social service agencies and the state department of education to identify which youth are at highest risk of future juvenile justice involvement. This information would then be used to inform interventions that support high risk youth and prevent their involvement in the juvenile justice system.

Previous feeder system analyses

Oregon's feeder system work has been guided by three research questions, presented below along with brief summaries of the findings to date.

Research Question 1: Are there opportunities to intervene during an individual's life and prevent them from becoming involved with the juvenile justice system?

The first feeder system analysis revealed that there may be ample opportunity to intervene in the lives of youth who are at risk for juvenile justice involvement through their childhood contact with other social service agencies (Braun, 2014). Using individual-level historical service records linked across state agencies including the Department of Human Services (DHS) and the Oregon Health Authority (OHA), researchers found that that 90% of youth committed to OYA between 2000 and 2013 had contact with at least one program an average of 6 years prior to commitment. These programs included foster care, child protective services, treatment services for mental health and alcohol and drugs, and subsidized health care coverage (i.e., the Oregon Health Plan).

Research Question 2: If prevention services are provided, which agencies and/or client populations are the best targets for interventions?

The next feeder system analysis identified state agencies serving the largest populations of at-risk youth to determine where best to concentrate prevention resources (Braun, 2015a). Using the same linked dataset of individual-level historical service records, researchers determined that the client populations served by child welfare (i.e., foster care), mental health treatment services, and alcohol and drug treatment services may benefit the most from prevention efforts as they serve the most clients who are likely to experience future OYA commitment compared to youth in other program areas.

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[1] Many county juvenile departments in Oregon also manage youth who are referred for status offenses or for behavior that is not considered delinquency (e.g., running away). This work focuses on youth offenses that are considered delinquent.

Research Question 3: What are the individual and family characteristics and service utilization patterns associated with increased risk of justice system involvement?

The most recent series of feeder system analyses focused on the populations in each of the three agencies identified in the second research question (i.e., foster care, mental health treatment services, and alcohol and drug treatment services; Braun, 2015b-d). Data from each agency was explored in turn to identify the individual and/or family-level characteristics and service utilization patterns that impacted the probability of OYA commitment among the youth in these client populations. Findings from each analysis suggest that young people at risk of becoming involved with OYA may be identifiable through assessment of certain characteristics and historical service patterns.

Current analysis

This report details the results of a new feeder system analysis focused on identifying key factors within Oregon students' education records that contribute to the risk of future involvement with the juvenile justice system. This analysis is an expansion of prior work in that it considers the probability of county juvenile probation in addition to the probability of OYA commitment. Using records from the Oregon Department of Education that were linked to records from all 36 county juvenile departments and OYA, we explored educational factors and their associations with the likelihood of future county probation and OYA commitment dispositions.[2,3]

Method

Our analytic approach involved developing separate statistical models predicting Oregon students' likelihood of future juvenile justice involvement by grade level. Conducting analyses by grade level allowed researchers to identify risk factors for juvenile justice involvement at each stage of students' early academic careers. Education records were compiled by grade level across multiple school years to boost sample sizes. Each grade level was treated as a separate sample for the analysis, with students who were enrolled in several grades over time naturally appearing in multiple samples. The paragraphs below detail how the education and juvenile justice datasets were compiled and merged together to create a master analytic dataset and subsets for the grade level samples.

Education dataset

To build the initial education dataset, Oregon elementary, middle, and high school students' education records were pulled from six academic years starting in 2007-2008 through 2012-2013. This resulted in a dataset of over 3.5 million education records for nearly 1 million students enrolled from 2007-2008 to 2012-2013 (hereafter: the "study time period") in grade levels ranging from pre-kindergarten through grade 12. For every year of enrollment, education records included information related to individual characteristics (e.g., gender, race/ethnicity, age, and disability status), social demographics (e.g., family economic disadvantage), student attendance, special education services,

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[2] A "disposition" is similar in meaning to a "sentence," and is a term used in the Oregon juvenile justice system.

[3] Most cases referred to the juvenile justice system in Oregon are handled informally and do not lead to formal adjudication or supervision. For example, allegations might be dismissed, a youth may be placed in diversion, receive a warning letter, or supervised informally through an accountability agreement. For purposes of this report, and in line with recent work by the Oregon Criminal Justice Commission (December, 2017), we focused our analysis on juvenile justice outcomes that reflect formal court adjudication and supervision by county juvenile departments or by OYA.

Limited English Proficiency instruction, disciplinary events, and standardized test information for reading, math, science, and writing.

To predict future juvenile justice involvement, the initial education dataset was first restricted to those students who were "eligible" for county probation or OYA services during the study time period. Similar to previous work (i.e., Braun, 2014, 2015a-d), "eligibility" for county probation or OYA services was determined by examining students' age and date of birth. No Oregon statute specifies the youngest age at which a person can be adjudicated delinquent, however youth must be no younger than 12 and no older than 19 years old to be eligible for commitment to OYA custody. While some county juvenile department programs may serve younger individuals, the same minimum and maximum age thresholds were used to determine county probation eligibility for purposes of the current analysis. Therefore, the initial education dataset was refined to include only students who were born between January 1981 and July 2001, putting their age within the eligibility window for county probation or OYA services during the study time period. Elimination of observations outside the age window for eligibility marginally shrank the education dataset to approximately 3.2 million education records for just over 775,000 students who were eligible for juvenile justice involvement during the study time period.

Juvenile justice dataset

In a separate step, records pertaining to juvenile justice outcomes of interest (i.e., dispositions of county probation and commitment to OYA probation or "close custody") were also pulled for the study time period (mid-2007 to mid-2013). Coding of the juvenile justice outcome of interest for each youth involved identifying their most intense disposition during the study time period. That is, youth who were placed on county probation but did not escalate to OYA during the study time period were coded as having a county probation outcome. Youth who were committed to OYA during the study time period were coded as having an OYA commitment outcome regardless of any prior county probation dispositions.[4] In cases where youth had multiple "most intense" dispositions during the study time period (e.g., multiple OYA commitment records), the first-most intense disposition record was chosen for analysis. This resulted in an initial juvenile justice dataset of 11,018 youth whose most intense disposition during the study time period was county probation and 3,814 whose most intense disposition was OYA commitment.

Master analytic dataset and grade-level sub-samples

To create the master analytic dataset, records in the juvenile justice dataset were merged with matching records in the education dataset. Of the 3,814 youth who were committed to OYA during the study time period, 3,606 had at least one student record in the education dataset. Of the 11,018 youth who were placed on county probation during the study time period, 9,915 had at least one student record in the education dataset. Together, this translated to about 2% of the approximately 775,000 juvenile justice-eligible students in the education dataset having either a county probation or OYA commitment outcome during the study time period.

The master analytic dataset was divided into sub-samples for developing the statistical models by grade level. Sufficient numbers of students with juvenile justice involvement during the study time period were found in the samples for grades 5 through 10. Analysis proceeded with six separate

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[4] It is possible that some county probation youth escalated to OYA after the end of the study time period. Our analysis reflects what was known during that time.

samples modeling the likelihood of future juvenile justice involvement among Oregon students in grades 5, 6, 7, 8, 9, and 10.

Designating the exposure and follow up periods. Because education records were combined for each grade-level sample across multiple school years, researchers needed to designate a minimum period of "exposure" to education and a minimum follow up period to track juvenile justice outcomes. Being somewhat limited by the overlapping time periods covered by the education and juvenile justice datasets, we chose an exposure period of at least one full academic year and a 12-month period following the academic year to maximize the utility of the dataset. Each student's follow up period was determined by subtracting the end date for each school year they attended from the date associated with their study outcome (i.e., date of juvenile justice involvement or end date of the study period). To illustrate, a student who entered county probation in January 2010 and was enrolled in 6th grade during the 2007-2008 academic year and in 7th grade in 2008-2009 would have a follow up period of about 18 months between the end of their 6th grade year and their study outcome date (i.e., June 2008 to January 2010) and about 6 months between the end of their 7th grade year and their study outcome date (June 2009 to January 2010). In this example, data from this student's 7th grade year would be excluded from analysis since the available follow up period was less than 12 months, and this student would only be included in the 6th grade sample. For students who were not involved with juvenile justice, the end of the study time period (July 2013) served as students' study outcome date. For example, a student who was enrolled in 8th grade during the 2010-2011 academic year and in 9th grade from 2011-2012 would have a follow up period of 25 months for their 8th grade year (June 2011 to July 2013) and 13 months for their 9th grade year (June 2012 to July 2013). In this example, this student would appear in both the 8th and 9th grade samples.

Designating an exposure period of one full academic year and a follow up period of at least 12 months led to the exclusion of all education records from the 2012-2013 academic year and all juvenile justice records before June 2009. The final samples included education records from the 2007-2008 academic year through the 2011-2012 academic year, linked with juvenile justice records from June 2009 through July 2013.

Grade-level samples

Demographic characteristics of students in each grade level sample are presented in Table 1. The samples were very similar apart from expected differences in age. Each sample was about half male and half female. Across all samples, the majority of students (between 66-71%) reported being White/Caucasian. Approximately 12-14% of students in all samples were Hispanic/Latinx, 4% were Asian, 3-4% were Multiracial/Multiethnic, 3% were Black/African American, about 1-2% were Native American/Alaska Native, and less than 1% were Native Hawaiian/Pacific Islander. Race/ethnicity was listed as Other or Unknown for between 5-8% of students depending on the sample. The average age at the start of the school year was 10 years old for students in the 5th grade sample, 11 for the 6th grade sample, 12 for the 7th grade sample, 13 for the 8th grade sample, 14 for the 9th grade sample, and 15 for the 10th grade sample. The follow up period for students in every sample ranged from 12 to 61 months with an average of 37 months. About 1% of students in each sample had a future juvenile justice outcome of county probation, and less than 1% of students across all samples had a future outcome of OYA commitment. The 5th graders and 10th graders had the lowest percentage with juvenile justice involvement.

Table 1:

Demographic characteristics of students in each grade level sample, Oregon 2007-2013.

	Grade Level					
	5th	6th	7th	8th	9th	10th
Total students in sample	216,505	217,512	215,768	214,532	220,171	220,589
Gender						
Female	106,087 (49%)	106,500 (49%	105,643 (49%)	105,331 (49%)	108,457 (49%)	109,047 (49%)
Male	110,418 (51%)	111,012 (51%)	110,125 (51%	109,201 (51%)	111,714 (51%)	111,542 (51%)
Race and Ethnicity						
Asian	8,849 (4%)	8,962 (4%)	8,614 (4%)	8,385 (4%)	8,596 (4%)	8,970 (4%)
Black/African American	5,898 (3%)	5,903 (3%)	5,838 (3%)	5,712 (3%)	5,759 (3%)	5,856 (3%)
Hispanic/Latinx	29,147 (14%)	29,476 (14%)	29,264 (14%)	28,590 (13%)	28,392 (13%)	26,992 (12%)
Multiracial/Multiethnic	7,983 (4%)	6,953 (3%)	7,074 (3%)	7,301 (4%)	7,834 (4%)	7,391 (3%)
Native American/ Alaska Native	3,238 (2%)	3,235 (2%)	3,191 (2%)	3,103 (1%)	3,101 (2%)	3,077 (1%)
Native Hawaiian/ Pacific Islander	537 (<1%)	594 (<1%)	676 (<1%)	648 (<1%)	669 (<1%)	557 (<1%)
Other/Unknown	17,478 (8%)	16,313 (8%)	14,243 (7%)	13,033 (6%)	12,205 (6%)	11,936 (5%)
White	143,375 (66%)	146,076 (67%)	146,868 (68%)	147,760 (69%)	153,615 (70%)	155,810 (71%)
Age at start of school year						
Average in years *(SD)*	10 *(0.4)*	11 *(0.4)*	12 *(0.4)*	13 *(0.4)*	14 *(0.4)*	15 *(0.5)*
Follow up period						
Average in months *(SD)*	37 *(17)*	37 *(17)*	37 *(17)*	37 *(17)*	37 *(17)*	37 *(17)*
Range in months	12 - 61	12 - 61	12 - 61	12 - 61	12 - 61	12 - 61
Outcomes of interest						
No juvenile justice outcome	214,445 (99%)	214,416 (99%)	211,968 (98%)	210,703 (98%)	217,042 (99%)	218,981 (99%)
County probation outcome	1,683 (0.8%)	2,377 (1%)	2,821 (1%)	2,721 (1%)	2,173 (1%)	1,125 (0.5%)
OYA commitment outcome	377 (0.2%)	719 (0.3%)	979 (0.5%)	1,108 (0.5%)	956 (0.4%)	483 (0.2%)

Note: Due to rounding, percentages in each category may not total 100%.

Analysis

Similar to previous feeder system analyses, we followed procedures recommended by Hosmer, Lemeshow, and Sturdivant (2013) to select variables in the education data for further testing in our predictive models. Taking each sample in turn, bivariate correlations were estimated between the juvenile justice outcomes of interest (i.e., county probation and OYA commitment) and variables representing students' experiences in that grade level. Education variables examined in bivariate correlation analyses included indicators of *school mobility* (i.e., whether a student changed schools during the school year), indicators of *chronic absenteeism* (i.e., student missed 10% or more school days during the year) and *severe chronic absenteeism* (i.e., student missed 20% or more school days during the year), *family economic disadvantage* (i.e., student's enrollment in free/reduced-price lunch), indicators of *talented-and-gifted status*, designators for *special education and disability status*, markers of *Limited English Proficiency* (LEP) services, *average number of disciplinary events per year*[5] in the study time period (e.g., expulsions or suspensions), and *performance on grade-level standardized tests* for math, reading, science, and writing. Education variables that were significantly correlated with the juvenile justice outcomes and were not significantly correlated with each other were selected for further testing in predictive models.

Predictive models were estimated using logistic regression. Variables were entered into predictive models in a two-step sequence so that the effects of key demographics and social determinants (i.e., gender, race/ethnicity, economic disadvantage, and disability status) were estimated first, followed by the effects of the selected educational factors (i.e., school mobility, chronic absenteeism, average number of disciplinary events per year, and performance on grade-level standardized tests in math and reading). A variable representing the school year during which the student was enrolled in the particular grade (i.e., "cohort") was also included in the first step to account for potential biases caused by differences in students' follow up time periods.[6] Variables were entered into a backward stepwise logistic regression model predicting either county probation or OYA commitment. Two models—one predicting each juvenile justice outcome—were estimated within each grade level for a total of 12 separate models.

Analyses were completed in SPSS version 25, and the .05 level of significance was used.

Results

Results showed nearly identical predictive models across all grade levels within each juvenile justice outcome. That is, the 5th through 10th grade models predicting the likelihood of county

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[5] The average number of discipline events per year in the study time period was calculated by taking the sum of each student's disciplinary events to date and dividing it by the sum of each student's number of school years in the data to date. This allowed us to capture students' experiences with discipline during both the current school year and previous school years. The desire to capture students' historical experiences with discipline was based on the hypothesis that the accumulation of multiple disciplinary events over time would have an effect on future juvenile justice outcomes.

[6] Simply put, a significant effect for cohort would indicate that the longer a student was "in" the study, the more years of data researchers had thereby increasing the opportunity to detect their juvenile justice outcome in the study time window. Expecting this effect, we entered "cohort" into the statistical models in the first step as a control variable, allowing us to estimate the unique impact of other key variables on the probability of our juvenile justice outcomes.

probation produced very similar results, as did the 5th through 10th grade models predicting the likelihood of OYA commitment. Because the models were virtually the same across all grade levels, we selected two models—one for each outcome—estimated among students in a single grade level (i.e., 8th grade) to discuss below. Tables of findings for the 10 models estimated for the remaining grade levels can be found in the Appendix.

Probability of county juvenile probation

Results of the final model estimating the likelihood of county juvenile probation among 8th grade students are presented in Table 2. Nine variables remained in the model at its final step (-2LL = 23,646.07; χ^2[19] = 4,595.88, p < .0001).

Table 2:
Final step of the backward stepwise regression model estimating the likelihood of county juvenile probation among Oregon 8th grade students (n=208,346).

	β	S.E.	Wald	df	Sig.	Odds ratio
Constant	-6.13	0.09	4951.47	1	.000	
Gender (Male=1)	0.83	0.05	328.34	1	.000	2.29
Race and Ethnicity (White=Reference category)			148.64	7	.000	
Asian	-1.23	0.22	32.09	1	.000	0.29
Black/African American	0.07	0.10	0.58	1	.445	1.08
Hispanic/Latinx	-0.15	0.06	7.56	1	.006	0.86
Multiracial/Multiethnic	-0.22	0.12	3.14	1	.077	0.81
Native American/Alaska Native	0.41	0.12	11.38	1	.001	1.50
Native Hawaiian/Pacific Islander	-0.44	0.37	1.45	1	.229	0.64
Other/Unknown	-1.49	0.15	94.84	1	.000	0.22
Economic disadvantage indicator (Yes=1)	0.73	0.05	248.44	1	.000	2.07
Disability/Special education indicator (Yes=1)	-0.01	0.05	0.01	1	.911	0.99
Average number of discipline events per year	0.23	0.01	653.46	1	.000	1.25
Performance on standardized 8th reading and math tests ("Meets standard" = Reference category)			235.39	2	.000	
Does not meet standard on one of two tests	0.65	0.05	144.27	1	.000	1.91
Does not meet standard on both tests	0.78	0.05	211.59	1	.000	2.19
Chronic absenteeism indicator (Yes=1)	0.57	0.04	170.70	1	.000	1.77
Student changed schools this year (Yes=1)	0.61	0.06	108.79	1	.000	1.85

Note: Some cases were eliminated during analyses due to missing data. There was also a significant effect for the control variable representing academic year (not shown; Wald = 563.06, *df* = 4, *p* < .0001). AUC = 0.847.

Demographics and social determinants indicators. Among the demographic and social determinants variables, results indicated that gender, race/ethnicity, and economic disadvantage each significantly predicted county juvenile probation among Oregon 8th grade students. Male students were more than twice as likely as female students to experience future county probation (β = 0.83, *p* < .0001; odds ratio [OR] = 2.29). Compared to White students, Native American/Alaska Native students were significantly more likely to experience county juvenile probation (β = 0.41, *p* < .01; OR = 1.50) and Asian students (β = -1.23, *p* < .0001; OR = 0.29), Hispanic/Latinx students (β = -0.15, *p* < .01; OR = 0.86), and students whose race was listed as Other/Unknown (β = -1.49, *p* < .0001; OR = 0.22) were significantly less likely to experience county juvenile probation. The probability of county probation was not statistically different between White students and students who identified as Black/African American, Multiracial/Multiethnic, or Native Hawaiian/Pacific Islander. Regression results also indicated that students whose records reflected current economic disadvantage were about twice as likely as students without this indicator to experience future county juvenile probation (β = 0.73, *p* < .0001; OR = 2.07). Results did not show a relationship between the indicator of student disability/special education status and county probation.

Significant effect of cohort. There was a large and significant effect for the control variable representing the academic year during which the student was enrolled in 8th grade (i.e., "cohort"). As anticipated, results indicated the probability of experiencing county juvenile probation during the study time period was greatest for students enrolled in 8th grade during academic years near the beginning of the study time period and that the probability decreased consistently with each advancing academic year.

Educational indicators. Four main indicators from students' educational records were significantly associated with the likelihood of county juvenile probation: discipline events, performance on standardized reading and math tests, chronic absenteeism, and school mobility.

Discipline events. Students' average number of discipline events per year had the largest effect on the probability of county probation (β = 0.23, *p* < .0001; OR = 1.25). Results indicated that with every increase in one unit of the average number of discipline events (e.g., expulsions and suspensions), the probability of county juvenile probation increased by 1.25 or 25%.[7]

Performance on standardized tests. Performance on standardized 8th grade reading and math tests was also significantly associated with the likelihood of county juvenile probation, and the association differed depending on whether students failed to meet performance standards on one or both tests. Compared to students who met performance standards on both math and reading tests, students who did not meet standards on one of the two tests were significantly more likely to experience future county probation (β = 0.65, *p* < .0001; OR = 1.91). Students who did not meet performance standards on both math and reading tests were even more likely to experience future county probation (β = 0.78, *p* < .0001; OR = 2.19). Odds ratios indicated the odds of county probation

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[7] For example, a 10% probability of future county juvenile probation would increase by 2.5 percentage points (0.10 * 0.25 = 0.025) with every one-unit increase in the average number of discipline events, raising the probability from 10% to 12.5%.

was more than double for students who did not meet performance standards on reading and math tests compared to students who met standards on both.

Chronic absenteeism. School attendance during students' 8th grade year was also significantly associated with the likelihood of county juvenile probation. Students whose attendance records indicated chronic absenteeism—that is, they were absent for 10% or more school days during the year—were more likely than students who missed fewer school days to experience future county probation (β = 0.57, *p* < .0001; OR = 1.77). Results showed that chronic absenteeism increased the probability of county juvenile probation by 1.77 times or 77%.

School mobility. Changing schools one or more times during the school year also had a significant effect on the probability of county juvenile probation. Compared to students who stayed in the same school throughout 8th grade, students who changed schools for any reason were significantly more likely to experience future county probation (β = 0.61, *p* < .0001; OR = 1.85). Findings suggested the probability of county juvenile probation is 85% larger for students who changed schools in 8th grade compared to students who did not experience this disruption.

Accuracy of the final model predicting county juvenile probation. As with previous feeder system work, the accuracy of the final model predicting future county juvenile probation was assessed by examining the area under the receiver operating curve (AUC). Estimates indicated the model had an AUC of 0.847, suggesting the combination of demographics, social determinants, and educational factors accurately predicted future county juvenile probation dispositions in our sample of 8th grade students nearly 85% of the time.

Furthermore, the classification results displayed in Table 3 show that the model detected both true positives and true negatives about 74% of the time on average. The model accurately predicted the outcome for 80% of the 8th grade student sample who experienced future county probation and for 74% of the students who did not experience county probation.

Table 3:
Classification table showing the final model's ability to predict future county juvenile probation among Oregon 8th grade students (n=208,346).

	Predicted		Percent correct
Observed	County probation – No	County probation – Yes	
County probation – No	151,323	54,391	74%
County probation - Yes	521	2,111	80%
Overall percent correct			**74%**

Note: The cut value is 0.013. [8]

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[8] The cutoff value that maximized both sensitivity and specificity was 0.013—that is, students in the sample with a model-estimated probability of at least 0.013 were classified as a future county probation youth. Adjusting the cutoff value to 0.013 from the standard 0.50 typically used in logistic regression did not impact the AUC statistic.

Probability of OYA commitment

Results of the final model estimating the probability of OYA commitment among 8th grade students are presented in Table 4. As with the model for county juvenile probation, nine variables remained in the OYA model at its final step (-2LL = 9,797.95; χ^2[19] = 3,115.21, $p < .0001$).

Table 4:
Final step of the backward stepwise regression model estimating the likelihood of OYA commitment among Oregon 8th grade students (n=206,738).

	β	S.E.	Wald	df	Sig.	Odds ratio
Constant	-8.78	0.14	3971.39	1	.000	0.00
Gender (Male=1)	1.26	0.08	226.54	1	.000	3.52
Race and Ethnicity (White=Reference category)			85.94	7	.000	
Asian	-0.60	0.30	4.05	1	.044	0.55
Black/African American	0.63	0.13	24.31	1	.000	1.87
Hispanic/Latinx	0.22	0.09	6.35	1	.012	1.24
Multiracial/Multiethnic	-0.33	0.22	2.13	1	.145	0.72
Native American/Alaska Native	0.72	0.18	16.54	1	.000	2.05
Native Hawaiian/Pacific Islander	-1.43	0.83	2.98	1	.084	0.24
Other/Unknown	-1.41	0.27	28.28	1	.000	0.24
Economic disadvantage indicator (Yes=1)	0.38	0.07	27.60	1	.000	1.46
Disability/Special education indicator (Yes=1)	0.29	0.08	13.82	1	.000	1.33
Student changed schools this year (Yes=1)	1.67	0.07	518.62	1	.000	5.31
Average number of discipline events per year	0.25	0.01	477.42	1	.000	1.28
Performance on standardized 8th reading and math tests ("Meets standard" = Reference category)			104.50	2	.000	
Does not meet standard on one of two tests	0.70	0.09	56.26	1	.000	2.02
Does not meet standard on both tests	0.91	0.09	101.80	1	.000	2.49
Chronic absenteeism indicator (Yes=1)	0.58	0.07	63.72	1	.000	1.79

Note: Some cases were eliminated during analyses due to missing data. There was also a significant effect for the control variable representing academic year (not shown; Wald = 211.59, *df* = 4, *p* < .0001). AUC = 0.910.

Demographics and social determinants indicators. Similar to the model estimating the likelihood of county probation, results indicated that gender, race/ethnicity, and economic disadvantage were significantly associated with future OYA commitment among Oregon 8th grade students.

Like county probation, male students were over three times more likely than female students to experience future OYA commitment (β = 1.26, *p* < .0001; OR = 3.52). The effects of race/ethnicity in

the prediction of OYA commitment, however, were different from the effects in the county probation model. Most notably, the probability of future OYA commitment was significantly larger among Black/African American students (β = 0.63, *p* < .0001; OR = 1.87) and Hispanic/Latinx students (β = 0.22, *p* < .05; OR = 1.24) compared to White students. Native American/Alaska Native students—who were found to be more likely than White students to experience county probation—had even higher probability of experiencing OYA commitment (β = 0.72, *p* < .01; OR = 2.05). As with county probation, Asian students (β = -0.60, *p* < .05; OR = 0.55) and students whose race was listed as Other/Unknown (β = -1.41, *p* < .0001; OR = 0.24) were significantly less likely than White students to experience future OYA commitment. There was no statistical difference in the probability of OYA commitment between White students and Multiracial/Multiethnic or Native Hawaiian/Pacific Islander students.

The effect for economic disadvantage in the model predicting OYA commitment was significant although slightly smaller than the effect found in the model predicting county probation. Students whose education records reflected economic disadvantage in 8th grade were about 1.5 times more likely than students without this indicator to experience future OYA commitment (β = 0.38, *p* < .0001; OR = 1.46).

Unlike the analysis for county probation, the analysis for OYA commitment revealed a significant effect for the indicator of disability/special education. Students whose records indicated the presence of a disability and recognition within special education services were about 33% more likely than students outside of special education to experience eventual OYA commitment (β = 0.29, *p* < .0001; OR = 1.33). There was no effect for disability/special education status found in the model predicting county juvenile probation.

Significant effect of cohort. As with the county probation model, there was a significant effect for the variable representing the academic year during which the student was enrolled in 8th grade (i.e., "cohort"). The probability of experiencing OYA commitment during the study time period was greatest for students enrolled in 8th grade at the beginning of the study time period and lowest for those enrolled at the end of the study period. Again, this is a reflection of the amount of data available to researchers and the resulting variation in the ability to detect juvenile justice outcomes.

Educational indicators. The same four indicators from students' educational records that were associated with county juvenile probation were also significantly associated with the probability of OYA commitment. However, model statistics suggest a different order of importance in the prediction of OYA commitment with the indicator of school mobility first, followed by discipline events, performance on standardized reading and math tests, and chronic absenteeism last.

School mobility. Changing schools one or more times during students' 8th grade year had a substantially larger effect on the probability of OYA commitment than the probability of county

probation. Model statistics indicated that 8th grade students who changed schools during the school year were more than five times more likely to experience future OYA commitment compared to students who stayed in the same school (β = 1.67, *p* < .0001; OR = 5.31).

Discipline events. Like the model predicting county probation, students' average number of discipline events per year was significantly related to the probability of OYA commitment (β = 0.25, *p* < .0001; OR = 1.28). Every increase in the average number of discipline events in students' education record to date increased the probability of OYA commitment by 1.28 or 28%.

Performance on standardized tests. The association between students' performance on standardized grade-level tests and OYA commitment was similar to what was found in the model predicting county probation. Compared to 8th grade students who met performance standards on both math and reading tests, students who did not meet standards on one of the two tests were significantly more likely to experience future OYA commitment (β = 0.70, *p* < .0001; OR = 2.02), and students who did not meet performance standards on both math and reading tests were even more likely to experience OYA commitment (β = 0.91, *p* < .0001; OR = 2.49).

Chronic absenteeism. Being absent for 10% or more school days during the 8th grade year had a significant effect on the probability of OYA commitment, just as it did on the probability of county probation. That is, students whose attendance record indicated chronic absenteeism were 1.79 times more likely to experience future OYA commitment than students who missed fewer school days (β = 0.58, *p* < .0001; OR = 1.79).

Accuracy of the final model predicting OYA commitment. AUC analyses indicated the model predicting future OYA commitment among 8th graders had an AUC estimate of .910. The combination of demographics, social determinants, and educational factors in the final model accurately predicted future OYA commitment among 8th grade students in the sample 91% of the time, and the model detected true positives and true negatives 81% of the time (Table 5). Classification was accurate for 85% of students who experienced future OYA commitment and 81% of students who did not experience future OYA commitment.

Table 5:
Classification table showing the final model's ability to predict future OYA commitment among Oregon 8th grade students (n=206,738).

	Predicted		Percent correct
Observed	OYA commitment – No	OYA commitment – Yes	
OYA commitment – No	166,813	38,901	81%
OYA commitment - Yes	158	866	85%
Overall percent correct			**81%**

Note: The cut value is 0.005. [9]

Discussion

Our data showed that between mid-2007 and mid-2013, about 1-2% of Oregon students experienced either county juvenile probation or OYA commitment around the time of their late

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[9] The cutoff value that maximized both sensitivity and specificity in the OYA model was 0.005. Students in the sample with a model-estimated probability of at least 0.005 were classified as a future OYA youth. Adjusting the cutoff value to 0.005 did not impact the AUC statistic.

elementary, middle, or early high school years. We developed models to identify key demographics, social determinants, and educational factors within students' school records that contributed to the risk of future involvement with the juvenile justice system. Findings suggest that certain demographic factors, social determinants, experiences with school discipline, changing schools mid-year, low performance on reading and math tests, and chronic absenteeism may influence students' likelihood of becoming involved with juvenile justice. These factors together predicted risk of juvenile justice involvement well, with an average accuracy (i.e., area under the curve) of about 0.87.

Summary of key findings

The results of our analyses suggested that certain demographic factors and social determinants were related to the odds of a student becoming involved with juvenile justice, although patterns varied somewhat depending on the justice outcome. With regard to student gender, results indicated that male students had significantly higher odds of both county probation and OYA commitment compared to female students. In the county probation model, we found that Asian students, Hispanic/Latinx students, and students whose race was reported as Other/Unknown were significantly less likely than White students to experience future county probation. There were no significant differences in the likelihood of county probation between White students and Native Hawaiian/Pacific Islander, Multiracial/Multiethnic, or Black/African American students; however, findings did suggest Native American/Alaska Native students had significantly higher odds of future county probation compared to White students. This effect for Native American/Alaska Native students was also found in the OYA model and was accompanied by significant effects for Black/African American and Hispanic/Latinx students. That is, results indicated that the odds of future OYA commitment were significantly higher among Native American/Alaska Native, Black/African American, and Hispanic/Latinx students compared to White students.

The effects of social determinants (i.e., economic disadvantage and disability/special education status) also differed somewhat depending on the juvenile justice outcome. Students whose education records indicated economic disadvantage had about double the odds of county probation and about 1.5 times the odds of OYA commitment compared to students without this indicator. Students' disability/special education status had no effect on the likelihood of future county probation but increased the odds of OYA commitment by about 33%.

With regard to educational factors, our findings indicated that experiences with school discipline, changing schools mid-year, below-standard performance on reading and math tests, and chronic absenteeism were related to students' likelihood of becoming involved with the juvenile justice system. Every unit increase in students' average number of discipline events (i.e., suspensions and expulsions) per year corresponded with an increase of 25% in the odds of county probation and an increase of 28% in the odds of future OYA commitment. Changing schools mid-year had a significant effect on the probability of both county probation and OYA commitment, although the effect for OYA commitment was substantially larger. Students who changed schools mid-year had about double the odds of future county probation and five times the odds of eventual OYA commitment.

Performance on standardized tests in reading and math were also significantly related to both county probation and OYA commitment. Compared to students who met or exceeded performance standards on both tests, students who did not meet performance standards on either math or reading tests were between 1.9-2 times more likely to experience future juvenile justice involvement. Students who did not meet performance standards on *both* math and reading tests were about 2-2.5 times

more likely to experience eventual juvenile justice involvement. Finally, students who were absent for 10% or more school days during the year (i.e., chronically absent), had between 77-79% higher odds of involvement with the juvenile justice system compared to students who attended more days.

Comparison to previous literature

Much of what we found in the current analysis is comparable to findings from previous examinations of individual, social, and educational factors related to future juvenile justice involvement. Prior literature confirms that criminal behavior and subsequent juvenile court referrals are more common among young men than young women due in part to their higher tendency toward "rebelliousness," associating with gangs, and weapons use (p. 38, Farrington, Jolliffe, Hawkins, Catalano, Hill, & Kosterman, 2010). There is also an extensive amount of literature on the overrepresentation of people of color throughout the justice system, and youth of color are no exception (Laub, 2018). Previous evidence has demonstrated that racial and ethnic disparities in the juvenile justice system are likely due to a combination of elements including disproportionate treatment of youth of color at every stage of the system (i.e., police, courts, and corrections; Henning, 2013; Nunn, 2002). There is also a mass of evidence suggesting that students of color are treated differently and often more harshly than White students when it comes to certain school policies, particularly discipline (Hirschfield, 2018; Losen, 2011), and that these inequities in school perpetuate disparities in the juvenile justice system (Hirschfield, 2018; Wilson, 2014). This affirms our findings related to the higher probability of juvenile justice involvement among Native American/Alaska Native, Black/African American, and Hispanic/Latinx youth.

The association we found between economic disadvantage (i.e., poverty) and juvenile justice involvement has also been confirmed elsewhere (Loeber & Farrington, 2000). Moreover, the exact measure of economic disadvantage that was related to county probation and OYA commitment in the current analysis (i.e., enrollment in free/reduced-price lunch) has predicted contact with the juvenile justice system in other studies (Marchbanks & Blake, 2018). The relationship we found between student disability status and juvenile justice involvement has also been confirmed in previous literature, where it has been further identified that certain disabilities (i.e., emotional disturbance and learning disability) have specific influence on the risk of juvenile justice involvement (Marchbanks & Blake, 2018). Data were not available for the current analysis to differentiate the effects of specific disabilities on juvenile justice involvement, however that could be a possible avenue for future work in Oregon.

Prior research also supports our findings related to certain educational factors and the risk of juvenile justice involvement. The connection between discipline—particularly exclusionary discipline practices like suspension and expulsion—and later juvenile justice involvement is well-established (Hirschfield, 2018; Marchbanks & Blake, 2018; Wilson, 2014). Evidence suggests that exclusionary discipline practices derail student progress, undermine learning of appropriate social behaviors, and contribute to the likelihood of academic failure and dropout, which in turn increase the risk of juvenile delinquency (Christle, Jolivette, & Nelson, 2005). Some argue that experience with exclusionary discipline is one of the main components of the "school-to-prison pipeline," and that the negative effects of these "zero tolerance" discipline strategies are amplified for students with disabilities and students of color (Christle et al., 2005; Wald & Losen, 2003; Wilson, 2014).

Low academic achievement, often defined as poor performance on standardized tests, has also been identified as a risk marker for juvenile justice involvement and is considered to be another key

element of the school-to-prison pipeline (Christle et al., 2005; Loeber & Farrington, 2000; Wald & Losen, 2003). Furthermore, prior research suggests the relationship between poor academic performance and eventual juvenile justice involvement is stronger for students experiencing economic disadvantage/poverty (Christle et al., 2005) and students who have experienced exclusionary discipline (Marchbanks & Blake, 2018).

Previous literature also corroborates our finding that chronic absenteeism significantly predicted juvenile justice involvement (Wang, Blomberg, & Li, 2005). Some of the evidence ties poor attendance to juvenile justice involvement via its connections with exclusionary discipline and dropout (Christle et al., 2005; Hirschfield, 2018). Poor attendance could also be an indicator of weak connections to school and a lacking sense of belonging (Christle et al., 2005), which are also related to the risk of delinquency (Loeber & Farrington, 2000).

Prior evidence on the relationship between school mobility (i.e., changing schools mid-year) and juvenile justice involvement is somewhat inconsistent. Studies have demonstrated a connection between school mobility and youth delinquency via increases in the likelihood of dropout (Gaspar, DeLuca, & Estacion, 2012), however a reliable, direct connection between school mobility and juvenile justice involvement has yet to be established (Rumberger, 2015). Researchers have found that school mobility is highly correlated with other issues that influence the risk of juvenile justice involvement (e.g., expulsion, unstable home life, and placement in foster care; Rumberger, 2015), therefore it is possible that our findings are a reflection of other factors that are unknown in the current data. Previous Oregon feeder system research has shown relationships between juvenile justice involvement and such factors, including foster care placement (Braun, 2015b) and markers of general instability (i.e., treatment for addiction and mental health; Braun, 2015c-d). Given these findings, it is likely the Oregon feeder system work would benefit from an "overall" feeder system analysis that combines all available data sources to estimate the predictors of juvenile justice involvement from education and other child and family-serving systems (i.e., child welfare, self-sufficiency services, addictions and mental health treatment services, education, and employment).

Utility of the models

Predictive accuracy of all Oregon feeder system models has been measured by estimating the area under the curve (AUC) statistic. AUC estimates for previous models predicting OYA commitment among young people in foster care and treatment for addictions and mental health have ranged from .810 to .825. The predictive accuracy of the current models estimating the likelihood of juvenile justice involvement among 8th grade students was higher, ranging from .847 for county probation and .910 for OYA commitment. The current analyses had the advantage of larger sample sizes relative to previous feeder models, however the greater predictive accuracy found within the education models may suggest that young people's experiences in school are relatively important contributors to the risk of future justice involvement. That said, previous observations indicate that experiences in education, at home, and with other services interact to shape risk (e.g., Marchbanks & Blake, 2018), therefore it is likely that the best and most predictive models of future juvenile justice involvement in Oregon will be estimated using combined data from multiple sources.

Limitations and remaining questions

As with all research, there are specific limitations to the current analyses that leave us with some remaining questions. First, the current analyses did not include measures of protective factors or

strengths that could help with model estimation and interpretation. We acknowledge that the goals of the current study were focused on estimating the *risk* of juvenile justice involvement, and as such did not leave much room for considering possible protective factors. However, one could easily interpret the findings through a protective/strengths-based lens by considering the inverse of the risk indicators we identified. For example, we found that more frequent experiences with discipline (i.e., suspension and expulsion) significantly increased the likelihood of juvenile justice involvement. Viewed through a protective lens, one could surmise that fewer disciplinary events that exclude the student from school might protect against future juvenile justice experiences. This interpretation could support the argument for implementing alternative approaches to discipline in schools (e.g., restorative justice) that are focused on keeping students in a safe and positive learning environment. Still, a more intentional consideration of protective factors is important for future studies to enhance the utility of the findings for informing interventions.

Second, future studies—particularly those using data from Oregon—might benefit from predicting multiple outcomes representing each stage of the juvenile justice system. Data for the current analysis was organized so that each outcome of interest (i.e., county probation and OYA commitment) was mutually exclusive. However, many youth who were categorized within the OYA commitment outcome group also had prior county probation dispositions, and youth in both outcome groups had records of even earlier juvenile justice contact (e.g., referrals, warnings, and informal supervision dispositions). Future analyses could examine how educational factors predict each stage of a students' juvenile justice involvement while also accounting for the effects of the previous stage. For example, researchers could estimate the likelihood of students getting a referral, then among those students estimate the likelihood of being adjudicated delinquent, and so on to determine whether different educational and juvenile justice experiences interact to increase or decrease the risk of escalating to the next stage.

Third, subsequent analyses should explore the reasons why the effects of certain educational factors differed in the prediction of county probation versus OYA commitment to more fully understand variations in school experiences and the populations served at these two stages of the system. For example, school mobility was more strongly associated with the probability of OYA commitment than county probation. While this could indicate that changing schools in the middle of a school year has more deleterious effects for some youth over others (resulting in a more intense juvenile justice outcome), it could also be a simple reflection of how youth who are destined for OYA commitment are processed through the system. Youth who are under the care and custody of OYA are a small subset of those who have committed serious and sometimes adult-level offenses, are considered to be an extreme risk to the community, or have been unsuccessful in county probation (OYA, n.d.). As such, it may be these youth are more likely that county probation youth spend time in a juvenile detention facility during the adjudication process prior to OYA commitment. Oregon juvenile detention facilities have their own schools that serve youth in their custody, therefore the education records of youth who are removed from home and placed in detention would reflect a change to the detention facility's school. To test this theory, referral dates, school transfer dates, and potentially detention records would need to be examined along with OYA commitment records. These data were not available for the current study.

Next steps

The models in the current study predicted the likelihood of juvenile justice involvement well, but it is critical to assess predictive capability within specific populations. Previous literature suggests that educational risk factors may be particularly indicative of future juvenile justice involvement among specific groups of students (i.e., students of color, students with disability(ies), and students experiencing economic disadvantage). Applying the model and comparing the results among different groups is key to gaining a preliminary understanding of the models' utility for all students and in targeting interventions.

We recommend further exploring the reason for differences in the likelihood of county probation and OYA commitment based on students' race and ethnicity, even after taking into account other social determinants. Questions that should be considered include: Why are Native American/Alaska Native students more likely to experience both county probation and OYA commitment compared to White students? Why are Black/African American and Hispanic/Latinx students more likely than White students to experience OYA commitment, but not county probation? Examining whether policies or practices within schools, school districts, or county juvenile departments are influencing these disparities would be important. Toward that end, there are legislative efforts underway in Oregon that are focused on revising school disciplinary policies with an eye toward ensuring equitable treatment of students, particularly students of color (McKechnie & Nishioka, 2015). In addition, OYA commissioned an analysis and report of racial and ethnic disparities across Oregon's juvenile justice system (i.e., Feyerherm, 2012) and recently began publishing annual reports on the Relative Rate Index for youth of color at key decision points in Oregon's juvenile justice system (i.e., Juvenile Justice Information System, 2016, 2017, 2018).

To get a sense of whether county or district would predict the likelihood of juvenile justice involvement after taking into account the other factors in the model, we conducted exploratory analyses adding county as a fixed effect and found it improved the AUC in our models, particularly in the model predicting county probation (i.e., from .847 to .869). These preliminary findings suggest that examining county level policies at various stages of the system (e.g., law enforcement, district attorneys), school district level policies (e.g., discipline, presence of school resource officers), practices (e.g., enforcement of policies), and environment (e.g., neighborhood safety, school bullying), could be a useful next step. Such analyses could highlight the need for cross-systems efforts to address the underlying issues putting youth at risk for juvenile justice involvement.

Concluding remarks

The current analyses and all previous Oregon feeder system work was made possible by state efforts to link individual client data across service systems. The original intent of these linked data was to allow state public service programs to forecast future caseloads; however, the data have shown immense potential for understanding how Oregon youth travel through public services, school, and for some, the juvenile justice system. The utility of these linked data is immeasurable for Oregon and should continue to be used to inform cross-system interventions that ensure the health and well-being of all Oregonians.

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Appendix

Table A1:

Final step of the backward stepwise regression models estimating the likelihood of juvenile justice involvement among Oregon 5th grade students.

	County Probation (n=207,611)						OYA Commitment (n=206,321)					
	β	S.E.	Wald	df	Sig.	Odds ratio	β	S.E.	Wald	df	Sig.	Odds ratio
Constant	-6.16	0.11	3197.03	1	.000		-8.78	0.23	1510.85	1	.000	
Gender (Male=1)	0.79	0.06	193.49	1	.000	2.20	1.29	0.14	87.97	1	.000	3.62
Race and Ethnicity (White=Ref category)			177.35	7	.000				30.88	7	.000	
Asian	-1.74	0.34	26.98	1	.000	0.18	-1.19	0.58	4.18	1	.041	0.30
Black/African American	-0.08	0.12	0.40	1	.530	0.93	0.36	0.22	2.62	1	.105	1.43
Hispanic/Latinx	-0.19	0.07	7.21	1	.007	0.83	0.22	0.14	2.56	1	.110	1.24
Multiracial/Multiethnic	0.002	0.15	0.00	1	.990	0.99	0.22	0.30	.54	1	.464	1.24
Native American/Alaska Native	0.86	0.12	49.68	1	.000	2.36	0.67	0.30	4.87	1	.027	1.95
Native Hawaiian/Pacific Islander	-1.84	1.00	3.35	1	.067	0.16	-0.15	1.01	.02	1	.880	0.86
Other/Unknown	-1.50	0.17	83.49	1	.000	0.22	-1.40	0.36	14.85	1	.000	0.25
Economic disadvantage indicator (Yes=1)	1.11	0.07	301.64	1	.000	3.04	0.40	0.14	52.01	1	.000	2.70
Disability/Special education indicator (Yes=1)	0.01	0.06	0.03	1	.861	1.01	0.04	0.13	.11	1	.738	1.04
Avg. number of discipline events per year	0.45	0.02	363.47	1	.000	1.56	0.47	0.04	183.69	1	.000	1.60
Performance on standardized 5th reading and math tests ("Meets standard" = Ref category)			142.62	2	.000				37.54	2	.000	
Does not meet standard on one of two tests	0.54	0.07	68.95	1	.000	1.71	0.65	0.14	22.96	1	.000	1.92
Does not meet standard on both tests	0.75	0.07	129.31	1	.000	2.12	0.78	0.14	31.71	1	.000	2.18
Chronic absenteeism indicator (Yes=1)	0.46	0.06	65.87	1	.000	1.58	--	--	--	--	--	--
Student changed schools this year (Yes=1)	0.58	0.08	58.57	1	.000	1.79	1.29	0.13	98.66	1	.000	3.63

Note: Some cases were eliminated during analyses due to missing data. There was also a significant effect in both models for the control variable representing academic year (not shown; County probation model: Wald = 693.34, df = 4, p < .0001; OYA commitment model: Wald = 175.51, df = 4, p < .0001). Chronic absenteeism did not remain in the OYA model at the final step. County probation model AUC = 0.856; OYA commitment model AUC = .898.

Table A2:

Final step of the backward stepwise regression models estimating the likelihood of juvenile justice involvement among Oregon 6th grade students.

	County Probation (n=211,019)						OYA Commitment (n=209,381)					
	β	S.E.	Wald	df	Sig.	Odds ratio	β	S.E.	Wald	df	Sig.	Odds ratio
Constant	-6.08	0.09	4366.72	1	.000		-8.15	0.17	2422.25	1	.000	
Gender (Male=1)	0.71	0.05	220.30	1	.000	2.03	1.18	0.10	141.08	1	.000	3.26
Race and Ethnicity (White=Ref category)			185.05	7	.000				43.26	7	.000	
Asian	-1.44	0.25	32.49	1	.000	0.24	-0.83	0.38	4.67	1	.031	0.44
Black/African American	-0.13	0.11	1.36	1	.243	0.88	0.22	0.17	1.67	1	.196	1.25
Hispanic/Latinx	-0.07	0.06	1.52	1	.218	0.93	0.08	0.10	0.54	1	.462	1.08
Multiracial/Multiethnic	0.05	0.12	0.15	1	.700	1.05	-0.17	0.25	0.43	1	.510	0.85
Native American/Alaska Native	0.73	0.11	41.86	1	.000	2.07	0.62	0.21	8.68	1	.003	1.86
Native Hawaiian/Pacific Islander	-1.34	0.59	5.11	1	.024	0.26	-0.51	0.73	0.49	1	.485	0.60
Other/Unknown	-1.45	0.15	97.98	1	.000	0.23	-1.42	0.29	24.90	1	.000	0.24
Economic disadvantage indicator (Yes=1)	0.97	0.05	338.08	1	.000	2.63	0.86	0.10	77.45	1	.000	2.37
Disability/Special education indicator (Yes=1)	0.02	0.05	0.11	1	.741	1.02	0.08	0.09	0.69	1	.406	1.08
Avg. number of discipline events per year	0.30	0.01	514.57	1	.000	1.35	0.29	0.02	297.71	1	.000	1.34
Performance on standardized 6th reading and math tests ("Meets standard" = Ref category)			186.12	2	.000				76.38	2	.000	
Does not meet standard on one of two tests	0.52	0.06	87.04	1	.000	1.69	0.59	0.11	30.77	1	.000	1.81
Does not meet standard on both tests	0.74	0.06	174.80	1	.000	2.10	0.89	0.10	75.23	1	.000	2.44
Chronic absenteeism indicator (Yes=1)	0.51	0.05	117.40	1	.000	1.66	0.79	0.08	87.70	1	.000	2.19
Student changed schools this year (Yes=1)	0.67	0.06	110.99	1	.000	1.96	1.09	0.10	122.31	1	.000	2.98

Note: Some cases were eliminated during analyses due to missing data. There was also a significant effect in both models for the control variable representing academic year (not shown; County probation model: Wald = 681.64, *df* = 4, *p* < .0001; OYA commitment model: Wald = 273.78, *df* = 4, *p* < .0001). County probation model AUC = 0.851; OYA commitment model AUC = .903.

Table A3:

Final step of the backward stepwise regression models estimating the likelihood of juvenile justice involvement among Oregon 7th grade students.

	County Probation (n=209,704)						OYA Commitment (n=207,885)					
	β	S.E.	Wald	df	Sig.	Odds ratio	β	S.E.	Wald	df	Sig.	Odds ratio
Constant	-5.89	0.08	4997.40	1	.000		-8.34	0.14	3381.60	1	.000	
Gender (Male=1)	0.75	0.04	285.71	1	.000	2.11	1.18	0.09	181.51	1	.000	3.26
Race and Ethnicity (White=Ref category)			180.34	7	.000				70.99	7	.000	
Asian	-1.49	0.24	38.54	1	.000	0.23	-0.57	0.30	3.62	1	.057	0.57
Black/African American	-0.03	0.10	0.07	1	.794	0.97	0.44	0.14	10.08	1	.002	1.55
Hispanic/Latinx	-0.13	0.05	5.71	1	.017	0.88	0.03	0.09	.13	1	.719	1.03
Multiracial/Multiethnic	-0.06	0.11	0.32	1	.574	0.94	-0.39	0.24	2.79	1	.095	0.68
Native American/Alaska Native	0.59	0.11	28.11	1	.000	1.81	0.78	0.18	18.41	1	.000	2.17
Native Hawaiian/Pacific Islander	-0.59	0.39	2.38	1	.123	0.55	-0.65	0.72	.82	1	.365	0.52
Other/Unknown	-1.46	0.14	104.70	1	.000	0.23	-1.56	0.28	32.04	1	.000	0.21
Economic disadvantage indicator (Yes=1)	0.79	0.05	291.56	1	.000	2.20	0.60	0.08	55.58	1	.000	1.82
Disability/Special education indicator (Yes=1)	-0.07	0.05	1.59	1	.207	0.94	0.12	0.08	2.17	1	.140	1.13
Avg. number of discipline events per year	0.24	0.01	619.30	1	.000	1.28	0.26	0.01	461.88	1	.000	1.30
Performance on standardized 7th reading and math tests ("Meets standard" = Ref category)			214.65	2	.000				125.96	2	.000	
Does not meet standard on one of two tests	0.59	0.05	134.72	1	.000	1.80	0.77	0.09	69.67	1	.000	2.15
Does not meet standard on both tests	0.71	0.05	178.09	1	.000	2.04	1.01	0.09	118.61	1	.000	2.74
Chronic absenteeism indicator (Yes=1)	0.58	0.04	182.49	1	.000	1.78	0.68	0.08	81.48	1	.000	1.97
Student changed schools this year (Yes=1)	0.70	0.06	146.90	1	.000	2.01	1.35	0.08	280.64	1	.000	3.87

Note: Some cases were eliminated during analyses due to missing data. There was also a significant effect in both models for the control variable representing academic year (not shown; County probation model: Wald = 768.89, *df* = 4, *p* < .0001; OYA commitment model: Wald = 257.49, *df* = 4, *p* < .0001. County probation model AUC = 0.845; OYA commitment model AUC = .909.

Table A4:

Final step of the backward stepwise regression models estimating the likelihood of juvenile justice involvement among Oregon 9th grade students.

	County Probation (n=219,215)						OYA Commitment (n=217,998)					
	β	S.E.	Wald	df	Sig.	Odds ratio	β	S.E.	Wald	df	Sig.	Odds ratio
Constant	-6.39	0.09	4942.42	1	.000		-9.04	0.14	4120.39	1	.000	
Gender (Male=1)	0.97	0.05	367.15	1	.000	2.62	1.47	0.09	275.67	1	.000	4.35
Race and Ethnicity (White=Ref category)			118.84	7	.000				128.02	7	.000	
Asian	-1.01	0.21	22.68	1	.000	0.37	-0.29	0.27	1.16	1	.281	0.75
Black/African American	0.30	0.10	8.19	1	.004	1.34	0.90	0.12	52.24	1	.000	2.45
Hispanic/Latinx	0.01	0.06	0.02	1	.887	1.01	0.56	0.09	44.06	1	.000	1.76
Multiracial/Multiethnic	-0.07	0.13	0.32	1	.575	0.93	-0.32	0.24	1.76	1	.185	0.72
Native American/Alaska Native	0.60	0.13	22.15	1	.000	1.83	0.85	0.19	20.49	1	.000	2.35
Native Hawaiian/Pacific Islander	-0.79	0.55	2.08	1	.149	0.46	-16.89	1360.11	0.00	1	.990	0.00
Other/Unknown	-1.29	0.17	59.45	1	.000	0.28	-1.27	0.29	19.72	1	.000	0.28
Economic disadvantage indicator (Yes=1)	0.53	0.05	127.18	1	.000	1.70	0.13	0.07	3.53	1	.060	1.14
Disability/Special education indicator (Yes=1)	0.16	0.06	7.61	1	.006	1.17	0.45	0.08	32.77	1	.000	1.57
Avg. number of discipline events per year	0.20	0.01	509.02	1	.000	1.22	0.22	0.01	398.21	1	.000	1.25
Chronic absenteeism indicator (Yes=1)	0.82	0.05	286.61	1	.000	2.28	0.84	0.08	113.83	1	.000	2.31
Student changed schools this year (Yes=1)	0.70	0.06	137.07	1	.000	2.02	1.75	0.07	562.75	1	.000	5.76

Note: Some cases were eliminated during analyses due to missing data. There was also a significant effect in both models for the control variable representing academic year (not shown; County probation model: Wald = 370.04, *df* = 4, *p* < .0001; OYA commitment model: Wald = 142.131, *df* = 4, *p* < .0001). Standardized testing does not occur in 9th grade in Oregon therefore performance on math and reading were not included in the models for this grade level. County probation model AUC = 0.820; OYA commitment model AUC = .891.

Table A5:

Final step of the backward stepwise regression models estimating the likelihood of juvenile justice involvement among Oregon 10th grade students.

	County Probation (n=218,981)						OYA Commitment (n=219,464)					
	β	S.E.	Wald	df	Sig.	Odds ratio	β	S.E.	Wald	df	Sig.	Odds ratio
Constant	-7.47	0.14	2683.14	1	.000		-10.08	0.21	2429.67	1	.000	
Gender (Male=1)	1.01	0.08	169.28	1	.000	2.74	1.76	0.14	166.15	1	.000	5.83
Race and Ethnicity (White=Ref category)			42.24	7	.000				80.10	7	.000	
Asian	-0.84	0.28	8.87	1	.003	0.43	-0.37	0.39	0.91	1	.340	0.69
Black/African American	0.03	0.16	0.04	1	.845	1.03	0.10	0.16	37.89	1	.000	2.72
Hispanic/Latinx	-0.13	0.10	1.73	1	.189	0.88	0.68	0.12	34.02	1	.000	1.97
Multiracial/Multiethnic	-0.41	0.23	3.20	1	.073	0.66	-0.44	0.36	1.46	1	.226	0.65
Native American/Alaska Native	0.32	0.22	2.06	1	.152	1.37	-0.04	0.39	0.01	1	.917	0.96
Native Hawaiian/Pacific Islander	-1.02	1.01	1.03	1	.311	0.36	-0.17	1.02	0.03	1	.868	0.85
Other/Unknown	-1.25	0.24	26.92	1	.000	0.29	-1.45	0.45	10.22	1	.001	0.23
Economic disadvantage indicator (Yes=1)	0.28	0.07	15.42	1	.000	1.33	-0.13	0.10	1.72	1	.190	0.88
Disability/Special education indicator (Yes=1)	0.15	0.09	2.73	1	.098	1.16	0.58	0.11	28.05	1	.000	1.78
Avg. number of discipline events per year	0.16	0.01	159.21	1	.000	1.18	0.18	0.02	144.79	1	.000	1.20
Performance on standardized 10th reading and math tests ("Meets standard" = Ref category)			76.90	2	.000				--	--	--	
Does not meet standard on one of two tests	0.68	0.10	49.61	1	.000	1.97	--	--	--	--	--	--
Does not meet standard on both tests	0.84	0.10	73.59	1	.000	2.31	--	--	--	--	--	--
Chronic absenteeism indicator (Yes=1)	0.64	0.08	74.24	1	.000	1.91	0.10	0.11	75.98	1	.000	2.71
Student changed schools this year (Yes=1)	0.68	0.09	55.84	1	.000	1.96	1.80	0.10	319.72	1	.000	6.02

Note: Some cases were eliminated during analyses due to missing data. There was also a significant effect in both models for the control variable representing academic year (not shown; County probation model: Wald = 84.00, df = 4, p < .0001; OYA commitment model: Wald = 65.88, df = 4, p < .0001). Performance on 10th grade reading and math tests did not remain in the OYA model at the final step. County probation model AUC = 0.799; OYA commitment model AUC = .894.

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