School Shootings and Academic Achievement: A Look at the 2014 Isla Vista Killings*

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Abstract

With the increased prevalence of school-related gun violence, there is growing interest in how shootings impact surviving students. This study analyzes how one fatal shooting–the 2014 Isla Vista Killings at the University of California, Santa Barbara–affected various student groups. Using detailed student-level data from several California universities, we estimate impacts at both the extensive margin, by comparing UCSB students to those at other universities using a synthetic control design, and at the intensive margin, by comparing students in victims' social networks to their UCSB peers using a standard difference-in-difference design. Observable outcomes include quarterly grades, course failure rates, and dropout rates. We find that the incident caused an immediate one-quarter grade increase along both margins, but UCSB students' academic performance deteriorates in subsequent quarters. Dropout rates for students in victims' social networks rose substantially, especially among female students.

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1 Introduction

The turn of the 21st century marked an important shift in the narrative surrounding gun violence in the United States. Riding off the coattails of the 1999 Columbine Massacre, the deadliest high school shooting at the time, public perception transitioned from quiet tragedy to a mass media phenomenon. Yet at the same time, it seems that this focus has spurred a new wave of violence across the nation with seven of the top ten deadliest school shootings occurring within the past 20 years. However, little is known about the consequences of a school shootings on the surviving students. Questions continue to arise regarding the greater impact that these events have on the community at large. How do surviving students react to these traumatic events and, ultimately, what are the consequences beyond just the investigative summary report?

There has been substantial research done beyond immediate consequences on families of victims regarding the side effects of traumatic events. Galea and Resnick (2005) show that disasters, particularly those that are human-induced, caused higher rates of posttraumatic stress disorder (PTSD) among both direct survivors and the general populace, providing evidence for "exposure" damage. Blanchard et al. (2005) showed college-age individuals were even more susceptible to PTSD a year after the 9/11 terror attacks, further demonstrating the potential long-term proximity effects of tragedies. Moreover, Paxson and Rouse (2008) as well as Bleemer and van der Klaauw (2019) found evidence of a substantial number of Hurricane Katrina victims never returning to New Orleans following the disaster, marking behavioral responses to tragedies and further suggesting the far reaching consequences of traumatic events.

Within the realm of mass and school shootings, research has typically focused on the effects within primary and secondary schools. Gershenson and Tekin (2018) found that traumatic events such as shootings and natural disasters led to decreased reading proficiency levels among elementary school students immediately after the event. Beland and Kim (2016) examined high school students, measuring the effects following a number of schools shootings. They found that shootings led to a significant decrease in 9th grade enrollment as well as substantial declines in standardized math and reading scores. Poutvaara and Ropponen (2010) provide further evidence of this by measuring the difference in test scores before and after high school matriculation exams following a school shooting, noting a significant decrease in the average score of males but no effect for females.

As for possible explanations why tragedies and traumatic events lead to these outcomes, Camp-

bell and Schwarz (1996) and Pastore et al. (1996) found that exposure to violence led to higher rates of depression and other mental health disorders, especially among children and young adults. Fergusson and Woodward (2002) found that adolescents with depression face an increased risk of adverse psychosocial outcomes entering adulthood. These higher levels of psychological trauma are often linked to negative impacts on academic achievement (Ding et al. (2009)).

This study estimates the impact of a particular school shooting, the 2014 Isla Vista Killings at the University of California, Santa Barbara, on student academic achievement as measured by: end of quarter GPA, grades of a C or lower in any course, and the dropout rate. These effects are measured across three groups of students. The first is the aggregate sample of UC Santa Barbara students. The second is a group of impacted students defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. The third and final group includes females within the impacted group of students. The 2014 Isla Vista Killings targeted UC Santa Barbara students and resulted in six students killed with nine more injured to varying degrees. Though many students were not directly involved with the incident itself because it had occurred off but near campus, both the aggregate and marginal effects on different student bodies are studied. By analyzing the incident as an exogenous shock to the groups of interest, I measure the differential outcomes as the effect of the event. The major contribution of this study is the focus on college-level outcomes and direct observation on student-level statistics.

The data used in this study includes nearly comprehensive student-level data for individuals enrolled in four University of California campuses–Davis, Irvine, Riverside, and Santa Barbara–from 2011 to 2018. This data includes students' demographics, grades, units, course information, and basic application data (SAT/adjusted ACT scores, high school GPA, application type, etc.). In this data set, a dropout is defined as a student who enrolled but failed to graduate from the University of California system and is no longer actively taking courses. Note that all summer quarters were removed for the analysis. Missing data includes: (1) course-level data for all UC Santa Barbara students the quarter prior to the attack, Winter 2014, and (2) course-level data for the deceased individuals for the quarter of the incident, Spring 2014. Data for the UC Santa Barbara's Winter 2014 school quarter was imputed using Multivariate Imputation by Chained Equations (MICE) for the extensive margin, but omitted for the intensive margin.[1]

[1] Buuren and Groothuis-Oudshoorn (2010) develop the *R* package for the Multivariate Imputation by Chained Equations (MICE). I chose to impute using MICE due to the fact that the missing covariates include both continuous and

With respect to the aggregate impact of the 2014 Isla Vista Killings, as measured by a synthetic control method (SCM), I find that UC Santa Barbara students observed an upwards shift in average GPA the quarter of the shooting with an estimated increase of 0.03 GPA points relative to the synthetic control. This effect only persisted for a single quarter before dropping, leading to a, on average, -0.05 point decrease in end of quarter GPA for at least 5 quarters following the event. This effect was mirrored by an average increase of 2.1% of students who received a C or lower in any course following the attack. There is no observed difference in dropout rates. These results can be explained by: (1) the shooting quarter (Spring 2014) effect as the single quarter grade inflation response by the school and (2) the long-term psychological impact on the students attending the campus. In other words, though the University sought to lessen the impact of the shooting on students by inflating grades for the quarter it occurred, long-term negative consequences persisted for many quarters after the event.

To measure the within school effect, I utilized double and triple difference designs for impacted students and impacted females, respectively. Impacted students as a whole observed an initial increase in end of quarter GPA by 0.11 points relative to the average non-impacted UCSB student the quarter of the shooting that, contrary to the schoolwide effect, continued to persist in the quarters following. These results can be seen as the initial shooting quarter effect where professors inflated grades due to sympathy for the students and the persistent effect where students in impacted courses observed an increased desire to graduate earlier, thus receiving better grades in the quarters to come. However, the quarter of the attack also led to a 2.5% increase in dropout rate for impacted students relative to the average UCSB student. Though this effect does not continually persist like end of quarter GPA, it returns to 2.7% exactly one year following the attack. This one-year dropout effect seems to be driven entirely by females within the impacted group, who later drop out at a much lower rate. In other words, impacted students tended to get better grades after the shooting despite dropping out a higher rate. Furthermore, impacted females are much more likely to drop out sooner than their male counterparts.

Section 2 provides background information on the University of California system as well as the 2014 Isla Vista Killings. Section 3 discusses the data used in this study. Sections 4 and 5 analyze the

categorical data and our belief that the missingness in the data is completely random. That is, we have reason to believe that the missingness of our data is independent of both the observable and unobservable characteristics of the sample. Though not employed in this analysis, MICE additionally allows us to create standard errors for the missing data as the method creates multiple potential datasets.

event impact along two different margins–extensive and intensive–implementing different empirical methods to answer the central question: How did the 2014 Isla Vista Killings impact academic achievement for students at the University of California, Santa Barbara? Section 6 concludes.

2 Background

The University of California (UC) is the one of the two major public higher education systems in the state of California. Established in 1869, the University serves over 238,700 students and 198,300 employees within 10 campuses–Berkeley, Davis, Los Angeles (UCLA), Riverside, San Diego, Santa Cruz, Santa Barbara, Irvine, Merced, and San Francisco–the first nine of which house undergraduates.[2] Santa Barbara, in particular, began as a state trade school in the 1880s, only entering the University of California informally in 1944 and officially in 1958. Serving over 18,000 undergraduate and 3,000 graduate students, UCSB stands as the sixth largest UC campus by enrollment and is a highly competitive public research institution with an undergraduate acceptance rate of 32.3%.[3] Furthermore, UC Santa Barbara is surrounded by the unincorporated county of Isla Vista where the majority of residents are college students at UCSB or Santa Barbara Community College.

After the 1999 Columbine High School Massacre, there has been an ever-growing fear with regards to the occurrence of school shootings. Despite the number of homicides steadily decreasing throughout the late 20th century into the 21st century, there has been a surprising lack of clarity regarding the prevalence of targeted school violence.[4] In Figure 1, I chart the number of fatal school shootings from 1990 to 2018.[5] Though the number of school shootings remained constant from 1990 through the first five years of the 21st century, 2006 marked a shift upwards in the number of fatal incidents. More so, starting after 2007, potentially inspired from the Virginia Tech shooting on April 16, 2007, the number of college related incidents increased dramatically. Fatal school shoot-

[2]Statistics from: https://www.universityofcalifornia.edu/uc-system

[3]Statistics from: http://admission.universityofcalifornia.edu/campuses/santa-barbara/freshman-profile/index.html

[4]Vossekuil et al. (2002) in a 2004 findings report for the United States Secret Service and United States Department of Education found that at the time the chance of a student dying in a school related homicide was "no greater than 1 in 1 million"

[5]A fatal school shooting is defined as a shooting that occurred on or near a school with the students or instructor as a target. The shooting must include at least one fatality not including the perpetrator. Shootings where an instructor shot another instructor without targeting students is not considered a school shooting in this case but rather a workplace shooting. The chart was created by scraping data from Wikipedia and aggregating shooting type by year. Then utilizing a word bank, I sorted each shooting into either a college/university level shooting or not and generated Figure 1 below. It is important to note that the Wikipedia page was created in 2012.

ings mirror the positive trends of mass shootings in the United States (Blair and Schweit (2013)), becoming an increasingly prevalent part of American life. These numbers suggest that the fears and consequences surrounding shootings are not unfounded, but rather of growing concern.

The 2014 Isla Vista Killings is an example of a modern school shooting. On May 23, 2014, Elliot Rodger, a 22-year-old former Santa Barbara Community College student opened fire at UCSB students are various locations on Isla Vista. Earlier that morning he stabbed his three roommates to death and posted both a video and a 141-page manifesto, titled *My Twisted World: The Story of Elliot Rodger*, that laid out both the motives and the plans for the attack.[6] In this manifesto, Rodger described feelings of social isolation, particularly from women, and called for a utopian society where he could punish any female for denying him sexual intercourse. This attack ultimately led to the death of seven individuals (including the perpetrator) and fourteen more injured. All six of the individuals slain and nine of the fourteen injured by Rodger were enrolled students at UC Santa Barbara. The day after the incident, the campus cancelled courses and issued a memorial service in honor of the victims. However, courses would ultimately continue as normal until the end of the quarter.

Two weeks before the end of the quarter and 4 weeks after the killings, the University of California issued a bi-annual cross-campus survey, called the University of California Undergraduate Experience Survey (UCUES), where students were asked various question regarding their holistic and campus-specific experience at the UC. Table 1 shows the response to one question: "Rate the general climate at UC Santa Barbara" for the year of the shooting (2014) and the years following. 2014 respondents were more prone to denote the campus climate as dangerous than those who responded in subsequent years, suggesting potential consequences from the from the event.

Despite Rodger's death, the motives of the 2014 Isla Vista Killings were clear. Fueled by the disdain for his status quo, the attack is extremely similar to other modern school shootings with the use of sophisticated weaponry and targetted malicious intent. With many more incidents such as the Umpqua Community College shooting directly referencing the Isla Vista Killings as inspiration, the attack has become a baseline for school and other mass shootings following it. However, what makes the Isla Vista incident slightly different than most shootings was the fact that it occurred off-campus and at various locations around the city, though near the university. A vast majority of the

[6]Link to full text: https://www.nytimes.com/interactive/2014/05/25/us/shooting-document.html

victims were still students attending UC Santa Barbara and much like many other school shootings, the students were the intended targets.

3 Data

The primary data used in this analysis is an administrative University of California enrollment database collected by the UC Office of the President. It contains a record for each course that an individual took from 2011 to 2018 at four University of California campuses–Davis, Irvine, Riverside, and Santa Barbara–totaling over 8 million records. The course-level data includes unique anonymized indicators for individual students, basic application data (SAT/adjusted ACT, high school GPA, admission type, etc.) as well as grades, units, and course information (course name, course department, course year, etc.). In addition, graduation quarter and incidence was recorded in the data as well. The data was then rolled up to the student level per each quarter. Note that all summer quarters were removed for the analysis. While the data was mostly comprehensive, one quarter for a single campus remained missing in the data. The quarter immediately preceding the incident, Winter 2014, for UC Santa Barbara is not recorded. The data for this quarter was imputed through Multivariate Imputation by Chained Equations (MICE)[7] at the campus-level for the synthetic control method and excluded for the difference-in-difference analysis.

The data also included identifiers for individuals who were either killed or injured during the incident. In context of the data at hand, it contains data for six students who were killed during the shooting and nine students who were injured from the event. The additional six individuals who were injured in the incident were not students enrolled at any of the UC campuses and therefore are not represented in the data. For the victims who were fatally wounded in the incident, all records with respect to their final quarter of attendance (Spring 2014) at UC Santa Barbara was not recorded.

Summary statistics for the extensive margin are recorded in Table 2. The pool of control campuses includes UC Davis, UC Riverside, and UC Irvine. On average, students from the control pool tended to differ from UC Santa Barbara students with regards to demographics. Students at UCSB were slightly more male, whiter, and more likely to be a freshman admits. UC Santa Barbara also seemed to be a more selective school relative to our control pool with higher average application

[7] See footnote 1

GPAs (high school and transfer) and average SAT/adjusted ACT scores. Additionally, after enrollment, students at UC Santa Barbara were far less likely to take engineering courses despite being enrolled a similar number of units and Upper-Division courses in a given quarter.

When comparing UC Santa Barbara to its synthetic counterparts (similarly in Table 2), the differences generally very similar to those reported against the average control pool. The end of quarter GPA synthetic cohort was even less white and took less units than actual UC Santa Barbara students. The C or Below synthetic cohort averaged a similar high school GPA to the real UC Santa Barbara though, once again, took far less units. The Dropout synthetic cohort shared all the same differences as the average of the control pool with the exception of similar high school and transfer GPAs to the real UC Santa Barbara population.

Table 5 shows descriptive statistic for the intensive margin. Impacted students are defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. In this case, I observe 376 students that fit this criterion. Compared to the non-impacted students, impacted students were just as female and just as likely to be a freshman admit though far less likely to be an international student. Additionally, impacted students recorded lower high school and transfer GPAs on average. While enrolled, though impacted students recorded taking more units, upper-division, and engineering courses, the magnitude of values do not imply a large difference between the two cohorts.

4 Extensive Margin

In order to measure the aggregate effects of the shooting for a single treatment group, I employ a technique developed by Abadie and Gardeazabal (2003) and extended by Abadie et al. (2010)–the synthetic control method (SCM). Under this approach, a weighted combination of control campuses are used to construct an estimate of the treatment campus from a set of shared covariates–known as the synthetic control. After the shooting takes place, the synthetic control can be used as a counterfactual for the treatment campus had the shooting not occurred by looking at the difference in outcome trends after the exogenous shock.

Using panel data, we observe $I_C + 1$ campuses over T periods. Only one campus, Santa Barbara receives the treatment (the shooting) at time T_0, while the remaining campuses do not. Thus the

treatment effect for Santa Barbara at time t can be defined as:

$$\tau_{it} = Y_{it}(1) - Y_{it}(0) = Y_{it} - Y_{it}(0) \tag{1}$$

where $Y_{it}(1)$ and $Y_{it}(0)$ stand for the potential outcome with and without the treatment for campus i at time t, respectively. The estimated outcome of interest, the vector τ_{it}, is complicated by the fact that we do not directly observe $Y_{it}(0)$, the true counterfactual.

Abadie et al. (2010) identify the counterfactual by following the general model:

$$Y_{jt}(0) = \delta_t + \nu_{jt} \tag{2}$$

$$Y_{jt}(1) = \tau_{jt} + \delta_t + \nu_{jt} \tag{3}$$

with $j = 1, ..., I_C + 1$. Given the treatment assignment is the same as above and only non-zero when $j = i$ and $t \geq T_0$. Thus one can see that besides τ_{jt}, the potential outcomes are dependent purely on a common factor δ_t and the error ν_{jt}. Assume that ν_{jt} can be expressed by the following model:

$$\nu_{jt} = Z_j\theta_t + \lambda_t\mu_j + \epsilon_{jt} \tag{4}$$

where Z_j is a vector of relevant observed covariates that are not affected by the event; θ_t is a vector of time-specific parameters; μ_j is a campus specific unobservable; λ_t is an unknown common factor; and ϵ_{jt} are zero-mean shocks. Note that j-subscript the Z-vector does not impose restrictions on the covariates in the model as long as they are independent from the event.

Within the context of the Isla Vista Shootings, all the elements of Z_j (Sex, Race, Admit Type, High School GPA, Transfer GPA, SAT/Adjusted ACT, Average SAT of High School, Total Units, Number of Upper-Division Courses, Number of Engineering Courses, and Number of Students) refer to the pre-shooting period. Due to the fact that the perpetrator was not an enrolled student at UCSB, it can be assumed that none of these variables are directly correlated with the occurrence of the killings.

Define $W = (w_1, ..., w_{I_c})'$ as a $(I_C \times 1)$ vector of weights such that $w_j \geq 0$ and $\sum w_j = 1$. Each w_j corresponds to a synthetic control weight for a particular campus i. Abadie et al. (2010) choose

w^* such that

$$\sum_{j=1}^{I_C} w_j^* \bar{Y}_j^k = \bar{Y}_i^k \quad \text{and} \quad \sum_{j=1}^{I_C} w_j^* \bar{Z}_j^k = \bar{Z}_i^k \tag{5}$$

and thus

$$\hat{\tau}_{it} = Y_{it} - \sum_{j=1}^{I_C} w_j^* \bar{Y}_j^k \tag{6}$$

is an unbiased estimate of τ_{it}. Weights, w^*, are estimated through the minimization of distance between a vector pre-treatment characteristics of the treated campus and a vector of pre-treatment characteristics of the control campuses. The distance is defined as:

$$\|X_1 - X_0 w\|_v = \sqrt{(X_1 - X_0 w)' V (X_1 - X_0 w)} \tag{7}$$

where X_1 is the vector of pre-treatment chracteristics for the treatment campus and X_0 is the matrix for pre-treatment characteristics for the control campuses. V is symmetric and positive semidefinite matrix.

Therefore in the context of this paper, the synthetic control method estimates a predicted counterfactual from the control campuses, UC Davis, UC Riverside, and UC Irvine, with a weighted average of their outcomes. By construction of the algorithm, the predicted counterfactual's covariates should be extremely similar to that of the treatment group, UC Santa Barbara. Since the incident of interest is the 2014 Isla Vista Killings which occurred three weeks before the end of the academic quarter, the predicted aggregate effect of the shooting would be the difference between the actual outcomes and the synthetic outcomes for the quarter including the shooting and thereafter. The outcomes of interest include: end of quarter GPA (on a 4.00 scale), the percentage of students who received a C or below in any class, and the dropout rate of the quarter in question.[8]

To conduct tests of inference for the synthetic controls, I employ placebo experiments utilizing permutation techniques as described by Abadie et al. (2010). By sequentially applying the synthetic control algorithm onto every unit of the potential control group as the treatment, I am able to compare the each placebo difference to the baseline results. In other words, by estimating τ_{it} for all subjects within our donor pool, the true treated effect can be compared to each of these placebos and a

[8]In this context, to drop out is defined as failing to complete a degree at the UC system and no longer taking courses. That is, students who transferred campuses within the UC system and completed or are continuing to take classes are not considered dropouts.

significance statistic can be formed. However, note that since the donor pool in this study only contains 3 campuses outside of our treatment campus, the maximum significance for a single quarter effect is $p = 0.25$. However for a multi-period effect, by randomly re-assigning treatment effects for different periods from both the predicted outcome effect and placebo experiments, we can construct a measure of significance by then comparing the observed effect to the permutation distribution.

Further limitations of this design within the context of this study are: (i) the fact that our number of potential control campuses only numbers to 3, and (ii) the number of pre-period observations are limited to only 5 periods before the shooting ($T_0 - 5$). Problems regarding the number of potential controls not only limit the effectiveness of creating accurate weights, but inhibits our ability to create significant inference tests for single period effects as discussed above. Having insufficient periods preceding the incident would only hurt the estimation of the weights. However, as discussed in the Section 3, the set of potential controls match well with Santa Barbara, though slightly underestimated.

Table 2 shows the weighted mean covariates for each of the synthetic controls with the respective per-campus-per-outcome weights displayed in Table 3. As discussed previously, the synthetic UCSBs are generally underestimated with respect to the covariates compared to the real UCSB. This is most notable with regards to white student population, SAT/Adjusted ACT (2400 point scale), Total Units, and Number of Upper-Division Courses. In general, it can be noted that on average, students from our synthetic controls tend to be more ethnically diverse, arrive at UCSB with lower test scores (SAT/Adjusted ACT), and enroll in fewer classes, though a higher percentage of those classes are upper division courses.

Figure 2 Panel A plots the trends in each of our outcomes of interest: end of quarter GPA (on a 4.00 scale), the percentage of students who received a C or below in any class, and the dropout rate. Contrary to what may have been expected, UC Santa Barbara observed an upward shift in average GPA the quarter of the shooting with an estimated increase of 0.03 GPA points relative to the synthetic control. In other words, despite the shooting occurring three weeks before finals, the average end of quarter GPA of a student moved in a positive direction. This can be interpreted as grade inflation across the campus. Due to the close proximity to final exams, professors may have artificially boosted the final grades as an attempt to offset the traumatic event, understanding the duress of students. However, the periods after the shooting tell a different story with the average

GPA falling below the synthetic control by an -0.05 GPA points (Table 4) and an extreme of -0.09 GPA points. These differences can be categorized as the long-term effects of the shootings on the student population. Though the T_0 and single period $t > T_0$ effects are only significant at $p = 0.25$ and $p = 0.5$ (Figure 2 Panel B), respectively, they tell a compelling story regarding the actions the administration took versus the long-term impact on the students. The persistent effects as described by average decrease in -0.05 GPA points for the periods following the attack is significant at $p = 0.108$, thus further substantiating the claim regarding the existence of long-term effects on the UC Santa Barbara populace compared to their UC peers.

The percentage of students who earn a C or lower follow similar trends to end of quarter GPA effects. Though there is no impact the quarter of, signaling that students who were going to do poorly in a course observed little to no impact at T_0, the quarters after show similar effects to the average GPA. Following the shooting, students at UC Santa Barbara observed an average increase in percent of students who earned a C or lower of about 2.1% relative to the synthetic control, significant at $p = 0.013$ (Table 4), once again pointing towards significant long-term negative effects on the general UC Santa Barbara populace. However, when taking a look at dropout rates, there appears to be no significant difference between the synthetic control and the actual sample for both the period of the shooting as well as the following quarters.

Ultimately, these results show the overall impact that the shooting had on the students at UC Santa Barbara. They suggest that although there may have been attempts to mitigate the damage the quarter of the shooting, the incident a had long-term negative net impact on the student population. While students were no more likely to drop out of UCSB, they observed negative repercussions with respect to their academic performance overall.

5 Intensive Margin

In addition to understanding the overall effect the event had on UC Santa Barbara students, it can be significant to look at how the 2014 Isla Vista Killings differentially impacted academic success for various students groups within the school as well. In particular, those who were related or familiar with the victims of the incident may have observed larger repercussions relative to the average student at the campus.

5.1 Impacted Students

To study this, I developed a social network of students based off relationships within specific courses. By analyzing the courses taken in Spring 2014, the quarter of the incident, I am able to construct a group a students who were potentially more familiar with the non-fatally wounded individuals than the average UC Santa Barbara student. Impacted individuals are defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. Modeling the event as an exogenous shock, I conducted a difference-in-difference analysis to measure the differential impact of the shooting on academic success for closely related students:

$$Y_{st} = \alpha_{H_s} + \beta(IM_s * Post_t) + \theta_1 IM_s + \theta_2 Post_t + \gamma X_{st} + \epsilon_{st} \tag{8}$$

where Y_{st} is the End of Quarter GPA (4.00 Scale), a C or below in any course indicator, or dropout indicator for student s at time t. The shooting occurred at $t = 0$ and the estimate of interest, β, measures how academic performance is impacted following the attack; IM_s indicates if student s was an impacted student; $Post_t$ indicates if $t \geq T_0$; α_{H_s} are high school fixed effects for student s; X_{st} is a vector of permanent student characteristics such as high school GPA, SAT/adjusted ACT score, admission type, etc. for student s at time t; and ϵ_{st} represent the unobservable characteristics of student s at time t assumed to be orthogonal to other predictors. The academic achievement model is estimated by OLS over all students enrolled at UCSB from 2011 to 2018 where the quarter right before the shooting, Winter 2014, is missing and summer quarters are excluded.[9]. Errors are robust.

In order to measure effects per quarter, the following specification was utilized:

$$Y_{st} = \alpha_{H_s} + \delta_t + \beta_t IM_s + \gamma X_{st} + \epsilon_{st} \tag{9}$$

where the estimates of interest β_t measure the how academic achievement is impacted at t periods after the attack; δ_t are time fixed effect; all other variables are the same as the previous specification. Indicators for six and seven quarter prior to the event are omitted.

Figure 6 shows that the 2014 Isla Vista Killings led to a 0.05 point average increase in end of quarter GPA for impacted students relative to their non-impacted peers. Additionally, Panel

[9] All OLS estimation in this study is conducted using the *felm* function in the *lfe R* package, version 2.8-2.

A in Figure 3 shows that impacted students observed an additional 0.11 point increase in end of quarter GPA the quarter of the shooting relative to the average non-impacted peer. Interestingly enough, the additional increase in GPA persisted for periods after the shooting, with one and three quarters following the shooting recording an approximately 0.09 point increase at a 10% significance level. Despite evidence of grade inflation, the percentage of students who earned a C or lower was statistically indistinguishable from the both the pre-trend and the rest of UCSB's population.

What caused these trends with academic success? Whereas the immediate GPA effects could be attributed to preferential treatment by professors who affected by the involvement of their students in the attack, the persistent effects tell a different story. Students may have been more motivated to graduate from UCSB after being in close proximity to the shooting. That is, the event inspired students to dedicate themselves to graduating as soon as possible in the periods following the shooting and thus earning better grades. Another hypothesis revolves around ideas of self-efficacy and social capital. In other words, since impacted students observed a pronounced upwards grade effect the quarter of the shooting, this may have boosted their sense of self-efficacy and led to higher rates of academic success (in this case GPA) down the road.[10]

In addition to grade effects, impacted students also observed substantial differential dropout rates. The shooting led to a 2.5% increase in dropout rate for impacted students relative to the average UCSB student the quarter of the attack. To put that in perspective, the average dropout rate at UC Santa Barbara across 2011 to 2018 was only 12%. Though this effect fails to persist the quarter immediately after, we observe that a full year after the shootings, the differential dropout rate returns to 2.7%. This effect peaks five quarters out with a differential dropout out rate of 4%. In essence, impacted student became far more likely than the average non-impacted student to drop out both in the immediate and long-term.

The findings suggest that impacted students tended to drop out at a higher rate regardless of the grades that they achieved. In the quarter of the attack itself, the spike in dropout rate could be explained by a natural reaction to a school shooting as students, as well as potentially parents, may have not wanted to be directly linked to the violent incident. Despite the average impacted student earning higher grades following the incident, they tended to drop out at a much higher rate.

[10]Richardson et al. (2012) find medium sized correlations with academic self-efficacy and academic achievement. Vuong et al. (2010) find similar results through an analysis of sophomore students at the California State University system in particular, they relate a sense of self-efficacy with GPA as well as college persistence rates.

This conundrum could be interpreted as the long-term psychological effects of the shooting itself. That is, despite performing better academically than the average student at UCSB, factors such as mental health and comfortability on campus pushed impacted students to drop out at much higher and regular rate.

5.2 Impacted Females

The motivations for the 2014 Isla Vista Killings provides us with another subgroup of students to study. With Elliot Rodger's posting of his "Retribution" video and manifesto during incident, it was clear the backdrop of the attack was misogynistic in nature. With these motives in mind, I analyze the differential impact that the attack had on female students by employing a triple difference for female students within the impacted group defined in the previous section. In other words, we define the group of interest as female students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. To measure quarterly effects, the model is as follows:

$$Y_{st} = \alpha_{H_s} + \delta_t + \beta_t IM_s + \beta'_t IM_s F_s + \delta_t F_s + \theta F_s IM_s + \gamma X_{st} + \epsilon_{st} \tag{10}$$

where Y_{st} is the end of quarter GPA (4.00 Scale), a C or below in any course indicator, or dropout indicator for student s at time t; the shooting occurred at $t = 0$; β_t measures how academic performance is impacted at t periods from the attack; IM_s indicates if student s was an impacted student; F_s indicates if individual s is female; thus β'_t is our outcome of interest defined as the differential impact for females at time t; α_{H_s} are high school fixed effects for student i; δ_t are time fixed effect; X_{st} is a vector of permanent student characteristics such as high school GPA, SAT/adjusted ACT score, admission type, etc. for student s at time t; and ϵ_{st} represent the unobservable characteristics of student s at time t assumed to be orthogonal to other predictors. The academic achievement model is estimated by OLS over all students enrolled at UCSB from 2011 to 2018 where the quarter right before the shooting, Winter 2014, is missing and summer quarters are excluded. Effects of quarters six and seven prior to the event are omitted. Errors are robust.

Panel B in Figure 3 shows the additional impact that the attack had on females relative to the impacted cohort. The results suggest that with regards to both end of quarter GPA and earning a

C or below in any course, there was no difference between impacted males and females. However, when observing the dropout rate, the results suggest that while females were no more likely to drop out in the period of the shooting, they were the driving force behind the dropout rate three quarters post-incident. In other words, impacted females tended to drop out at the end of the year following the attack at a 5% higher rate than males. This suggests that they were the driving force behind the first post-year dropout spike for the impacted students. This effect is almost immediately followed by a statistically significant decrease of about -6% in dropout rate five quarters from the shooting. This offsetting effect can be seen as a side effect of the initial dropout increase as students who would have dropped out five quarters out had already dropped out two quarters prior. Being more personally targeted by the attack may have been a driving factor for why impacted female students dropped out sooner than their male counterparts.

5.3 Robustness Checks

In this section, I show that the main results for the intensive margin are robust to different definitions of an impacted student, as well as the removal and addition of covariates. In previous sections, impacted students were defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. I expand this definition to include courses with less than 70 students. Then, utilizing the same difference-in-difference and triple difference framework noted above for impacted students and impacted females, I show that the main effects of the analysis remain robust.

Figure 4 estimates the incident effects for the expanded cohort of impacted students. Impacted students in this case were defined as students who were enrolled in a Spring 2014 course with section sizes less than 70 students that contained at least one individual who was injured in the Isla Vista Killings. The comparison between Figure 4 Panel A to Figure 3 Panel A shows that the general trends following the shooting remains relatively the same for both definitions of the impacted group. Students in the expanded definition tended to experience pre-trends with respect to end of quarter GPA. That is, individuals within the expanded definition of impacted, has statically higher GPAs than the average student prior to the attack. However following the shooting, the event schick is just as substantial as our smaller cohort. Trends following dropout rates for the expanded cohort of both impacted students and impacted females remained just as significant as the smaller cohort.

Figure 5 shows that the effects on academic achievement for impacted students remained robust to various specifications of the difference-in-difference design. That is, the effects following the attack remained significant regardless if covariates such as years at UC, admissions controls (high school GPA, transfer GPA, SAT/adjusted ACT, and admit type), or high school fixed effects were included in the model. Panel A shows that GPA effects following the shooting are generally unaffected by the addition or subtraction of different covariates. Panel B shows similar results with respect to dropout rates. That is, the immediate, one-year, and long-term dropout effects remain significant regardless of covariates. This claim is substantiated in Table 7 where the addition of covariates has little impact on the β estimate of the event with respect to student dropout. However, when observing the effect of the shooting relative to end of quarter GPA, the addition of the years at UC variable leads to the effect being halved. Despite the average impact of the shooting on end of quarter GPA effectively being halved, the effect remains both significant and robust against the addition of other covariates.

Figure 6 additionally shows that impacted female effects remain robust to the addition and subtraction of covariates. Regardless of the existence of covariates in our fully specified model, the one-year and five-month effects remain both present and significant.

6 Conclusion

Tragedies have large-scale impacts reaching far beyond those directly involved. This study examines the effect of a particular shooting, the 2014 Isla Vista Killings, on three students groups–the overall campus, students who shared courses with the victims, and females within that subset– with respect to academic achievement at the University of California, Santa Barbara.

By the time Elliot Rodger killed himself on May 23, 2014, it had been 30 minutes since he first opened fire and had claimed the lives of six victims and left fourteen others injured. There were only three weeks remaining in the quarter. When the school year finally came to a close, contrary to what is often expected with traumatic events, the average GPA at UC Santa Barbara increased along with a dip in the number of students who received a C or lower in any course. This effect, seen as administrative grade inflation, would only persist for the quarter of the shooting. Afterwards, students on average would exhibit a persistent -0.05 point decrease in average GPA and

a 2% increase in receiving a grade C or lower for at least a year following the incident.

Within UC Santa Barbara, students that were directly impacted by the shootings were those that exhibited the largest effect with respect to academic performance. Impacted students observed higher GPAs around a magnitude of 0.11 GPA points higher than the average UCSB student the quarter of the shooting, an effect that continued to persist far after the event; once again evidence of professor-level grade inflation possibly rolling into self-efficacy effects. However at the same time, these impacted students observed much larger dropout rates, 2.5% higher than the average UCSB student, immediately following the attack. In particular, impacted females were the most susceptible to the effects of the shooting, dropping out at a 5% higher rate one year after the incident.

This study is restricted to only analyzing student-level academic achievement at the University of California, Santa Barbara following the 2014 Isla Vista Killings. In many ways school shootings could have a larger impact on the student body beyond grades and dropout rates. In particular, University of California students participated in a UC-wide survey, called UCUES, a few eeks following the shooting that could plausibly identify psychological effects (along both margins) that drove administrative changes.[11] Linking results from this survey to students at the UC campuses could provide valuable insight on how students were impacted. Additionally, this project does not provide evidence for long-term effects that may persist beyond schooling. These are important questions left to future research.

[11] Source: http://bap.ucsb.edu/institutional.research/ucues/

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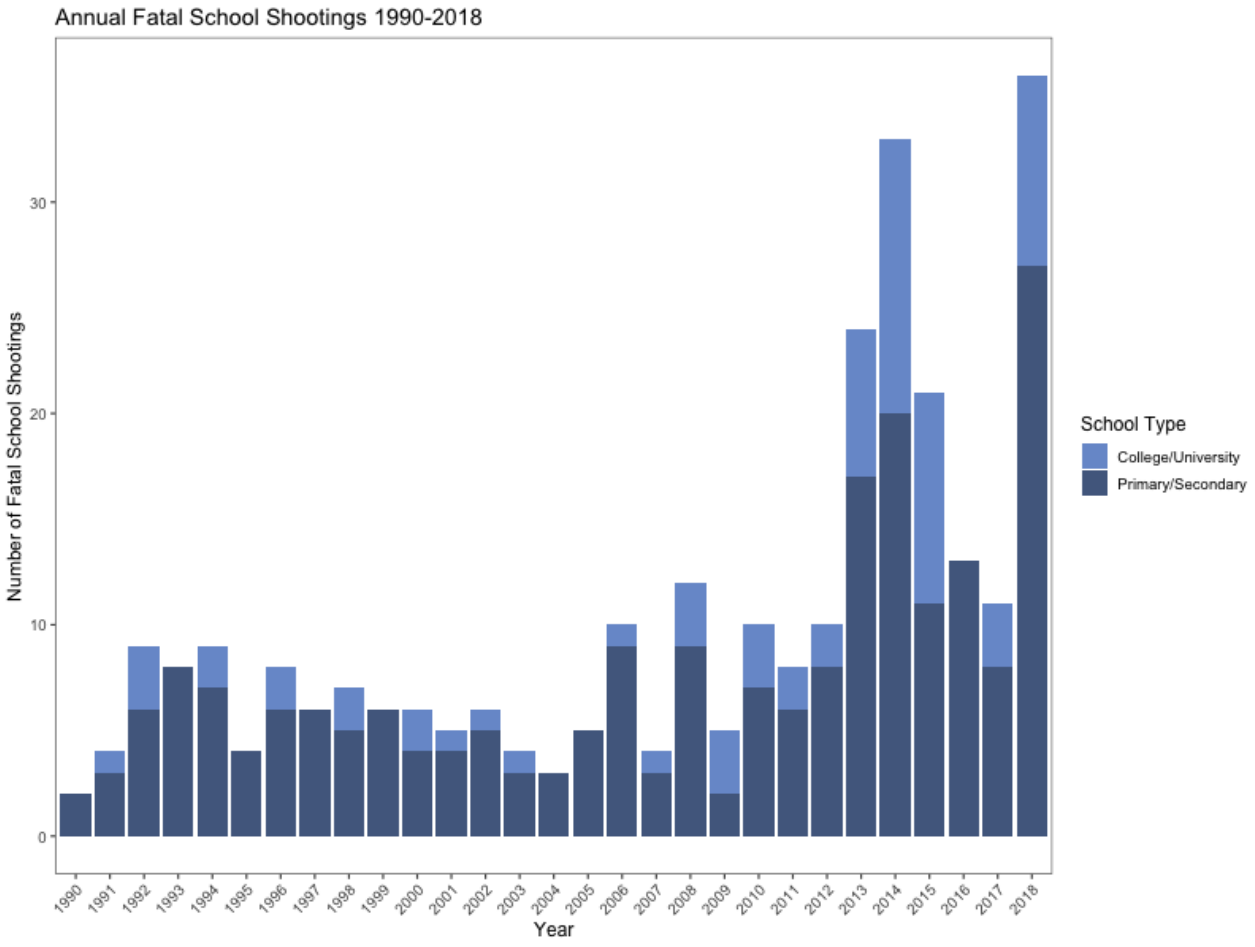
Figure 1: Fatal School Shootings by Year



Note: The figure shows the number of fatal school shootings for each year from 1990 to 2018. A fatal school shooting is defined as a shooting that occurred on or near a school with the students or instructor as a target. The shooting must include at least one fatality not including the perpetrator. Shootings where an instructor shot another instructor without targeting students is not considered a school shooting in this case but rather a workplace shooting. Data source: Wikipedia.

Table 1: University of California Undergraduate Experience Survey (UCUES) Results for General Climate Question, 2014 to 2018

	Rate the general climate at UC Santa Barbara						
	Safe					Dangerous	
	1	2	3	4	5	6	Grand Total
UCUES 2014	273	709	726	502	234	83	2,527
	(11%)	(28%)	(29%)	(20%)	(9%)	(3%)	(100%)
UCUES 2016	1,191	2,067	1,757	670	205	58	5,948
	(20%)	(35%)	(30%)	(11%)	(3%)	(1%)	(100%)
UCUES 2018	1,202	2,033	1,470	440	115	36	5,296
	(23%)	(38%)	(28%)	(8%)	(2%)	(1%)	(100%)

Note: Results for University of California Undergraduate Experience Survey (UCUES) for 2014, 2016, and 2018. Students were asked to "Rate the general climate at UC Santa Barbara" from Safe (1) to Dangerous (6). The survey was given 2 weeks before the end of classes and response rates range from 25 percent to 45 percent. Source: https://www.universityofcalifornia.edu/infocenter/ucues-data-tables-main

Table 2: Covariates and Outcome Means - Synthetic Santa Barbara

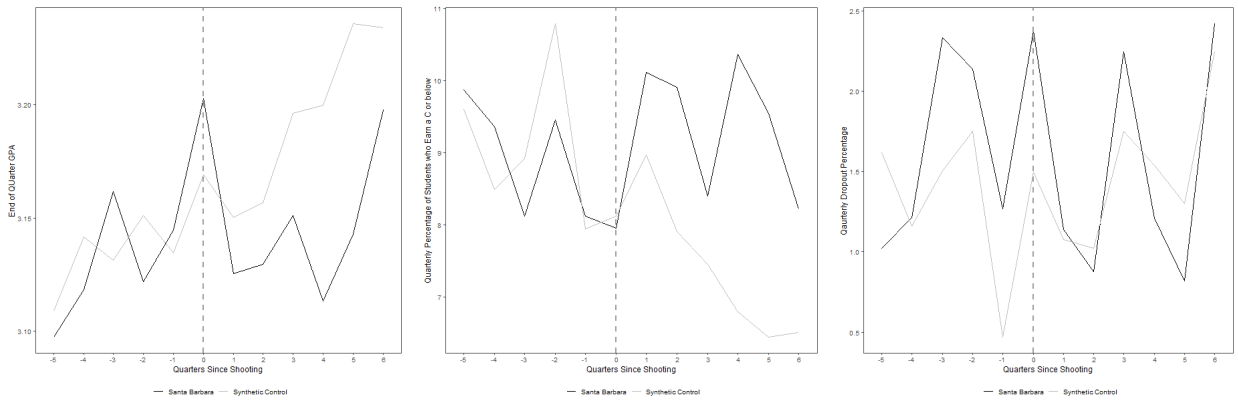
		Synthetic Controls			
	UC Santa Barbara	End of Quarter GPA	C or Below	Dropout	Average of 3 Control Campuses
Male	47.5%	4.62%	46.0%	4.59%	4.53%
White	3.63%	16.7%	18.4%	20.7%	20.2%
Freshman Admit	8.35%	82.8%	82.7%	82.6%	80.2%
International Student	3.7%	3.8%	4.1%	4.4%	4.0%
High School GPA (5.00 Scale)	3.872	3.798	3.840	3.884	3.797
Transfer GPA (4.00 Scale)	3.526	3.325	3.368	3.418	3.299
SAT/Adjusted ACT (2400 pt scale)	1,838	1,712	1,732	1,756	1,728
Average SAT of High School (2400 pt scale)	1,755	1,705	1,711	1,719	1,712
Total Units	11.977	10.404	9.995	9.610	11.694
Number of Upper-Division Courses	1.513	1.274	1.262	1.255	1.446
Number of Engineering Courses	0.113	0.173	0.157	0.140	0.253
Number of Students	19,190	20,181	20,241	20,267	21,873
End of Quarter GPA (4.00 Scale)	3.142	3.144	3.169	3.194	3.070
C or lower in Given Quarter	9.1%	8.6%	8.0%	7.4%	1.11%
Dropout per Quarter	1.6%	1.5%	1.4%	1.3%	1.5%

Note: The table shows the mean values of the covariates and outcome variables for students enrolled at 4 University of California campuses (Davis, Riverside, Santa Barbara and Irvine) from 2012 to 2017, averaged across aggregate quarterly rates. Outcomes: End of quarter GPA (4.00 Scale), C or Below (if a student earned a C or below in any class in said quarter), and Dropout (if a student does not continue courses at said campus and does not achieve a UC degree). Covariates: Male, White, Freshman Admit, International Student, High School GPA, Transfer GPA, SAT/Adjusted ACT, Average SAT of High School, Total Units, Number of Upper Division Courses, Number of Engineering Courses, and Number of Students. Covariates are averaged across the pre-treatment period, Fall 2012 to Winter 2014. Column 1 contains the averages for our treatment group, UCSB. Columns 2, 3 and 4 refer to synthetically weighted samples for UCSB generated from UCD, UCR and UCI. The dependent variable is noted above the respective columns and is averaged across the entire sample period. Column 5 contains the popluation weighted averages for the 3 control states.

Figure 2: Estimated Effect of Shooting on Academic Performance for UC Santa Barbara vs. Synthetic Control

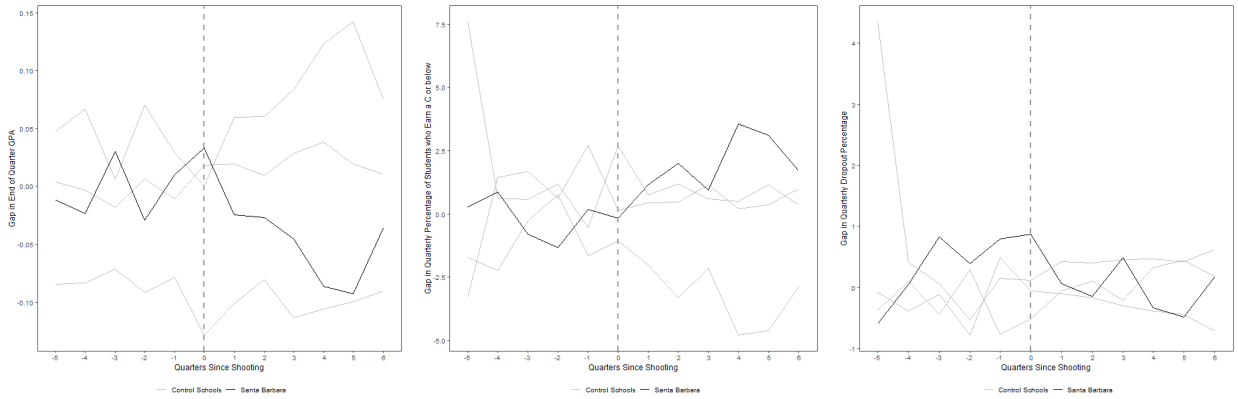
Panel A: Outcome Trends, UC Santa Barbara vs. Synthetic Control

(a) End of quarter GPA (b) Course grade lower than a C (c) Dropout rate



Panel B: Placebo Experiments

(d) End of quarter GPA (e) Course grade lower than a C (f) Dropout rate



Note: Actual versus synthetic control estimates for the effect of the 2014 Isla Vista Killings. Treatment group: UC Santa Barbara. Control Pool: UC Davis, UC Riverside, UC Irvine. Outcomes: End of quarter GPA (4.00 Scale), C or Below (if a student earned a C or below in any class in said quarter), and Dropout (if a student does not continue courses at said campus and does not achieve a UC degree) Covariates: Male, White, Freshman Admit, International Student, High School GPA, Transfer GPA, SAT/Adjusted ACT, Average SAT of High School, Total Units, Number of Upper Division Courses, Number of Engineering Courses, and Number of Students.

Panel B shows the differential outcomes relative to the respective synthetic control. Solid line: outcome difference between each treated campus and its synthetic control. Dashed lines: outcome difference between each of the treated campus's potential controls and their synthetic control in placebo experiments.

Table 3: Campus Weights in Synthetic Santa Barbara

	Outcome		
	End of Quarter GPA	C or Below	Dropout
Davis	0.244	0.129	0.002
Riverside	0.00001	0.073	0.179
Irvine	0.756	0.798	0.818

Note: The table above shows the weights applied to each of variables in the control pool, three other UC campuses, to create the synthetic control. Each column denotes the dependent variable used in the estimation of the synthetic control method.

Table 4: SCM - Estimated Average Persistent Effect of Shooting

	Outcome		
	End of Quarter GPA	C or Below	Dropout
Average Effect	-0.052	2.1%	-0.04%
Permuation p-value	0.108	0.013	0.824

Note: The table above shows the average estimated effect of the shooting for six quarters following the attack beginning from the first quarter after the event utilizing the synthetic control method (SCM). Significance was calculated utilizing the joint permutation tests by randomly re-assigning treatment effects from both the predicted outcome effect and placebo experiments. The average predicted effect is then compared to the two-sided permutation distribution.

Table 5: Descriptive Statistics/Selected Variables for Impacted and Non-Impacted Students, Class Size < 35

	Control Group	Treatment Group	
	Non-Impacted	Impacted	Equality Test vs. Pop
Female	52.9%	53.5%	0.840
Freshman Admit	76.8%	78.2%	0.512
International Student	3.3%	2.7%	0.457
High School GPA (5.00 Scale)	3.865	3.799	0.0002
Transfer GPA (4.00 Scale)	3.503	3.387	0.0001
SAT/Adjusted ACT (2400 pt scale)	1,839	1,832	0.564
Total Units	12.261	12.608	0.0003
Number of Upper-Division Courses	1.707	1.780	0.036
Number of Engineering Courses	0.118	0.190	0.006
Years at UC	3.140	3.151	0.646
End of Quarter GPA	3.057	3.031	0.563
C or lower in Given Quarter	16.0%	14.3%	0.100
Dropout	11.9%	8.5%	0.019
Observations	50,121	376	–

Note: The table above shows the descriptive statistics and outcome variables for students enrolled at University of California, Santa Barbara from 2011 to 2018. Impacted Students are defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. The control group is made up of students attending University of California, Santa Barbara who are not in the treatment group. Data excludes individuals who did not recieve a final grade and all summer quarters. The quarter before the attack, Winter 2014, is missing from the data. The descriptive make-ups of the different student groups are noted above. Columns 1 and 2 show the average make up for each of the variables for the groups of interest. Columns 3 shows the p-value for the difference in means between the control group and the treatment group.

Table 6: Estimated Average Effect of Shooting on Academic Achievement for Impacted Students, Class Size < 35

	Dependent variable:		
	End of quarter GPA	Course Grade lower then a C	Dropout
	(1)	(2)	(3)
Post Shooting	0.004^{**}	0.002^{*}	0.002^{***}
	(0.002)	(0.001)	(0.0005)
Impacted	-0.011	-0.006	-0.014^{***}
	(0.014)	(0.009)	(0.003)
Impacted:Post Shooting	0.050^{**}	-0.015	0.018^{***}
	(0.021)	(0.013)	(0.005)
SAT/Adjusted ACT	0.0005^{***}	-0.0002^{***}	-0.00002^{***}
	(0.00001)	(0.00001)	(0.00000)
High School GPA	0.156^{***}	-0.064^{***}	-0.012^{***}
	(0.007)	(0.004)	(0.002)
Transfer GPA	0.273^{***}	-0.092^{***}	-0.009^{***}
	(0.007)	(0.004)	(0.001)
Freshman Admit	0.243^{***}	-0.058	0.025
	(0.080)	(0.049)	(0.018)
Years at UC	0.049^{***}	-0.010^{***}	0.002^{***}
	(0.001)	(0.0004)	(0.0002)
HS GPA:SAT/Adjusted ACT	-0.00002^{***}	0.00001^{***}	0.00000^{***}
	(0.00000)	(0.00000)	(0.00000)
Transfer GPA:SAT/Adjusted ACT	-0.0001^{***}	0.00005^{***}	0.00000^{***}
	(0.00000)	(0.00000)	(0.00000)
High School Fixed Effects	Yes	Yes	Yes
Observations	365,797	365,797	365,797
R^2	0.128	0.048	0.033
Adjusted R^2	0.119	0.038	0.023
Residual Std. Error	0.578	0.354	0.127

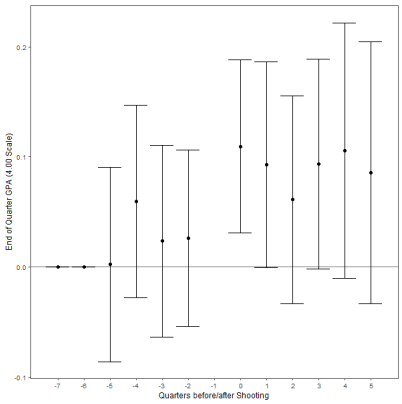
*p<0.1; **p<0.05; ***p<0.01

Note: Difference-in-Difference estimate of the average effect of the 2014 Isla Vista Killings on impacted students compared to non-impacted peers estimated from Equation 8. Impacted students are defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. The sample includes individuals enrolled at UCSB from 2011 to 2018 who recieved a final grade, excluding summer quarters. The quarter before the attack, Winter 2014, is missing from the data. OLS regressions control for years at UC, admissions variables (high school GPA, SAT/ adjusted ACT score, etc.), and high school fixed effects.

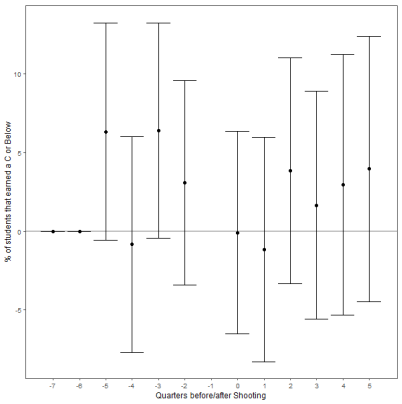
Figure 3: Estimated Quarterly Effect of Shooting on Academic Achievement for Impacted Students, Class Size < 35

Panel A: Impacted Students

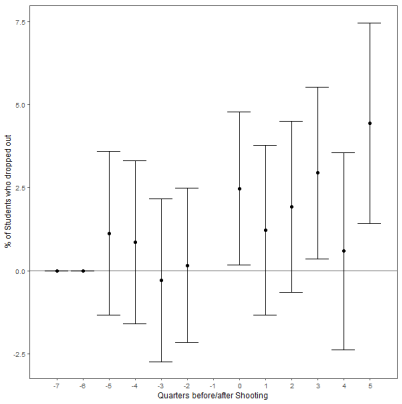
(a) End of quarter GPA



(b) Course grade lower than a C

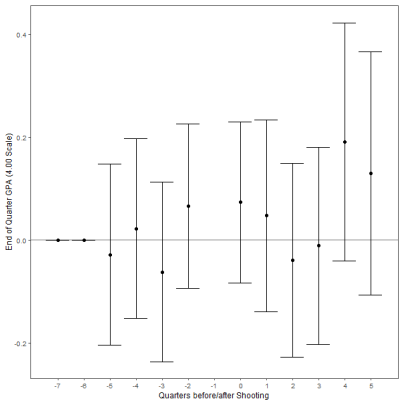


(c) Dropout

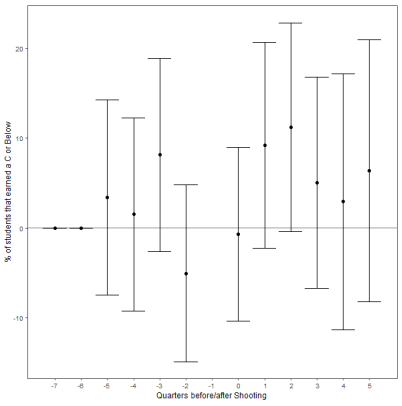


Panel B: Impacted Females

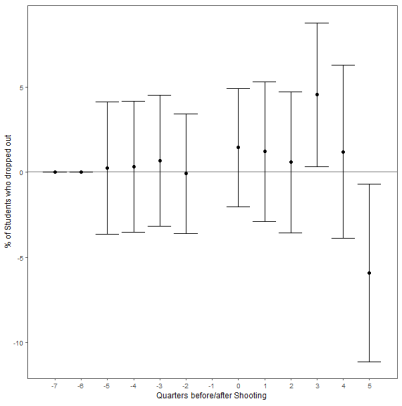
(d) End of quarter GPA



(e) Course grade lower than a C



(f) Dropout

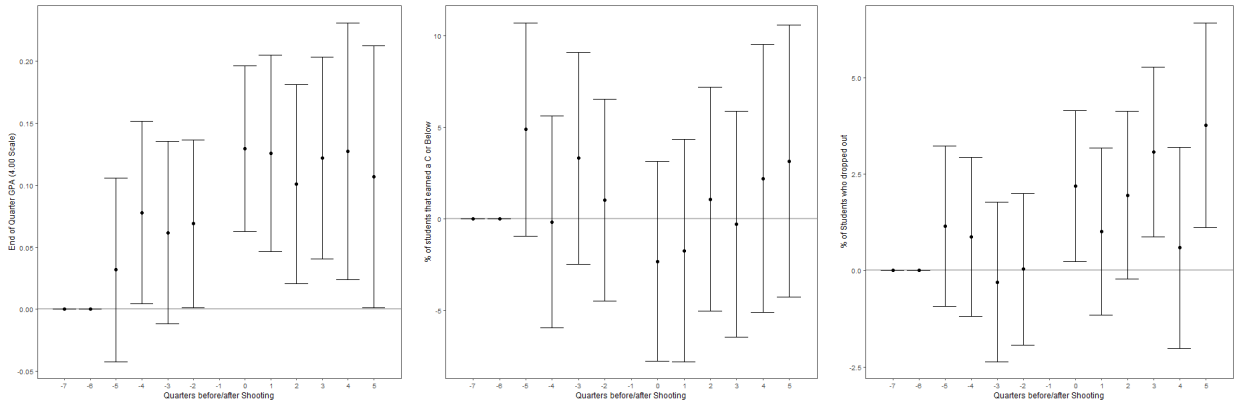


Note: Difference-in-Difference and Triple Difference beta estimates of the effect of the 2014 Isla Vista Killings on impacted students compared to non-impacted peers, estimated from Equation 9 and Equation 10, respectively. Impacted students are defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. Panel B students are additionally differenced females from the impacted group. The sample includes individuals enrolled at UCSB from 2011 to 2018 who recieved a final grade, excluding summer quarters. The quarter before the attack, Winter 2014, is missing from the data. OLS regressions control for years at UC, admissions variables (high school GPA, SAT/ adjusted ACT score, etc.), and high school fixed effects. Winter 2012 and Spring 2012 indicators are omitted. Errors bar refer to the 95% CI.

Figure 4: Estimated Quarterly Effect of Shooting on Academic Achievement for Impacted Students, Class Size < 70

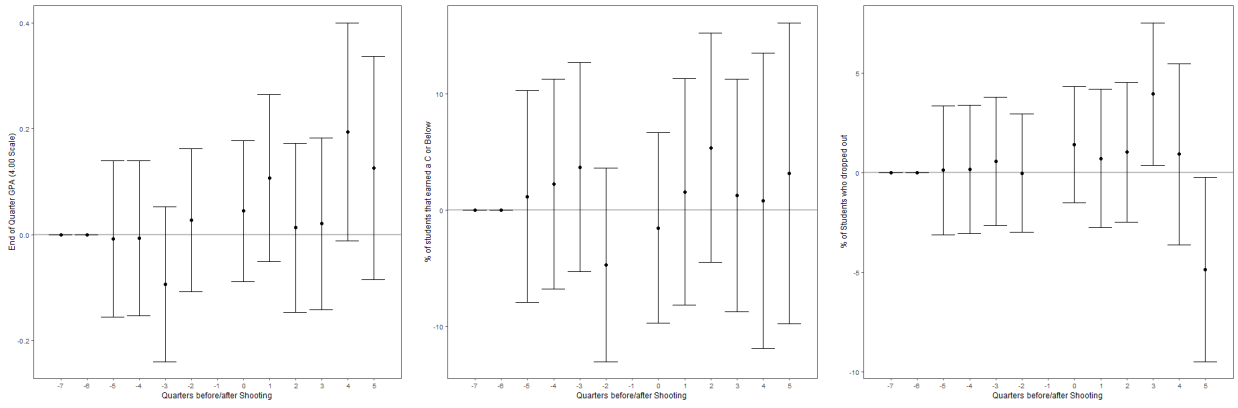
Panel A: Impacted Students

(a) End of quarter GPA (b) Course grade lower than a C (c) Dropout



Panel B: Impacted Females

(d) End of quarter GPA (e) Course grade lower than a C (f) Dropout



Note: Difference-in-Difference and Triple Difference beta estimates of the effect of the 2014 Isla Vista Killings on impacted students compared to non-impacted peers, estimated from Equation 9 and Equation 10, respectively. Impacted students are defined as students who were enrolled in a medium-sized (<70 students) Spring 2014 class with someone injured in the attack. Panel B students are additionally differenced females from the impacted group. The sample includes individuals enrolled at UCSB from 2011 to 2018 who recieved a final grade, excluding summer quarters. The quarter before the attack, Winter 2014, is missing from the data. OLS regressions control for years at UC, admissions variables (high school GPA, SAT/ adjusted ACT score, etc.), and high school fixed effects. Winter 2012 and Spring 2012 indicators are omitted. Errors bar refer to the 95% CI.

Table 7: Estimated Average Effect of Shooting on Academic Achievement for Impacted Students, Class Size < 35, with and without Covariates

	Dependent variable:							
	End of quarter GPA				Dropout			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post Shooting	0.047***	0.032***	0.006***	0.004**	0.002***	0.001***	0.002***	0.002***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.0004)	(0.0004)	(0.0004)	(0.0005)
Impacted	−0.041***	−0.024*	−0.021	−0.011	−0.015***	−0.014***	−0.014***	−0.014***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.003)	(0.003)	(0.003)	(0.003)
Impacted:Post Shooting	0.105***	0.052**	0.058***	0.050**	0.021***	0.019***	0.018***	0.018***
	(0.022)	(0.022)	(0.022)	(0.021)	(0.005)	(0.005)	(0.005)	(0.005)
SAT/Adjusted ACT			0.001***	0.0005***			−0.00002***	−0.00002***
			(0.00001)	(0.00001)			(0.00000)	(0.00000)
High Schol GPA			−0.040***	0.156***			−0.006***	−0.012***
			(0.006)	(0.007)			(0.001)	(0.002)
Transfer GPA			0.279***	0.273***			−0.010***	−0.009***
			(0.007)	(0.007)			(0.001)	(0.001)
Freshman Admit			−0.091***	0.243***			0.010***	0.025
			(0.009)	(0.080)			(0.002)	(0.018)
Years at UC		0.044***	0.048***	0.049***		0.001***	0.002***	0.002***
		(0.001)	(0.001)	(0.001)		(0.0001)	(0.0002)	(0.0002)
HS GPA:SAT/Adjusted ACT			0.00005***	−0.00002***			0.00000**	0.00000***
			(0.00000)	(0.00000)			(0.00000)	(0.00000)
Transfer GPA:SAT/Adjusted ACT			−0.0001***	−0.0001***			0.00001***	0.00000***
			(0.00000)	(0.00000)			(0.00000)	(0.00000)
Constant	3.128***	3.004***	2.000***		0.016***	0.012***	0.050***	
	(0.002)	(0.003)	(0.023)		(0.0003)	(0.001)	(0.005)	
High School Fixed Effects	No	No	No	Yes	No	No	No	Yes
Observations	365,797	365,797	365,797	365,797	365,797	365,797	365,797	365,797
R^2	0.002	0.012	0.063	0.128	0.0001	0.0004	0.001	0.033
Adjusted R^2	0.002	0.012	0.063	0.119	0.0001	0.0004	0.001	0.023
Residual Std. Error	0.616	0.612	0.596	0.578	0.129	0.129	0.128	0.127

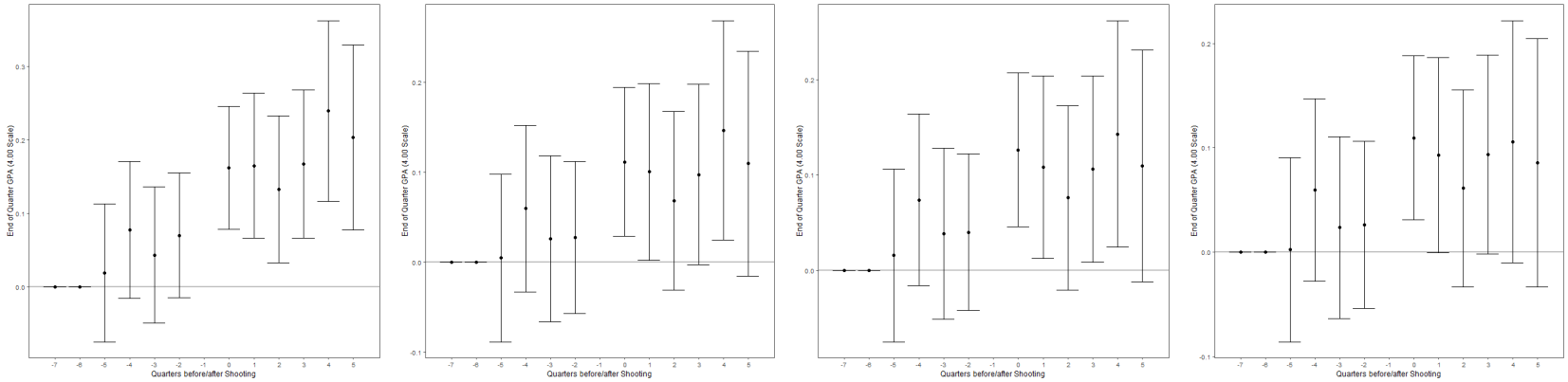
*p<0.1; **p<0.05; ***p<0.01

Note: Difference-in-Difference estimate of the average effect of the 2014 Isla Vista Killings on impacted students compared to non-impacted peers from Equation 8. Impacted students are defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. The sample includes individuals enrolled at UCSB from 2011 to 2018 who recieved a final grade, excluding summer quarters. The quarter before the attack, Winter 2014, is missing from the data. Columns 1 to 4 refer to End of Quarter GPA while Columns 5 to 8 refer to Dropout.

Figure 5: Estimated Quarterly Effect of Shooting on End of Quarter GPA and Dropout for Impacted Students, Class Size < 35, with and without Covariates

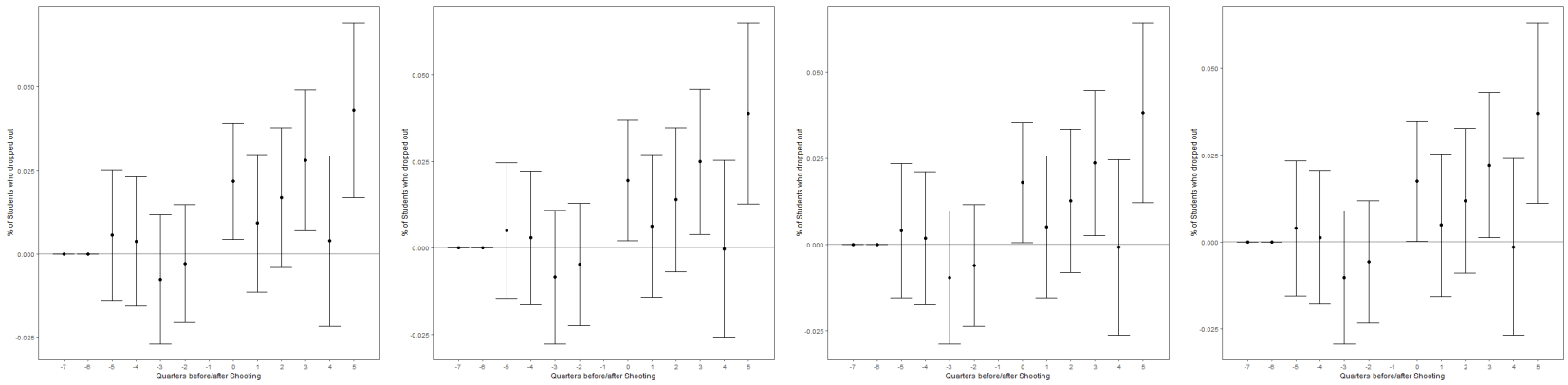
Panel A: End of Quarter GPA

(a) No Controls (b) Years at UC Control (c) Years at UC + Admission Controls (d) Fully Specified Model



Panel B: Dropout

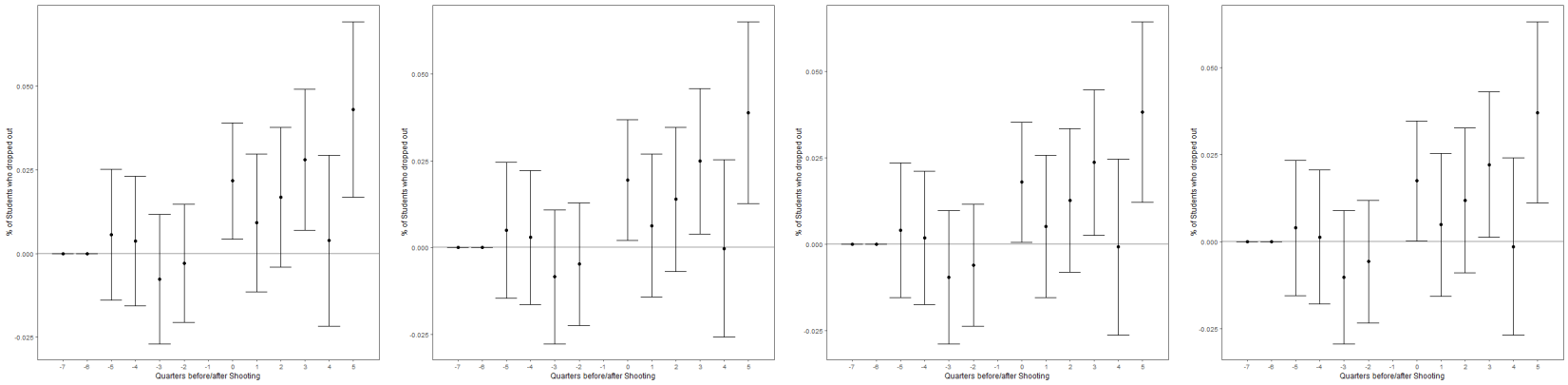
(e) No Controls (f) Years at UC Control (g) Years at UC + Admission Controls (h) Fully Specified Model



Note: Difference-in-Difference beta estimates of the effect of the 2014 Isla Vista Killings on impacted students compared to non-impacted peers with varying covariates (Equation 9). Impacted students are defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. The sample includes individuals enrolled at UCSB from 2011 to 2018 who recieved a final grade, excluding summer quarters. The quarter before the attack, Winter 2014, is missing from the data. OLS regressions control for years at UC, admissions variables (high school GPA, SAT/ adjusted ACT score, etc.), and/or high school fixed effects depending on specification. Winter 2012 and Spring 2012 indicators are omitted. Errors bar refer to the 95% CI.

Figure 6: Estimated Quarterly Effect of Shooting on Student Dropout for Impacted Females, Class Size < 35, with and without Covariates

(a) No Controls (b) Years at UC Control (c) Years at UC + Admission Controls (d) Fully Specified Model



Note: Triple Difference beta estimates of the effect of the 2014 Isla Vista Killings on impacted females compared to impacted males with varying covariates (Equation 10). Impacted students are defined as students who were enrolled in a small (<35 student) Spring 2014 class that contained an individual injured in the attack. The sample includes individuals enrolled at UCSB from 2011 to 2018 who recieved a final grade, excluding summer quarters. The quarter before the attack, Winter 2014, is missing from the data. OLS regressions control for years at UC, admissions variables (high school GPA, SAT/ adjusted ACT score, etc.), and/or high school fixed effects depending on specification. Winter 2012 and Spring 2012 indicators are omitted. Errors bar refer to the 95% CI.