The Effect of Cannabis Dispensaries on Student Achievement; Evidence from Washington State

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Abstract:

Employing public educational and commercial data from the State of Washington, this study aims to estimate the impact of the establishment of a marijuana dispensary on student growth percentiles (SGPs) on standardized Math and English exams using difference-in-difference regression analysis. The results of the study indicate that the placement of a recreational marijuana dispensary in the vicinity of a school is correlated to negative effects on student growth rates, corresponding to a statistically significant 2.81

in support for recreational cannabis laws (RCLs) is not only a product of progressive, nationwide trends or consumer preferences; it is concurrently driven by the immense tax revenue potential of licensed marijuana dispensaries, a development that incites interest from lawmakers of both major parties. Washington became the second state behind Colorado to legalize recreational cannabis sales in 2012, effective as of January 2014, and the first recreational dispensaries in the state opened in July of 2014. The state collected nearly $400 million in tax revenue from dispensaries in 2019 alone, nearly half of which is routed towards their Basic Health Plan Trust

necessary basic health care services to working persons and others who lack coverage (Washington State Treasury 2020). Increased funding for this initiative improves health outcomes among the most vulnerable in society, reducing statewide inequities in health care with the added benefit

Colorado, the first state to decriminalize cannabis, generated $1.2 billion in revenue from sales and excise taxes since licensed dispensaries began operations in 2014, a significant portion of which served to supplement state educational grants to schools as well as fund school renovation and maintenance costs (State of Colorado 2020). Many studies find correlation between increased educational funding and better outcomes; one study found that 10% increases in expenditures were associated with increased test scores and lower dropout rates, especially among poorer school districts (Kreisman and Steinberg 2019). Additionally, there is evidence linking cannabis availability to lower Medicare Part D expenditures (Bradford and Bradford 2018) and opiate prescriptions (McMichael et al. 2020), insinuating that cannabis legislation is possibly an effective tool in combating the Opioid Crisis.

Nonetheless, critics argue that benefits generated from taxable marijuana sales are overstated; many states are reporting lower than expected revenues which are more than offset

by the various costs explicit and implicit costs associated with individual use and availability.

dangerous substances and claim that dispensaries promote increased use, further exacerbating

there is a common belief that legalization would cause individuals to discount the present and future negative effects of cannabis consumption, leading to more widespread and intensive use among younger persons. These sentiments are echoed in the Executive branch of the federal government; the Trump Administration, which previously held more lax views regarding marijuana legislation, is now considering removing medical marijuana protections in 2021. Trump himself recently stated that cannabis use causes a loss in IQ (Chicago Tribune 2020), and former Attorney General Jeff Sessions, a parti

This study is novel for several reasons. Generally, studies analyzing the educational implications of marijuana legislation identify the implementation of a statewide medicinal law as their event of interest. This study instead focuses on recreational dispensary openings which expand marijuana availability and use to a much greater degree, plausibly pronouncing the effect on response variables related to academic performance. This would provide a deeper understanding of how the effects of marijuana commerce and policy at local levels differ compared to state levels. Rather than measuring changes in test scores, this study aims to measure changes in test score growth rates which are a stronger indication of relative performance. Additionally, this study will evaluate the effects on school level score growth for various racial and socioeconomic demographics, controlling for school fixed effects and variables such as geography school funding. The results of this study will provide valuable information on the marijuana policy debate by informing lawmakers of some of the most important implications of localized marijuana commerce on youth outcomes.

Literature Review:

Existing cannabis literature focuses primarily on

which currently provide more data by virtue of their greater frequency and duration compared to

California, at the time only permitting medicinal use. Despite being classified by the DEA as a schedule I drug, defined as

cannabis is shown to be useful in treating chronic pain, migraines, and nausea resulting from chemotherapy. Its effectiveness as a pain reliever is such that it may be powerful mechanism for

statewide opioid prescriptions (McMichael et al 2020) in addition to prescriptions under

Medicare Part D, producing the added benefit of nearly $1.2 billion in annual M

burden lower-income teens, fueling existing educational and socioeconomic inequality. Additionally, marijuana use may negatively affect mental health outcomes, corresponding to slightly increased suicidal thoughts among men (van Ours and Williams 2015). Reductions in human capital accumulation can lead to long-term consequences for teens, limiting future wages and employment (van Ours and Williams 2007), undercutting the financial benefits (i.e., tax revenue) of cannabis commerce.

Olivier and Zolitz 2017 suggests that limiting cannabis access can reverse adverse educational effects; taking advantage of a Dutch law that forbid foreigners from frequenting pot shops, the researchers measured changes in university passing rates in addition to course

Crime rates are another dependent variable of importance relating to dispensary openings that are analyzed in similar ways, although findings are not fully in agreement across the literature. Dispensary closings are shown to correspond with upticks in violent crime within the immediate vicinity of the dispensary (Chang and Jacobson 2017) while openings generate the opposite effect; violent crime as well as marijuana related offenses decreased significantly outside of new dispensaries, although vehicle break-ins increased in frequency (Burkhardt and Goemens 2019). Alternate studies replicating said results also account for exogenous variation in dispensary density, suggesting that Denver dispensaries are more apt to be locate themselves near highways and areas with greater employment (Brinkman and Mok-Lamme 2017). Heightened private security and increased police presence are both possible mechanisms driving these responses. However, it is worth noting that said effects are highly localized, within only a 1/10-mile radius in the case of *Chang and Jacobson 2017,* and did not generate spillover effects in surrounding areas.

Fewer studies explicitly assess the impact of commercial cannabis access on individual outcomes. If the location of cannabis sources influences transactional costs, one would expect that those living closer to a source may be more prone to partaking in its use. *Van Ours and Palali 2015* provides valuable insight regarding the spatial effects of Dutch pot shops on individuals and how one could measure similar effects from U.S. dispensaries. The authors used onset age of marijuana exposure and commercial

implications, educational outcomes are shown to be affected by onset use (Cobb et al 2015 and van Ours and Williams 2017), indicating the possibility of a secondary relationship between dispensary location and educational outcomes.

This paper elaborates on this possibility by studying the responses of educational variables, standardized test score growth rates, in relation to the presence of licensed dispensaries in Washington school districts. It will control for individual characteristics, such as race and income, while also accounting for neighborhood and school district characteristics using a difference-in-difference method. The method utilized in this study represents an improvement on previous studies because it measures instead how student growth rates respond to the presence of a dispensary and possesses built-in mechanisms that control for certain unobservable area attributes. Results will provide novel information involving the external costs to teens associated with cannabis dispensaries and improve upon our collective understanding of the implications of cannabis policy.

I predict that the spatial effects of dispensaries on test score growth rates will be negative, but also relatively insignificant. Math scores may respond to a greater degree than English scores due its dependency on cognitive skills, skills that are more susceptible to the negative effects of marijuana use (Olivier and Zolitz 2019). Nonetheless, a recreational dispensary only extends availability to individuals over the age of 21, and although *van Ours and Palali 2015* finds correlation between the percentage of students reporting onset use of marijuana at age 16 and neighborhood dispensaries, the oldest students in our study are aged 14 and presumably less likely to be using marijuana in any legislative circumstance. As a result, I believe that the negative impact of early onset use detailed in *Cobb et al. 2015* and *van Ours and Williams 2007* is unlikely to be as pronounced in my model.

Data:

The data employed in performing the statistical analysis for this study contains three main aspects: locational data of schools and dispensaries, test score data, and individual school characteristics. Data detailing district level school funding and school demographics is available through the Washington Office of Superintendent of Public Instruction (OSPI) and its Report Card data, a repository that also includes the test score data utilized in this study. Every year, students in grades 3-8 are assessed on math, science, and language arts skills through the Smarter Balanced Assessments (SBAs). Schools are required to administer the assessments at any time between March and the beginning of June. The state began administering said exams in 2014 to assess s

We designate the groups in this fashion to plausibly control for some unobservable differences between areas. On the microeconomic level, dispensary owners are trying to maximize profits; to do so, they seek to open their businesses in areas where they believe that they can sell the most product. Empirical evidence suggests exogenous variation in dispensary density (Brinkman and Mok-Lamme 2017), therefore it is possible that those identified areas, whether it be due to area characteristics, local preferences, real estate, infrastructure etc., share more similarities than areas that do not contain dispensaries.

Data on Alcohol

local authorities have a process to mitigate problems with chronic public inebriation or illegal activities linked to the sale or consumption of alcohol within a geographic area of their city, town or county Cannabis Board 2020). There are currently Sales of certain alcoholic beverages, generally inexpensive, high alcohol products, are prohibited in these areas. This variable is included as a potential control for area substance abuse; it is plausible that the residents of an AIA are more inclined to abuse alcohol and other drugs, pronouncing the negative effects on student achievement in these areas. We will employ the geographic distribution of

directly adjacent to one.

Methodology:

This study employs difference-in-difference estimation via a multilinear regression model containing categorical and

consider it to be a conceivable maximum distance for which families living in the outer limits of could walk to. We consider the entire family unit because the dispensary itself, while not necessarily increasing availability for young teens, does provide better

marijuana use. The majority of said schools are either Elementary or Middle schools, with several interspersed K-8 schools. Schools surrounding dispensaries that commenced operations between March and May of 2015 are denoted as the treatment group while the remaining schools make up the control group.

Tables 1 and 2 detail the mean demographics of the control and treatment groups in the first period (2014). The number of observations reflects the number of grade levels per school for each group. On average, schools in the treatment group performed better at the outset in terms of student growth, with 36.3% achieving high growth and only 30.0% exhibiting low growth compared to 33.6% and 32.3% in the control group. Treated schools have higher proportions of Asian American students but are less diverse overall with more white students and lesser amounts of Hispanic, African American, and English Language learners. Control schools are much more likely to be located rurally; this reflects trends in the recreational cannabis market, as many earlier dispensaries are in major cities such as Seattle and Spokane rather than rural areas. Mean per capita spending between the two groups is relatively similar. Perhaps most importantly, treated schools display lower proportions of low-income students. Due to the potential exacerbated effects of cannabis use unique to poor students (Cobb et. al 2015), it will be imperative to control for the proportion low-income students at each school.

The below figure describes the setup of the baseline regression model utilized in the study. A categorical variable

erm that isolates the impact of a dispensary opening on the response variable and controls for the explanatory variables.

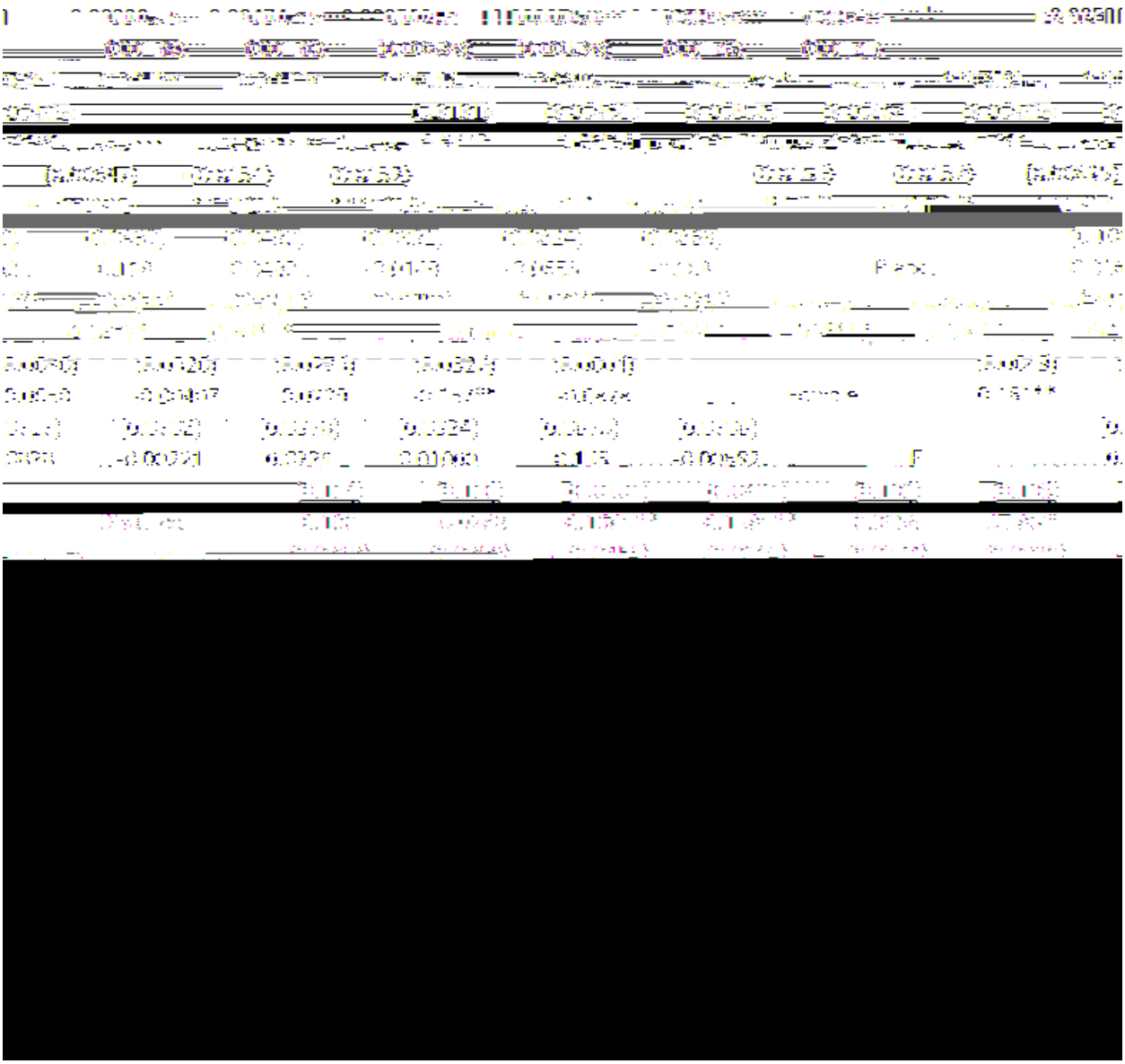
represent our response variables; we measure the change in the proportion of students recording low, medium, and high growth at each school. We estimate the effect on all three terciles of growth to provide a better understanding of the direction and amplitude of response. For example, if the high and low growth terciles responded strongly to the difference-in-difference variable, but not the typical growth tercile, it is possible that the presence of the dispensary is associated with a more pronounced decline in growth.

hispanic+

unweighted place equal value on all schools regardless of enrollment. data that is clustered based on school name to control for school fixed effects.

Table 3

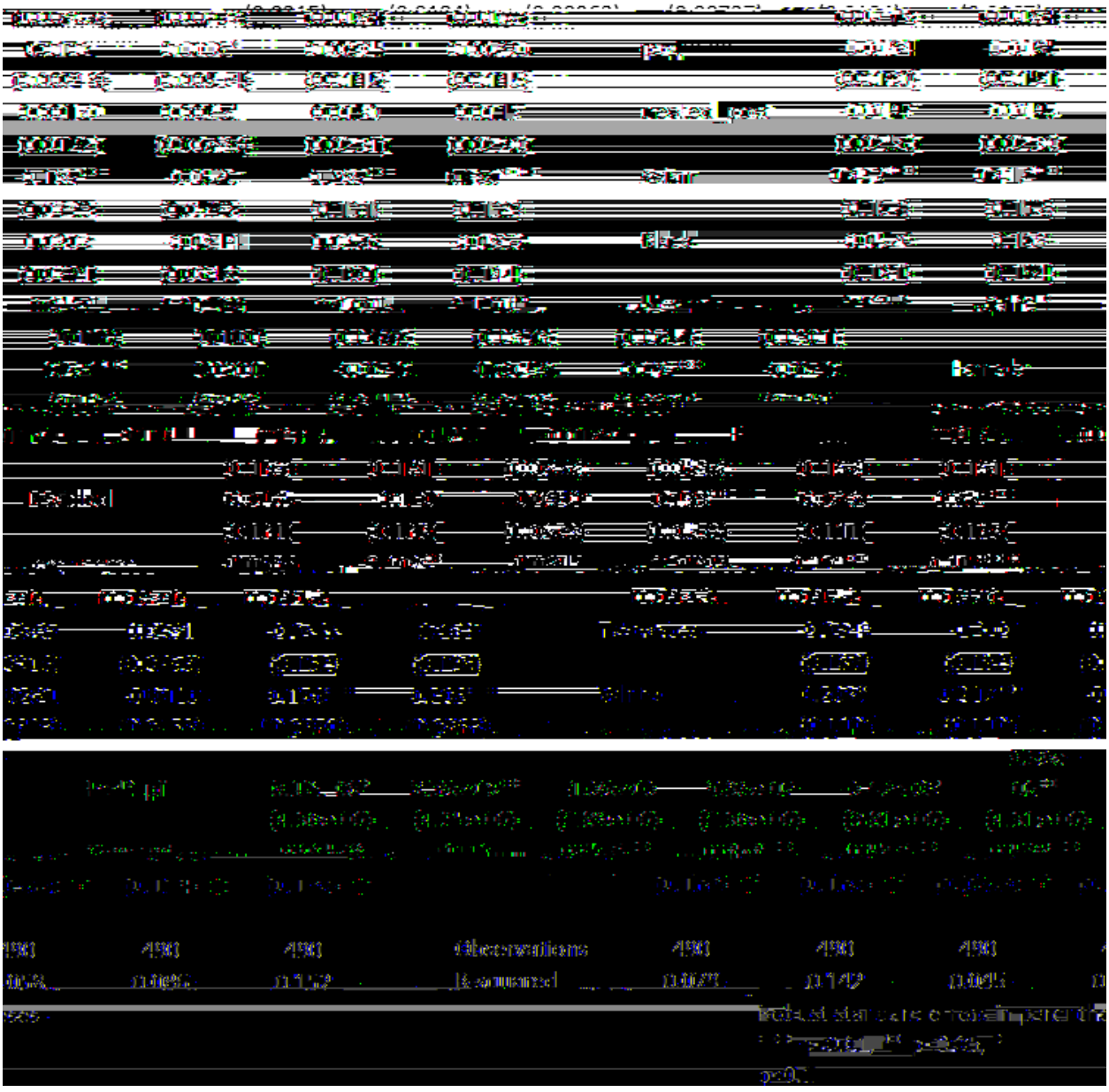
(4) Ful Weighted	(9) Ful	(10) Ful Weighted	(15) Ful	(16) Ful Weighted	VARIABLES	(1) Ful



however,

Table 4

	HIGH GROWTH		TYPICAL GROWTH		LOW GROWTH	
	(4)	(5)	(10)	(11)	(16)	(17)
VARIABLES	Full	Weighted	Full	Weighted	Full	Weighted
treated	-0.0103	-0.0155	0.00787	0.00454	0.00250	0.0111



Marijuana negatively affects cognitive function which would plausibly generate more pronounced effects on courses that require more cognitive skills, such as math. Prior to running

these regressions, my hypothesis guessed that math scores would be more responsive to the dispensary opening. However, somewhat surprisingly, Math growth rates are not significantly responsive to the presence of the dispensary, contrasting with the results found in *Olivier and Zolitz 2017*. Table 4 displays coefficients of explanatory variables predicting the proportion of high, typical, and low math test score growth rates in accordance with each model. The weighted model displayed the highest predictive capability with an R squared value of 0.142. Schools in the treated group experienced a 1.85 point decrease in their proportion of high growth students and a 1.17 point increase in the proportion of low growth students; however, none of the models found significant correlation between the percentage of students exhibiting high growth and the presence of a nearby recreational marijuana dispensary. In no case was the t-value of the diff-in-diff variable ever greater than 0.73, casting doubt on the hypothesis that math acumen deteriorates with heightened access to marijuana.

Variables that did significantly correlate with the response include several quantitative school characteristic indicators. Significant at the one percent level is the proportion of students of Asian descent at a school; a one percentage point increase in the proportion of Asian Americans correlates to a 0.417 percentage point increase in the proportion of the school population achieving high math score growth. The proportions of female students (in unweighted and clustered regressions), white, and Hispanic (weighted regression), and per pupil spending

Each of the previously mentioned variables

If the results suggest that, overall, growth rates respond significantly to dispensary opening, but Math scores do not, we presume that English scores must be driving the patterns in our findings. Table 5 details the effects of each variable on each growth level of English and Language Arts scores. Our diff-in-diff variable is significant at the 5% level when measuring changes in high growth and the 10% level when measuring changes in low growth. All else equal, the opening of a dispensary in the vicinity of a school is associated with a 4.13%-point decrease in the proportion of students achieving high growth and a 3.44%-point increase in the proportion of students with low growth.

The reasoning behind these trends is not concrete; it is possible that marijuana use among students in the treatment group increased, mirroring the findings in *van Ours and Williams 2007,* which produced effects like those found in *Cobb et al. 2015.* Parent behavior may also be affecting our results; it is possible that marijuana use among parents increases in the treated group, generating secondary effects on their children either via more permissive attitudes towards drugs, less time spent together, etc. However, without student survey data, we can only postulate that these secondary effects are occurring and instigating the effect of the diff-in-diff variable. Again, the diff-in-

students may be more inclined to experience high relative growth; because said students are in the early stages of learning the English language, they are likely improving their skills at a more exponential rate than native speakers. Conversely, schools with differing exogenous characteristics, such as lower quality teachers, would see higher levels of ELL students correspond to low growth

Fixed Effects:

In addition to the weighted and unweighted models provided above, we constructed a weighted clustered model adjusting for intra-school standard error to measure the impact of our variables when accounting for school fixed effects. Table 6 details the coefficients corresponding to this model for each subject and level of our response. If the coefficients do not significantly deviate from the other models, we presumably are doing a good job accounting for differences across schools.

What we find is that the coefficients of the fixed effects model are identical to the coefficients found in our weighted model when our response includes all subjects. The coefficients of the fixed effects regressions modeling Math and English instead corresponded to their respective unweighted models. While the value of the coefficients does not change, the significance of said values are slightly adjusted. In the regression modeling the response of all subjects, our coefficients gain significance when controlling for school effects; our diff-in-diff variable is now significant at the 5% level rather than the 10% level when measuring proportions of high and low growth. The t-value of our diff-in-diff coefficient corresponding to Math scores, although still insignificant, rises slightly in the fixed effects model compared to the unweighted model; however, its value is less significant than in the full weighted model. Likewise, the diff-in-diff variable in the English model is only significant at the 10% level in the fixed effects model. In the new model, the dispensary opening corresponds to a 3.35 point reduction in the proportion of high growth students and a 3.11 point increase in the proportion of low growth students.

Adding fixed effects to our model does not significantly impact our findings. It does suggest that the coefficients of the unweighted subject models may be more reliable than those in the weighted models, resulting in slightly less significant values for our diff-in-diff coefficients. However, our previous conclusions are largely unaltered; it still appears that the presence of a growth rates via a significant drop in English scores. Likewise, the effect on all subjects is even more significant, serving to reinforce our findings regarding the negative spatial effects of recreational marijuana dispensaries.

Conclusion:

I hypothesized that a dispensary opening would likely produce a statistically insignificant . In addition, I postulated that the effect on Math score growth would be greater than the effect on English due to the negative effect on cognitive skills due to expanded marijuana accessibility. Overall, the impact of dispensary openings exceeded my expectations; schools located near a dispensary experienced a statistically significant 2.81 point reduction in their proportion of high growth students and a 2.32%-point increase in low-growth students, although it is worth noting that the effect on typical growth rates is not significant. Surprisingly, the combined subject results are driven by a large impact on English growth rather than Math; dispensaries reduced the proportion of high growth students by 4.13 percentage points and increased the proportion low growth students by 3.44 points, both statistically significant, compared to changes of 1.85 and 0.79 points for Math scores. When accounting for school fixed effects, a more accurate way of estimating the coefficients, I found similar effects on both subjects, with the proportion of high growth and low growth English students changing by -3.35 and 3.11 respectively. Not only do growth rates respond more strongly to the opening of a nearby dispensary, but the results also suggest that the effect is more

pronounced. Typical growth rates do not vary greatly between the treated and control group, however, the movement between high and low growth is quite large, indicating that the afflicted students are much worse off because of the dispensary opening.

It is worth noting that the R squared value of all weighted regressions is low; none can account for more than 15.2% of variation in growth percentile response. It is possible that, in the presence of exogenous variables, our diff-in-diff variable is insignificant. Our model fails to control for variation in the distance of a dispensary from a school in addition to school characteristics such as student to teacher ratios. Many more unobservable effects may be influencing the outcome of our response. Plausible unobservable school characteristics include variables such as teacher quality, student engagement, and student attitudes regarding standardized tests.

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Newsweek. March 19th, 2017.https://www.newsweek.com/jeff-sessions-marijuana-quotes-about-pot-570177