February 14, 2013

Combining Ten Jurisdictions Reveals The Net Effect Of Gun Control Laws On Murder Rates Was Statistically Insignificant

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Abstract

Firearms have existed for centuries, and murder since the dawn of recorded time. However, there's still no consensus on whether gun control laws save lives. Some studies say they do. Others say they don't, or worse. To try to reconcile the contradictions, I tested the statistical hypothesis that gun control laws affect murder rates in America. I pooled data from ten jurisdictions that passed gun control laws, spread over a hundred years, thousands of miles and millions of people. The rest of the nation served as the statistical control. I found that murder rates tended to rise after gun control laws went into effect, but the rise was small compared to the variation otherwise seen between jurisdictions. Overall, the net effect of gun control laws on murder rates was statistically insignificant (p=0.38).

Introduction

Murder is a frighteningly serious matter of life and death.

It has been attributed to a variety of causes, including population density, race, guns, drugs, alcohol, and violent video games.

Making matters worse, different jurisdictions and eras experienced different murder rates after gun control laws took effect. They seemed to work in some places at some times, and to have had no, or the opposite effect, in others.

I searched the scholarly literature, and was perplexed to find no consensus on whether gun control laws work.

It seemed to me that murder rates would be an appropriate criterion for a statistical analysis because they tend to be reported reliably[1].

After giving it some thought, I came up with a few techniques to objectively, dispassionately and clearly focus on testing the statistical hypothesis that gun control laws affect murder rates in America,

I also tested the statistical hypotheses that banning certain types of guns, and requiring licenses, affected murder rates.

[1]Murder rates before 1960 were reported as "homicide rates", and after were reported as "murders and non negligent manslaughter". Both should work fine in my analysis because I looked at their rates of change.

Materials and Methods

I tried to precisely pin-point how confident we can be that gun control laws affect murder rates by

1. lessening the effect of other potential causes of murder by
   (a) comparing murder rates to the last rate before gun control laws took effect, and
   (b) using the rest of the Nation as a statistical control, and
2. pooling average murder rates in jurisdictions spread over 100 years, thousands of miles and millions of people in a statistical technique called a "meta-analysis"[2]

In choosing jurisdictions to combine, I looked for ones that passed gun control laws in different times and places so other possible influences on murder rates would tend to cancel each other out[3].

My data spanned ten jurisdictions, from Hawaii to Massachusetts, Michigan to Texas, and from 1910 to 2009.

Half of them banned certain guns.

The other half required licenses.

I collected the murder rates and population sizes for at least twelve years after each law went into effect.

Aside from that, I used the first ten jurisdictions that I happened to find the murder rates and population sizes of[4].

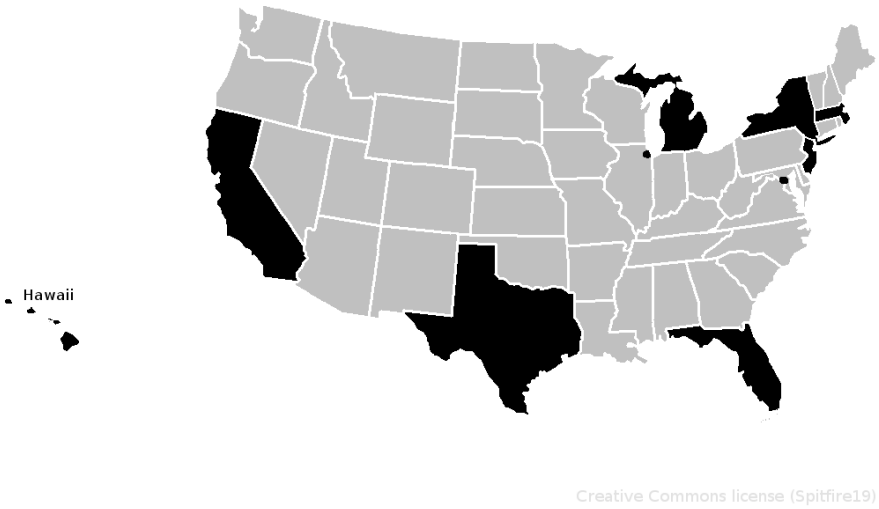
I also collected national murder rates and population counts to use as statistical controls.

The data came from the US Census, US Department of Justice, Randolph Roth and James D. Agresti[1-13].

[2]The term "meta-analysis" was coined in 1976 by Gene V. Glass. It encompasses a variety of analytic techniques that generally contrast and combine the results of different studies.

[3]Ie: population density, race, drugs, etc...

[4]Randolph Roth published homicide rates in states for 1907-1941[3]. The FBI published the murder and non negligent manslaughter rates of states in its uniform crime reports for years going back to 1960[2]. However, I didn't find murder rates at the state level for 18 years from 1942 to 1959. As a practical matter, this prevented me from including Washington State's experience with its 1935 gun control law, because I didn't have its murder rates for all twelve years after the law took effect. I ended up using New Jersey's 1924 law instead.



Jurisdiction	Year gun control law took effect	Type of law
New York State	1911	license
New Jersey	1924	license
Michigan	1927	license
Washington, DC	1977	ban
Chicago	1982	ban
Florida	1988	license
California	1989	ban
Hawaii	1992	ban
Texas	1996	license
Massachusetts	1998	ban

I organized the murder rate and population data with a free and open source spread sheet program called "gnumeric"[16].

I indexed each jurisdiction's murder rates and population sizes by year. Along side them, I noted the murder rate in, and population of, the rest of the country for later use as a statistical control.

To increase the statistical power of my analysis, I allowed different jurisdictions to be combined and compared by normalizing their murder rates two ways.

First, I divided each year's murder rate by the last murder rate before the law changed[5]. This also diminished the effect of local conditions before gun control laws took effect.

Second, I converted calendar years to the number of years that had passed since each gun control law took effect[6]

I summarized the results of gun control laws in each jurisdiction and the rest of the nation by calculating the average and standard deviation[7]of their normalized murder rates. These summaries were exported from the computer spread sheet to a file in "csv" format[8]. A colorized version of the csv data is in Appendix A.

I performed the meta-analysis of the ten jurisdictions' csv summaries with the free and open source statistical programming language named "R"[17], its similarly free and open source meta-analysis package called "meta"[9][18], and specifically the functions named "forest()" and "metacont()"[10].

The same methods were used to test the hypotheses that laws licensing or banning guns had a significant effect on murder rates, using data from half of the 10 jurisdictions for each, ie: 5.

[5]For example, 29.2 people per 100,000 were murdered in Chicago, IL in 1981. Next year, in 1982, its gun control law took effect and its murder rate was 22.3 per 100,000 people. So, the first normalization converted 22.3 to 22.3/29.2, or 76%. Similar divisions were done for the next 11 years, 9 jurisdictions, and the rest of the nation.

[6]For example, Chicago, IL's gun control law became effective in 1982, so that year's murder rate was used for its normalized year number 1. Likewise, its rate in 1983 became its rate in normalized year number 2, 1984 became year number 3, etc... This normalization was also done to murder rates and populations in all years and jurisdictions, including the rest of the nation.

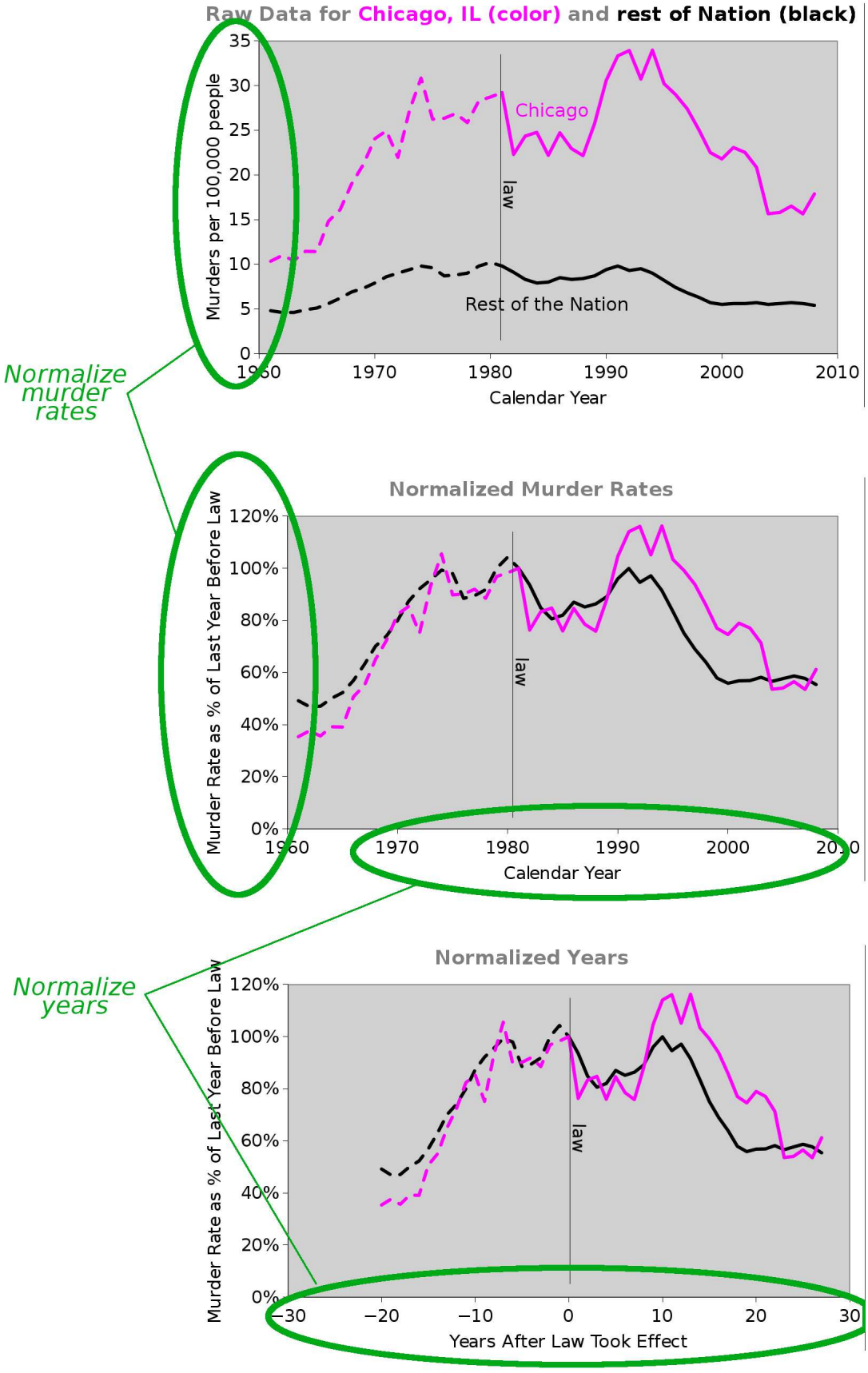
[7]Standard deviation is a statistical measure of how much data varies.

[8]"csv" is an abbreviation for "comma separated variable", which is a simple data format that separates numbers with commas, like "7, 5, 8, 3".

[9]Version 2.1-4.

[10]The name "metacont" is a contraction of "meta-analysis of continuous data". Continuous data can have numbers with decimal points and negative signs, like 13.8, -4.111 and 55.04.

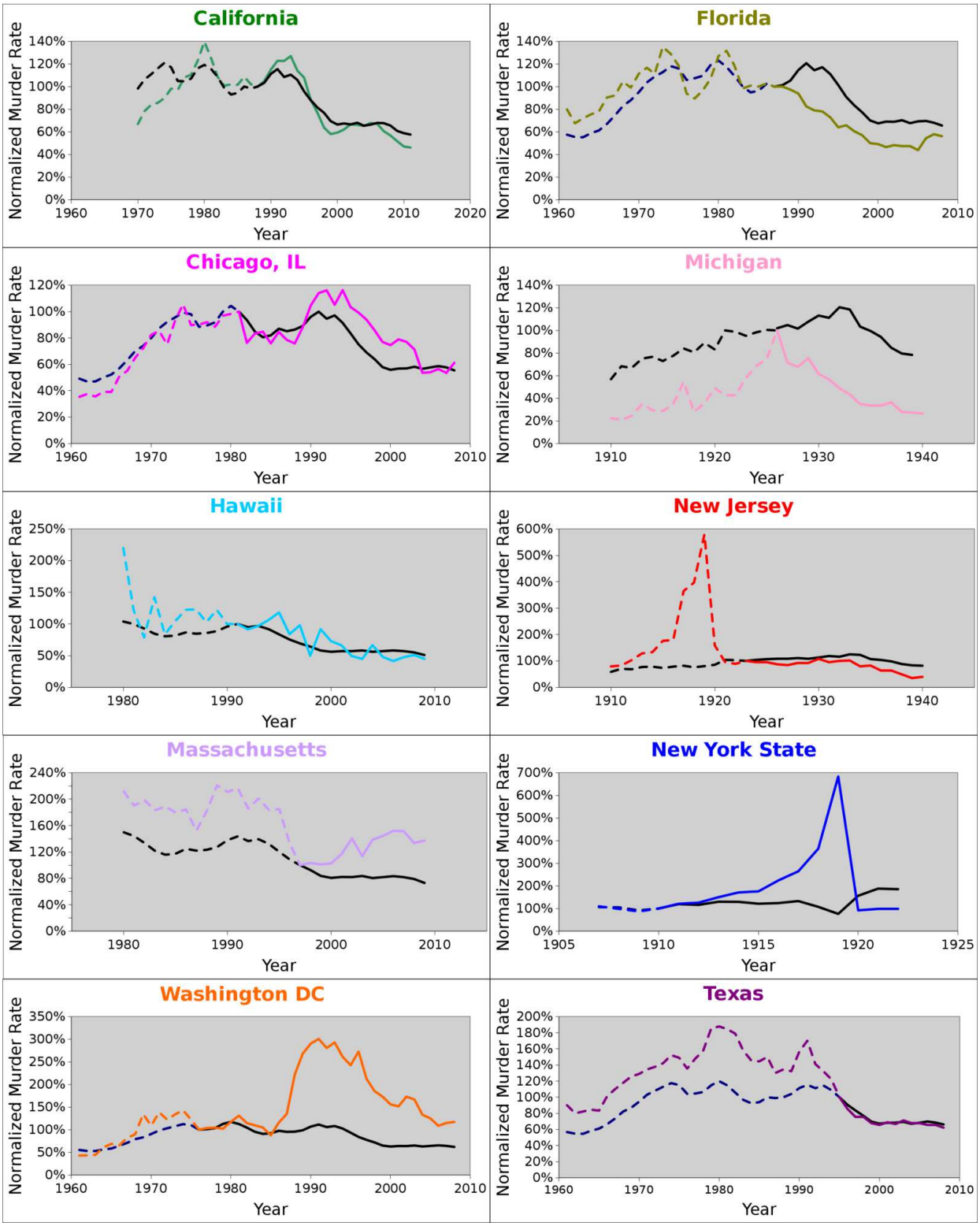
Two Normalizations Of The Same Data



Results

Murder Rates in
10 Jurisdictions (color)
vs.
The Rest Of The Nation (Black)
Before (dotted) and After (solid) Gun Control Laws Took Effect

Banned Guns | Licensed Guns



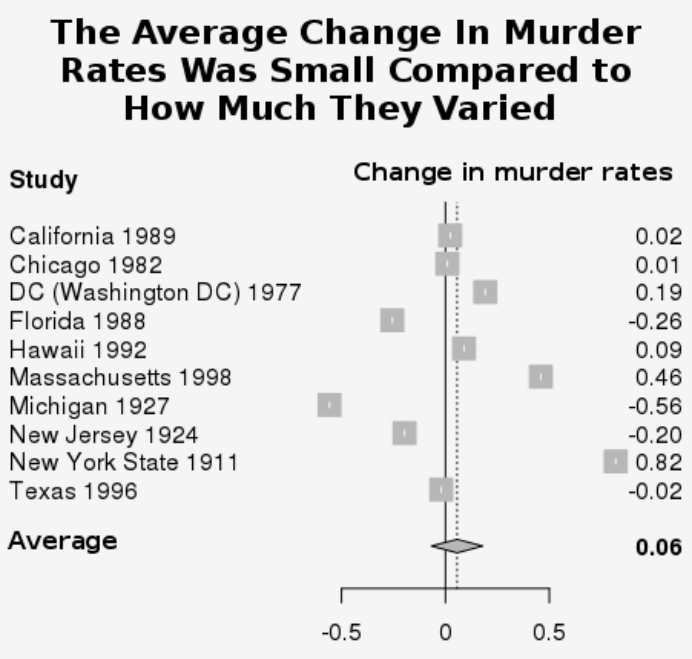
After gun control laws took effect, different jurisdictions experienced different changes in their murder rates. In some places murder rates went up. In others they went down[11].

The average murder rate increased by 6%, but don't stop reading here and go off half cocked.

We live in an uncertain world.

I checked if the 6% average increase was significant four ways. All four indicated that it's not.

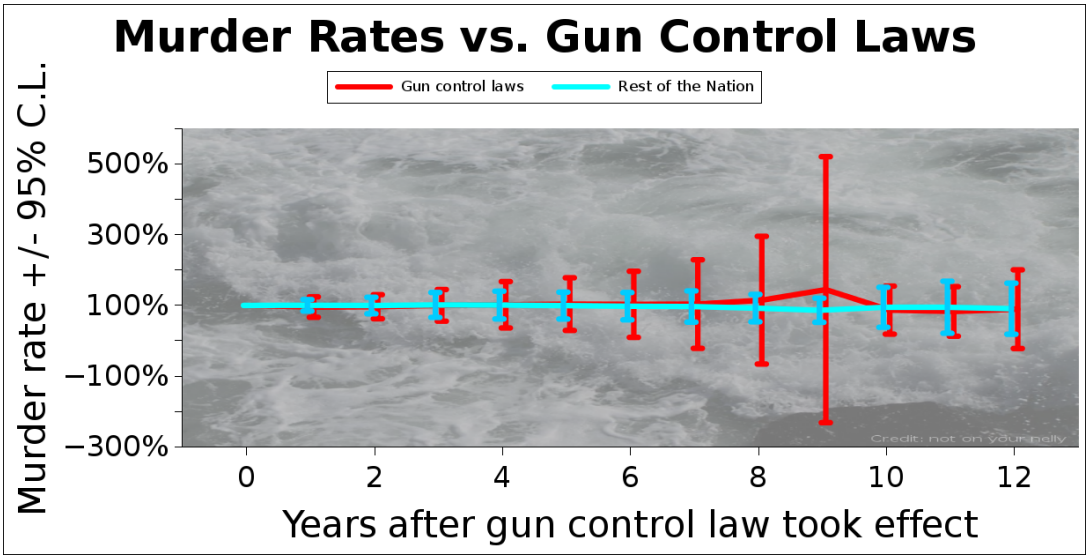
1. I compared the average 6% increase in murder rates to the change in each jurisdiction[12]. Their variation overshadowed it.



[11]Statisticians call this variation "heterogeneity", or "I^2". If it's more than what would be expected from chance, using a type of meta-analysis called the "random-effects" model is recommended. The I^2 of these jurisdictions was nearly 100%, so I performed a random effects meta-analysis.

[12]Statisticians call this a forest plot.

2. I plotted how the average murder rate changed over time. The following chart's vertical bars show how much murder rates varied between jurisdictions in any given year[13]. The average rise in murder rates was small compared to their variation.



[13]The vertical lines are called 95% confidence limits. They're the ranges we can be 95% confident each year's average falls in. Note the 95% confidence limits are bigger than the difference in murder rates. That suggests the effect of gun control laws on murder rates was insignificant.

3. I mathematically estimated the range that the average murder rate might be expected to fall in for this much variation.[14]. It seems to me that 95% of the time the average change would be between a 7% drop and an 18% increase. Since there was a reasonable chance that murder rates actually dropped, the 6% increase isn't convincing.

4. I calculated the probability that something other than gun control laws[15] increased the average murder rate by 6% or more[16]. It was 38%. We normally say an effect is statistically insignificant if this number is over 5%, which happened here.

All four checks indicate the effect of gun control laws on murder rates was insignificant.

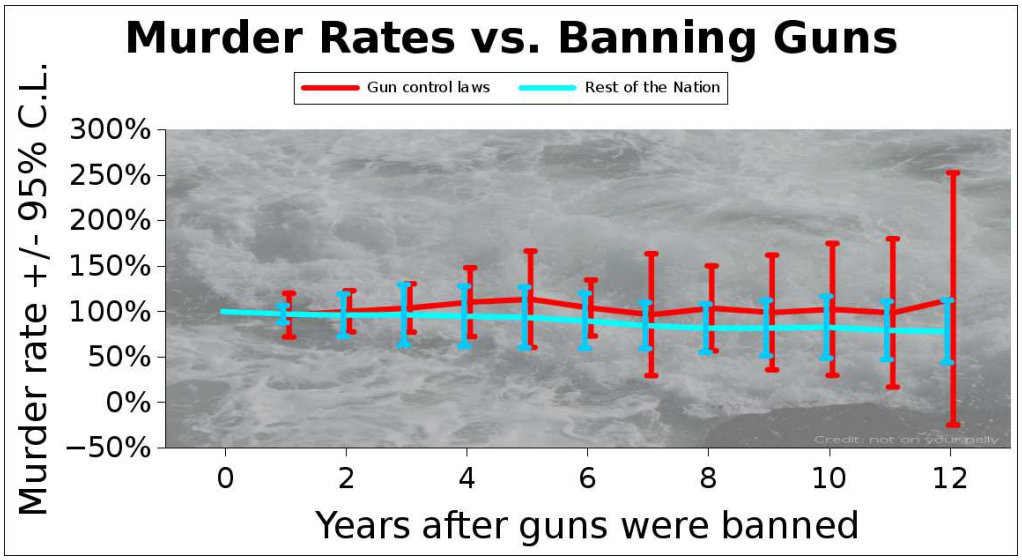
[14]Statisticians call this the 95% confidence interval.

[15]For example, drugs, alcohol or poverty.

[16]Statisticians call this a "p value". P values may be the most important result of meta-analyses. They estimate the probability that the observed difference was caused by something else, or by chance. When the p value is less than 5% we often say the main thing being studied, like gun control laws, had a "statistically significant" effect, On the other hand, if the p value is greater than 5%, statistical insignificance is often assumed. Sometimes 1% or 10% is used instead of 5%. The metacont() function (which calls the ci() function) calculated the p value with the following formula

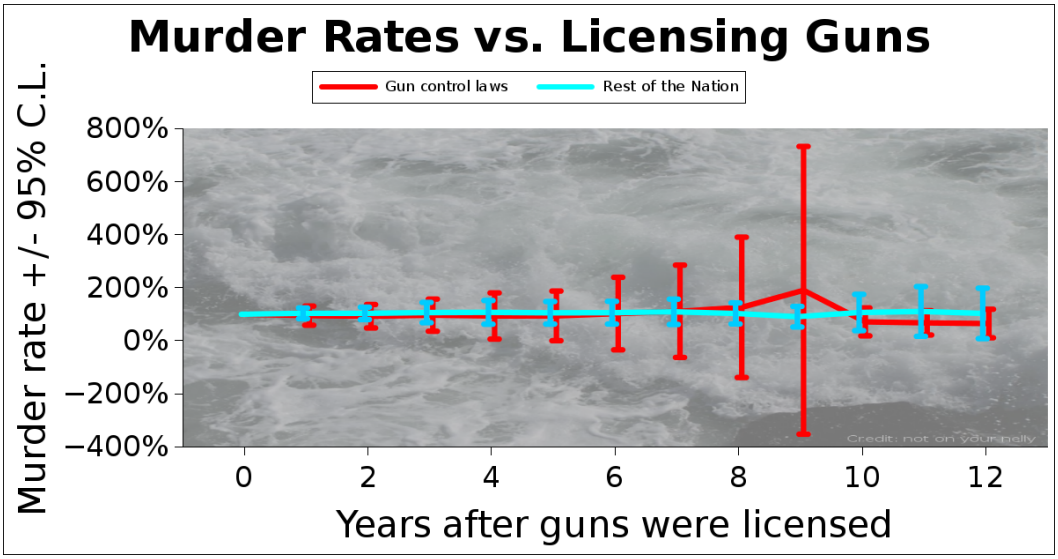
$$\text{p value} = 2 * (1 - \text{normal\_distribution\_function}(\text{absolute\_value}(\frac{treatment\,effect}{standard\,error\,of\,the\,treatment\,effect})))$$

Like in all 10 jurisdictions, the variation in murder rates was relatively large between the 5 that banned guns[17].



Further analysis of laws banning guns found murder rates tended to increase by 15%, but that was also insignificant (p=.15)[18].

There was also much variation in murder rates between the 5 jurisdictions that required guns to be licensed[19].



Laws that required guns to be licensed tended to decrease murder rates by 4%, but the effect was also insignificant (p=.63).

[17] Consequently, a random effects model was used for the meta-analysis of banning guns too.

[18] Of the three types of gun laws I studied, banning them came the closest to achieving statistical significance, with a p value of 15%. However, it's customary to dismiss results over 5%, so 15% is still insignificant.

[19] A random effects model was used for the meta-analysis of licensing laws too.

Discussion

At first glance, it might seem gun control laws had the counter-intuitive effect of increasing murder rates. However, closer examination reveals that the increase was overshadowed by the greater variation of murder rates between jurisdictions. The upshot is that the effect of gun control laws in America on murder rates is statistically insignificant, and should not be exaggerated

If someone wants to discern whether gun control laws have a smaller effect on murder rates, and has the time and expertise to extend my research, it seems to me that it should be possible to include more jurisdictions and/or eras. More data means more statistical power. However, collecting and analyzing the data for each jurisdiction takes time[20].

A critique of my analysis might be that we don't know how long it would take for gun control laws to have an effect, if any, and I chose to check for a somewhat arbitrary 12 years.

The effect of gun control laws in Hawaii is noteworthy. Having no land borders, it's harder for smugglers to circumvent bans. In a sense, it's experience with control laws may be a purer experiment. It's chart on page 7 suggests gun control laws had no effect, which is consistent with the net result of all 10 jurisdictions. It might be interesting to perform a meta-analysis of other islands, like Australia, Iceland and Greenland.

The charts on page 7 also show that murder rates in New York State and New Jersey increased in 1919, independent of their gun control laws and the rest of the Nation. It might be interesting to research other potential influences on murder rates in those states and that year.

Perhaps my techniques could test other hypotheses. For example

1. Do gun control laws affect the rate of suicides or accidental deaths?
2. Do harsher sentencing laws affect robberies?
3. Do country wide gun control laws affect murder rates? Maybe murder rates could be compared in countries with and without gun control laws.

Conclusion

The effect of gun control laws on murder rates was statistically insignificant in America.

Acknowledgments

Robert Campbell's and Bill Kappele's[19] suggestions were helpful.

[20]Specifically, a.) find an American jurisdiction that passed a gun control law at least 12 years ago, b.) determine which year the law took effect (It might be the year the law was passed, or the year after.), c.) collect the murder rates for the jurisdiction for 13 years, including the year before the law took effect, d.) find the size of the jurisdiction's population during those 13 years, e.) find the murder rates and populations of the Nation for those 13 years, f.) add them into my spread sheet, which should be available, and g.) re-run the meta-analysis software in R.

Appendix A

Jurisdiction Summaries Fed Into Meta-Analysis

jurisdiction and year	Type of law	Average population of jurisdiction	Mean normalized murder rate in jurisdiction	Standard deviation of normalized murder rate in jurisdiction	Average population of rest of nation	Mean normalized murder rate in rest of nation	Standard deviation of normalized murder rate in rest of nation
California 1989	ban	31,672,096	97%	26%	232,858,484	94%	17%
Chicago 1982	ban	2,855,744	91%	15%	241,476,089	90%	6%
DC (Washington DC) 1977	ban	641,617	121%	34%	231,794,967	102%	9%
Florida 1988	license	14,074,381	75%	16%	247,316,786	101%	17%
Hawaii 1992	ban	1,204,501	81%	24%	272,808,486	72%	16%
Massachusetts 1998	ban	6,438,642	128%	19%	285,261,042	82%	4%
Michigan 1927	license	4,907,764	49%	17%	120,023,403	105%	10%
New Jersey 1924	license	3,901,237	93%	8%	117,749,263	112%	7%
New York State 1911	license	9,963,443	214%	168%	92,043,140	132%	32%
Texas 1996	license	21,514,719	70%	6%	264,426,184	72%	8%

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