Distracted Driving:
An analysis on the effect of cell-phone driving laws in America

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Data Driven Methods for Policy Evaluation

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Background

The 21st century has seen advancements and improvements on many technological inventions. Chief among them, the cell phone. From the exclusive brick-sized phones to the Nokia many millennials fondly remember has the go-to device to play *Snake* to the iphone and its many versions, cell phone ownership transitioned from a club of exclusivity to becoming ubiquitous.

For the most part, cell phones have done more good than not – they allow us to stay in touch with people and have offered various ways to communicate (call, text, or any app that has some messaging feature), to access the internet, and can even serve as a gaming device. Almost anyone can afford at least some version of a cell phone – and in lots of places in the world, it is the only device which allows an individual to connect to the internet (Handley). Personally, I find my cell phone to be one of my most valuable possessions – it is both my refuge from boredom and my access point to the rest of the world.

However, there is one area of my life where a cell phone might be more harmful than not – driving. Sure, phones can be useful while driving – they provide GPS support and often are the device responsible for the soundtrack of my journey. But they are not without its own concerns. While driving, phones can make an already risky activity that much more dangerous – answering a call, sending a text, or looking at a screen can all result in devastating consequences if they are done simultaneously while driving.

As a born-and-bred Californian, I feel well-versed in car culture. It is something that is forced in our lives – almost every family has a car, and even compared to other metropolitan areas, car use is still more popular than public transit. In fact, Los Angeles is notorious for its hours-long traffic jams that even the newly formed rivalry between the 2 MLS teams based in the city has been coined as 'El Traffico'.

For my project, I wanted to analyze a policy that I thought could be meaningful on both a personal as well as an academic level. This motivated me to study the impact of distracted driving laws – specifically within the context of cell-phone usage while driving.

Introduction

In this paper, I plan to analyze various state policies that address distracted-driving and see how efforts done to combat this issue effect car crash rates. I classify California (CA) as a *treatment* group, as the state has passed more than 2 laws, since 2008, that punish you for using a phone while driving (Vogel, Rothfeld) (Michon). I identify 3 states that serve as an *untreated* group: Ohio (OH), Pennsylvania (PA), and Massachusetts (MA). Untreated in this case means, there's no statewide distracted-driving bill that considers cell phone usage while driving a primary offense -- more often than not, you would need to be caught committing another offense (like speeding) to then be charged for using your phone (Distracted) (Mosby) (Tuthill). Choosing untreated states proved difficult as I wanted to choose states that could be fairly compared to California – they needed to have a *large enough* population with at least one major urban center. Ideal candidates would have been states like Texas and Florida, but statewide data on car accidents was unavailable, so I had to make what I consider reasonable adjustments.

Essentially, my project is trying to answer one main question – Do car crash rates differ between states with distracted driving laws vs states that don't?

Policy and Context

To start, what does "distracted driving" even mean? As defined by the National Highway Traffic Safety Administration (NHTSA): "distracted driving is any activity that diverts attention from driving, including talking or texting on your phone, eating and drinking, talking to people in your vehicle…" (Andrew). In short, doing anything that doesn't have to do with driving is considered a distraction. In this project, I'm focusing only on laws that address phone usage – laws dealing with texting while driving and then subsequent hands-free laws. This allows me to set California has the treatment group, and the other 3 states as the untreated group, as previously mentioned.

My initial awareness of distracted driving came in 2008, when California elections brought distracted driving laws to the mainstream. As a fifteen-year-old, this was the first time I followed an election with an understanding of what was happening. I thought that this issue was being blown out of proportion – *how bad could using a phone while driving be*? It wasn't until I started learning how to drive where I realized even trying to use the radio dial while driving wasn't as easy as I thought, that I realized that using a phone essentially turned a car into an even greater death trap.

The 2008 CA law banned texting while driving and had a wide array of support from motorists, cyclists, insurers, to even cell phone providers (Vogel, Rothfeld) (Michon). While there was no single event that can be directly attributed to inspiring the law, many people point to a 2008 Metrolink crash that killed 12 people and injured a hundred more. The investigation into the accident had people asking the same question – was texting to blame? While the answer to that has never been indisputably confirmed, it certainly seems that the crash helped catalyze the movement for CA to ban texting while driving (Vogel, Rothfeld). Furthermore, policy makers portended that the law needed to catch up with the tech. It makes sense, technology is almost always advancing faster than laws can keep up, and up until 2008 CA had never addressed phone usage while driving.

We've established that CA is the treatment group. But what about the untreated states? Why do I classify them as untreated? First – those states have not had statewide distracted-driving laws, and if they did end up getting one, the data used from those states do not have years in which the law went into effect (Distracted) (Mosby) (Tuthill). This is also why I compare on a state-by-state basis. If I were to use certain cities in CA and find comparative ones across the country, those other cities would most likely already have some form of a distracted driving law (cities can tend implement more progressive policy than at the state-level) (Mosby). Factor in that I need official data to make my comparisons, cities that have open data portals (a progressive and forward-thinking move) might also already have active laws preventing texting while driving. For me to make as fair of a one-to-one comparison, I had to look at the state level, leading me to select Massachusetts, Ohio, and Pennsylvania (Distracted) (Mosby) (Tuthill).

This problem merits an in-depth analysis as drivers (across age and gender groups) still use phones while driving even though the research shows that you're at a greater risk of an accident when using one! In fact, in some studies, survey results show that 31% of drivers aged between 18 and 64 admitted to using a phone while driving in the past 31 days (at the time of their survey-response) (Gliklich, et. all).

Related literature of course hypothesizes and shows that there is an unfortunate relationship between cell phone usage and driving leading to accidents. To prove this though, in a real-life environment, would be unethical. Researchers can't knowingly tell subjects to engage in risky behavior. As such, most studies in this real involve simulating real-life environments (Glicklich et. all).

Most studies show that cell phone usage (while driving) is pervasive. Through studies, including behavioral simulations, researchers show much more likely someone can crash while engaging in distracted driving, and it's even worse the younger the driver (Glicklich et. all). While these studies show that the risks are greater, my study aims to analyze the data, as reported by the states to show the effects of such laws.

Data Sources

I pulled data from 4 main sources. For California, getting statewide crash statistics proved difficult until finding out about the Stanford Open Policing Project. However, this dataset was extremely large and had more than just crash records, so I had to filter records coded as an accident. Ohio had no data portal with easily downloadable csv's for analysis. I had to contact their state highway patrol and request a pin to download data. To their credit, acquiring the pin was not difficult, they proved to be helpful and accommodating in my data acquisition process. (Also, Ohio did have an interactive map where you could visually the breakdown of accidents in different counties) (Exner) (OSHP). Massachusetts and Pennsylvania were by far the easiest states to collect data on – their respective open data portals had yearly datasets that were published and available for the public. In general, I think car accident data is fairly easy to measure which is why it's relatively easy to get. All data source references can be found in the works cited (MassDOT) (OSHP) (The Stanford) (Traffic). Population data for normalization were acquired from Macrotrends, referenced in the works cited as well.

Data Cleaning and Limitations

One caveat to my study is that all states do ban minors from using phones while driving (Andrew) (Distracted) (Mosby) (Tuthill). Unfortunately, the age of the drivers involved in the accident is not available in the datasets used. This distinction is important to note but as there's no way to obtain that data (especially with privacy being even more instrumental when dealing with minors), all data used from the untreated states will be considered as having no policy effecting them.

Another issue I had with my data is that for some states the files were too large. CA's dataset spanned over 7 years and had over 36 million records, uploading the file into Python was a cumbersome process. Ohio's dataset was also large – since I had to request data, I requested more years of records than I probably needed just to make sure I could get the data all at once. For both CA and OH, I utilized a dask data frame – essentially works likes a pandas data frame, except it's able to handle more data. This proved effective as there were times where running certain computations, or even uploading the dataset, could result in memory errors.

For all 4 states, I needed to make the data easy to wrangle and handle – this involved deleting columns that had any missing values. To me, it made no difference how many columns were there as long as I had the date (and more importantly, the year) and that each crash was being recorded. No rows were deleted to keep an accurate count of crashes per year. The main

problem with deleting columns is that it prevented me from doing a more in-depth analysis on other measurable factors that could be studied to see what else effects car crashes. This problem would still exist even if I didn't delete columns because each state measures different things when recording accidents. For example, CA and PA both measured light conditions for each accident (no doubt a useful and interesting factor, that in itself could be a full-length project), but OH and MA didn't measure that.

Perhaps the most difficult aspect of cleaning the data was dealing with the date columns. The end of goal of using date was to show how crash rates changed (or didn't change) over time. What I needed was the month (and the year) an accident happened. Some states reported month and year separately, so grouping by month alone proved to be ineffective (I would get X-years' worth of data for each of the 12 months). Some states reported date by recording the day, month, and year which meant I had to extract the month and year together. Once I gathered month and year for each accident, I could begin my analysis.

Analysis

Initial findings

The first steps of my analysis were just to simply see how California behaved after the passage of the 2008 law (between 2009-2016). The results of which can be seen in Figure 1. In the figure, time (measured in years) spans the x-axis while the accidents rate spans the y-axis. The rate was determined by dividing the total number of accidents for that year, over the respective year's population. 2009 and 2016 should be documented as blips because only 6 months of data for each year were recorded. What's telling about this graph is that from 2010-2014, the crash rate ever so slightly dips before we see a huge spike in 2015.

While I can't explain why that spike occurs (various internet searches proved fruitless), I assume that in the initial years following the law's passage, people changed their behavior to avoid being punished. After a couple of years, drivers probably feel more comfortable at breaking the rule (and arguably better at getting away with it too) thus leading to the spike.

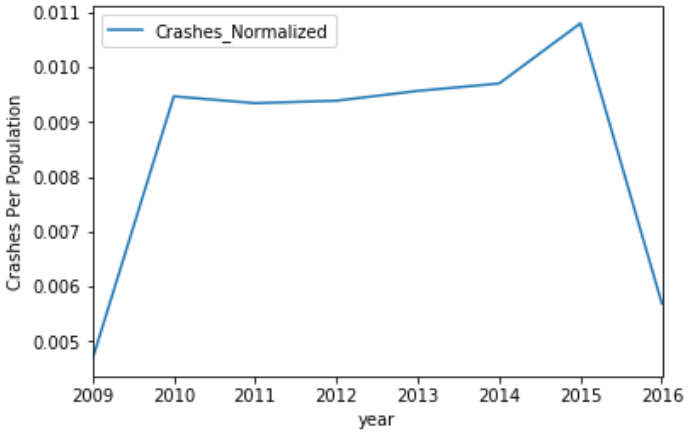

Figure 1: Crash Rate in CA (2009-2016)

Another point to note is that CA in 2015 also started to lead a *Silence the Distraction* campaign. This campaign is another policy initiative that CA took to help lower both the

instances of distracted driving as well as the accidents that can be associated with it. Unsurprisingly, it was generally targeted towards young drivers (aged 16-24) – as mentioned before, they are the most likely to use a phone while driving) (California).

Further Analysis

When discussing initial results with Professor Shroff, he suggested to break down the data (if possible) into monthly or weekly segments to get a better sense of any trends and to see if there were any recognizable patters (seasonal, certain weeks or months of the year that see a spike, etc.). In Figure 2, I show the breakdown on a monthly level in CA, with each color representing a different year in the data. In this graph, I exclude 2009 and 2016 from the data as those years did not report accidents for all 12 months.

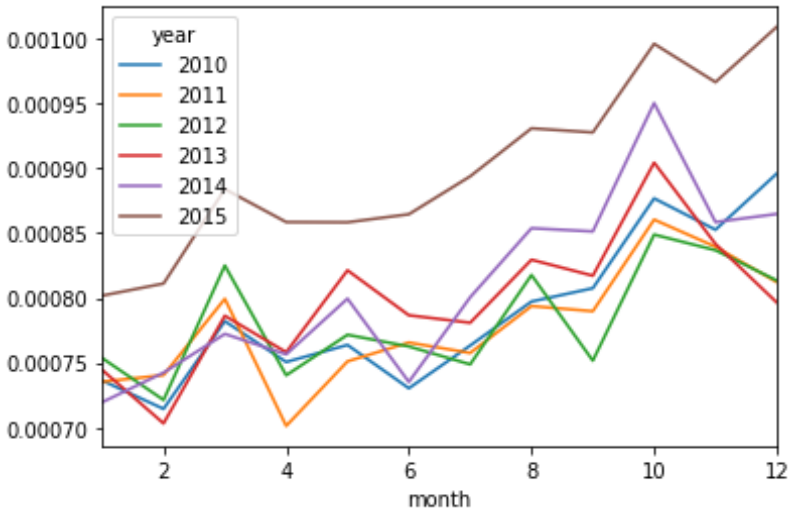

Figure 2: Monthly break down of CA accident rates

On a monthly level, one key pattern becomes noticeable. Almost all 6 years in the data show a spike in the winter months. This could be a for a couple of key reasons – weather and light. Winter months typically brings more hazardous driving conditions (yes, even in CA where it hardly rains).

And for light, there is less sunlight after Daylight Savings Time ends, which could mean that darker lighting conditions play a key role in causing an accident. Again, this chart shows car crashes as a rate, normalized by population. The y-axis here, compared to Figure 1, has is an entire one-thousandth smaller than looking at the rates by year alone. This can be explained by the denominator remaining the same for each year (population for that respective year) in both graphs, but the numerator in Figure 1 represents the aggregate crashes for the year, while in Figure 2 the numerator changes month-to-month – representing the number of crashes for that month-year.

Figure 2 also shows some revealing insights in the years we see a dip (2010-2013) and in the years we see a spike. The immediate years following the implementation of CA's law, show that there is a drop in the accident rate (the 2010 blue line typically remains higher than the orange and green lines of 2011 and 2012 respectively). The spike in 2013-2015, again, cannot be

explained by any change in CA policy but we do see the winter months of those years being noticeably high.

CA synopsis

In short, we can't definitely say that distracted driving laws in CA led to a decrease in car crash rates. If we only looked at 2010-2013, then maybe we could say there's a causal effects but the unfortunate spike from 2014-2015 causes some concern – especially since CA then implemented other distracted driving laws along with an extensive campaign to discourage distracted driving (including adverts, social media blitzes, billboards, hashtags, etc.) (California) (Michon).

Comparing Treatment vs Untreated

How do the untreated states fare? When looking at accident rates across years, CA performs better than both OH and MA (see Figures 3 and 4 respectively).

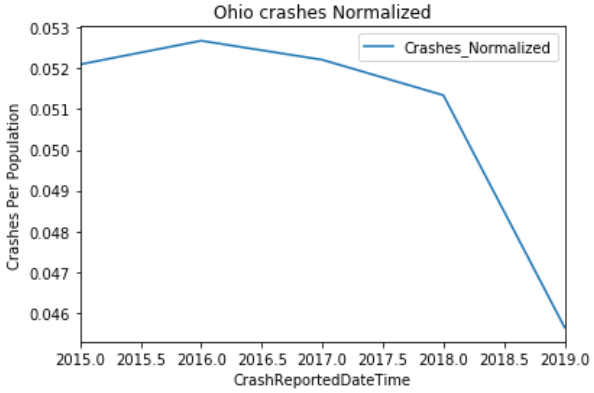

Figure 3: Ohio car crash rates normalized (2015-2019)

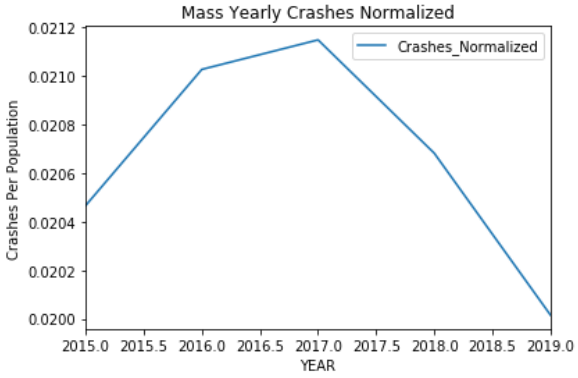

Figure 4: Massachusetts car crash rates normalized (2015-2019)

One of the first things to point is the years used in the data analysis. While the years do not coincide directly with the CA analysis, I maintain that since these states are untreated, the years used do not matter. Furthermore, I was limited by data availability, so I used the years I had access to. To compare with CA, I believe this is okay, because I had data for the years after

CA got “treated”, so I can compare the years after treatment (for CA), with any years for the untreated states.

When comparing across years, you’ll notice that the y-axis in OH and MA start at 0.046 and 0.02, significantly larger than CA’s starting point – 0.0007. I concede that the default starting point is determined by Python, depending on the input data – but what’s important to note is that the lowest value for CA is almost two times smaller than MA’s beginning point. Furthermore, the *largest* y-label is smaller than MA’s starting point. When comparing treatment vs untreated states, it’s clear that CA’s crash rate is significantly smaller than OH and MA. In the context of this paper, this leads me to believe that distracted driving laws pertaining to cell phones help lower car crash rates.

As further comparison between treatment and untreated, I also looked at the *monthly breakdown.* In this analysis, I used the information provided from Figure 2 (CA’s monthly breakdown of accident rates over 6 years) and compare it to monthly accident rate in Pennsylvania (PA). Figure 5 shows the results of the PA monthly breakdown.

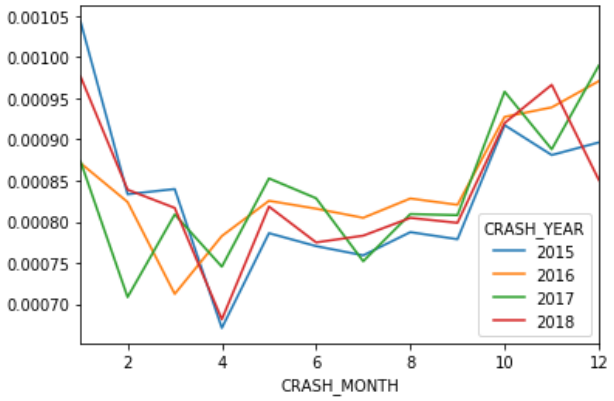

Figure 5: Pennsylvania monthly car crash rate normalized (2015-2018)

In figure 5, we see that Pennsylvania sees similar crash rates to California. As an untreated state, this is unexpected to say the least. Even more surprising is that during April of 2015 and 2018, PA even sees lower rates than CA. Unfortunately, further analysis into the data does not prove fruitful (no variables measured / columns in the data provide context to the crash besides lighting).

Findings and Limitations

If the study had only looked at CA and PA as the 2 subjects, we’d reach the conclusion that distracted driving laws have no effect on accident rates. If the study had looked at just OH and MA, one might say there is indisputable evidence that distracted driving laws have their intended effect of lowering crash rates.

Unfortunately, there is no conclusive evidence based on the 3 states chosen if distracted driving laws have their intended effect. What should be concluded from the data and from

previous studies, however, is that both the science and majority of the data shows that cell phone usage while driving (especially texting), is harmful and leads to more accidents.

When comparing accident rates between OH and PA to CA, we see almost double the rates of accidents – a jarring fact considering there are far fewer people in both the state and on the road in the smaller states. From a volume standpoint, one would expect CA to always have more accidents, they are the biggest state in the country, with more than 10 million people separating them from the next closest state (US States). Considering this, CA needs to be looking at the rate of accidents and can contribute lowered rates due to effective laws and campaigns helping people change their behavior when it comes to distracted driving.

Of course, there are many limitations and nuances that must be considered when analyzing data to make causal conclusions. As mentioned previously, 2 of the main obstacles I ran into during this study were discovering that states did not measure the same things when recording accidents and certain files were too large that I would run into memory issues. Unfortunately, for the lack of uniformity, there was no way to address that besides only focusing on counts of accidents. This ultimately prevented me from performing any more nuanced analysis.

For the memory issues, there were a few ways in which I could avoid them. For certain files, I would move where they were being stored (from a cloud-based account to my main desktop), which allowed for more memory but also prevented me from backing up my data as consistently as I'd like. Other techniques I used included saving csv files of the filtered datasets. The filtered files were typically smaller as I'd delete columns that were not vital to my analysis and from there, I would only need to import the filtered files rather than relying on large and unfiltered data sets.

Ethical Concerns

Distracted driving laws, from a policy standpoint, are intended as a cautionary law to ensure all drivers/passengers/pedestrians safety. Personally, I view the main and original goal of laws that ban texting/calling while driving and requiring hands-free cell phone usage as an initiative like Ralph Nader spearheading the movement to make seat belts mandatory (Jensen). With that being said, it is not to say that these laws can be devoid of any ethical concerns.

A fair critique of these laws is that it gives another opportunity for officers to pull over minorities (specifically, minorities that have been historically disadvantaged by the justice system). By adding another law into effect, one can argue that it gives law enforcement another opportunity to harass drivers. In fact, throughout this class, we have gone over many studies that have shown that "driving while black" can increase your chances of getting pulled over, searched (with probable cause or not), and in general, increase the negative interactions between drivers and officers.

Furthermore, younger, and non-white Americans are more likely to rely on a phone for internet (New York Daily News). Essentially, these demographic groups might not have computer/internet access at home and rely on their phones for more than talking and texting

(New York Daily News). With this in mind, distracted driving laws that are specifically tailored around phone usage, could seemingly encourage law enforcement to target minorities since they are the group more likely to be on their phone and in turn makes them more at risk of having an officer interaction.

Although my project did not focus on policing, it would be a glaring oversight if I do not concede that in America, not all laws are equally enforced. To assume that the distracted driving laws would be immune to this, would be a disservice to vulnerable communities who feel over-policed already.

Another debate on the necessity of distracted-driving laws is that is it necessary? There are schools of thought that believe legislating issues like these might make the US more of a nanny-state and that people should have the liberty to choose whether they want to put themselves at risk. Some people might feel that – providing the info is good enough. If the information is out there on the increased risk of getting into an accident when you're distracted driving, then let them do what they want. Let people make their own decisions. This argument might hold weight for adult drivers, but driving is a privilege also afforded to minors, and allowing them to engage in risky behavior seems to be misguided. I disagree with this notion and argue that driving is a communal activity and that what one person does in their car can have tremendous effects on nearby drivers and pedestrians. The law here serves to not only protect a driver from themselves, but also to protect others.

Conclusion

Distracted driving laws are on their way to becoming the norm in this country. As phones continue to advance as well as other tech, policy makers continue to play from behind and struggle to make the law catch up. Academic studies show the necessity of requiring such laws – engaging in distracted driving is dangerous, regardless of the outcome of each instance.

The analysis I undertook shows that California experienced a significant reduction in the rate of car crashes after implementing bans on texting and calling while driving. When comparing to Ohio and Massachusetts, California performed almost twice as better. Considering the results, it would be fair to say that distracted driving laws have a positive effect on decreasing accidents. In the context of my research, it's concerning that California had just as comparable of an accident rate as Pennsylvania even though both states have different laws regarding using a phone while driving.

Further research to strengthen results would be to consider factors such as type of car and light/weather conditions to make a stronger analysis. It should be noted that all untreated states have harsher winters. Other concepts to consider would be to see how before and after rates vary by demographics and to correlate that with police stops after distracted driving laws are implemented.

Although not all geographic regions are similar, I believe that human behavior with phones and driving is, and support passing distracted driving laws to combat the negative consequences using a phone while driving.

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