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 data set we link the race of police officers who kill suspects with the race of those who are killed across the United States. We have data on a total of 2,699 fatal police killings for the years 2013 to 2015. This is 1,333 more killings by police than is provided by the FBI data on justifiable police homicides. When either the violent crime rate or the demographics of a city are accounted for, we find that white police officers are not significantly more likely to kill a black suspect. For the estimates where we know the race of the officer who killed the suspect, the ratio of the rate that blacks are killed by black versus white officers is large — ranging from 3 to 5 times larger. However, because the media may under report the officer's race when black officers are involved, other results that account for the fact that a disproportionate number of the unknown race officers may be more reliable. They indicate no statistically significant difference between killings of black suspects by black and white officers. Our panel data analysis that looks at killings at the police department level confirms this. These findings are inconsistent with taste-based racial discrimination against blacks by white police officers. Our estimates examining the killings of white and Hispanic suspects found no differences with respect to the races of police officers. If the police are engaged in discrimination, such discriminatory behavior should also be more difficult when body or other cameras are recording their actions. We find no evidence that body cameras affect either the number of police killings or the racial composition of those killings.

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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] The resulting anti-police sentiment has led to several "ambush" killings of police officers in Dallas, New York, and Baton Rouge. From January 1 to September 17, 2016, felonious police killings were up 61 percent compared to the same period in 2015.[2] It has also led Hillary Clinton to call for Federal regulations on the use of force by police officers.[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] http://www.odmp.org/search/year?year=2015 and http://www.odmp.org/search/year?year=2016.

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

[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 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

- 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 (we will provide a detailed discussion later). 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.

false racism claims are putting cops' lives in danger," New York Post, July 8, 2016 (http://ny-post.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

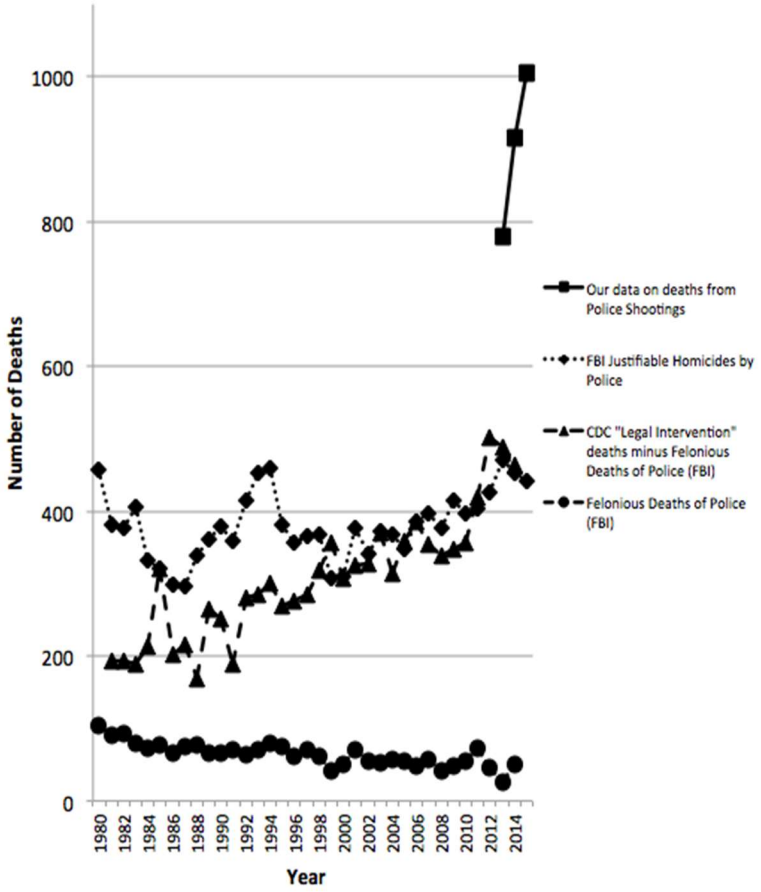
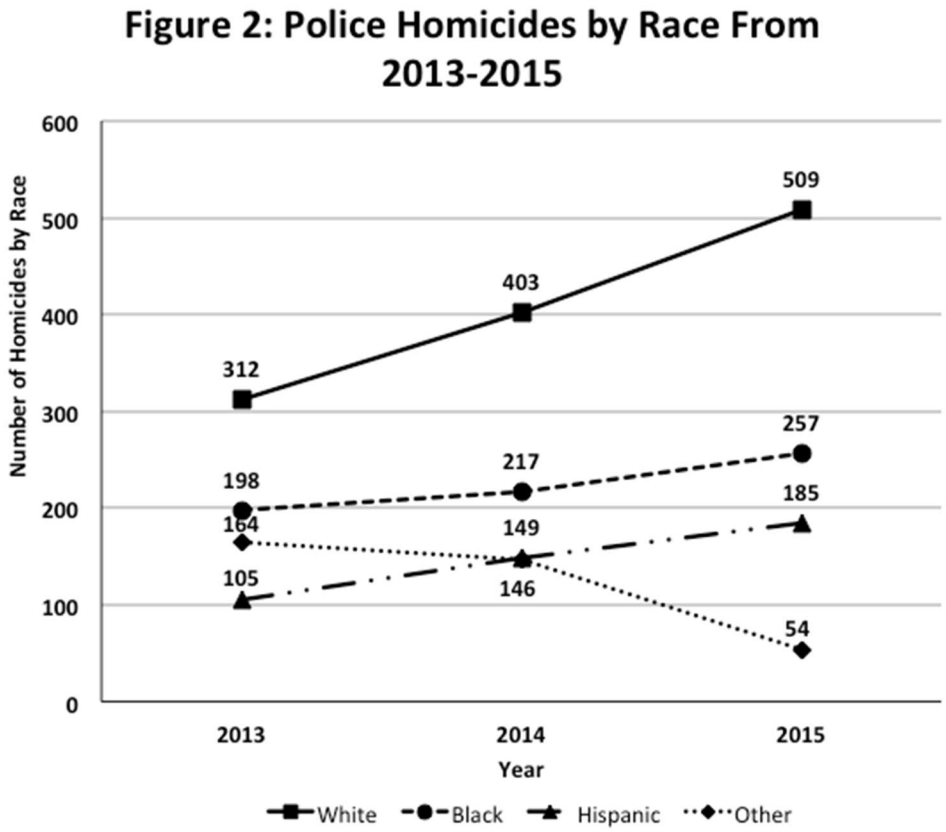


Figure 2 presents our breakdown by race. It appears that the sharpest upward trend in killings was among white suspects. The percentage of suspects killed who were white and Hispanic rose, while the percentage of those who were black remained virtually unchanged. At least over recent history, the evidence 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 transparency, promoting accountability, and advancing public safety." In May 2015, she provided $20 million to study these possible benefits.[9]

[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).

[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).

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 killings. 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 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. This study is also based on ecological rather than incident data.

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 violent arrests are controlled for, the study finds that whites are subject to

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

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

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 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).

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

Other surveys, such as one from June 2013 by the Pew Research Center, show a similar pattern.[15]

But there is a problem. What people tell pollsters isn't always what they think. If blacks don't trust the police, they presumably won't turn to them as frequently as whites when crime occurs. And 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.

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.

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)

[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)

	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)									

These data at least raises questions about whether black victims of crime tend to view the police as 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 (available online from the lead author's website) 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.

Although we have observations over three years, this is not a panel data set. Only a relatively small number of large cities are in the data set for all three years. Most cities have only one incident and some cities have multiple incidents in a single year. For these reasons we cannot estimate an incident-level model with city fixed effects. However, we can estimate regressions with state and year dummies, which allows us to control, at least partially, for unobserved heterogeneity. The state and year dummies are not always significant and we omit them from some of our models. However, although not reported, we estimated all models using state and year dummies. The results were essentially the same as reported in the tables below. Complete results can be downloaded from the lead author's website.

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. 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. With respect to the suspect, 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 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 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 the 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. 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).[17]

V. Methodology

There are essentially two hypotheses. The null hypothesis is that police officers are race neutral, employing lethal force against black suspects at the same rate as they do against suspects of other races. They use such force to defend themselves or others from perceived lethal threats. The race of the threatening suspect is irrelevant. The alternative hypothesis is that racial bias is the primary reason why white police officers shoot and kill black suspects at a higher rate than suspects of other races.

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. Is this disproportionate representation due to racism on the part of white police officers? 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.

However, crime rates differ across neighborhoods. Black neighborhoods tend to experience higher crime rates. Therefore, race-neutral police randomly assigned to neighborhoods will encounter more criminal activity in black neighborhoods. As such, they can 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." These areas tend to be relatively poor and black, leading to more encounters between the majority-white police force and black suspects. A small percentage of these encounters will result in the deaths of black suspects. For both of these reasons, suspects shot by a color-blind police force will be disproportionately black, as compared with the overall population.

We test this null hypothesis using a logit regression on a binary dependent variable. The coefficients are odds ratios giving the estimated probability of a white officer, for example, shooting a black suspect compared to that of shooting a suspect of another race. If the odds ratio is over one, then the probability of a black suspect being killed is higher than for suspects of other races.

The sample consists of 2,699 cases in which a suspect has been killed by a police officer in the three years from 2013-2015. While we do not have neighborhood data, we do know the city in which the homicide took place. The dependent variable is a dummy variable taking the unit value if the person killed is black. The independent variables of interest are a set of dummy variables indicating that the officer is black, another if the officer is Hispanic, and a third if the officer is of another race (usually Asian or American Indian). The omitted class is white police officers, so that the effect is captured by the intercept. If white police officers kill black suspects at a significantly higher rate than the other races do, the estimated coefficients on the variables indicating race other than white will be significantly less than one. Finally, while the race of the suspect is

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

known in every case, the race of the police officer is known in only 904 cases. In order to utilize the maximum number of observations, we include another dummy indicating that the race of the officer is unknown. The result of this regression will indicate whether white officers kill black suspects significantly more often than they kill suspects of other races.

Because police departments are predominantly white but crime is higher in black neighborhoods, we would expect that in a logit regression which includes only the intercept, three dummies reflecting nonwhite officers' race and the overall population, the coefficient on the intercept (estimating the odds ratio) could be significantly greater than one while the coefficients on the dummy variables for the nonwhite officers could be significantly less than one. This would indicate that white police officers kill black suspects at a significantly higher rate than suspects of other races and at a significantly higher rate than officers of other races. However, this regression does not control for differences in crime rates across cities. If we were to include the violent crime rate, a positive estimated coefficient on the crime rate, a reduced intercept estimate, and no estimated coefficients significantly less than one on the nonwhite officer variables would indicate that cities with higher crime rates lead to more interactions between police and criminals, who tend to be disproportionally black, generating greater odds of a black suspect being killed by a white officer.

We also have data on the proportion of the city's population comprised of black males between the ages of 15 and 29 — the crime-prone years for most people. If the estimated coefficient on this variable is positive then cities with a higher proportion of young black men will have more encounters between blacks and predominantly white police officers, some of which will be fatal. The higher the crime rate, the more interactions there are between police and violent suspects. The higher the proportion of young black men, the greater the probability there is that these suspects will be black.

If white police officers shoot black suspects primarily because of racial animus, then we would expect that black police officers would shoot black suspects at a lower rate than white officers do. If both black and white officers shoot black suspects at a higher rate than other suspects, this would support the race neutral hypothesis that black and white police officers tend to encounter more black criminals than white criminals.

It is not possible to disprove the racism hypothesis, only a "racism" variable could do that. But it is possible to test the race neutral hypothesis, the rejection of which would imply the racism hypothesis. Rejecting the race neutral hypothesis requires that (1) the coefficient on the intercept be significantly greater than one (2) the coefficients on the nonwhite police officer variables be significantly less than one, and (3) the coefficients on the crime rate and proportion of young black men be insignificant.

We also investigate a number of other potentially relevant variables that could affect the rate at which white officers kill black suspects. If these are also insignificant, the intercept is significantly greater than one, and the coefficients on the nonwhite officers are significantly less than one then the racism hypothesis is supported by the analysis.

VI. Results

The regression is a logit model with a binary dependent variable. The standard errors are robust with respect to heteroscedasticity. The results are reported in Table 5. There are four models. Model 1 includes the police officer's race (black, Hispanic, and other, primarily Asian and American Indian) with white police officers being the omitted class, and population. The coefficients for the different race of officers thus give the overall odds of a black suspect being killed by the different race of police officers relative to white officers. Model 2 controls for the violent crime rate, Model 3 controls for the violent crime rate and the proportion of young black men in the population. Model 4 adds state and year dummies.

The results are consistent with the race-neutral hypothesis for white officers. The estimated intercept term is significantly less than one. White officers are significantly less likely than black officers to kill black suspects, and they are not statistically significantly different from Hispanic, other race, and unknown race police officers (except in Model 2 where Hispanic officers are estimated to be marginally more likely to kill black suspects). Controlling for the violent crime rate alone or with the proportion of young black men reduces the estimated intercept, consistent with the race neutral hypothesis.

In all four models, black officers are significantly more likely than white officers to shoot a black suspect. Unknown race officers do not kill black suspects at a different rate than white officers. Given that this unknown group likely contains a greater share of black officers than their share of all police officers, the result that unknown officers are less likely to kill black suspects than whites raises caution concerning any conclusions that black officers kill black suspects at a higher rate than other officers. The rate for Hispanic officers is only statistically significant different from white officers in one specification, but F-tests show that the coefficients for black officers are significantly greater than the coefficients for Hispanic, other, and unknown officers. Also, the odds of a police officer killing a black suspect increase with both the crime rate and the proportion of young black men.

For 67 percent of the cases (1,783) the race of the officer is unknown. Only two percent of the cases involve black officers (41). This could indicate that black officers rarely fire compared to white officers. But it could also mean that the media finds it less newsworthy to report cases where a black officer rather than a white officer shoots a suspect (either because of reporters' reluctance or lack of interest on the part of readers). In gathering the race of police officers, most of the cases involving the race of black officers were obtained from sources other than media reports, e.g., by using photos from police departments. Most of the races of white officers were taken from media reports. This indicates that blacks may be underrepresented where we know the race of the officers and overrepresented in the unknown group. Whatever the racial composition of the unknown group, the coefficients are always approximately equal to, and insignificantly different from, the coefficient on white officers, which implies that black police officers do not kill black suspects at a lower rate than white officers. Note that, because of the added state and year dummies, the intercept term in Model 4 is not the coefficient for white police officers in

general, but only for the omitted state (Alaska) in the omitted year (2015). This is true for all models in which state and year dummies are included.[18]

Table 6 shows the effect of limiting the sample to cases where the race of the officer is known. It yields a smaller sample but virtually the same conclusion. The coefficients for both black and white officers are almost the same in this sample and the levels of statistical significance remain unchanged. The rate that blacks are killed by black relative to white officers remains very high. However, we still face the caveat raised regarding the fact that the media tends to report the race of officers at different rates. The only difference with Table 5 is that there is a little more evidence that Hispanic and Asian and American Indian race officers are less likely than black or white officers to shoot black suspects. Although unreported, F-tests show that the coefficients for black officers are significantly greater than the coefficients for Hispanic, other, and unknown officers in all of the models in Tables 5 and 6.

The odds of a black suspect being killed by a black police officer are consistently greater than a white officer. These results could be due to other influences that have been omitted from the regressions so far. To test this hypothesis we estimate two versions of a more general model that includes a substantial number of potentially relevant variables. See Table 7. The first model is purely cross-sectional and uses the data that we obtained from the 2013 Law Enforcement Management and Administrative Statistics (LEMAS) survey as well as information that we obtained from the media reports on the characteristics of the suspect and the number of police on the scene. The second model covers all three years of data increasing the sample size but at the expense of dropping many of the LEMAS variables.

The results are again consistent with the race neutral hypothesis for white officers. When we include the relevant variables in the model, the coefficients indicate that black officers are at least as likely to kill black suspects than either white, Hispanic, other, or officers of unknown race in both models, though the difference between black and white officers is only statistically significant in Model 2. The rate that black officers kill blacks is statistically significant greater than the rates for the coefficients on Hispanic, other, or unknown officers in both Models 1 and 2.

Because of the public's interest in the effectiveness of body cameras on police officers, we include a body cam variable in the model. Disappointingly, it is not significant. The violent crime rate, police unionization, and the suspect's involvement in a property crime all significantly increase the black suspect's odds of being killed. The impact of unionization is extremely large – with black suspects about 65 to 140 percent more like to be shot by unionized police officers.

Older suspects are also much less likely to be killed. Each additional year older that a suspect is reduces the probability that there will be killed by almost 4 percent. Given that black suspects are on average over 7 years younger than white ones, this is an important factor to consider.

On the other hand, increasing the number of police on the scene reduces the suspects' odds of being killed by about 14 to 18 percent for each additional officer. Going from one officer to the average number of the police on the scene of 2.39 thus implies a drop in the rate of killings from 19

[18] We also re-estimated these regressions by including the second officer's race and gender, but these variables were not statistically significant and they did not alter our reported results. The same is true for the other regressions that we report.

to 25 percent. This is either because the suspect is less likely to resist, because the police officers are less likely to think that they need to resort to lethal force to make the arrest, or individual officers know that it would be difficult to lie about the circumstances. In this last case, it would be expected to have an effect similar to cameras. Whatever the reason, having more police officers on the scene lowers the likelihood that the suspect will be killed. Being suicidal also significantly reduces the odds of being killed.

Armed suspects are less likely to be killed. We analyze this result more thoroughly below. The greater is the percentage of a department's officers who are female, the more suspects who are killed. Over all, despite the stark difference in these two specifications and samples the results are remarkably consistent, with the same coefficients being statistically significant and roughly the same size in both regressions.

The rest of the potentially relevant variables have no significant effect on suspects' odds of being killed by the police. No significant effect was found from the racial composition of the police force, the practice of community policing, assigning the same officers to the same neighborhoods, the number of police cars, helicopters, gunshot detection systems, using part-time officers, requiring some college education for new hires, or putting cameras on weapons. The number of police officers killed in the line of duty apparently has no significant effect on the odds of a black suspect being killed.

We did a variety of robustness checks. We estimated the models reported in Tables 5 and 6 using logarithmic functions of the continuous variables. We also assumed that the category "officer race unknown" indicated white police officers by adding together the two dummy variables. The results were the same. Using the various categories of violent crime (murder, rape, assault, robbery) instead of the overall violent crime rate had no effect on the size or significance of the coefficient on white officers. We also repeated these regressions on white and Hispanic suspects, but the results were the same. That is, there was no relationship between the race of the police officer and the odds that a suspect would be killed, if the crime rate and the proportion of young white or Hispanic males are included as control variables. To conserve space, the results concerning white and Hispanic victims are not reported. But all results, data, and programs may be downloaded from the lead author's website.

VII. Anwar-Fang test for racial discrimination

Anwar and Fang (2006) and Knowles, Persico and Todd (2001) test for discrimination by looking at whether black and white suspects are 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 a simple test of the difference between two means: the proportion of armed black suspects shot by a white police officer compared to the proportion of armed white suspects shot by a white officer. If white officers are racist, they will be more likely to shoot black suspects who are later found to be unarmed. That is, if the suspect is black, they will shoot first and determine if the suspect is armed later. Thus, if the proportion of black suspects shot by whites that are eventually determined to be armed is significantly less than the proportion of potentially armed white suspects shot by whites, then that is evidence of taste-based racial discrimination. However, it

may also be the result of the officers' experience with black suspects, if the probability of the latter being armed is higher than for suspects of other races.

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 the absence taste-based racial discrimination by white police officers.

However, 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 firearm. 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. The proportion of young black males may pick up two factors: the level of violent crime rates that are higher for young black males that won't be picked up by the overall violent crime rate and the more experience that officers will have with black suspects. Finally, we follow Fryer and account for the racial composition of officers in different police departments. It is possible that racial bias by individual police officers could be affected by the racial composition of the department. For example, a white officer in a heavily black department will find it more difficult to be racist. We modify and extend the Anwar-Fang test by controlling for these factors. The results are reported in Table 8.

The initial model in the first column is a simple regression in which the dependent variable is a dummy variable that takes the unit value if the suspect had a weapon. The variable of interest is a dummy variable indicating a black suspect. The result is a negative and highly significant coefficient on the black suspect dummy, possibly significant evidence of racial discrimination.

Yet, there are obviously other factors related to the suspect's actions that have nothing to do with discrimination that could explain at least part of what is happening here, such as whether the suspect was involved in the commission of a crime. The suspect's age might also be related to whether the police could view the suspect as a threat or whether the suspect will follow the police officer's instructions. Including these other suspect characteristics reduces the size of the black suspect coefficient by 37 percent and reduces its level of significant from the 1% to the 10% level for a two-tailed t-test.

There are other factors that can measure rational discrimination based on the area's characteristics. Including the violent crime rate accounts for police officers' experience with violent criminals. The percent of the population who are black males ages 15 to 29 for experience with black suspects. When we add these two variables to the simple regression, the coefficient drops in value by another 24 percent and becomes insignificant. The apparent racial discrimination in the simple regression appears to be mostly explained as resulting from other omitted characteristics of the suspects or a form of statistical discrimination based on experience. The remainder could be a measure of taste-based discrimination, but it could also be a reflection of other omitted unmeasured variables. In any case, there is no significant racial discrimination by white police officers after we have controlled for violent crime and the proportion of young black males.

Including state and year dummies in the fourth specification has no impact on the likelihood that an unarmed black suspect will be shot but does cause the city violent crime rate and the percent of young black males in the population to become statistically significant. Including the racial composition of officers in the police departments has no impact on the rate white officers kill black suspects.

We also repeated this analysis for black officers. The coefficients on both black and white suspects were all insignificantly different from zero, perhaps because of the small number of black officers in the sample. Further, we performed the above analysis with the weapons broken down into firearm, knife, and other. None of the estimated coefficients on either the black or white suspect dummy variables were significant in any of those regressions. All results, programs, and data may be downloaded from the lead author's website.

VIII. Panel estimation

Although we have three years of data, at the incident level we have a cross section. We do not have a panel because the incidents do not repeat. The most serious problem with cross section data is unobserved heterogeneity. Since cities can vary substantially with respect to unobserved and often unobservable characteristics such as history, culture, climate, racial composition, attitude of civilians toward police, police attitude toward civilians, etc., any cross section regression would be biased by these omitted variables. The only way to address unobserved heterogeneity is to estimate a fixed effects model on panel data. We can create a panel data set by aggregating up to the city level. This aggregation loses some detail, for example we can no longer assign a particular suspect, or a particular officer, to a given incident. Instead we have the percentage of suspects or officers who are white, black, Hispanic, etc. We also lose the information on the police departments, such as whether officers are required to wear body cameras, the racial composition of the police department, etc. However, the effect of these police department variables on police killings will be captured by the fixed effects dummy variables for each city. Fixed year effects are also included both specifications in Table 12 and in the last specification in Tables 10, 11, and 13, but they never make any difference to the results.

The variables of interest in the panel data set are summarized in Table 9. In the first exercise we reproduce the model estimated in Table 5. The dependent variable is the percentage of black suspects killed by police. The explanatory variable of interest is the proportion of the police involved in killings who are black (the left out category is again the percent of the police involved in killings who are white). The results are presented in Table 10. In contrast to the results in Table 5, as the proportion of black police officers increases, the proportion of black suspects killed increases, but the effect is small (just over a 1.2 percent increase in the average percent of suspects killed who are black) and statistically insignificant. The results, when we limit the sample to cases where the race of all the police officers is known, are presented in Table 11. The estimated coefficients on the proportion of percentage of black police officers consistently show no significant effect on the percentage of blacks suspects killed by police. The coefficient on police officers being of other race is not statistically significant when the percent of the population who are young black males is accounted for.

With respect to the Anwar-Fang test for racial discrimination, we can estimate a panel version of the test using the percentage of the suspects found to be armed as the dependent variable and the percentage of the various races of the suspects as the explanatory variables. Table 12 presents the results, using police officers of all races. There is no significance associated with the percentage of black suspects, indicating no apparent racial bias on the part of the police. Table 13 shows the results where we restrict the sample to white police officers only. Again, the proportion of black suspects is not significant. In addition, there is no significant difference between the coefficients on blacks, whites, or Hispanic suspects in any of the regression models.

IX. Female Police Officers and Shootings

Previous research found that it was particularly white female officers who were more likely to accidentally shoot suspects (Lott, 2000). With a large strength difference between female officers and male suspects, female officers might be more likely to shoot an unarmed suspect. The current raw data suggests something similar might be occurring, with female officers 79% more likely to kill an unarmed suspect than male officers (19.1% to 10.7%) (Table 14). While the samples are small, white female officers are much more likely than the average female officer to kill an unarmed suspect (25.0% to 19.1%).

Table 14: Comparing the rates that Male and Female Officers Kill Suspects

Type of Officer by Gender (number)	Percent of suspects killed who were unarmed by type of Officer
Male Officers (2,574)	**10.7%**
Female Officers (63)	**19.1%**
White Female Officers (24)	**25.0%**
Unknown Race Female Officers (33)	**18.2%**
Black Female Officers (4)	**0%**

A more systematic approach is presented in Table 15, which uses similar regressions to those we reported in Table 8 to examine the rate that officers killed armed suspects. The difference is that we now include information on the race and sex of the officer to explain whether the person killed by the officer was armed. Model 1 shows that female officers are more likely to shoot an unarmed suspect. When female officers are broken down by race in Models 2 and 3, the F-tests find that white female officers are more likely than white males to shoot unarmed suspects, but for unknown race or other female officers there is no statistically significant difference with white male officers. Yet, once the city violent crime rate and the percent of young black males are accounted for, white female officers no longer show any difference in behavior from other officers.

Thus far the results on female officers have been mixed. In Table 7, while the gender of the individual officer doing the shooting doesn't appear significantly related to whether a black suspect is killed, departments with a higher percentage of female officers have significantly more killings of suspects – with each one percentage point increase in the share of a department's officers who are female indicating about a 7 percent increase in suspect killings. One possible explanation for this is that male officers are more likely to kill a suspect when a female officer is present as a way of protecting the female officer, but our tests did nor find evidence for that.

X. Summary and conclusion

Using data from 2699 police involved homicides; we find that the odds of a black suspect being killed by a white police officer are significantly less than one. Nevertheless, the coefficient decreases when the violent crime rate is included in the model. Adding the proportion of young black males and state and year dummies as control variables reinforces this conclusion. We also find that black officers do not shoot black suspects at a lower rate than other suspects. This finding is quite robust and supports the race-neutral theory that a small proportion of encounters between suspects and police officers end in the death of the suspect. This proportion is apparently constant across races of suspects and police officers. However, since the majority of police officers are white, white police officers encounter more black suspects due to being disproportionately assigned to relatively high crime, mostly black neighborhoods, resulting in a disproportionate number of police homicides of blacks.

For the estimates where we know the race of the officer who killed the suspect, the ratio of the rate that blacks are killed by black versus white officers is very large. However, because the media appears to rarely report the officer's race when black officers are involved, other results that account for the fact that a disproportionate number of the unknown race officers may be black could be more reliable. They indicate no statistically significant difference between killings of black suspects by black and white officers. These findings are inconsistent with taste-based racial discrimination against blacks by white police officers. Our estimates examining the killings of white and Hispanic suspects found no differences with respect to the races of police officers.

We find in a simple regression that the proportion of armed black suspects killed by white police officers is significantly lower than that for armed suspects of other races (Table 8, Model 1). However, controlling for the citywide violent crime rate and the proportion of young black men, whether the suspect was involved in a violent crime, and the age of the suspect makes the coefficient on black suspects insignificantly different from zero. This indicates that the apparent racial discrimination indicated by the simple regression is at least partially explained as a form of rational discrimination based on experience.

Interestingly, despite all of the emphasis placed on body cameras, the presence of such cameras seems to have no effect on the number of police killings. The additional evidence provided by the camera does not seem to alter the behavior of officers. This is also consistent with police not having a personal, irrational bias against black suspects.

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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	0.18	1224	0.16	672	0.18	439	0.26
cameras on weapons, percent	2699	0.06	1224	0.06	672	0.07	439	0.05
gunshot detection tech used, percent	2699	0.16	1224	0.09	672	0.26	439	0.22
same officers in neighborhood, percent	2699	0.56	1224	0.48	672	0.65	439	0.64
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

Variable	Overall N	Overall Mean	Suspect White N	Suspect White Mean	Suspect Black N	Suspect Black Mean	Suspect Hispanic N	Suspect Hispanic 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

Black suspects: odds of being killed by police (coefficients are log odds ratios)

Variable	Model 1	Model 2	Model 3	Model 4
officer black	4.905	4.086	2.626	2.664
	(4.87)***	(3.84)***	(2.15)**	(2.09)**
officer Hispanic	0.687	0.489	0.494	0.644
	(1.12)	(1.70)*	(1.45)	(0.92)
officer other race	0.464	0.590	0.786	0.932
	(1.41)	(0.84)	(0.38)	(0.11)
officer race unknown, percent	0.962	0.903	0.851	0.831
	(0.39)	(0.91)	(1.29)	(1.34)
total population/1000	1.002	1.002	1.002	1.003
	(5.21)***	(4.46)***	(4.33)***	(3.81)***
violent crime rate per 100K		1.001	1.001	1.001
		(11.75)***	(3.41)***	(4.11)***
percent black males 15-29			1.508	1.345
			(10.86)***	(6.14)***
Constant	0.298	0.128	0.100	0.254
	(14.36)***	(16.56)***	(16.72)***	(3.26)***
State & year dummies	No	No	No	Yes
N	2,662	2,178	1,938	1,897

Note: logit regression, dependent variable is a dummy indicating a black suspect, estimates are odds ratios, robust standard errors, z-statistics in parentheses, white police officers are the omitted class, *.10, **.05, ***.01, two-tailed.

Table 6:
Black suspects odds of being killed by police: Sample limited to observations where the police officer's race is known (coefficients are log odds ratios)

Variable	Model 1	Model 2	Model 3	Model 4
officer black	5.070	4.197	2.716	2.780
	(4.97)***	(3.92)***	(2.25)**	(2.14)**
officer Hispanic	0.600	0.437	0.415	0.439
	(1.35)	(1.87)*	(1.70)*	(1.53)
officer other race	0.262	0.371	0.459	0.441
	(2.15)**	(1.48)	(1.06)	(1.11)
total population/1000	1.006	1.005	1.005	1.008
	(2.63)***	(2.59)***	(2.17)**	(2.41)**
violent crime rate per 100K		1.002	1.001	1.001
		(6.99)***	(2.36)**	(2.32)**
percent black males 15-29			1.470	1.400
			(6.40)***	(4.55)***
Constant	0.266	0.111	0.086	0.175
	(13.23)***	(12.52)***	(12.53)***	(2.89)***
State & year dummies	No	No	No	Yes
N	896	753	694	649

Note: logit regression, dependent variable is a dummy indicating a black suspect, estimates are odds ratios, robust standard errors, z-statistics in parentheses, white police officers are the omitted class, *.10, **.05, ***.01, two-tail.

Table 7: Black suspect killed, with control variables (coefficients are log odds ratios)

Variable	Model 1	Z	Model 2	Z
	Including LEMAS variables and other variables that we collected from newspaper stories		Including LEMAS variables and other variables that we collected from newspaper stories	
Officer black	1.450	0.72	2.108	1.77*
Officer Hispanic	0.568	1.03	0.681	0.79
Officer other race	0.516	0.67	0.650	0.54
Officer race unknown	0.689	1.56	0.973	0.15
Officer female	0.751	0.58	0.860	0.34
Total population/1000	1.004	2.28**	1.004	3.30***
Number police on scene	0.822	2.46**	0.864	2.33**
Involved in property crime, percent	1.433	1.31	1.344	1.42
Involved in violent crime, percent	1.053	0.23	0.993	0.04
Drug related	1.381	0.79	1.701	1.58
Suicidal	0.138	3.84***	0.159	4.04***
Suspect armed, percent	0.544	2.05**	0.642	1.90*
Suspect's age	0.963	3.91***	0.962	5.17***
Violent crime rate per 100K	1.001	2.68***	1.001	2.90***
Percent black males 15-29	1.331	2.75***	1.440	5.09***
Police killed	0.911	1.26	0.983	0.32
Police union, percent	2.397	1.93*	1.651	2.51**
Bodycams used, percent	0.732	1.13		
Cameras on weapons, percent	2.010	1.48		
Gunshot detection tech used, percent	1.004	0.01		
Helicopters used, percent	0.977	0.09		
Marked cars per 100k pop	0.997	0.15		
Unmarked cars per 100k pop	0.997	0.30		
Percent of police department part-time officers	0.845	0.08		
Percent of police department black officers	1.010	0.48		
Percent of police department white officers	1.000	0.02		
Percent of police department Hispanic officers	1.000	0.03		
Percent female officers	1.069	2.08**		
Some college education required, percent	1.064	0.16		
Community policing mission, percent	0.717	0.81		
Same officers in neighborhood, percent	1.104	0.31		
Constant	0.638	0.29	1.023	0.04
State & year dummies	Yes		Yes	
N	794		1,194	

Note: logit regression, robust standard errors, z-statistics in parentheses; white police officers are the omitted class; both models include state and year dummies, *.10, **.05, ***.01.

Table 8
Did a white police officer kill a suspect with a weapon?

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Suspect black	-0.125	-0.079	-0.060	-0.057	-0.057
	(2.90)***	(1.82)*	(1.16)	(1.02)	(0.76)
Suspect white	-0.044	-0.022	0.019	0.030	0.053
	(1.24)	(0.62)	(0.42)	(0.59)	(0.76)
Suspect Hispanic	-0.038	0.005	0.026	0.020	0.072
	(0.80)	(0.11)	(0.42)	(0.29)	(0.81)
Suspect involved in a violent crime		0.115	0.125	0.122	0.123
		(4.75)***	(4.60)***	(4.16)***	(3.59)***
Suspect involved in a property crime		-0.007	-0.010	-0.025	-0.001
		(0.17)	(0.24)	(0.58)	(0.02)
Suspect involved in a drug related crime		-0.060	-0.104	-0.140	-0.119
		(0.87)	(1.29)	(1.62)	(1.22)
Suspect suicidal		0.152	0.152	0.159	0.112
		(7.79)***	(6.29)***	(5.28)***	(2.98)***
Suspect age		0.002	0.001	0.002	0.002
		(1.82)*	(1.34)	(1.41)	(1.47)
violent crime rate per 100K			-0.007	-0.013	-0.014
			(1.60)	(2.65)***	(2.13)**
Percent of the population who are black males 15-29			0.012	0.032	0.038
			(1.62)	(3.13)***	(2.97)***
Percent police dept black					-0.004
					(1.56)
Percent police dept white					-0.001
					(1.85)*
Percent police dept Hispanic					-0.002
					(1.02)
Constant	0.920	0.784	0.787	0.871	1.153
	(29.3)***	(15.75)***	(12.92)***	(7.34)***	(8.24)***
N	765	764	591	591	397
State & year dummies	No	No	No	Yes	Yes

Notes: OLS regressions: dependent variable is a dummy variable indicating that the suspect had a weapon, t-ratios are in parentheses, sample limited to white officers, *.10, **.05, ***.01.

Table 9
Number of observations and means, panel data

Variable	N	Mean
Percent of suspects killed who are black	1847	21.55
Percent of suspects killed who are white	1847	51.69
Percent of suspects killed who are Hispanic	1847	13.63
Percent of the police involved in killings who are white	1847	29.83
Percent of the police involved in killings who are black	1847	1.58
Percent of the police involved in killings who are Hispanic	1847	1.90
Percent of the police involved in killings who are of unknown race	1847	66.26
population	1828	14.27
Percent of suspects who are armed	1847	87.45
Percent of suspects who are involved in violent crime	1847	39.67
Percent of suspects who are involved in property crime	1847	15.44
Percent of suspects who are involved in drug related crime	1847	5.32
Percent suicidal	1847	10.26
Suspect age	1839	37.41
Rate that police were feloniously killed in state that year	1847	3.60
violent crime rate	1393	499.14
Percent of the population who are black males 15-29	1408	1.87

Table 10
Percentage of black suspects killed by police

Variables	Model 1	Model 2	Model 3	Model 4
Percent of the police involved in killings who are black	0.281 (1.53)	0.355 (1.60)	0.352 (1.58)	0.346 (1.54)
Percent of the police involved in killings who are Hispanic	-0.082 (0.47)	0.068 (0.30)	0.054 (0.24)	0.083 (0.37)
Percent of the police involved in killings who are "other" race	0.035 (0.49)	0.021 (0.16)	-0.001 (0.00)	0.031 (0.24)
Percent of the police involved in killings who are of unknown race	0.059 (1.34)	0.057 (1.22)	0.058 (1.24)	0.035 (0.73)
population	-0.422 (0.39)	-0.314 (0.28)	1.549 (1.26)	1.169 (0.88)
violent crime rate		0.013 (1.05)	0.009 (0.68)	0.002 (0.10)
Percent of the population who are black males 15-29			30.225 (2.32)**	27.974 (2.00)**
Constant	26.816 (1.51)	18.803 (0.70)	-71.576 (1.49)	-52.159 (1.03)
N	1,828	1,393	1,164	1,164
Fixed effects for police departments	Yes	Yes	Yes	Yes
Fixed effects for years	No	No	No	Yes

Notes: fixed effects linear regression; dependent variable is percent black suspect; robust standard errors; t-statistics in parentheses, *.10 **.05 ***.01, two-tailed.

Table 11
Percentage of black suspects killed by police: Sample limited to observations where race of police officer is known

Variables	Model 1	Model 2	Model 3	Model 4
Percent of the police involved in killings who are black	0.019 (0.73)	-0.185 (0.61)	-0.247 (0.73)	-0.229 (0.67)
Percent of the police involved in killings who are Hispanic	0.071 (0.26)	0.480 (1.38)	0.473 (1.34)	0.592 (1.59)
Percent of the police involved in killings who are "other" race	0.897 (3.56)***	0.550 (1.71)*	0.386 (1.08)	-0.124 (0.12)
population	0.582 (1.39)	-3.606 (0.67)	8.013 (0.68)	6.176 (0.46)
violent crime rate		-0.091 (0.68)	-0.110 (0.76)	-0.127 (0.89)
Percent of the population who are black males 15-29			264.021 (0.85)	235.042 (0.71)
Constant	102.195 (4.40)***	151.235 (1.23)	-446.028 (0.69)	-418.525 (0.55)
N	554	435	380	380
Fixed effects for police departments	Yes	Yes	Yes	Yes
Fixed effects for years	No	No	No	Yes

Notes: fixed effects linear regression; dependent variable is percent black suspect; robust standard errors; t-statistics in parentheses, *.10 **.05 ***.01, two-tailed.

Table 12
Percent of suspects who are armed, all officers

Variables	Model 1	t-ratio	Model 2	t-ratio
Percent of the police involved in killings who are black	0.194	1.29	0.215	1.58
Percent of the police involved in killings who are Hispanic	0.055	0.26	-0.102	0.62
Percent of the police involved in killings who are "other" race	-0.047	0.26	0.069	0.70
Percent of the police involved in killings who are of unknown race	0.039	0.89	0.039	0.87
Percent of the police involved in killings who are female	-0.048	0.33		
number police on scene	-0.969	1.05		
population	1.372	1.06		
Percent of suspects who are armed	0.063	1.05		
Percent of suspects who are involved in violent crime	-0.054	1.14		
Percent of suspects who are involved in property crime	-0.003	0.05		
Percent of suspects who are involved in drug related crime	0.001	0.01		
Percent of suspects who are suicidal	-0.175	2.98***	-0.148	2.82***
suspect age	-0.635	3.63***	-0.629	4.29***
violent crime rate	-0.005	0.31		
Percent of the population who are black males 15-29	33.411	2.37**	14.856	1.23
Rate that police were feloniously killed in state that year	-0.863	0.86	21.624	0.88
N	1,160		1,402	
Fixed effects for police departments and years	Yes		Yes	

Notes: fixed effects linear regression; the dependent variable is percent armed suspects; robust standard errors; t-statistics in parentheses, *.10 **.05 ***.01, two-tailed.

Table 13
Percent of suspects who are armed, white officers

Variable	Model 1	Model 2	Model 3	Model 4
Percent of the police involved in killings who are black	0.052 (0.92)	0.051 (0.86)	0.047 (0.72)	0.057 (0.80)
Percent of the police involved in killings who are white	0.028 (0.52)	0.026 (0.50)	0.009 (0.16)	0.013 (0.21)
Percent of the police involved in killings who are Hispanic	0.017 (0.23)	0.007 (0.09)	-0.001 (0.01)	0.004 (0.05)
Percent of suspects who are involved in violent crime		0.060 (1.67)*	0.066 (1.60)	0.062 (1.51)
Percent of suspects who are involved in property crime		-0.061 (1.11)	-0.061 (0.98)	-0.060 (0.95)
Percent of suspects who are drug related crime		-0.000 (0.00)	-0.075 (0.81)	-0.065 (0.71)
Percent of suspects who are suicidal		-0.003 (0.06)	0.011 (0.18)	0.016 (0.27)
suspect age		-0.047 (0.30)	-0.036 (0.21)	-0.038 (0.22)
violent crime rate			0.003 (0.24)	0.006 (0.47)
Percent of the population who are black males 15-29			2.985 (0.26)	2.715 (0.24)
Constant	84.666 (20.11)***	85.257 (10.63)***	79.074 (3.96)***	76.169 (3.86)***
N	1,847	1,839	1,160	1,160
Fixed effects for police departments	Yes	Yes	Yes	Yes
Fixed effects for years	No	No	No	Yes

Notes: fixed effects linear regression; the dependent variable is percent armed suspects; sample limited to white police officers only; robust standard errors; t-statistics in parentheses, *.10 **.05 ***.01, two-tailed.

Table 15
Looking at whether Different Types of Officers are more likely to shoot Unarmed Suspects

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Officer black	-0.053	-0.079	-0.071	-0.110	-0.118
	(1.05)	(1.53)	(1.38)	(1.80)*	(1.59)
Officer Hispanic	0.061	0.057	0.053	0.071	0.105
	(1.51)	(1.39)	(1.32)	(1.51)	(2.02)**
Officer unknown	0.048	0.047	0.043	0.044	0.05
	(3.57)***	(3.48)***	(3.23)***	(2.63)***	(2.42)**
Officer female	-.0734	0.182	0.158	0.202	0.201
	(1.85)*	(1.39)	(1.22)	(1.40)	(1.38)
Officer white female		-0.294	-0.275	-0.238	-.209
		(2.01)**	(1.91)*	(1.46)	(1.25)
Officer unknown race female		-0.272	-0.240	-0.286	-0.311
		(1.91)*	(1.71)*	(1.79)*	(1.92)*
Suspect involved in a violent crime			0.069	0.070	0.089
			(5.49)***	(4.53)***	(4.91)***
Suspect involved in a property crime			0.0034	-0.008	-0.004
			(0.21)	(0.43)	(0.16)
Suspect involved in a drug related crime			-0.062	-0.095	-0.067
			(2.29)**	(2.79)**	(1.77)*
Suspect suicidal			0.101	0.104	0.101
			(4.82)***	(3.85)***	(3.23)***
Suspect age			0.0018	0.0017	0.002
			(4.05)***	(3.01)***	(1.47)
violent crime rate per 100K				-0.00004	-0.014
				(1.50)	(2.13)**
Percent of the population who are black males 15-29				0.011	0.038
				(1.82)	(2.97)***
Percent police dept female					0.0016
					(0.82)
Percent police dept black					-0.002
					(1.15)
Percent police dept white					-0.0001
					(0.23)

Percent police dept Hispanic					-0.002 (2.45)**
Constant	0.860 (77.2)***	0.861 (76.62)***	0.763 (36.40)***	0.684 (9.77)***	0.767 (6.25)***
F-test for Officer Female + officer white female=0		2.98 8.45%	3.38 6.59%	0.21 64.36%	0.01 93.10%
F-test for Officer unknown + Officer Female + officer unknown female=0		0.61 43.64%	0.50 48.02%	0.34 56.20%	0.69 40.67%
N	2637	2637	2611	1894	1355
State & year dummies	No	No	No	Yes	Yes

Notes: OLS regressions: dependent variable is a dummy variable indicating that the suspect had a weapon, t-ratios are in parentheses, *.10, **.05, ***.01.