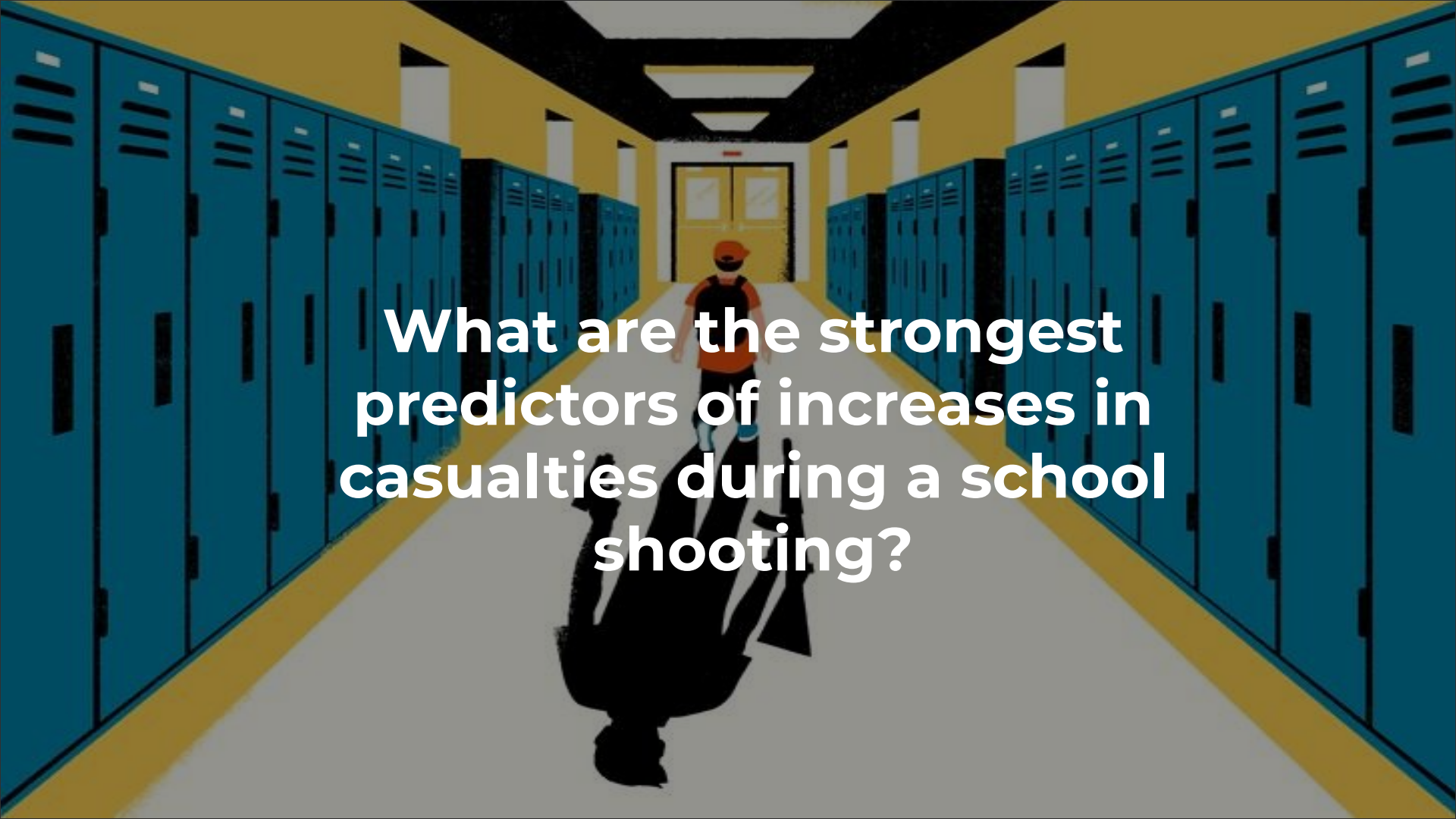


A photograph of a school shooting scene. In the foreground, two women are embracing on the left side of the road. In the background, a white police car with "POLICE" written on its side is parked. Several police officers are standing around the scene. There are "SCHOOL" and "SPEEDING FINES DOUBLED" signs in the background. The scene is set on a road with a crosswalk.

Exploratory Analysis of School Shootings

Significantly Different

Judyth Estrada Salinas, Dhanush Madabusi, Yeonju Suh

A perspective view of a school hallway with rows of blue lockers on both sides. The walls are yellow, and the floor is light gray. In the distance, a person wearing an orange shirt and a red cap is running away from the viewer towards a set of double doors. In the foreground, a dark silhouette of a person is lying face down on the floor. The text "What are the strongest predictors of increases in casualties during a school shooting?" is overlaid in white, bold font in the center of the image.

**What are the strongest
predictors of increases in
casualties during a school
shooting?**

What does the literature say?

- Who are the active shooters? (Bonanno & Levenson, 2014)
 - Mental instability, social isolation, had access to weapons prior to shooting
 - Analysis of 37 incidences (Vossekuil et al., 2002):
 - Male attackers, 95% current students (5% former)
 - 81% attacked alone, 11% executed attack alone but planned with peer, and 8% multiple attackers
 - 76% used one weapon, 46% had more than one weapon, 61% handguns, 49% shotguns or rifles
 - 59% of attacks occurred during school, 22% before school, and 16% after school

Prevention?

- Security Measures:
 - Physical Devices (security cameras), Trained Personnel (Security Guards)
 - Potential for negative school environment (prison-like feel), student privacy
- Climates of Safety:
 - Threat Assessments, bullying prevention, addressing socio-economical needs
- Family-Level:
 - Storing guns out of reach for children, as students had access to weapons primarily from family members (Levin & Madfis, 2009)

Consensus among literature: there are no “profiles” for student attackers



schools-shootings-data.csv

- Data provided by Washington Post
- 221 observations since April 20, 1999
- Recorded any act of gunfire at schools that occurred during, immediately before and after school hours
- Collected using “Nexis, news articles, open-source databases, law enforcement reports” etc.

9	time	Approximate time of shooting
10	day_of_week	Day of week of shooting
11	city	City where school is located
12	state	State where school is located
13	school_type	Type of school (public or private)
14	enrollment	Enrollment at school at time of shooting
15	killed	Number killed in shooting (excludes shooter)
16	injured	Number injured in shooting (excludes shooter)
17	casualties	Number killed and injured in shooting (excludes shooter)
18	shooting_type	Type of shooting
19	age_shooter1	Age of first shooter
20	gender_shooter1	Gender of first shooter
21	race_ethnicity_shooter1	Race or ethnicity of first shooter
22	shooter_relationship1	First shooter's relationship to school
23	shooter_deceased1	Flag indicating whether first shooter died in shooting
30	deceased_notes2	If second shooter deceased, how first shooter died
31	white	Enrollment of white students at time of shooting
32	black	Enrollment of black students at time of shooting
33	hispanic	Enrollment of Hispanic students at time of shooting
34	asian	Enrollment of Asian students at time of shooting
35	american_indian_alaska_native	Enrollment of American Indian and Alaskan native students
36	hawaiian_native_pacific_islander	Enrollment of Hawaiian native and Pacific islander students
37	two_or_more	Enrollment of students of two or more races at time of shooting
38	resource_officer	Flag indicating presence of school resource officer or security guard
39	weapon	Weapon(s) used in shooting
40	weapon_source	Where shooter acquired weapon(s) used in shooting
41	lat	Latitude of school
42	long	Longitude of school
43	staffing	Full-time equivalent teachers at school at time of shooting
44	low_grade	Lowest grade-level offered by school
45	high_grade	Highest grade-level offered at time of shooting
46	lunch	Number of students at school eligible to receive a free or reduced-price lunch
47	county	County name where school is located
48	state_fips	Two-digit state Federal Information Processing Standard code
49	county_fips	Five-digit county Federal Information Processing Standard code
50	ulocale	National Center for Education Statistics urban-centric locale

Regression Analysis: Model Selection



Started out with our full model:

```
casualties ~ enrollment + factor(shooting_type) + staffing + white_percent + black_percent +  
hispanic_percent + asian_percent + lunch_percent + factor(resource_officer) + factor(day_of_week) +  
american_indian_alaska_native_percent
```

Performed backwards model selection in order to find our ideal model:

```
casualties ~ enrollment + factor(shooting_type) + staffing + lunch_percent + factor(resource_officer) +  
american_indian_alaska_native_percent
```

*number of students enrolled at time of shooting, what type of shooting, number of full-time teachers, number of students eligible for free/reduced lunch, whether a resource officer was present and percent of american indian or alaska native students

term <chr>	estimate <dbl>	
(Intercept)	2.869936122	
enrollment	0.001276192	
factor(shooting_type)accidental or targeted	0.127416763	
factor(shooting_type)hostage suicide	-1.284265453	
factor(shooting_type)indiscriminate	3.174706677	
factor(shooting_type)public suicide	-1.078421364	
factor(shooting_type)public suicide (attempted)	-1.899810135	
factor(shooting_type)targeted	-0.797179114	
factor(shooting_type)targeted and indiscriminate	0.564395896	
factor(shooting_type)unclear	-0.972637703	
staffing	-0.025890015	
lunch_percent	-2.864631201	
factor(resource_officer)1	1.452561617	
american_indian_alaska_native_percent	6.454461395	

Adjusted R-Squared:

0.1783479

About 17% of the data
can be explained by
our model.

*It's not a very high
number

Interpretations

- **Intercept:** 0 enrolled, accidental, 0 staff, 0 lunch, no RO will have an average of **2.8699 casualties**
- **Lunch_percent:** for **every unit increase** in the amount of students eligible for free/reduced lunch, the number of casualties will, on average, **decrease by 2.8646**, all else held constant.
- **American_indian_alaska_native_percent:** for **every unit increase** in the amount of students eligible for free/reduced lunch, the number of casualties will, on average, **increase by 6.4544**, all else held constant.

ShinyApp

Choose a variable:

State

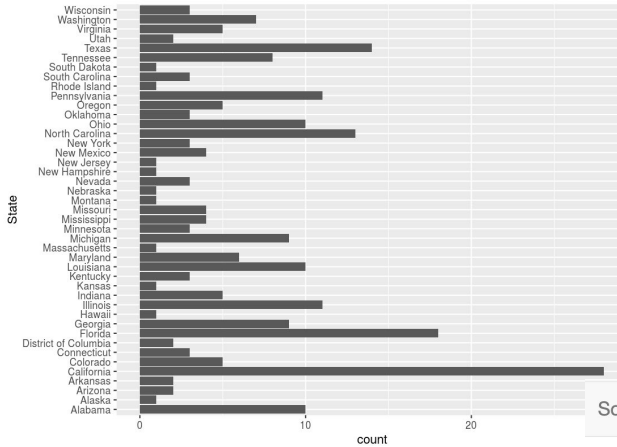
State

School Type

Shooting Type

Locale Type

Resource Officer Present



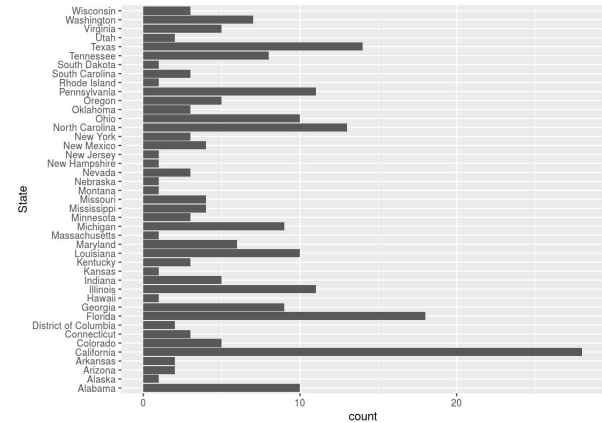
School Shooting Visualizations

Bar Graphs

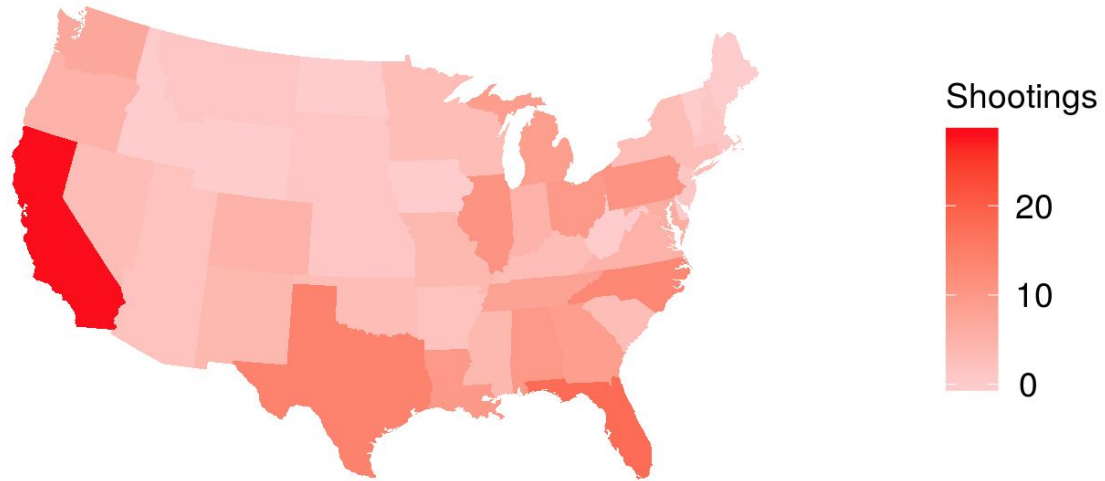
ScatterPlot

Choose a variable:

State



School Shooting Distribution in U.S.



Conclusion

- So, what are the best predictors?
 - Staffing, Enrollment, Percentage of Free or Reduced Price Lunch, Resource Officer Presence, and type of shooting
- Percentage eligible for free/reduced lunch and the percentage of American Indian/Alaska Native students have the strongest effect
 - Do these make sense?

Limitations?

- Source of Data
 - Newspaper articles, information available to the public
 - A lot of data points missing for this reason (NAs)
- No data on schools where shooting incidence didn't happen
 - Would have been interesting to compare this!
- No data on what preventive measures the schools already had when shooting occurred
 - If we had this, we could have analyzed which measures are more effective than others
- Could be missing important potential predictors

References

Bonanno, C. M., & Levenson Jr, R. L. (2014). School shooters: History, current theoretical and empirical findings, and strategies for prevention. *Sage Open*, 4(1), 2158244014525425.

Levin, J., & Madfis, E. (2009). Mass murder at school and cumulative strain: A sequential model. *American Behavioral Scientist*, 52, 1227-1245. doi:10.1177/0002764209332543

Vossekuil, B., Fein, R. A., Reddy, M., Borum, R., & Modzeleski, W. (2002). *The final report and findings of the safe school initiative: Implications for the prevention of school attacks in the United States*. Washington, DC: U.S. Secret Service and U.S. Department of Education.