Do white police officers unfairly target black suspects?

John R. Lott, Jr

Crime Prevention Research Center

johnrlott@crimeresearch.org

and

Carlisle E. Moody

College of William & Mary and the Crime Prevention Research Center

cemood@wm.edu

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Abstract

Using a unique new data set on police-involved homicides, we apply several discrimination tests to determine if white police officers discriminate against black suspects. We find that the probability of an unarmed black suspect being killed by a white police officer is significantly greater than the probability of a black suspect being killed by a black police officer. We also find that while black officers are generally more likely than white officers to kill unarmed black suspects at a higher rate than they kill unarmed white ones, the differences in these gaps for black and white officers are not statistically significant. These findings are inconsistent with taste-based discrimination on the part of white police officers.

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I. Introduction

The Black Lives Matter movement was born out of the August 2014 shooting of 18-year-old Michael Brown. Darren Wilson, a 28 year-old white police officer, shot and killed Brown in Ferguson, Missouri. Although Wilson was eventually exonerated by both a grand jury and the Department of Justice, there has been a growing public perception that police in general are biased against blacks in their use of lethal force. This perception has been reinforced by several subsequent, highly-publicized police homicides of blacks.[1] It has also led Hillary Clinton to call for Federal regulations on the use of force by police officers.[2]

The resulting anti-police sentiment has led to several "ambush" killings of police officers in Dallas, New York, Baton Rouge and elsewhere. From January 1 to September 17, 2016, felonious police killings were up 61 percent compared to the same period in 2015.[3]

The CDC and FBI collect data on police killings (see Figure 1). But they miss many killings. Not all jurisdictions provide data, and very important data is left out such as race of the officer and the race of the person who was shot. There is also a lack of information on the incident (e.g., whether the suspect was armed).

- The CDC collects data on deaths by "legal intervention." This is defined as any death — including that of a bystander — sustained as a result of an encounter with a law enforcement official.[4] This definition includes both killings by and of police officers. To obtain homicides committed by police, we subtract the number of felonious deaths of police (as provided by the FBI). Data for that is available from 1981 to 2014.

- The FBI provides data on justifiable homicides by law enforcement over the years from 1976 to 2015.[5] The FBI provides 24% more cases than the CDC for the years that data is available from both sources, though most of that difference is for the years from 1981 to 1997. That these data are incomplete is well-known.[6]

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[1] https://www.buzzfeed.com/nicholasquah/heres-a-timeline-of-unarmed-black-men-killed-by-police-over?utm_term=.croq6y0ok#.waeJVLRg5

[2] https://still4hill.com/2016/07/08/hillary-clinton-calls-for-national-guidelines-for-use-of-force/

[3] http://www.odmp.org/search/year?year=2015 and http://www.odmp.org/search/year?year=2016.

[4] http://webappa.cdc.gov/sasweb/ncipc/dataRestriction_inj.html and http://www.icd10data.com/ICD10CM/Codes/V00-Y99/Y35-Y38/Y35-

[5] The FBI UCR data from 1976 to 1998 is available here (http://www.bjs.gov/content/pub/pdf/ph98.pdf). Data for other more recent years are available from annual FBI UCR reports (e.g., https://ucr.fbi.gov/crime-in-the-u.s/2015/crime-in-the-u.s.-2015/tables/expanded_homicide_data_table_14_justifiable_homicide_by_weapon_law_enforcement_2011-2015.xls). When conflicts existed in the numbers reported by the FBI, we used the most recent years for which that data were available.

[6] Even the media generally understands the missing data in the FBI numbers on justifiable homicides by police. Rob Barry and Coulter Jones, "Hundreds of Police Killings Are

- We collected our own dataset on police killings for 2013 through 2015. It was obtained from Lexis/Nexis, Google, Google Alerts, and several online databases. For the years in which our data overlaps with those from the FBI and CDC, we find that the FBI missed 1,333 cases (over three years) and the CDC missed 741 cases (over two years).

- The Washington Post has also collected cases for 2015, one of the three years that we put together, but they found 18 fewer cases than we had.[7] We also collected information not collected by the Washington Post on the number of officers on the scene; the officer's name, age, gender, and race; the officer's years in law enforcement; whether the person shot was involved in a violent crime, property crime, or drug related crime; whether the offender was suicidal; and the final legal resolution of the case. The one variable that the Washington Post collected that we didn't was for mental illness.

Our numbers show a 29% increase in police killings from 2013 to 2015. This is in sharp contrast to the FBI data, which show a small, 6% drop in police killings. Not only does the FBI report many fewer cases than have actually occurred, it is also missing many significant details about the cases that it does report. In only about 31% to 35% of the cases does the FBI have data on the age, race, and gender of the deceased. By contrast, we have this information for 100% of our cases.

Uncounted in Federal Stats," Wall Street Journal, December 3, 2014 (http://www.wsj.com/articles/hundreds-of-police-killings-are-uncounted-in-federal-statistics-1417577504). John R Lott, Jr., "Obama's false racism claims are putting cops' lives in danger," New York Post, July 8, 2016 (http://nypost.com/2016/07/08/obama-should-stop-smearing-cops-by-calling-them-racist/).

[7] The cases missed by the Washington Post in 2015: Andre Larone Murphey, Norfolk, Nebraska, January 7, 2015; Jonathan Paul Pierce, Port St. Joe, Florida, February 11, 2015; Jose E. Herrera, Delano, California, April 22, 2015; Jonathan Nelson, Albertville, Alabama, May 19, 2015; Curtis David Johnson, Huntsville, AL, June 4, 2015; Andrew Ellerbe, Philadelphia, Pennsylvania, June 5, 2015; Estevan Andrade Gomez, Farmersville, California, July 18, 2015; Juan Adolfo Ibarra, Houston, Texas, July 20, 2015; Stephen Ray Brown, Choctaw, Oklahoma, July 20, 2015; Allan F. White III, Cleveland, Tennessee, July 28, 2015; Pablo C. Tiersten, Kansas City, Kansas, August 20, 2015; Nicholas Alan Johnson, San Bernardino, California, September 18, 2015; Jarek Kozlowski, Gardnerville, Nevada, October 16, 2015; Jeffrey Womack, Houston, Texas, October 16, 2015; Larry Busby, Old Town, Florida, October 29, 2015; Brian Crawford, Houston, Texas, October 30, 2015; Unknown, San Juan, Puerto Rico, November 3, 2015; and Unknown, Fontana, California, November 20, 2015.

Figure 1: Different Measures of Fatalities from Police Shootings

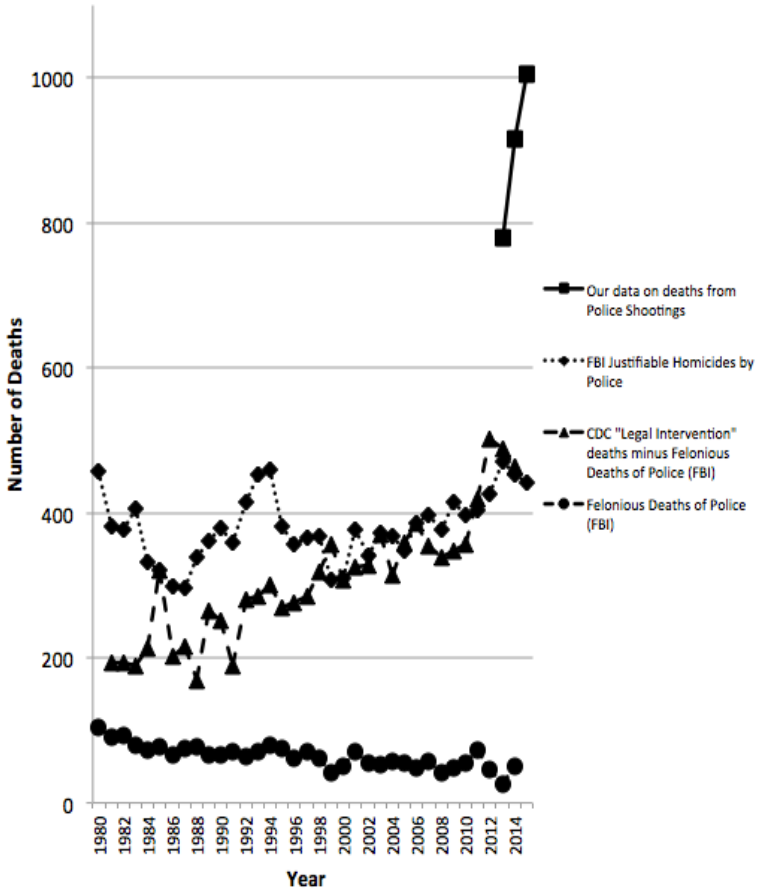
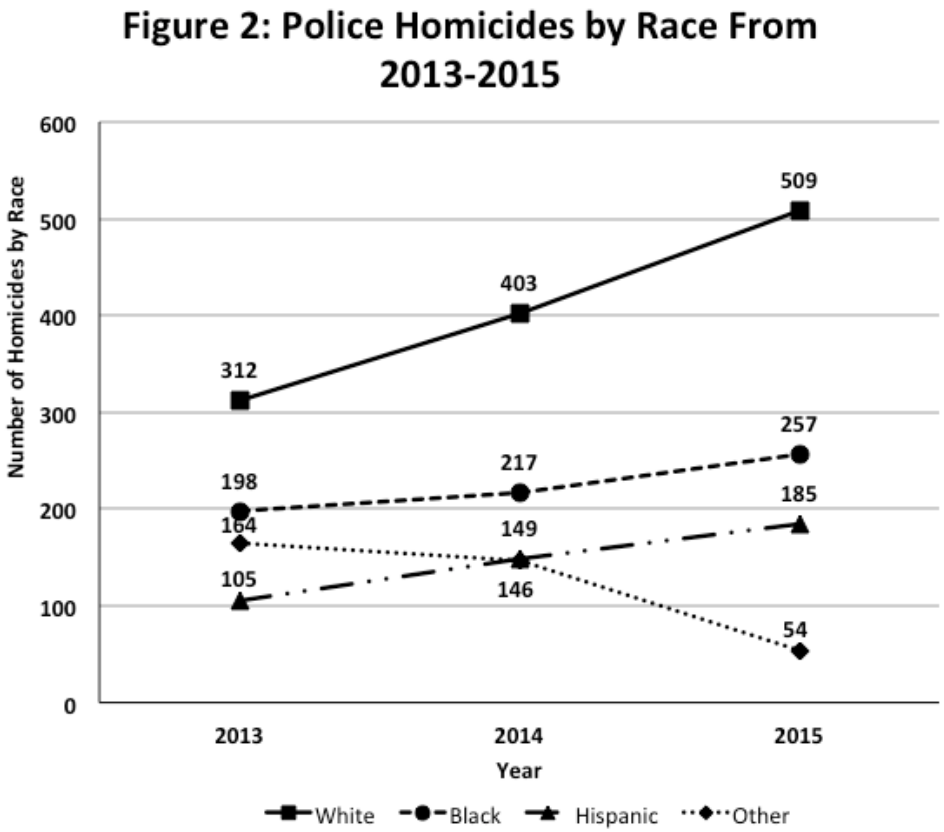


Figure 2 presents our breakdown by race. It appears that the sharpest upward trend in killings was among white suspects. The percentage of suspects killed who were white and Hispanic rose, while the percentage of those who were black remained virtually unchanged. At least over recent history, the evidence does not support the hypothesis that police are targeting blacks more now than they did in the past. However, the fact that blacks have historically been overrepresented in police homicides could be indicative of racial bias.



After the August 2014 shooting of Michael Brown in Ferguson, one might expect that the ensuing publicity would have caused a drop in the rate at which blacks were shot. Yet, blacks' share of police killings remained virtually identical (24.8% before Ferguson and 25% afterwards).

Of course, there are other potential deterrents to police engaging in racial bias such as the use of police body cameras. When a shooting is recorded by a body cam, officers know that it will become a central focus of the public debate. After the recent shooting of Keith Lamont Scott in Charlotte, massive pressure was put on the police department to release the video (even though the police chief had cautioned that there was little to learn from the video).[8] If an officer unjustifiably shoots a suspect because of his race, cameras or the presence of other police will make it harder to hide the truth. Attorney General Loretta Lynch claimed: "Body-worn cameras hold tremendous promise for enhancing

[8] Julia Jacobo, "Charlotte Police to Release Full Body and Dashboard Camera Videos of Shooting of Keith Scott," ABC News, September 30, 2016 (http://abcnews.go.com/US/charlotte-police-release-full-body-dashboard-camera-videos/story?id=42487682).

transparency, promoting accountability, and advancing public safety." In May 2015, she provided $20 million to study these possible benefits.[9]

The FBI and CDC data also don't contain any information on the race or gender of the police officers involved in the shooting. In 33% of shooting cases, we have information on the races of the officers. But this information is important if we are going to be able to try to determine any racial bias in killings. If white and blacks officers respond similarly, it is less likely that they are shooting the suspect because of a personal taste for racism.

In this paper, we use a new database with 2,699 officer-involved homicides. It contains detailed data on the incident itself, the officers and departments involved, and the demographics of the places where the incidents occurred. With these data, we attempt to test the hypothesis that racial animosity causes white police officers to kill blacks more often than people of other races.

II. Previous research

The most closely-related study is by Roland Fryer (2016). It uses a detailed database constructed from police data on interactions with civilians in New York City, Houston, Austin, Dallas, Los Angeles County, and six large Florida counties. Fryer tests several hypotheses concerning possible racial bias in the use of both lethal and non-lethal force. Fryer finds that black suspects are more likely to be victims of non-lethal force, but are no more likely to be victims of lethal force.

The Fryer study has been criticized in part because the most controversial finding — that black suspects are no more likely to be shot than whites — is based entirely on the Houston data and may not be generalizable. Our data are more general and cover thousands of towns and cities in every U.S. state. Fryer has also been criticized for relying on arrest reports to determine whether the incident was one in which the officer had to decide whether to use lethal force. If there is bias in the officer's attitude toward blacks, then that bias is likely to extend to the decision of whether to arrest or not. If so, then Fryer's study suffers from selection bias.[10]

Using county-level data, C.T. Ross (2015) found that armed black suspects face a significantly higher chance of being shot by police than do armed white suspects. The same was found to be true of unarmed black suspects as compared to unarmed white suspects. This study can be faulted for not using incident-based data and therefore for being subject to the ecological fallacy.

On the other hand, in a recent study published in *Injury Prevention.* T.R. Miller (2016) and several co-authors compared hospital records on incidents involving police assault and compared them to those for cases of assault in general. Injuries resulting from general assaults tended to be more severe than those inflicted by law enforcement, and victims of

[9] Office of Public Affairs, US Department of Justice, "Justice Department Announces $20 Million in Funding to Support Body-Worn Camera Pilot Program," US Department of Justice, May 1, 2015 (https://www.justice.gov/opa/pr/justice-department-announces-20-million-funding-support-body-worn-camera-pilot-program).

[10] http://andrewgelman.com/2016/07/14/about-that-claim-that-police-are-less-likely-to-shoot-blacks-than-whites/

police assault were less likely to be admitted to the hospital. However, forty percent of gunshot wounds inflicted by law enforcement were fatal, compared to 26 percent of gunshot wounds in general.

In a study for the Center for Policing Equity, P.A. Goff and several co-authors used incident-level data for 12 police departments. They found that arrested blacks are more likely to be subject to police force than are arrested whites, except when it comes to lethal force, confirming Fryer's result.[11] When arrests for violent crimes are controlled for, the study finds that whites are subject to more severe force than blacks (Goff, et al 2016. Table 5, p. 18). Finally, there is a widely reported but as yet unpublished study of the 93 unarmed victims listed in the Washington Post database of police homicides. It found that blacks are significantly more highly represented than are whites or Hispanics.[12]

Other research has shown that when police departments adopt different physical strength standards for women, there is a positive association between the percentage of white female officers and rates of police shootings (Lott 2000, see especially pp. 258-260). Because female officers are less physically strong, getting into a hand-to-hand altercation with a criminal is riskier. Male officers may be able to take more time before deciding whether it is absolutely necessary to use lethal force.[13]

MacDonald (2016, pp. 31-35, 73-80) argues that police, the majority of whom are white, are disproportionately assigned to high-crime areas, which tend to be largely black. The result is more violent encounters, including lethal encounters in which white police officers shoot black suspects.

Our study uses incident-level data on line-of-duty police homicides from a large number of departments. Unlike the analysis by Fryer, we do not have data on the use of non-lethal force. However, we have very detailed data on police homicides from far more police departments. Finally, the fact that our data is at the incident level means that our analysis does not suffer from the ecological fallacy.

III. Do Blacks View Police as Racist?

A recent Gallup survey shows 50% of blacks believe that black males are more likely to go to prison than white males primarily because of discrimination.[14] By contrast, only

[11] http://policingequity.org/wp-content/uploads/2016/07/CPE_SoJ_Race-Arrests-UoF_2016-07-08-1130.pdf

[12] https://www.washingtonpost.com/national/study-finds-police-fatally-shoot-unarmed-black-men-at-disproportionate-rates/2016/04/06/e494563e-fa74-11e5-80e4-c381214de1a3_story.html

[13] Lowering strength standards for female officers also changed departments in other important ways. Namely, it ends single-officer patrol units and makes foot and bicycle patrols significantly less common.

[14] Frank Newport, "Gallup Review: Black and White Attitudes Toward Police," Gallup, August 20, 2014 (http://www.gallup.com/poll/175088/gallup-review-black-white-attitudes-toward-

19% of whites agreed. Blacks also indicate that they have less confidence in police and the criminal justice system than whites in other ways, though those differences are significantly smaller. Compared to whites, thirteen percentage points more blacks have very little/no confidence in police (25 percent versus 12 percent) and ten percentage points more feel that way about the criminal justice system (40 percent versus 30 percent). But on the honesty and ethics of police, the gap is even smaller – seven percent say it is low/very low (17 percent to 10 percent). Other surveys, such as one from June 2013 by the Pew Research Center, show a similar pattern.[15]

But there are some possible problems with this claim of discrimination. People might perceive discrimination even when none exists. Later in the paper we will provide evidence on whether white police are in fact systematically discriminating against blacks. In addition, as economists know all too well, what people tell pollsters isn't always what they think. If blacks believe the police are biased against them, they presumably won't turn to them as frequently as whites when crime occurs. There could be real costs to this reticence. If criminals really believed that black victims are less likely to contact the police about crime, it might even encourage criminals to attack black victims. Yet, blacks report violent crime to police at the same or a higher rate than either whites or Hispanics (Table 1), in part perhaps because they are more likely to be victims of crime.

Only for those below the poverty level are the rates of violent crime reported to the police similar for blacks and whites, though even there blacks report at a slightly higher rate of 1.1 percentage points.[16] For those who are 101% to 200% above the poverty level or 201% to 400% above the poverty level, blacks are about 11 percentage points more likely than whites to report violent crime to police. The Bureau of Justice Statistics reports that whites who are below 200 percent of the poverty level face a higher violent crime rate than blacks with the same income, yet blacks still report those crimes at a higher rate. For incomes above 200 percent of poverty, blacks are more frequent victims of violent crime, but again they are still more likely to report them.

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police.aspx?utm_source=alert&utm_medium=email&utm_campaign=syndication&utm_content=morelink&utm_term=Politics).

[15] PEW Research Center, Social & Demographic Trends, "King's Dream an Elusive Goal," PEW Research Center, August 22, 2013 (http://www.pewsocialtrends.org/files/2013/08/final_full_report_racial_disparities.pdf).

[16] Bureau of Justice Statistics, National Crime Victimization Survey, 2008-2012 (http://www.bjs.gov/content/pub/pdf/hpnvv0812.pdf)

Table 1: Violent Crime Victimization Reported to Police by poverty level and race (Race with the highest reporting rate to police is shown in bold)			
	White	Black	Hispanic
Poor	51.7	**52.8**	50.4
Low Income	48.1	**59.4**	49.8
Mid-Income	42.7	**53.2**	35.7
High Income	44	**51.3**	44.8
Source: Bureau of Justice Statistics, National Crime Victimization Survey, 2008-2012 (http://www.bjs.gov/content/pub/pdf/hpnvv0812.pdf)			

It is also possible to see the numbers broken down by income, race and location of residence (Table 2). In that case, in eight of the twelve possible breakdowns, blacks are still much more like to report crimes to police than whites or Hispanics.

These data at least raises questions about whether blacks, or at least black victims of crime, believe that the police are systematically racist.

IV. Data

We have 2,699 observations of police killings from over 1,500 cities in the United States from 2013 to 2015. The data were collected from several sources: LexisNexis, Google, Google Alerts, and several online databases concerned with police killings. We also consulted online police data from Philadelphia and Dallas. As there is a lack of publicly disclosed information concerning officers, we tried to contact each police department so as to get more information on the officers involved in the killings. See the Data Appendix for more information, including details as to how the searches were conducted and the URL addresses for the online databases. The Data Appendix also has a list of the contact information for the police departments that were willing to provide more details about their officers.

With respect to the incident, we have the race of the suspects killed (Black, White, Hispanic, other) and their age. With respect to the officer(s) involved, we have race and gender for 904 incidents.[17] We also have data for the number of officers on the scene. We suspect that the more officers on the scene, the less likely it is that the suspect will resist. The police report, we believe, is also more likely to be accurate. We have data on whether the suspect was involved in a violent crime, a property crime, or a drug-related crime. We also have data on whether the suspect was armed and, if so, the type of weapon (firearm, knife, vehicle, other).

With respect to the police departments, we used the 2013 Law Enforcement Management and Administrative Statistics survey (LEMAS) data on their racial makeup, use of body cameras, if there are cameras on weapons, whether gunshot sound detection technology is

[17] When more than one officer was involved, we use the race of the officer reported as the killer.

used (to reduce response times), if the same officers are assigned to given neighborhoods, and whether community policing is part of the department's mission statement. We also know whether the department uses helicopters (a proxy for militarization), the number of marked and unmarked police cars per 100,000 population, the proportion of part-time officers, whether some college education is required for new hires, and whether the police are unionized (which gives an additional layer of legal protection and job security for officers).

We can also control for the city's total population, violent crime levels (broken down by murder, rape, robbery, and assault), and the number of black, white and Hispanic males in the age group 15-29. Finally, we have state-level data on the number of police officers killed in the line of duty. This, we suspect, may influence officers' willingness to use lethal force.

The number of observations and means are shown in Tables 3 and 4. Table 3 shows that 25 percent of the suspects killed were black, 45 percent white, and 16 percent Hispanic. The remaining 14 percent were Asian, American Indian, or other. With respect to the officer's race, 29% were white, 2% black (41 cases), 2% Hispanic (63 cases), and for 67% their race is unknown. Four percent of the officers were female (65 cases). There was an average of 2.4 officers on the scene — an average that was approximately constant for suspects of the various races. The average city population is 415,000 overall and over 600,000 for cities experiencing incidents in which black suspects were shot. White suspects tend to be killed in smaller cities with an average population of 250,000.

Eighteen percent of the police departments reported use of body cameras on patrol officers, while 6% used cameras on weapons, and 16 % used gunshot detection systems. Fifty-six percent reported that they assign the same officers to given neighborhoods and 55% report that community policing is in the mission statement. Both percentages are somewhat higher for cases in which black suspects are killed. There are more marked and unmarked police cars per 100,000 population in cities where white suspects were killed. Helicopters are used in 35% of all departments — somewhat higher in cities where black suspects were killed. Part-time sworn officers are rare, and only a few departments require some college education for a new hire. The majority of departments are unionized. Sixty-eight percent of the police officers in these departments were white, 10 percent black, and 14 percent Hispanic, although the departments involved in the killing of black suspects tended to have more black officers and those involved with Hispanic suspects had relatively more Hispanic officers.

Perusal of Table 4 reveals that suspects were an average age of 36, with whites somewhat older than blacks. Thirty-nine percent of the suspects were involved in a violent crime, 17% in a property crime, and 5% in a drug crime. Hispanics were less likely to be involved in a violent crime, while blacks were more likely to be involved in a property crime than whites or Hispanics. Blacks are least likely to be armed. Eighty-nine percent of the suspects killed by police where armed. Most of the suspects, 60 percent, were armed with a firearm, 18% with a knife or cutting instrument, and 4% of the suspects used a vehicle as a weapon.

Cities experiencing police homicides have higher than average violent crime rates (578 violent crimes per 100,000 compared to 368 for the U.S. as a whole.) and violent crime

rates are higher in cities where black suspects were killed (758) compared to cities in which white suspects were killed (480). The same is true for the subcategories of violent crime. The murder rate is particularly high in cities where blacks were killed by police (11.2) compared to cities in which white suspects were killed (4.6). Young black men represent a greater proportion of the population in cities that experience police killings of blacks (3.5%) compared to cities where whites were killed (1.4%). The proportion of young white men in the population is relatively constant across all cities, with an average of 5.4%.

One possible qualification regarding the suspect death rates should be raised: if trauma care isn't as good in heavily black areas, a police shooting of a black suspect may be more likely to result in the death of the suspect compared to the exact same shooting of a white. Police might thus be blamed for a higher death rate of black suspects for reasons that have nothing to do with their actions. Some research suggests this might be the case for urban areas: "… black and white patients treated at hospitals with a high concentration of black trauma patients had a 45 percent higher risk of death and a 73 percent higher risk of death or a major complication when they were compared to patients of both races who were admitted to hospitals that treat low proportions of black patients" (Glance et al., 2013).[18]

V. Methodology

The null hypothesis is that all police officers are race neutral, employing lethal force against all suspects at the same rate. They use such force to defend themselves or others from perceived lethal threats independent of the suspect's race. The alternative hypothesis is that all police officers are racially biased. That is, white police officers are biased against, and more likely to kill, black and Hispanic suspects; black police officers are biased against white and Hispanic suspects; Hispanic officers are biased against white and black suspects.

From 2013 to 2015, there were 2,699 fatal killings by police. Our data show that blacks make up 25% of those killed by police, but only 12% of the total population. This disproportionate representation could be due to racism on the part of white police officers.

However, suppose that police officers are race neutral, are randomly assigned to neighborhoods within cities, and that the crime rate is constant across neighborhoods. Then, under the null hypothesis, we would expect that the proportion of black suspects killed would be approximately equal to the proportion of the population that is black.

But crime rates differ across neighborhoods. Black neighborhoods tend to experience higher crime rates. Therefore, race-neutral police randomly assigned to neighborhoods would encounter more criminal activity in black neighborhoods. As such, they could be expected to employ lethal force against a higher proportion of black suspects. Furthermore, police are not randomly assigned to neighborhoods, but tend to be concentrated more heavily in crime "hot spots" and neighborhoods in which the crime rate is relatively high. Such areas tend to be relatively poor and black (or other minority), leading to more encounters between the police, the majority of whom are white, and black,

[18] Other research suggests that the death rate from lack of trauma care is highest in rural areas where whites account for relatively more of the population (Hsia and Shen, 2011).

Hispanic or other minority suspects. A small percentage of these encounters will result in the deaths of the suspect. Thus, suspects killed by a color-blind police force would be disproportionately minority, as compared with the overall population.

Anwar and Fang (2006) and Knowles, Persico and Todd (2001) test for discrimination by looking at whether black and white motorists are stopped and searched at similar rates by white officers. Fryer (2016) employs a similar test for officer-involved killings, though Fryer uses only information on the racial composition of police departments, not the race of the officers involved in the shooting. It is possible that the racial composition of a department changes the cost of racial bias by individual officers, but the race of the individual officers would still presumably matter. The Anwar-Fang test is a simple test of the difference between two means, for example, the proportion of unarmed black suspects killed by white police officers compared to the proportion of unarmed white suspects shot by white officers. If white officers are racist, they will be more likely to shoot black suspects who are later found to be unarmed.

Fryer finds that the proportion of armed black suspects shot in an officer-involved shooting by a white police officer is four percent lower than for armed white suspects. However, the difference is insignificant, indicating that there is no significant taste-based racial discrimination by white police officers.

It is important to note that whether a suspect is armed isn't the only factor that determines whether an officer fires his weapon. For example, an officer might shoot an unarmed suspect if he is committing a violent crime, not obeying the officer's commands, or attempting to get possession of the officer's weapon. The more violent crime in the city, the more likely it is that officers will have experience with dangerous suspects who are likely to resist, fail to obey orders, or threaten other civilians. It is thus possible that even after accounting for whether a suspect is armed there might be systematic differences across suspect races depending on how they vary with respect to these other two factors.

We test the hypothesis of race neutrality by testing two of its implications. The first is that the probability of an unarmed black suspect being killed by a white police officer should be the same as the probability of the same suspect being killed by a black officer. That is,

$$(1) \qquad P(\mathrm{U} \mid \mathrm{S}_B, O_W, \mathrm{K}) = P(\mathrm{U} \mid \mathrm{S}_B, O_B, \mathrm{K})$$

The notation is as follows: suspect is unarmed (U), suspect is killed (K), suspect is black (S_B), suspect is white (S_W), officer is white (O_W), and officer is black (O_B). The alternative hypothesis, that white officers discriminate against black suspects, requires that the probability that white officers will kill unarmed black suspects be significantly greater than the probability of a black officer killing an unarmed black suspect.

The second implication of the race neutral hypothesis is that the probability that an unarmed black suspect is killed by a white officer is equal to the probability that an unarmed white suspect is killed by a white officer.[19]

$$(2) \qquad P(\mathrm{U} \mid \mathrm{S}_B, O_W, \mathrm{K}) = P(\mathrm{U} \mid \mathrm{S}_W, O_W, \mathrm{K})$$

We expect that, if officers are race-neutral, a suspect of any race would be treated the same by officers of any race. The alternative hypothesis that white police officers discriminate against black suspects requires that white police kill unarmed black suspects with higher probability than they do unarmed white suspects. However, it also requires that black officers do not kill unarmed black suspects with greater probability than they do unarmed white suspects. If black and white police officers are killing unarmed black suspect at higher rates than they are killing unarmed white suspects, then there could be some kind of discrimination, but it is not racial discrimination.

VI. Results

The model is a city-level fixed-effects linear probability regression. The dependent variable is a dummy variable indicating that the suspect was unarmed. The regression results are presented in Table 5. The variables of interest are the interaction variables between the race of the officer and the race of the suspect. For example, the coefficient in the first row gives the probability of a white officer killing an unarmed black suspect. There are corresponding coefficients for other pairs of officers and suspects. However there are no cases of black officers killing unarmed Hispanic suspects.[20]

The model controls for the overall probabilities that white, black and Hispanic offices kill unarmed suspects regardless of race and the corresponding probabilities that unarmed black, white and Hispanic suspects are killed by an officer of any race. We introduce incident-level variables in Model 2, state and local variables in Model 3, and the LEMAS department-level variables in Model 4.

With respect to the variables of interest, the only significant coefficients are associated with black officers and Hispanic officers. The coefficient on black officers is significantly positive for both black and white suspects. The coefficient on Hispanic officers is significantly negative for Hispanic suspects.

The relevant F-tests for the equality of these coefficients are presented in Table 6, along with the corresponding coefficients. For each model, the rows corresponding to "All officers" show the F-tests for the hypotheses that unarmed black, white, and Hispanic suspects are treated the same by officers of different races, corresponding to (1) above. This hypothesis is rejected for both black and white suspects in three out of four models. However, it is black officers who kill unarmed black and white suspects at a higher rate

[19] We extend these hypotheses and tests to Hispanic officers and suspects. We ignore these cases in this development for simplicity.

[20] In fact there is only one example of a black officer killing a Hispanic suspect (in Texas in 2014).

than either white or Hispanic officers, indicating some support for the Forman (2017) class-based discrimination hypothesis.[21] We dropped the black officers from the F-test and found no significant difference between white and Hispanic officers with respect to unarmed black and white suspects (not reported to conserve space). Also, Hispanic officers apparently treat unarmed suspects of all races similarly. These tests indicate that unarmed black suspects are more likely to be killed by black officers than by either white or Hispanic officers, indicating no taste-based racial discrimination by white or Hispanic officers.

With respect to the second test, we want to know whether an unarmed black suspect is more likely to be killed by a white officer than is an unarmed white suspect. The results are also presented in Table 6. In two out of the four models (models 1 and 3), white officers are significantly more likely to kill an unarmed black suspect than an unarmed white suspect. This is evidence of racial discrimination on the part of white officers. However, in two out of four models (models 2 and 3), black officers are also more likely to kill an unarmed black suspect than an unarmed white suspect.

As we noted previously, there still might be other factors that vary systematically with respect to the race of the suspect that we can't control for. For example, suspects might not obey the officer's commands or attempting to get possession of the officer's weapon. We attempt to account for these other reasons by examining whether black and white officers differ in terms of their greater likelihood in shooting unarmed black suspects relative to unarmed white ones. If there is racial bias by white officers, there should then be a bigger gap between the rate that they shot unarmed black suspects relative to white ones compared to the same gap for black officers.

In fact, in three of the four estimates in Table (models 2 through 4), the gap between black officers shooting unarmed black suspects relative to unarmed white ones is much larger than it is for white officers. However, the F-tests that we conducted on these differences (not shown) found that, for all four models, this relative gap for black and white officers was never statistically significant. That is, both black and white officers kill unarmed black suspects at the same higher rate than they kill unarmed white suspects. All results can be downloaded from the lead author's website.

Hispanic officers do not kill unarmed black suspects more frequently than they kill unarmed white suspects. In two models, Hispanic officers kill unarmed white suspects with a higher frequency than unarmed Hispanic suspects. In all four models, Hispanic officers kill unarmed black suspects more often than they do unarmed Hispanic suspects. This is evidence that runs counter to the results with respect to hypothesis (1), namely that Hispanic officers apparently discriminate against both black and white suspects. It is also evidence that Hispanic officers may have experience with Hispanic suspects that leads them to assume that Hispanic suspects are less likely to be armed than whites or blacks.

[21] Forman (2017) argues that black officers identify with the black middle class, who tend to be tough on crime, not with poor black residents who are overrepresented among criminals. He also argues that black police officers view their job as one of reducing crime, not promoting civil rights.

Overall, we find that black police officers have the highest probability of killing an unarmed black suspect compared to whites and Hispanics. We find no significant taste-based racial discrimination by white officers against black suspects in that white officers do not kill unarmed black suspects at a significantly higher rate than do black officers. We find mixed evidence with respect to Hispanic officers.

VII Robustness tests

A. Alternative tests for racial discrimination[22]

An alternative test follows from the hypothesis that, assuming race-neutrality on the part of police officers, the probability of a black suspect being killed by a white police officer should be equal to the probability of a black suspect being killed by a black officer, independent of whether the suspect is armed. The event notation is the same as above: suspect is killed (K), suspect is black (S_B), suspect is white (S_W), officer is white (O_W), officer is black (O_B). The null hypothesis is[23]

(3) $$P(K \mid S_B, O_W) = P(K \mid S_B, O_B)$$

Because we do not have data on incidents in which the suspect was not killed, we only know the probability that a suspect was black, given that the suspect was killed and the officer was white and the probability that the suspect is black given that the suspect was killed by a black officer. That is, we know

(4) $$P(S_B \mid O_W, K)$$

and

(5) $$P(S_B \mid O_B, K).$$

To reverse these conditional probabilities, we need Bayes' rule. For the left hand side of (3) we have,

(6) $$P(K \mid S_B, O_W) = \frac{P(S_B, O_W \mid K)P(K)}{P(S_B, O_W)} = \frac{P(S_B \mid O_W, K)P(O_W \mid K)P(K)}{P(S_B \mid O_W)P(O_W)}$$

For the right hand side of (3) we have

(7) $$P(K \mid S_B, O_B) = \frac{P(S_B, O_B \mid K)P(K)}{P(S_B, O_B)} = \frac{P(S_B \mid O_B, K)P(O_W \mid K)P(K)}{P(S_B \mid O_B)P(O_B)}$$

So, we can express (3) as

[22] We thank an anonymous referee for suggesting the development used in this section.

[23] As in Section V above, of these hypotheses are stated in terms of white and black suspects and officers, although we also test the hypotheses with Hispanic suspects and officers. The development with Hispanic officers and suspects is completely analogous and is omitted here.

(8) $$\frac{P(\mathrm{S}_B \mid O_W, K)\,\mathrm{P}(O_W \mid K)\,\mathrm{P}(\mathrm{K})}{P(\mathrm{S}_\mathrm{B} \mid \mathrm{O}_W)\,\mathrm{P}(\mathrm{O}_W)} = \frac{P(\mathrm{S}_B \mid O_B, K)\,\mathrm{P}(O_W \mid K)\,\mathrm{P}(\mathrm{K})}{P(\mathrm{S}_\mathrm{B} \mid \mathrm{O}_B)\,\mathrm{P}(\mathrm{O}_B)} =$$

Given that we only have data on (4) and (5) we need to assume

(9) $$\mathrm{P}(O_W \mid K) = \mathrm{P}(O_B \mid K)$$

and

(10) $$P(\mathrm{S}_\mathrm{B} \mid \mathrm{O}_W)\,\mathrm{P}(\mathrm{O}_W) = P(\mathrm{S}_\mathrm{B} \mid \mathrm{O}_B)\,\mathrm{P}(\mathrm{O}_B)$$

That is, we need to assume that the probability of a white officer killing a suspect of any race is equal to the same probability for a black officer, that is, police officers of all races are equally lethal. We also need to assume that the probability that a black suspect will encounter a white officer is the same as his chance of encountering a black officer.

We can test (9) by regressing the incidence rate for a suspect being killed in each city on the proportion of black, white, and Hispanic officers in the city's police department. We did that regression with and without city fixed effects and found no significant difference between the proportions of black and white, black and Hispanic, or white and Hispanic officers in the city's police department. (Not reported to conserve space.) For this reason we are comfortable assuming that police officers of different races are equally lethal.

We cannot test (10). However, we have data on the demographics of the city in which the incident occurred, specifically the proportion of the population consisting of young black men between the ages of 15 and 29. We also have the proportion of the city's police department consisting of white, black, and Hispanic officers. Finally, we also have city fixed effects. Including these variables in the regression will control, at least in part, for the chances of black suspects encountering black, white, and Hispanic officers.

The results of this test are reported in Table 7. The regression is a city-level fixed-effect linear probability model with standard errors robust to heteroscedasticity. The dependent variable is a binary variable indicating that a black suspect was killed. The standard errors are robust with respect to heteroscedasticity. Model 1 includes, along with the dummy variables for the police officer's race (white, black, Hispanic, and unknown), the proportion of black males 15-29, the proportion of black, white, and Hispanic officers in the relevant police department, and year dummies. The coefficients for the different race of officers thus give the overall odds of a black suspect being killed by officers of each race, relative to officers of Asian, American Indian or other race. Model 2 adds incident level variables. Model 3 adds state and local variables, and Model 4 adds the LEMAS department-level variables.

The results of the corresponding tests of equality between the various pairs of coefficients testing the null hypothesis (1) above are presented at the bottom of Table 7. As the table shows, there is no significant difference between the coefficients of white and black police officers, indicating no significant bias among white officers when confronting black suspects relative to black officers. If we include all the potentially relevant control variables, the possibility of omitted variable bias is reduced, but so is the sample size.

However, for Model 4, there are no significant differences among any of the pairs of coefficients indicating the race of the police officer. The only tests that are significant for Table 4 involve officers whose race is unknown, from which we cannot draw any firm conclusions. There is some evidence from Models 1 and 2 that black and white officers kill black suspects at a higher rate than Hispanic officers do. In fact, although insignificantly different from zero, black officers have the highest probability of killing black suspects, white officers are second and Hispanic officers have the lowest probability. This is the same rank order as found in the analysis reported in Table 5.

For all four models, white officers are not significantly more likely than black officers to kill black suspects. The race neutral hypothesis is rejected in two out of four models for white officers relative to Hispanic officers and in three out of four models for black versus Hispanic officers. With respect to the control variables, the probability of a police officer killing a black suspect decrease with the number of officers on the scene, if the suspect is suicidal, and if the suspect is armed. The remaining control variables are not significant.

Following the development in Section V, we also test the hypothesis that the probability of a black suspect being killed by a white police officer is the same as the probability of a white suspect being killed by a white officer. That is,

$$(11) \qquad P(K \mid \mathrm{S}_B, O_W) = P(K \mid \mathrm{S}_W, O_W)$$

The left hand side of (11) is the same as the left hand side of (3) and the development is the same, yielding equation (6).

The right hand side is analogous,

$$(12) \qquad P(K \mid \mathrm{S}_W, O_W) = \frac{P(\mathrm{S}_W, O_W \mid K)\,\mathrm{P(K)}}{P(\mathrm{S}_W, O_W)} = \frac{P(\mathrm{S}_W \mid O_W, K)\,\mathrm{P}(O_W \mid K)\,\mathrm{P(K)}}{P(\mathrm{S}_W \mid \mathrm{O}_W)\,\mathrm{P}(\mathrm{O}_W)}$$

Therefore this hypothesis can be expressed as

$$(13) \qquad \frac{P(\mathrm{S}_B \mid O_W, K)\,\mathrm{P}(O_W \mid K)\,\mathrm{P(K)}}{P(\mathrm{S_B} \mid \mathrm{O}_W)\,\mathrm{P}(\mathrm{O}_W)} = \frac{P(\mathrm{S}_W \mid O_W, K)\,\mathrm{P}(O_W \mid K)\,\mathrm{P(K)}}{P(\mathrm{S}_W \mid \mathrm{O}_W)\,\mathrm{P}(\mathrm{O}_W)}$$

Thus, (13) has the same properties as (6) and requires the same two assumptions.

However, for estimation purposes to test (13) we need to estimate two functions: one with the dummy for black suspects as the dependent variable with the officers' race dummies as the independent variables and a corresponding equation with the dummy for white suspects as the dependent variable. We then test the equality of the coefficients on the officer's race across equations. This entails estimating the equations jointly using seemingly unrelated regressions. In this case, we use the same list of regressors for both equations, so the result is identical to estimating the two equations using OLS. There is one problem with this model, namely, the standard linear fixed-effects model generated a

linearly dependent variance-covariance matrix. However, we were able to estimate all of the models presented in Table 7 except the final model with the LEMAS variables by using state, rather than city, fixed-effects. The model with the LEMAS variables had a non-invertible variance-covariance matrix even with state fixed effects. The results with respect to hypothesis (4) are presented in Table 8.

We suppress the coefficients of the control variables to conserve space. As the table shows, we find no significant coefficients on the variables of interest. F-tests on the equality of coefficients across equations, also suppressed to conserve space, could not reject the null hypothesis of no difference in the coefficients of white, black, or Hispanic officers with respect to their treatment of black versus white suspects, black versus Hispanic suspects, and white versus Hispanic suspects at p=.10 or below. Complete results are available from the lead author's website. Thus, we find no evidence of racial discrimination using this test.

Overall, using these two alternative tests, we find no evidence that white police officers are significantly more likely to kill black suspects than black police officers. We do find some evidence that Hispanic police officers are significantly less likely to kill black suspects than either black or white officers.

B. Alternative estimates

We estimated the regressions reported in Table 7 using white suspects instead of black suspects. The results were similar. There was no evidence of racial discrimination for white officers compared to either black or Hispanic officers. We also repeated the analysis for Hispanic suspects. We found some evidence that white officers killed Hispanic suspects with a significantly higher probability than black officers did. However, we also found that there was no significant difference in the treatment of Hispanic suspects by white and Hispanic officers. Re-estimating these models using fixed-effects logit did not change the results that white officers did not discriminate against any race of suspects relative to black or Hispanic officers. We were unable to estimate any of the Table 5 models using logit.

C. Female officers

We have data on the gender of the officers who killed suspects. However, we have only 65 cases in which a female officer killed a suspect, 34 of which have no information on the officer's race. Adding a dummy variable for officer female makes no difference in the overall results and the dummy itself is insignificant in all four models. We found some potentially interesting results with respect to the treatment of unarmed suspects by black and white female officers, but because of the very small sample size we do not report the results here. All results are available on the lead author's website.

VIII Summary and Conclusions

Using a unique new data set on police-involved homicides, we applied the Anwar-Fang (2006) test to unarmed suspects killed by police officers. There are two tests of race-neutrality on the part of police officers. (1) The probability of an unarmed black suspect being killed by a white police officer should be equal to the probability of a black suspect being killed by a black police officer. This hypothesis was tested in Table 6. We found that the hypothesis was rejected. However, we found that black officers killed unarmed black suspects at a significantly higher rate than white or Hispanic officers. This result rejects the hypothesis of race neutrality, but it is inconsistent with the hypothesis of taste-based discrimination on the part of white police officers. With respect to the second hypothesis, we find that both black and white police officers kill unarmed black suspects with higher probability than unarmed white or Hispanic suspects. This finding is also inconsistent with taste-based discrimination on the part of white police officers.

In Section VII we test an alternative to the Anwar-Fang test by asking whether white police officers kill black suspects with higher probability than do black officers, irrespective of whether they are armed or not. We find no evidence that white police officers are more likely to kill black suspects relative to black officers. We also find no evidence that white police officers kill black suspects with a higher probability than they do white suspects. We do find some evidence that Hispanic police officers are significantly less likely to kill black suspects than either black or white officers.

Overall, we find no evidence of significant taste-based racial discrimination on the part of white police officers with respect to black suspects.

References

Anwar, S. and H. Fang (2006) An alternative test of racial prejudice in motor vehicle searches: Theory and evidence. *American Economic Review* 96: 127-151.

Foreman, J. Jr. (2017) *Locking up our own: Crime and punishment in Black America*. New York: Farrar, Straus and Giroux.

Fryer, R.G. Jr. (2016) An empirical analysis of racial differences in police use of force, NBER working paper 22399.

Glance Laurent G, Turner M. Osler, Dana B. Mukamel, J. Wayne Meredith, Yue Li, Feng Qian and Andrew W. Dick (2013). Trends in Racial Disparities for Injured Patients Admitted to Trauma Centers, *Health Services Research*. October, 1684–1703. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3796108/

Goff, P.A., T. Lloyd, A. Geller, S. Raphael, J. Glaser (2016). *The science of justice: race, arrests, and police use of force.* Los Angeles: Center for Policing Equity. http://policingequity.org/wp-content/uploads/2016/07/CPE_SoJ_Race-Arrests-UoF_2016-07-08-1130.pdf

Hsia, R. and Y. Shen (2011). Possible Geographical Barriers to Trauma Center Access for Vulnerable Patients in the United States. Arch Surg. 2011 Jan; 146(1): 46–52. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3121679/

Knowles, J. N. Persico and P. Todd (2001) Racial bias in motor vehicle searches: Theory and evidence. *Journal of Political Economy*109: 203-229.

Lott, John R., Jr. (2000). "Does a helping hand put others at risk? Affirmative Action, Police Departments, and Crime," *Economic Inquiry* 2: 239-277.

MacDonald, H. (2016). *The War on Cops*. New York: Encounter Books

Miller, T.R. et al (2016). Perils of police action: a cautionary tale from U S datasets. *Injury Prevention* http://injuryprevention.bmj.com/content/early/2016/07/27/injuryprev-2016-042023

Ross, C.T. (2015). A multi-level Bayesian analysis of racial bias in police shootings at the county-level in the United States, 2011–2014. *PLoS ONE* 10(11): e0141854. doi:10.1371/journal.pone.0141854.

Table 2: Violent Crime Victimization Reported to Police by poverty level and race and location (Race with the highest reporting rate to police is shown in bold)									
	Urban			Suburban			Rural		
	White	Black	Hispanic	White	Black	Hispanic	White	Black	Hispanic
Poor	**51.9**	51.2	53.7	47.6	**57**	45.5	**57**	53	48.7
Low Income	49.2	**56.8**	49.8	44.9	**69.6**	50.6	**53.4**	46.8	44.7
Mid-Income	46.7	**52.7**	39	41.1	**50.8**	31.3	41.6	**82.6**	35.6
High Income	43	35.5	**52.1**	40.7	**71.7**	39.9	64.5	**79.4**	56.9
Source: Bureau of Justice Statistics, National Crime Victimization Survey, 2008-2012 (http://www.bjs.gov/content/pub/pdf/hpnvv0812.pdf)									

Table 3: Number of observations and means: incident and police attributes by race of suspect

	Overall		Suspect White		Suspect Black		Suspect Hispanic	
Variable	N	Mean	N	Mean	N	Mean	N	Mean
suspect white, percent	2699	0.45	1224	1	672	0	439	0
suspect black, percent	2699	0.25	1224	0	672	1	439	0
suspect Hispanic, percent	2699	0.16	1224	0	672	0	439	1
police officer white, percent	2699	0.29	1224	0.35	672	0.29	439	0.19
police officer black, percent	2699	0.02	1224	0.01	672	0.04	439	0.00
police officer Hispanic, percent	2699	0.02	1224	0.02	672	0.02	439	0.04
officer race other, percent	2699	0.01	1224	0.01	672	0.00	439	0.01
officer race unknown, percent	2699	0.67	1224	0.61	672	0.65	439	0.75
officer female	1710	0.04	841	0.03	430	0.04	253	0.04
total population/1000	2678	41.48	1210	24.85	667	60.86	439	55.97
number police on scene	2699	2.39	1224	2.49	672	2.18	439	2.40
Rate that police were feloniously killed in state that year/100k	2686	10.11	1218	10.83	669	9.67	439	10.02
bodycams used, percent	2699	18.49	1224	16.18	672	18.01	439	26.42
cameras on weapons, percent	2699	6.45	1224	6.06	672	6.70	439	5.24
gunshot detection tech used, percent	2699	16.15	1224	9.23	672	25.89	439	21.87
same officers in neighborhood, percent	2699	55.87	1224	48.12	672	65.48	439	64.01
marked cars per 100k pop	1642	53.88	684	72.31	454	66.06	289	7.30
unmarked cars per 100k pop	1642	33.15	684	50.34	454	30.88	289	3.77
helicopters used, percent	2699	0.35	1224	0.27	672	0.45	439	0.44
percent part-time officers	1811	0.01	737	0.02	503	0.01	333	0.01
percent white officers	1804	68.65	732	76.70	502	65.25	332	58.55
percent black officers	1804	10.48	732	6.93	502	17.40	332	7.73
percent Hispanic officers	1804	14.42	732	9.86	502	12.71	332	27.43

percent female officers	1801	12.40	730	10.72	501	14.73	332	12.43
police union, percent	2699	0.59	1224	0.50	672	0.68	439	0.70
Some college education required, percent	2699	0.08	1224	0.06	672	0.13	439	0.06
community policing mission, percent	2699	0.55	1224	0.47	672	0.66	439	0.66

Table 4: Number of observations and means: suspect and city attributes by race of suspect

		Overall		Suspect White		Suspect Black		Suspect Hispanic
Variable	N	Mean	N	Mean	N	Mean	N	Mean
suspect's age	2671	36.49	1222	39.30	670	31.99	436	32.64
involved in violent crime	2699	0.39	1224	0.39	672	0.39	439	0.36
involved in property crime	2699	0.17	1224	0.15	672	0.22	439	0.17
involved in drug related crime	2699	0.05	1224	0.04	672	0.07	439	0.06
suspect armed	2637	0.89	1200	0.90	660	0.85	430	0.87
suspect armed with firearm	2699	0.60	1224	0.63	672	0.61	439	0.51
suspect armed with knife	2699	0.18	1224	0.17	672	0.14	439	0.20
suspect used vehicle as weapon	2699	0.04	1224	0.04	672	0.05	439	0.05
suspect used other weapon	2699	0.06	1224	0.06	672	0.05	439	0.08
percent of the population who are black males 15-29	2235	2.00	950	1.44	588	3.51	386	1.19
percent of the population who are white males 15-29	2235	5.38	950	6.42	588	4.88	386	3.85
percent of the population who are Hispanic males 15-29	2235	3.18	950	2.33	588	2.72	386	5.87
violent crime rate per 100K	1381	577.94	563	479.70	353	757.74	221	558.98
murder rate per 100K	1381	7.34	563	4.62	353	11.20	221	7.41
rape rate per 100K	1381	30.58	563	31.79	353	38.05	221	20.00
aggravated assault rate per 100K	1381	346.38	563	303.62	353	436.24	221	329.55
robbery rate per 100K	1381	184.05	563	126.40	353	267.48	221	189.94

Table 5: Probability an unarmed suspect is killed by police (by race of officer and suspect)

Variable	Model 1	|t|	Model 2	|t|	Model 3	|t|	Model 4	|t|
officer W suspect B	0.075	1.20	0.040	0.54	0.015	0.20	0.043	0.44
officer W suspect W	-0.052	0.86	-0.041	0.57	-0.081	1.07	-0.105	1.09
officer W suspect H	-0.092	1.27	-0.098	1.16	-0.141	1.61	-0.131	1.24
officer B suspect B	0.670	5.28***	0.676	5.03***	0.633	4.69***	0.483	1.69*
officer B suspect W	0.634	4.07***	0.385	4.45***	0.337	3.68***	0.176	0.67
officer H suspect B	0.049	0.34	0.035	0.27	0.111	0.98	0.171	1.19
officer H suspect W	0.022	0.27	0.053	0.61	0.022	0.23	0.044	0.38
officer H suspect H	-0.167	2.94***	-0.156	2.03**	-0.193	2.48**	-0.160	1.67*
suspect black	0.057	1.81*	0.051	0.74	0.078	1.13	0.016	0.21
suspect white	0.040	1.20	-0.002	0.04	0.030	0.51	-0.005	0.08
suspect Hispanic	0.108	3.11***	0.061	0.93	0.090	1.31	0.042	0.66
officer white	-0.190	1.32	-0.194	1.32	-0.202	1.32	-0.133	0.76
officer black	-0.697	4.93***	-0.631	4.17***	-0.636	4.04***	-0.362	1.33
officer Hispanic	-0.288	2.06**	-0.333	2.34**	-0.346	2.35**	-0.309	1.79*
officer race unknown	-0.258	1.87*	-0.264	1.93*	-0.294	2.06**	-0.210	1.25
total population/1000	0.002	0.37	-0.001	0.14	-0.030	2.87***	0.005	0.17
number police on scene			-0.011	1.07	-0.007	0.63	-0.001	0.11
officer female			0.010	0.15	0.019	0.27	0.041	0.45
involved in property crime			-0.032	0.85	-0.044	1.12	-0.037	0.82
involved in violent crime			-0.085	3.31***	-0.096	3.70***	-0.095	3.10***
drug related			0.084	1.16	0.076	1.03	0.057	0.73
suicidal			-0.092	3.00***	-0.101	3.06***	-0.087	2.49**
suspect's age			-0.003	2.60***	-0.003	2.69***	-0.004	3.07***
percent black males 15-29					-0.316	1.55	0.664	0.98
violent crime rate per 100K					-0.031	2.19**	-0.048	3.32***
police killed					0.009	0.84	0.017	1.35
police union, percent							-0.434	2.44**
bodycams used, percent							0.002	1.12
cameras on weapons, percent							-0.001	0.61
gunshot detection tech used, percent							0.000	0.21
helicopters used, percent							0.093	0.62
marked cars per 100k pop							0.016	1.17
unmarked cars per 100k pop							-0.032	0.75
percent part-time officers							0.866	2.32**
pct police dept black							0.002	0.40
pct police dept white							0.003	1.70*
pct police dept Hispanic							0.005	0.59
pct police dept female							0.007	0.68
some college ed required, percent							-0.255	1.74*
community policing mission, percent							0.227	1.57
same officers in neighborhood, percent							-0.002	2.34**

N	2,600	1,654	1,240	833

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

Table 6: F-tests for equality of coefficients in Table 5

	Coefficients	Model 1		Coefficients	Model 2	
All officers		F	p		F	p
Suspect black Officer white= Suspect black Officer black = Suspect black Officer Hispanic	.075=.670=.049	**11.79**	**0.000**	.040=.676=.035	**12.41**	**0.000**
Suspect white Officer white = Suspect white Officer black = Suspect white Officer Hispanic	.052=.634=.022	**9.66**	**0.000**	-.041=.385=.053	**14.30**	**0.000**
Suspect Hispanic Officer white = Suspect Hispanic Officer black = Suspect Hispanic Officer Hispanic	-.092=na=-.167	0.03	0.870	-.098=na=-.156	0.00	0.977
White officers						
Suspect black Officer white = Suspect white Officer white	.075=-.052	**7.38**	**0.007**	.040=-.041	1.82	0.177
Suspect Hispanic Officer white = Suspect white Officer white	-.092=-.052	0.45	0.502	-.098=-.041	0.81	0.370
Suspect Hispanic Officer white = Suspect black Officer white	-.092=.075	**6.33**	**0.012**	.098=.040	**3.54**	**0.06**
Black officers						
Suspect black Officer black = Suspect white Officer black	.670=.634	0.04	0.851	.676=.385	**5.21**	**0.023**
Hispanic officers						
Suspect Hispanic Officer Hispanic = Suspect white Officer Hispanic	.049=.022	0.03	0.874	.035=.053	0.01	0.909
Suspect Hispanic Officer Hispanic = Suspect white Officer Hispanic	-.167=.022	1.83	0.176	-.156=.053	1.48	0.224
Suspect Hispanic Officer Hispanic = Suspect black Officer Hispanic	-.167=.049	**5.00**	**0.025**	-.156=.035	**6.38**	**0.012**

	Coefficients	Model 3		Coefficients	Model 4	
All officers		F	p		F	P
Suspect black Officer white= Suspect black Officer black = Suspect black Officer Hispanic	.015=.633=.111	**10.98**	**0.000**	.043=.483=.171	2.24	0.107

Suspect white Officer white = Suspect white Officer black = Suspect white Officer Hispanic	.081=.337=.022	**11.77**	**0.000**	-.105=.176=.044	1.14	0.320
Suspect Hispanic Officer white = Suspect Hispanic Officer black = Suspect Hispanic Officer Hispanic	-.141=na=-.193	0.54	0.462	-.131=na=-.160	0.64	0.425
White officers						
Suspect black Officer white = Suspect white Officer white	.015=-.081	2.62	0.106	.043=-.105	**4.53**	**0.034**
Suspect Hispanic Officer white = Suspect white Officer white	-.141=-.081	0.8	0.373	-.131=-.105	0.16	0.692
Suspect Hispanic Officer white = Suspect black Officer white	-.141=.015	**4.53**	**0.034**	-.131=.143	**4.77**	**0.03**
Black officers						
Suspect black Officer black = Suspect white Officer black	.633=.337	**4.99**	**0.026**	.483=.176	2.61	0.107
Hispanic officers						
Suspect Hispanic Officer Hispanic = Suspect white Officer Hispanic	.111=.022	0.38	0.537	.171=.044	0.69	0.406
Suspect Hispanic Officer Hispanic = Suspect white Officer Hispanic	-.193=.022	**4.65**	**0.031**	-.160=.044	**6.42**	**0.02**
Suspect Hispanic Officer Hispanic = Suspect black Officer Hispanic	-.193=.111	**6.01**	**0.014**	-.160=.171	**4.36**	**0.037**

Notes: bold indicates significant at p<.10.

Table 7: Is a black suspect more likely to be killed by a white police officer?

Variable	Model 1	t-ratio	Model 2	t-ratio	Model 3	t-ratio	Model 4	t-ratio
officer white	0.030	0.23	0.043	0.31	0.028	0.18	0.044	0.25
officer black	0.179	1.23	0.171	1.30	0.150	1.02	0.154	0.92
officer Hispanic	-0.100	0.77	-0.062	0.45	-0.042	0.27	-0.008	0.04
officer race unknown	-0.094	0.73	-0.035	0.26	-0.044	0.29	-0.041	0.23
total population/1000	0.021	2.74***	0.018	2.08**	0.019	1.92*	0.044	1.18
percent black males 15-29	0.383	4.57***	0.243	1.73*	0.255	2.02**	0.742	0.92
pct police dept black	0.004	1.37	-0.009	1.51	-0.009	1.55	-0.011	1.76*
pct police dept white	-0.001	0.83	-0.001	1.28	-0.001	1.24	-0.004	2.18**
pct police dept Hispanic	-0.005	1.66*	-0.001	0.15	-0.000	0.08	-0.001	0.08
number police on scene			-0.018	1.74*	-0.019	1.67*	-0.023	2.11**
officer female			-0.038	0.37	-0.017	0.16	-0.003	0.03
involved in property crime			0.026	0.53	0.029	0.55	0.026	0.51
involved in violent crime			0.036	1.00	0.030	0.79	0.053	1.36
drug related			0.049	0.63	0.053	0.68	0.067	0.88
suicidal			-0.122	2.61***	-0.159	3.68***	-0.135	3.29***
suspect armed			-0.114	2.11**	-0.128	2.27**	-0.146	2.49**
suspect's age			-0.005	2.67***	-0.004	2.41**	-0.005	2.58**
violent crime rate per 100K					-0.000	0.10	0.000	0.04
police killed					-0.010	0.90	-0.012	0.98
police union, percent							-0.015	0.10
bodycams used, percent							0.001	1.59
cameras on weapons, percent							0.003	1.67*
gunshot detection tech used, percent							-0.003	2.96***
helicopters used, percent							-0.165	1.68*
marked cars per 100k pop							-0.041	5.22***
unmarked cars per 100k pop							0.115	4.17***
percent part-time officers							-0.263	0.53
pct police dept female							0.002	0.21
some college ed required, percent							-0.146	1.41
community policing mission, percent							-0.150	1.93*
same officers in neighborhood, percent							0.003	3.27***
F-tests for equality of coefficients	F-ratio	P-value	F-ratio	P-value	F-ratio	P-value	F-ratio	P-value
Officer W = Officer B	1.95	.164	2.12	.146	1.64	.201	1.19	.277
Officer W = Officer H	**4.75**	**.030**	**2.70**	**.100**	1.11	.293	0.63	.426
Officer W = Officer U	**10.06**	**.002**	**3.31**	**.070**	2.64	.105	**3.25**	**.072**
Officer B = Officer H	**5.50**	**.019**	**4.75**	**.030**	**2.83**	**.093**	1.83	.177
Officer B = Officer U	**6.74**	**.010**	**5.85**	**.016**	**4.34**	**.038**	**3.70**	**.055**
Officer H = Officer U	0.01	.908	0.16	.690	0.00	.981	0.27	.606
N	1,546		963		877		833	

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

Table 8: Are black suspects more likely to be killed by white officers than white suspects?

	(1) Model 1	(2) Model 2	(3) Model 3
suspect black			
officer white	0.0196	0.0567	0.0454
	(0.17)	(0.51)	(0.38)
officer black	0.0835	0.0654	0.0754
	(0.60)	(0.47)	(0.51)
officer Hispanic	-0.0465	0.0253	-0.0236
	(-0.37)	(0.21)	(-0.18)
officer race unknown	-0.0446	0.0348	0.0186
	(-0.40)	(0.31)	(0.16)
suspect white			
officer white	0.0386	0.00196	-0.0295
	(0.31)	(0.02)	(-0.22)
officer black	0.0896	0.117	0.0505
	(0.58)	(0.74)	(0.30)
officer Hispanic	0.115	0.0570	0.0171
	(0.83)	(0.41)	(0.11)
officer race unknown	0.0276	-0.0109	-0.0420
	(0.22)	(-0.09)	(-0.31)
suspect Hispanic			
officer white	-0.0654	-0.0627	0.00984
	(-0.65)	(-0.64)	(0.09)
officer black	-0.147	-0.130	-0.0527
	(-1.19)	(-1.06)	(-0.39)
officer Hispanic	-0.117	-0.121	-0.0325
	(-1.04)	(-1.11)	(-0.27)
officer race unknown	-0.0526	-0.0328	0.0444
	(-0.53)	(-0.33)	(0.41)
Observations	1546	963	877

Notes: *t* statistics in parentheses; * $p < .10$, ** $p < .05$, *** $p < .01$. Incident-level models with state fixed effects and year fixed effects. Model 1 also includes

population. Model 2 adds incident-level variables. Model 3 adds state-level variables. Model 4, which includes department-level variables could not be estimated. Coefficients for the control variables are suppressed to conserve space.

Appendix

To start with, we collected fatal police shooting cases from several sources.

1) LexisNexis (using keywords such as "police shooting", "police cleared")
2) Google/Google Alert (using keywords such as "police shooting", "police cleared")
3) http://killedbypolice.net/
4) https://docs.google.com/spreadsheets/d/1cEGQ3eAFKpFBVq1k2mZIy5mBPxC6nBTJHzuSWtZQSVw/edit#gid=1144428085
5) https://en.wikipedia.org/wiki/List_of_killings_by_law_enforcement_officers_in_the_United_States
6) fatalencounters.org
7) https://www.washingtonpost.com/graphics/national/police-shootings/
8) http://www.sandiegouniontribune.com/news/2015/jun/06/police-shootings-reviewed-justified-reviews/
9) http://www.nytimes.com/interactive/2015/04/08/us/fatal-police-shooting-accounts.html?_r=0
10) https://github.com/washingtonpost/data-police-shootings/blob/master/fatal-police-shootings-data.csv

Some states themselves also keep records of police shooting cases.

1) Philadelphia Police Department
https://www.phillypolice.com/ois/
2) Dallas Police Department
http://www.dallaspolice.net/ois/ois.html
3) Los Angeles Times
http://homicide.latimes.com/cause/gunshot/officer_involved/true/year/2015

After putting together these cases, we started to fill in the missing part in the database. The following links are very useful in gathering the offenders' information.

1) http://victimsofpolice.com/
2) http://deadlyforce.info/
3) http://www.theguardian.com/us-news/ng-interactive/2015/jun/01/the-counted-police-killings-us-database#

Besides, we did further news searches through both LexisNexis and Google. If the race of the offender is missing, we searched ("name of person shot" Picture). To get information on the police, we did searches such as ("name of the person shot" "justified") or ("name of the person shot" "investigation"). We tried ("police cleared" "Name of person shot") or ("police charged" "Name of person shot") to get the name of the officers and used ("Officer's title and name" "the police department" Picture) for more details. Sometimes we were able to find the pictures of the offenders and the officers, which help us to determine their gender and race.

As the public disclosure of the officers is limited, we started to contact each police department so as to get more information on the officers involved in the shootings. The following is the list of the contact information for the police departments which are willing to provide more details about their officers.

State	Police Department	Contact Information
Alabama	Dallas County Sheriff's Office	Randy Pugh <randy.pugh@dallascounty-al.org>
Arizona	GILBERT POLICE DEPT	Maria Gunter <Maria.Gunter@gilbertaz.gov>
Arizona	GLENDALE POLICE DEPT	Vidaure, David <DVidaure@GLENDALEAZ.com>
Arizona	South Tucson Police Department	Jeff Inorio <jinorio@southtucson.org>
Arizona	TUCSON POLICE DEPT	Lynn Jung <Lynn.Jung@tucsonaz.gov>
Arizona	YUMA COUNTY SHERIFFS OFFICE	Miranda Ball <Miranda.Ball@ycso.yumacountyaz.gov>
California	BAKERSFIELD POLICE DEPT	Lorraine Reza <lreza@bakersfieldcity.us>
California	Banning Police Department	Maria Munoz <mmunoz@awattorneys.com>
California	BUTTE COUNTY SHERIFFS OFFICE	Wilson, Roger <rwilson@buttecounty.net>
California	Colton Police Department	Joe Gutierrez <jgutierrez@ci.colton.ca.us>
California	EL CAJON POLICE DEPT	Barbara Luck <BLuck@cityofelcajon.us>
California	FOLSOM POLICE DEPT	Sharon Blackburn <SBlackburn@folsom.ca.us>
California	Gardena Police Department	Elva Bayardo <ebayardo@ci.gardena.ca.us>
California	HUNTINGTON	Martin, Tim <TMartin@hbpd.org>

	BEACH POLICE DEPT	
California	Huron Police Department	George.Turegano@fcle.org
California	INDIO POLICE DEPT	Erika Martinez <emartinez@indiopd.org>
California	KERN COUNTY SHERIFFS DEPT	Russ Albro <albro@kernsheriff.com>
California	La Puente Police Department	cclerk@lapuente.org
California	ORANGE COUNTY SHERIFF	Prarequests <Prarequests@ocsd.org>
California	RIVERSIDE POLICE DEPT	Violette, Kenneth <kviolett@riversidesheriff.org>
California	SAN BERNARDINO POLICE DEPT	Soria, Josie <Josie.Soria@cc.sbcounty.gov>
California	SAN JOAQUIN COUNTY SHERIFFS DEPT; STOCKTON POLICE DEPT	lgarcia@sjgov.org <lgarcia@sjgov.org>;
California	SAN JOSE POLICE DEPT	Villarreal, Monique <Monique.Villarreal@sanjoseca.gov>
California	San Leandro Police Department	Chiu, Vivian <VChiu@sanleandro.org>
California	SANTA ANA POLICE DEPT	Bertagna, Anthony <ABertagna@santa-ana.org>
California	Santa Barbara Police Department	Harwood, Riley <RHarwood@sbpd.com>
California	SIMI VALLEY POLICE DEPT	Ky Spangler <KSpangler@simivalley.org>
California	Sonoma County Sheriff's Office	Sheriff-CIB@sonoma-county.org <Sheriff-CIB@sonoma-county.org>
California	Trinity County Police Department	Michelle Fletcher <michelle@plelawfirm.com>
California	Tustin Police	Rabe, Erica <ERabe@tustinca.org>

	Department	
California	Visalia Police Department	Caren Curtiss <ccurtiss@hpblaw.net>
California	Woodland Police Department	Brett Hancock <Brett.Hancock@cityofwoodland.org>
Colorado	Fruita Police Department	Judy Macy <jmacy@fruita.org>
Colorado	Trinidad Police Department	Kim Pelham <kim.pelham@trinidad.co.gov>
Connecticut	Farmington Police Department	Paul Melanson <melansonp@farmington-ct.org>
Florida	Leesburg Police Department	Brian Cash <Brian.Cash@leesburgflorida.gov>
Florida	PALM BEACH GARDENS POLICE DEPT	Kenthia White <kwhite@pbgfl.com>
Florida	PALM BEACH POLICE DEPT	Hurbs, Simone L <HurbsS@pbso.org>
Florida	ST. JOHNS COUNTY SHERIFFS OFFICE	Stephanie Weir <sweir@sjso.org>
Florida	TALLAHASSEE POLICE DEPT	Northway, David <David.Northway@talgov.com>
Georgia	COBB COUNTY POLICE DEPT	CobbRecords@gmail.com
Georgia	Columbia County Sheriff's Department	Smith, Clay <csmith@columbiacountyso.org>
Georgia	PAULDING COUNTY SHERIFFS OFFICE	Lisa Sheirling <lsheirling@paulding.gov>
Illinois	Danville Police Department	Larry Thomason <lthomason@danvillepd.org>
Illinois	DeKalb Police Department	Meier, Penny <PMEIER@CITYOFDEKALB.com>

Illinois	EVANSTON POLICE DEPT	Smith, Michelle <mismith@cityofevanston.org>
Illinois	Lincoln Police Department	Chief Paul Adams <padams@lincolnpolice.us>
Indiana	Indiana State Police	Miller, Rochelle <RMiller2@isp.IN.gov>
Kansas	Cowley County Sheriff's Office	Don Read <dread@cowleycounty.org>
Kansas	Newton Police Department	EMurphy@npdks.org
Kansas	OLATHE POLICE DEPT	Karri Barker <KBarker@olatheks.org>
Louisiana	BATON ROUGE POLICE DEPT	Kim Brooks <KBrooks@brgov.com>
Louisiana	NEW ORLEANS POLICE DEPT	deadams@nopd.org
Maryland	ANNAPOLIS POLICE DEPT	Ashley Leonard <aeleonard@annapolis.gov>
Mississippi	DeSoto County Sheriff's Department	Lent Rice <LRice@desotocountyms.gov>
Mississippi	Marion County Sheriff's Office	Jamie Singley <jsingley@marioncountyms.com>
Nebraska	Nebraska State Patrol	Schmidt, Kari <Kari.Schmidt@nebraska.gov>
Nevada	Henderson Police Department	Santana Garcia <ContactHenderson@cityofhenderson.com>
New York	MIDDLETOWN (CITY) POLICE DEPT	Gregory Metakes <gmetakes@middletownpolice.com>
Ohio	TOLEDO POLICE DEPT	Willis, Janice <Janice.Willis@toledo.oh.gov>
Ohio	Troy Police Department	Terri Ray <terri.ray@troyohio.gov>
Oklahoma	Hugo Police Department; Choctaw County Sheriff's Office	Michele Lindau <MLindau@ci.hugo.mn.us>

Oklahoma	OKLAHOMA CITY POLICE DEPT	juan.balderrama@okc.gov
Oregon	Klamath Falls Police Department	Sandy Walton <swalton@klamathfalls.city>
Oregon	PORTLAND POLICE BUREAU	Simpson, Peter <Peter.Simpson@portlandoregon.gov>
Pennsylvania	CATASAUQUA POLICE DEPT; Pennsylvania State Police	Douglas Kish <dkish@catapd.org>
Pennsylvania	Western Berks Regional Police	Jim Girard <JGirard@sheidpd.org>
South Carolina	GREENVILLE COUNTY SHERIFFS OFFICE	Johnathan Bragg <jbragg@greenvillesc.gov>
South Carolina	Santa Cruz Police Department	Sheriff Leon Lott <Sheriff@RCSD.NET>
Texas	BEAUMONT POLICE DEPT	SSPITZER@CI.BEAUMONT.TX.US
Texas	Cobb County Police Department	Cavender, Chelsea <Chelsea.Cavender@cobbcounty.org>
Texas	Fort Bend County Sheriff's Office	Grove, Matthew <Matthew.Grove@fortbendcountytx.gov>
Texas	Garland Police Department	Betz, Mike (Police) <BetzM@garlandtx.gov>
Texas	GRAND PRAIRIE POLICE DEPT	Teresa Coomes <Tcoomes@GPTX.org>
Texas	Grapevine Police Department	Sarah Severn <ssevern@grapevinetexas.gov>
Texas	Grapevine Police Department	Mark Bills <Mbills@grapevinetexas.gov>
Texas	Jourdanton Police Department	Chief Eric Kaiser <ekaiser@jourdantonpd.net>

Texas	PARIS POLICE DEPT; Lamar County Sheriff's Office	Stephanie Harris <sharris@paristexas.gov>
Texas	RICHARDSON POLICE DEPT	Lisa.Chaney@cor.gov
Texas	ROUND ROCK POLICE DEPT	Susan Camp-Lee <Susan@scrrlaw.com>
Texas	SUGAR LAND POLICE DEPT	Christine E. Rankin <crankin@sugarlandtx.gov>
Texas	TYLER POLICE DEPT	Jonathan Thornhill <Jthornhill@tylertexas.com>
Texas	Vidor Police Department	Dave Shows <dlshows@cityofvidor.com>
Texas	Watauga Police Department	David Shertzer <DShertzer@wataugatx.org>
Virginia	FAIRFAX COUNTY POLICE DEPT	FCPD FOIA <FCPDFOIA@fairfaxcounty.gov>
Virginia	Norfolk Police Department	Hudson, Daniel <Daniel.Hudson@norfolk.gov>
Washington	Lacey Police Department	Anna McBee <AMcBee@ci.lacey.wa.us>
Washington	LAKEWOOD POLICE DEPT	Michael Fulmer <MFulmer@cityoflakewood.us>
Washington	SPOKANE POLICE DEPT	Farnsworth, Laurie <lfarnsworth@spokanecity.org>
Washington	Tukwila Police Department	Leon Richardson <L.Richardson@TukwilaWA.gov>
Washington	WHATCOM COUNTY SHERIFFS OFFICE	Tara Tienhaara <TTienhaa@co.whatcom.wa.us>
Wisconsin	Eau Claire S.W.A.T	Gunness, Paul <pgunness@co.dunn.wi.us>

The specific sources used for each case will be put up on the data section of the website crimerese ??