

AN ANALYSIS OF RACIAL DISPARITIES IN TRAFFIC POLICING: BURLINGTON  
POLICE DEPARTMENT 2012-15<sup>1</sup>

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*I. Introduction*

This document provides an analysis of Burlington Police Department (BPD) data on traffic stops and post-stop actions by race from 2012-15. Our approach in this analysis is to focus on outcomes that are the result of officer discretion—that is, where officers are in a position to make independent decisions on whom to stop, ticket, arrest, and search. We therefore omit instances of traffic stops that are externally generated and the post-stop outcome of arrest based on a warrant.<sup>2</sup>

To assess racial disparities in outcomes, we examine several indicators. First, we evaluate stop rates by race, comparing these to racial shares of the population. Second, we evaluate the proportion of drivers receiving tickets versus warnings. Third, we compare racial differences in arrest rates. Fourth, we examine search rates by race, as well as the percentage of searches that yield contraband. The range of contraband found in searches can be very minor (cigarettes carried by a teenager) to serious (large amounts of illegal substances). In order to focus on the more serious infractions, we also calculate the percentage of searches

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<sup>1</sup> The authors are grateful to Kyle Mitofsky for invaluable assistance with data cleaning and analysis, and Sara Solnick and Brock Gibian for helpful comments.

<sup>2</sup> Examples of sources of externally generated stops are Be On the Lookout (BOLO) alerts from a police agency, or a 911 call.

by race that yields contraband in which the outcome was a ticket or arrest (but not a warning, issued in minor cases of contraband evidence). Fifth, we examine differences in racial stop behavior by officer. Our analysis estimates these indicators for the entire five-year period (2012 through 2015). We also provide information on the trends over time for each of the indicators. The latter is useful for evaluating the effectiveness of steps taken by the Burlington Police Department to reduce racial disparities over time. Our assessment of racial disparities does not rest solely on any one indicator. Rather, our approach is to assess the data to determine whether there are consistent patterns of racial disparities across multiple indicators. Finally, we also evaluate the quality of the data generated by the Burlington Police Department.

## *II. Racial Disparities in Stop Rates and Stop Reasons*

### *A. Stop Rates*

In order to calculate the rate at which drivers are stopped by race/ethnicity, we compute the number of traffic stops<sup>3</sup> by race divided by the racial share of the population.<sup>4</sup> The race of the driver is based on officer perception since Vermont driver's licenses do not include this information.

Accurate and up-to-date data on racial shares of the population present a challenge because the Census was conducted in 2010, and the racial/ethnic composition of the city may have changed since that time. One source of information is the American Community Survey (ACS), which reports estimates of annual data on population by race and ethnicity for Burlington. For our population estimates, we use the most recently available 3-year estimates (2011-13) of racial shares of the population as our denominator in calculating traffic stop rates.<sup>5</sup>

Table 1 compares the number and percentage of annual and total traffic stops by race/ethnicity for 2012-15. The share of stops relative to the racial share of population is

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<sup>3</sup> The data provided by the Burlington Police Department records a single stop multiple times if there was more than one outcome per stop (e.g., a driver could receive a warning and a ticket, or two tickets, etc.). We have corrected for this.

<sup>4</sup> It would be preferable to have an estimate of the driving population. The Department of Motor Vehicles (DMV) collects accident data, which is a potential source of such data. Data provided by the DMV for the period July 7, 2010 through October 31, 2015 includes data reported by the Burlington Police Department. Our calculations of Burlington racial driving population shares from those data are 89.1% white, 5.2% black, 4.6% Asian, and 0.7% Hispanic. These shares are similar to the racial shares obtained from the ACS shown in Table 1. A weakness of the DMV dataset and the reason we do not rely on it for this study is that race of the driver is missing in 25% of the reported accidents.

<sup>5</sup> Burlington, VT is too small to have annual ACS population estimates. To calculate population share, we count as white those who identify as white alone in the ACS. If a person identifies as *two races and one is white, the person is assigned to the non-white group (Asian, black, or Native American)*. In cases in which individuals identify as two non-white races, we attribute half of those to each racial identity. For example, a person who identifies as black and Asian would count as 0.5 black and 0.5 Asian. We ignore those who identify as 3 or more races for the purposes of calculating population share.

calculated only for blacks, Asians, and whites, while the category of Hispanics is excluded. This is because the Census/ACS and the police officers collecting data on traffic stops do not use comparable methods of classifying drivers as Hispanic. Note that the table denotes the number of stops for which the race of the driver is either missing or marked unknown. For the purposes of calculating the racial shares of stops, however, we only count those stops for which the officer recorded the perceived race of the driver.

Table 1. Traffic Stops by Race/Ethnicity, 2012-15

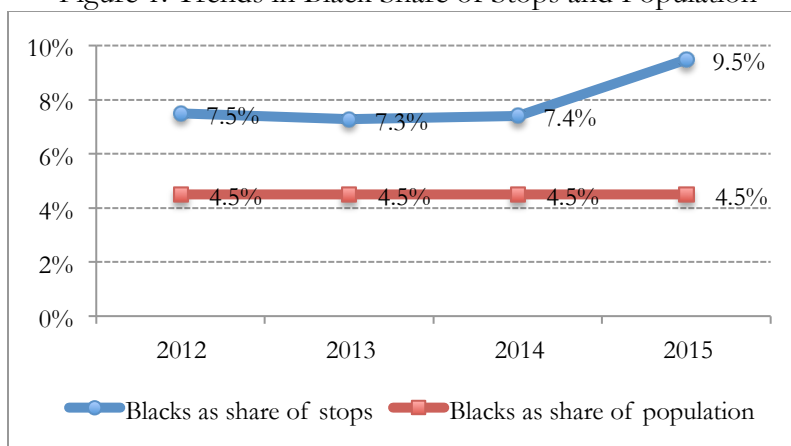
Year	White	Black	Asian	Hispanic	Missing/ Unknown	Grand Total
<i>Total number of stops</i>						
2012	4,788	401	205	30	135	5,561
2013	3,912	331	184	38	292	4,758
2014	4,709	401	234	38	249	5,638
2015	4,136	458	209	33	348	5,191
<b>Grand Total</b>	17,545	1,591	832	139	1,024	21,148
<i>Share of stops</i>						
2012	88.2%	7.4%	3.8%	0.6%	2.5%	100%
2013	87.6%	7.4%	4.1%	0.9%	6.5%	100%
2014	87.4%	7.4%	4.3%	0.7%	4.6%	100%
2015	85.4%	9.5%	4.3%	0.7%	7.2%	100%
<b>Grand Total</b>	87.2%	7.9%	4.1%	0.7%	5.1%	100%
<i>Share of population</i>						
2011-13	88.1%	4.5%	5.4%	NA	NA	100%

Note: Native Americans were less than 0.1% of all stops, totaling 19 over five years. Hispanics are a marginally larger group at 139 drivers of all stops during this time period and are included here for completeness. Because of the small sample size, both of these groups are omitted from the ensuing analysis. *NA* signifies “not applicable.” Racial shares are measured as a percentage of total stops minus missing/unknowns.

Source: Authors’ calculations based on raw data provided by the Burlington Police Department to the authors in February 2016.

As the data indicate, whites and Asians are stopped at a lower rate than would be expected, given their population shares, while black stop rates exceed their share of the population. For the period 2012-15, blacks are approximately 4.5% of the population but they are 7.9% of those stopped. Figure 1 shows that the share of stopped drivers who are black is rising, as compared to their population share. That is, racial disparities in stop rates are on the rise since 2012 so that by 2015, blacks are stopped at a rate that is almost double their estimated population share. This is indicative of a worsening of racial disparity in traffic stops.

Figure 1. Trends in Black Share of Stops and Population



### B. Investigatory Stops

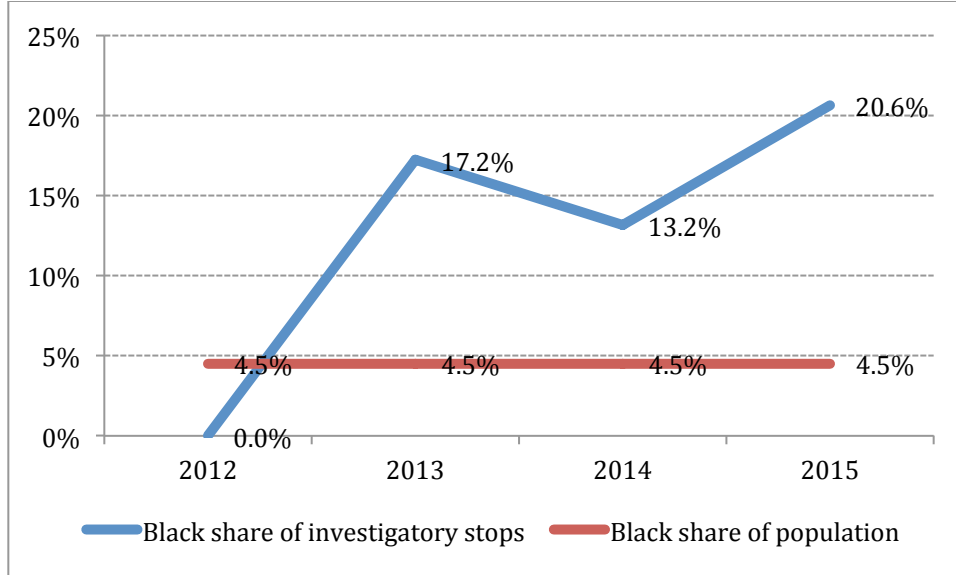
On their incident reports, police officers identify the reason for a traffic stop. Apart from externally generated stops, discussed above, possible reasons include: moving violation, vehicle equipment, suspicion of driving while intoxicated, and investigatory stops. Here, we examine in further detail racial disparities in investigatory stops. These stops are always discretionary, and may be for minor violations like driving too slowly or failing to signal a turn. Racial bias can especially come into play in such stops since the stop is prompted by suspicion rather than identifiable behavior. Racial stereotypes often shape those biases and thus suspicions.

From 2012 to 2015, a total of 149 investigatory stops were conducted, less than 1 percent of all stops. Of those investigatory stops, 15.4% were of black drivers, more than 3 times the black share of the population. A disproportionate and increasing percentage of those stops, however, involved black drivers. As the data in Figure 2 indicate, while there were no investigatory stops of black drivers in 2012, by 2015, the black share rose to 20.6% of all such stops.

The data in Figure 2 should be viewed with some caution since the annual number of investigatory stops is very small, making percentages volatile. Nevertheless, we include this to draw attention to this type of racial disparity that warrants monitoring. This growing racial disparity in investigatory stops may well be related to officer behavior in response to a growing opiate crisis, with black drivers increasingly the object of suspicion. As the data in the following section show, however, black drivers are less likely to be found with contraband, subsequent to a search, suggesting at a minimum, inefficient policing.

There is no agreed-on statistical test for racial profiling, which is defined as the improper and unconstitutional substitution of race for objective evidence of criminal activity in conducting stops, searches and other law enforcement investigative procedures. That said, the data on investigatory stops shown here raises serious concerns about policing protocol by the Burlington Police Department when the driver is black.

Figure 2. Black Drivers As % of All Investigatory Stops, 2012-15



Note: See Table A.2 for raw data on investigatory stops.

### III. Post-Stop Outcomes

Police officers frequently state they do not know the race of a driver before a stop. Once a driver has been stopped, however, officers are in a position to form an assessment of the driver's race. Therefore, post-stop outcomes are of much interest. The data in Table 2 summarize post-stop outcomes for 2012-15. We first discuss ticket and warning rates, then arrest, search, and "hit" rates (the percentage of searches that result in contraband being found). Annual data are provided in the appendix in Table A.1. We have not included the Hispanic population in our post-stop analysis since their total count in the dataset is small.

#### A. Ticket and Warning Rates

One way to evaluate possible racial differences in post-stop outcomes is to compare the percentage of drivers receiving a warning versus a citation (ticket). These percentages may total more than 100% since some drivers receive both a ticket and a warning, or multiple tickets. The data in Table 2 summarize these outcomes. Asians were ticketed at a rate of 28.6% during this four-year period of time, compared to 31.8% of white drivers, and 42.2% of black drivers. Black drivers then were close to 50% more likely to receive a ticket than Asian drivers and a third more likely than white drivers. Only 72.3%<sup>6</sup> of blacks received warnings, compared to 78.1% of whites and 79.6% of Asians.

<sup>6</sup> Table A.4 in the appendix provides the hypothesis test results for the differences in proportions between the black and white populations for all post-stop outcomes. The differences in outcomes between blacks and whites are statistically significant in all cases except for arrest rates. Overall, blacks and whites were arrested for violations at approximately the same rate, as will be discussed below.

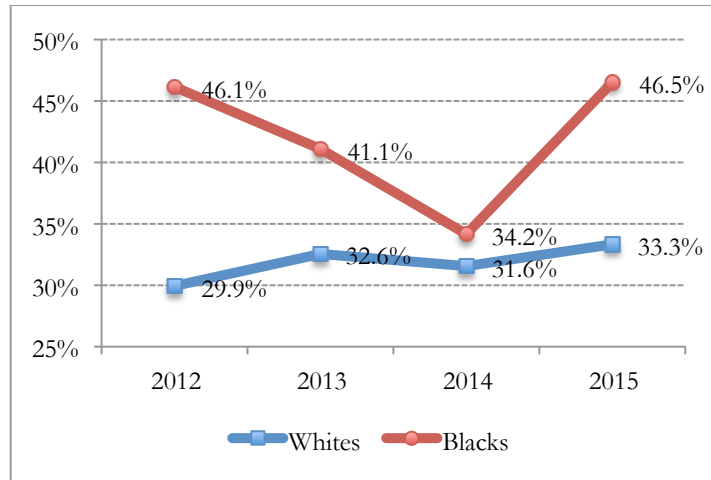
Table 2. Post Stop Outcomes

2012-15 Average	White	Black	Asian
Tickets	5,571	671	238
Warnings	13,709	1,151	662
Arrests for violation	235	26	10
Searches	141	46	1
Searches with contraband found	97	23	0
Hits (excluding warnings)	77	16	0
Hits (total outcomes including warnings)	120	24	0
Ticket Rate	31.8%	42.2%	28.6%
Warning Rate	78.1%	72.3%	79.6%
Arrest Rate	1.3%	1.6%	1.2%
Search Rate	0.8%	2.9%	0.1%
Proportion of stops with contraband found	68.8%	50.0%	0.0%
Hit Rate (total outcomes excluding warnings as % of searched stops)	54.6%	34.8%	0.0%
Hit Rate (total outcomes including warnings as % of searched stops)	85.1%	52.2%	0.0%

Note: The top section of the table shows the raw numbers of stopped drivers who received tickets, warnings, or were arrested or searched. Searches include only those based on probable cause and reasonable suspicion (thus excluding searches on warrant). The bottom section shows ticket, warning, arrest, and search rates as a share of all stops. Data on percentage of searches that yield contraband are also provided. The hit rates are the number of incident reports stemming from contraband being found divided by the number of stops that were searched—this percentage reflects the fact that the police officer can issue (and in Burlington often does) more than one citation per stop.

Figure 2 shows the evolution of black and white ticket rates over time from 2012 to 2015. The black-white gap widened in 2015 after narrowing considerably in 2014. Year-to-year variation is likely to exist in the data and a longer time series is required to assess whether a widening gap is a trend or simply a statistical irregularity in any particular year. That said, the data indicate that in every year, the black ticket rate exceeded the white rate, and in most years, the margin was wide—between 25% and 50% higher for blacks than whites.

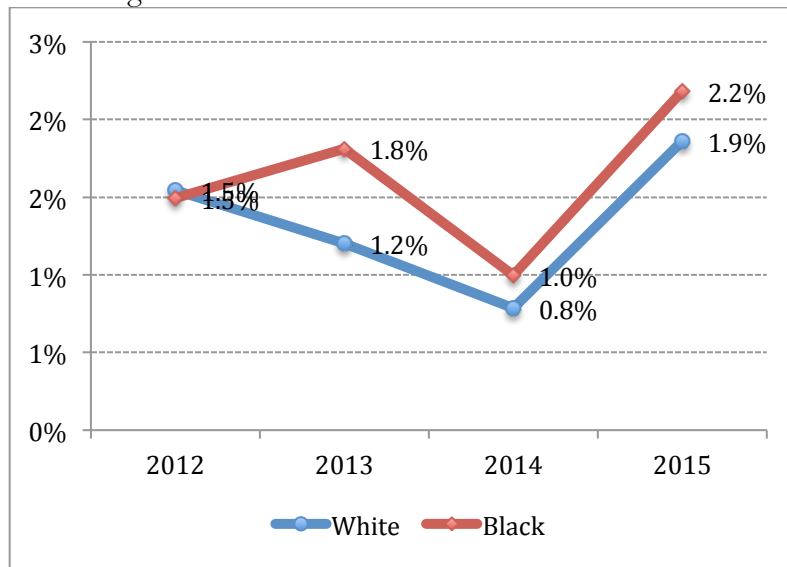
Figure 2. Trends in Black and White Ticket Rates



*B. Arrest Rates*

The data in Table 2 show that the black arrest rate is slightly higher than for any other racial/ethnic group at 1.6%, compared to 1.3% for whites and 1.2% for Asians. Figure 2 provides trend data on black and white arrest rates. In all years except 2012, the black arrest rate exceeds the white rate but it is not a large enough difference to be statistically significant.<sup>7</sup>

Figure 3. Trends in Black and White Arrest Rates



<sup>7</sup> Table A.4 in the appendix summarizes statistical tests, including p-values and confidence intervals for differences in proportions.

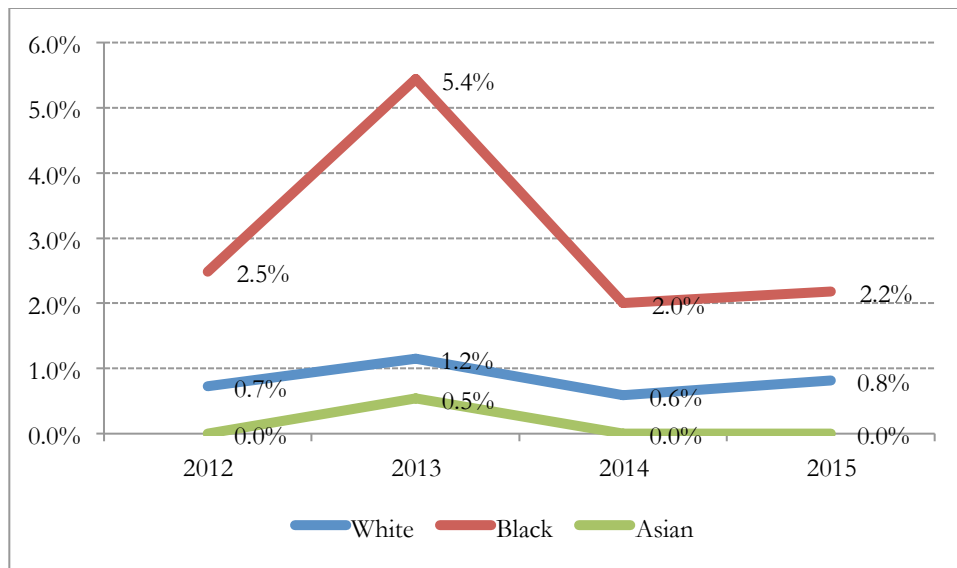
### C. Search Rates

The BPD traffic dataset provides information on searches based on three criteria: 1) probable cause; 2) reasonable suspicion (a lower bar of evidence than probable cause); and 3) warrants. The first two are known as consent searches. In those cases, the driver agrees to a search, signing a consent form. A search based on a warrant typically results from a case in which an officer requests but does not obtain consent, then impounding the vehicle and seeking a warrant from a judge.<sup>8</sup>

We focus here on consent searches, although the inclusion of searches based on a warrant does not substantially alter our results. As the data in Table 2 indicate, the (consent) search rate for black drivers is 2.89%, a rate that is 3.6 times that of whites. Although Asians comprise a larger share of the Burlington population than blacks (5.4% compared to 4.5%), BPD conducted only one consent search of an Asian driver during the time period in question, compared to 46 consent searches of blacks.<sup>9</sup>

Trends in search rates by race over time are shown in Figure 4. In this case, we also include Asians by way of comparison to blacks to illustrate the different treatment of these two minority groups. Asian search rates in most years are 0%, compared to an average of 2.89% for blacks. This is a surprising and very wide disparity, and underscores why studies of racial disparities should not group minorities into one category.

Figure 4. Trends in Black, Asian, and White Consent Search Rates



Note: Search rates are for the sum of rates for probable cause and reasonable suspicion (consent searches). Probable cause requires stronger evidence than reasonable suspicion.

<sup>8</sup> Searches based on a warrant are not entirely discretionary since a judge must grant the warrant, although such requests are rarely denied.



#### D. Contraband and “Hit” Rates

A key method for detecting racial bias in policing is the evaluation of differences in the percentage of searches in which contraband is found (this is, in jargon, called the *hit rate*). In the absence of racial bias, officers would be expected to pursue a search strategy that maximizes the number of successful searches, defined as searches that yield contraband. In that case, hit rates would be the same across racial/ethnic groups. If, however, racial bias plays a role in influencing the decision to search, the hit rate for minority drivers (e.g., black drivers) would be lower than that of white drivers. Another way to view this is that minority hit rates that are lower than white hit rates are an indication that police are over-searching minorities (and/or under-searching whites).

We look at hit rates in two ways. First, we calculate hit rates only in those cases where a ticket is issued or the driver is arrested (or both). Thus, we ignore those hits where only a warning is issued. The rationale for excluding hits that result in warnings is that the contraband found is likely to have been of a relatively insignificant amount or quality. For example, an underage driver with cigarettes and/or drivers with small amounts of marijuana may only receive warnings. For comparison, we also calculate the hit rate for searches that yield contraband and result in *any* outcome—a ticket, warning, or arrest.

For the period 2012-2015, the average hit rate when warnings are excluded is 34.8% for blacks, lower than the average white hit rate (54.6%).<sup>10</sup> Inclusion of searches that result in warnings raises all hit rates. The white hit rate rises the most—from 54.6% to 85.1%—while the black rate rises from 34.8% to 52.2%. The black-white disparity in hit rates widens with the inclusion of warnings to about 33 percentage points.<sup>11</sup>

Figure 5 shows trends in hit rates for white and black drivers. *Panel A* reflects trends for searches that result in a ticket or an arrest. Apart from 2012, when the black hit rate exceeded the white rate, searches of white drivers are substantially more likely to yield contraband than searches of black drivers, with no narrowing of this disparity over time.

*Panel B* indicates trends in hit rates for searches, regardless of outcome. Here, the white hit rate is greater than the black rate in every year. This suggests inefficiency in search decisions, given the lower probability that searched black drivers are found carrying contraband, compared to white drivers.

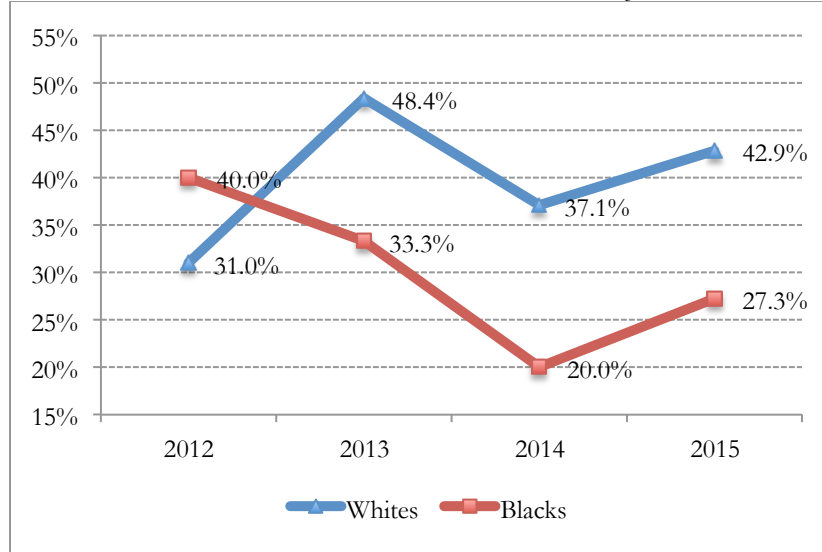
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<sup>10</sup> This roughly 20-percentage point difference is statistically significant. See appendix A.4.

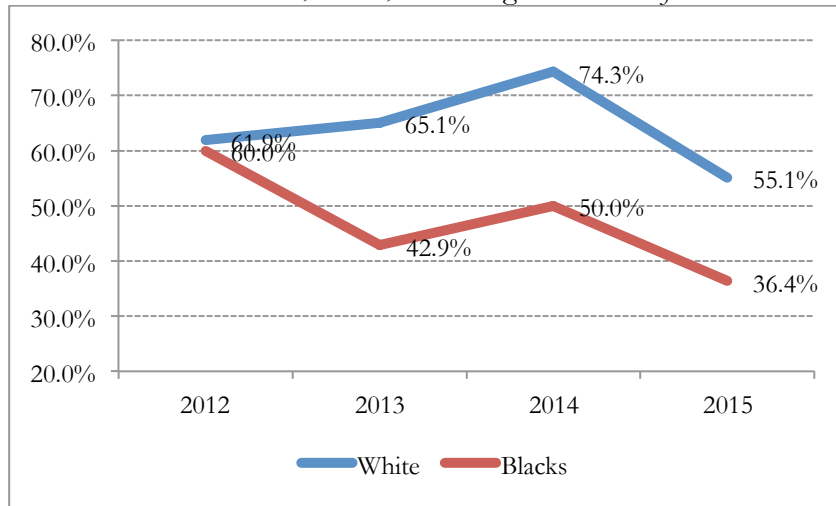
<sup>11</sup> In appendix A.4, we also include a statistical test that includes the situations where contraband was found but no search was recorded (the contraband may have been seen by the officer without the need for a search). Qualitatively consistent with the findings from the other two measures, in this case we find a (statistically significant) difference of 35 percentage points.

Figure 5. Percentages of Searches Yielding Contraband

*Panel A. With tickets or arrests as an outcome of the search*



*Panel B. With tickets, arrests, or warnings as outcome of the search*



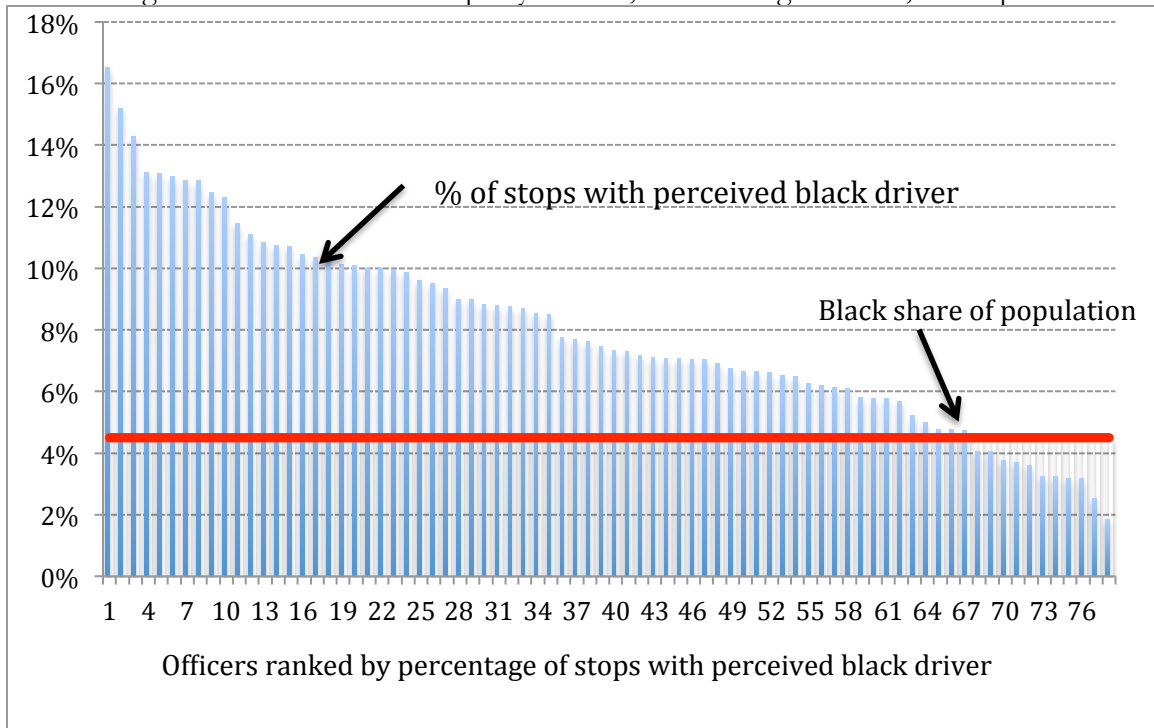
#### *IV. Black Stop Rates by Officer*

Officer identification codes are provided in the Burlington data set, allowing us to assess racial disparities in traffic policing by officer. To conduct this analysis, we exclude those officers who have recorded fewer than 80 stops over the period 2012-15 in order to avoid small sample size and to focus on those officers routinely engaged in traffic policing.

We calculate stop rates of drivers perceived as black (by officers), the racial category for which stop rates diverge the most from population shares. We then rank officers from highest to lowest black share of stops. Figure 6 shows this ranking. The red line is the

estimated share of the Burlington population that is black and we would expect that, absent racial disparities, the share of stopped drivers would be roughly equivalent. At the far left, we observe that for 10 officers, the share of black drivers they stop exceeded 12%, while about 50 officers' black stop rates exceeded 6%. This is approximately 30% greater than the black population share. The data indicate that not all officers have disproportionately stopped black drivers, but a large percentage does.

Figure 6. Blacks as % of Stops by Officer, Ranked High to Low, 80 Stops+



Note: The numbers on the x-axis are code numbers assigned to each officer.

#### IV. Data Quality

Data quality depends in large part on the completeness of incident reports. Table 3 summarizes the number of incidents for which categories of data were missing or marked “unknown.” The highest percentage of missing/unknown data—4.8%—is the race of the driver. While it might be assumed that in the early years of the race data collection process (data collection started in 2009), officers would provide incomplete information, over time data quality should improve. In the case of Burlington Police Department, however, the rate of “missingness” is increasing. In fact, in 2015, fully 6.5% of incidents failed to record the race of the driver. The reason for the stop is also missing in a substantial percentage of incident reports (3.3%).

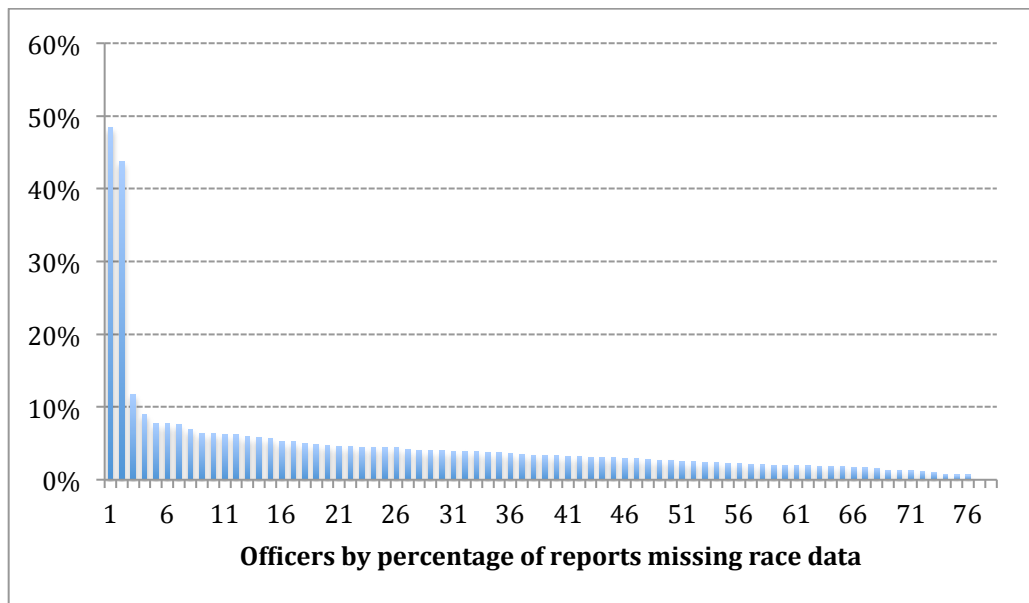
Table 3. Missing/Unknown Data

Year	Total Stops	Demographic data			Incident data			
		Age	Race	Sex	Reason	Result	Search	Search Outcome
2012	6,359	1.6%	2.5%	1.7%	3.4%	0.8%	1.2%	1.2%
2013	5,505	2.3%	6.0%	2.4%	3.3%	1.6%	3.1%	2.8%
2014	6,317	0.7%	4.4%	0.8%	2.1%	0.9%	1.6%	1.6%
2015	5,669	2.4%	6.5%	3.8%	4.7%	1.4%	1.8%	1.8%
Grand Total	23,850	1.7%	4.8%	2.1%	3.3%	1.2%	1.9%	1.8%

Note: These data exclude externally generated stops.

The data in Figure 7 show the percentage of incident reports in which the race of the driver is missing or recorded as “unknown” for officers with 80 or more stops over the 2012-15 time period. Two officers failed to record race more than 40% of the time, and almost 30 more officers omit race on incident reports more than 4% of the time. These are unusually high rates of “missingness” and undermine the quality of the race data collection.

Figure 7. Percentage of Incident Reports With Race of Driver Missing or Recorded as “Unknown” by Officer, 2012-2015 (80+ Stops)



Note: The numbers on the x-axis are code numbers assigned to each officer.

### V. Conclusions

In this analysis, we looked at several indicators of racial disparities: 1) stop rates, 2) ticket rates, 3) warning rates, 4) investigatory stop rates, 5) arrest rates, 6) search rates, and 7) hit

rates (with and without warnings as outcomes). The most significant racial disparity we can identify is between the treatment of black and white drivers.

Table 4 lists the variables evaluated in this analysis, indicating those for which the data indicate statistically significant white-black disparities. Significant disparities are in evidence for all but two indicators (arrests and hits that exclude warnings), symptomatic of a consistent pattern of racial disparities in policing in Burlington between 2012 and 2015.

Table 4. Summary of Results for All Indicators

<b>Indicator</b>	<b>Statistically Significant White-Black Disparities</b>
Stop rates	<b>Yes</b>
Ticket rates	<b>Yes</b>
Warning rates	<b>Yes</b>
Arrest rates	No
Search rates	<b>Yes</b>
Hit rates (incl. warnings)	<b>Yes</b>
Hit rates (excl. warnings)	Yes
Hit rates (incl. contraband found with no search recorded)	<b>Yes</b>

Note: For statistical significance tests, see Table A.4.

Perceptions of disparate police treatment in Burlington have been the impetus behind data collection on traffic stops. The data in this report, collected by police officers during traffic stops, are consistent with those perceptions. The Burlington Police Department continues to register disparities in traffic stops and outcomes by race and ethnicity and shows little evidence, if any, of improvement since 2012.

This type of data analysis can serve as a tool to the Burlington Police Department so that it can assess the steps that are needed to promote fair and impartial policing and to track the effectiveness of their efforts to eliminate disparities.

## APPENDIX

Table A.1. Raw Data on Traffic Stops by Race, 2012-15

All Years	White	Black	Asian
<b>Total Traffic Stops</b>			
<i>Including externally generated stops</i>	18,226	1,651	859
<i>Excluding externally generated stops</i>	17,545	1,591	832
<b>Outcomes (excl. externally generated stops)</b>			
<i>Ticket</i>	5,571	671	238
<i>Warning</i>	13,709	1,151	662
<i>Arrest for violation</i>	235	26	10
<i>Arrest for warrant</i>	28	3	0
<b>Searches (excl. externally generated stops)</b>			
<i>Total Stops with No Search</i>	17,153	1,520	817
<i>Total Stops with Unknown Search</i>	225	23	13
<i>Total Stops with Search</i>	167	48	2
<i>Search with probable cause</i>	100	35	0
Stops with no contraband found	16	11	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	78	20	0
<i>Incidents:</i>			
Warning	33	7	0
Ticket	42	11	0
Arrest on violation	19	2	0
<i>Search with reasonable suspicion</i>	41	11	1
Stops with no contraband found	21	8	1
Stops with unknown contraband found	0	0	0
Stops with contraband found	19	3	0
<i>Incidents</i>			
Warning	10	1	0
Ticket	11	3	0
Arrest on violation	5	0	0
<i>Search with warrant</i>	26	2	1
Stops with no contraband found	3	1	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	15	1	1
<i>Incidents</i>			
Warning	2	0	0
Ticket	9	0	1
Arrest on violation	2	1	0
<b>Outcome rates as a % of stops (excl. externally generated stops and arrests on warrant)</b>			
<i>Warning rate</i>	78.1%	72.3%	79.6%
<i>Ticket rate</i>	31.8%	42.2%	28.6%
<i>Arrest rate</i>	1.34%	1.63%	1.20%

<i>Search rates</i>			
<i>Search rate</i> (excl. searches on warrant)	0.80%	2.89%	0.12%
<i>Search rate</i> (incl. searches on warrant)	0.95%	3.02%	0.24%
<i>Hit rates</i> (as a % of searches)			
Hit rates (includes all outcomes)	85.1%	52.2%	0.0%
Hit rates (excl. warnings as outcomes of searches)	54.6%	34.8%	0.0%
Stops with Hits Despite No Search Recorded (all outcomes)	31	1	4
Stops with Hits Despite No Search Recorded (excl. warnings)	15	1	1

2012	White	Black	Asian
<b>Total Traffic Stops</b>			
<i>Including externally generated stops</i>	4,993	424	211
<i>Excluding externally generated stops</i>	4,788	401	205
<b>Outcomes (excl. externally generated stops)</b>			
<i>Ticket</i>	1,433	185	53
<i>Warning</i>	3,899	292	169
<i>Arrest for violation</i>	74	6	4
<i>Arrest for warrant</i>	12	0	0
<b>Searches (excl. externally generated stops)</b>			
<i>Total Stops with No Search</i>	4,718	381	201
<i>Total Stops with Unknown Search</i>	31	9	4
<i>Total Stops with Search</i>	39	11	0
<i>Search with probable cause</i>	28	8	0
Stops with no contraband found	5	3	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	22	5	0
<i>Incidents:</i>			
Warning	11	2	0
Ticket	8	2	0
Arrest on violation	4	1	0
<i>Search with reasonable suspicion</i>	7	2	0
Stops with no contraband found	4	1	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	3	1	0
<i>Incidents</i>			
Warning	2	0	0
Ticket	0	1	0
Arrest on violation	1	0	0
<i>Search with warrant</i>	4	1	0
Stops with no contraband found	1	1	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	3	0	0
<i>Incidents</i>			
Warning	1	0	0

Ticket	0	0	0
Arrest on violation	1	0	0
<b>Outcome rates as a % of stops (excl. externally generated stops and arrests on warrant)</b>			
<i>Warning rate</i>	81.4%	72.8%	82.4%
<i>Ticket rate</i>	29.9%	46.1%	25.9%
<i>Arrest rate</i>	1.55%	1.50%	1.95%
<i>Search rates</i>			
<i>Search rate</i> (excl. searches on warrant)	0.73%	2.49%	0.00%
<i>Search rate</i> (incl. searches on warrant)	0.81%	2.74%	0.00%
<i>Hit rates</i> (as a % of searches)			
Hit rates (includes all outcomes)	74.3%	60.0%	-
Hit rates (excl. warnings as outcomes of searches)	37.1%	40.0%	-
Stops with Hits Despite No Search Recorded (all outcomes)	5	0	0
Stops with Hits Despite No Search Recorded (excl. warnings)	4	0	0

2013	White	Black	Asian
<b>Total Traffic Stops</b>			
<i>Including externally generated stops</i>	4,099	340	196
<i>Excluding externally generated stops</i>	3,912	331	184
<b>Outcomes (excl. externally generated stops)</b>			
<i>Ticket</i>	1,274	136	43
<i>Warning</i>	3,126	258	157
<i>Arrest for violation</i>	47	6	0
<i>Arrest for warrant</i>	3	2	0
<b>Searches (excl. externally generated stops)</b>			
<i>Total Stops with No Search</i>	3,755	304	179
<i>Total Stops with Unknown Search</i>	96	8	3
<i>Total Stops with Search</i>	61	19	2
<i>Search with probable cause</i>			
Stops with no contraband found	6	5	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	25	9	0
<i>Incidents:</i>			
Warning	9	2	0
Ticket	13	7	0
Arrest on violation	12	0	0
<i>Search with reasonable suspicion</i>			
Stops with no contraband found	5	0	1
Stops with unknown contraband found	0	0	0
Stops with contraband found	4	0	0
<i>Incidents</i>			
Warning	2	0	0
Ticket	4	0	0



Arrest on violation	1	0	0
<i>Search with warrant</i>	16	1	1
Stops with no contraband found	1	0	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	7	1	1
<i>Incidents</i>			
Warning	1	0	0
Ticket	6	0	1
Arrest on violation	1	1	0
<b>Outcome rates as a % of stops (excl. externally generated stops and arrests on warrant)</b>			
<i>Warning rate</i>	79.9%	77.9%	85.3%
<i>Ticket rate</i>	32.6%	41.1%	23.4%
<i>Arrest rate</i>	1.20%	1.81%	0.00%
<i>Search rates</i>			
<i>Search rate</i> (excl. searches on warrant)	1.15%	5.44%	0.54%
<i>Search rate</i> (incl. searches on warrant)	1.56%	5.74%	1.09%
<i>Hit rates</i> (as a % of searches)			
Hit rates (includes all outcomes)	91.1%	50.0%	0.0%
Hit rates (excl. warnings as outcomes of searches)	66.7%	38.9%	0.0%
Stops with Hits Despite No Search Recorded (all outcomes)	17	0	3
Stops with Hits Despite No Search Recorded (excl. warnings)	6	0	0

2014	<b>White</b>	<b>Black</b>	<b>Asian</b>
<b>Total Traffic Stops</b>			
<i>Including externally generated stops</i>	4,839	410	239
<i>Excluding externally generated stops</i>	4,709	401	234
<b>Outcomes (excl. externally generated stops)</b>			
<i>Ticket</i>	1,486	137	71
<i>Warning</i>	3,691	315	188
<i>Arrest for violation</i>	37	4	4
<i>Arrest for warrant</i>	4	0	0
<b>Searches (excl. externally generated stops)</b>			
<i>Total Stops with No Search</i>	4,647	391	231
<i>Total Stops with Unknown Search</i>	34	2	3
<i>Total Stops with Search</i>	28	8	0
<i>Search with probable cause</i>	17	4	0
Stops with no contraband found	1	1	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	15	3	0
<i>Incidents:</i>			
Warning	10	2	0
Ticket	10	0	0

Arrest on violation	0	1	0
<i>Search with reasonable suspicion</i>	10	4	0
Stops with no contraband found	5	3	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	5	1	0
<i>Incidents</i>			
Warning	3	1	0
Ticket	3	1	0
Arrest on violation	0	0	0
<i>Search with warrant</i>	1	0	0
Stops with no contraband found	1	0	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	0	0	0
<i>Incidents</i>			
Warning	0	0	0
Ticket	0	0	0
Arrest on violation	0	0	0
<b>Outcome rates as a % of stops (excl. externally generated stops and arrests on warrant)</b>			
<i>Warning rate</i>	78.4%	78.6%	80.3%
<i>Ticket rate</i>	31.6%	34.2%	30.3%
<i>Arrest rate</i>	0.79%	1.00%	1.71%
<i>Search rates</i>			
<i>Search rate</i> (excl. searches on warrant)	0.57%	2.00%	0.00%
<i>Search rate</i> (incl. searches on warrant)	0.59%	2.00%	0.00%
<i>Hit rates</i> (as a % of searches)			
Hit rates (includes all outcomes)	96.3%	62.5%	-
Hit rates (excl. warnings as outcomes of searches)	48.1%	25.0%	-
Stops with Hits Despite No Search Recorded (all outcomes)	3	1	0
Stops with Hits Despite No Search Recorded (excl. warnings)	2	1	0

2015	<b>White</b>	<b>Black</b>	<b>Asian</b>
<b>Total Traffic Stops</b>			
<i>Including externally generated stops</i>	4,295	477	213
<i>Excluding externally generated stops</i>	4,136	458	209
<b>Outcomes (excl. externally generated stops)</b>			
<i>Ticket</i>	1,378	213	71
<i>Warning</i>	2,993	286	148
<i>Arrest for violation</i>	77	10	2
<i>Arrest for warrant</i>	9	1	0
<b>Searches (excl. externally generated stops)</b>			
<i>Total Stops with No Search</i>	4,033	444	206
<i>Total Stops with Unknown Search</i>	64	4	3

<i>Total Stops with Search</i>	39	10	0
<i>Search with probable cause</i>	20	5	0
Stops with no contraband found	4	2	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	16	3	0
<i>Incidents:</i>			
Warning	3	1	0
Ticket	11	2	0
Arrest on violation	3	0	0
<i>Search with reasonable suspicion</i>	14	5	0
Stops with no contraband found	7	4	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	7	1	0
<i>Incidents</i>			
Warning	3	0	0
Ticket	4	1	0
Arrest on violation	3	0	0
<i>Search with warrant</i>	5	0	0
Stops with no contraband found	0	0	0
Stops with unknown contraband found	0	0	0
Stops with contraband found	5	0	0
<i>Incidents</i>			
Warning	0	0	0
Ticket	3	0	0
Arrest on violation	0	0	0
<b>Outcome rates as a % of stops (excl. externally generated stops and arrests on warrant)</b>			
<i>Warning rate</i>	72.4%	62.4%	70.8%
<i>Ticket rate</i>	33.3%	46.5%	34.0%
<i>Arrest rate</i>	1.86%	2.18%	0.96%
<i>Search rates</i>			
<i>Search rate</i> (excl. searches on warrant)	0.82%	2.18%	0.00%
<i>Search rate</i> (incl. searches on warrant)	0.94%	2.18%	0.00%
<i>Hit rates</i> (as a % of searches)			
Hit rates (includes all outcomes)	79.4%	40.0%	-
Hit rates (excl. warnings as outcomes of searches)	61.8%	30.0%	-
Stops with Hits Despite No Search Recorded (all outcomes)	6	0	1
Stops with Hits Despite No Search Recorded (excl. warnings)	3	0	1

Note: The first two lines of each table measures stops, while the remaining raw data in each table measure the number of incidents. The number of incidents is larger than the number of stops because there can be more than one outcome per stop (e.g., multiple tickets, or some other combination of outcomes). See Table A.5 for number of outcomes per stop by race.

Source: Authors' calculations based on data provided by Burlington Police Department, February 2016.

Table A.2. Investigatory Stops by Race, 2012 to 2015

	White	Black	Asian
2012	22	0	1
2013	20	5	0
2014	39	7	2
2015	62	22	0
<b>Grand Total</b>	143	34	3

Note: Hispanic and Native American investigatory stops are omitted from the table. Black shares of investigatory stops in Figure 2 are calculated as a percentage of total investigatory stops minus cases in which race is unknown. This table records the number of incident reports issued at investigatory stops. Since it is possible to issue more than one citation at a stop, the numbers in this table are slightly larger than the actual number of investigatory stops.

Table A.3. Data Quality: Numbers of Missing and Unknown by Category

Year	Total Stops	Demographic			Incidents			
		Age	Race	Sex	Reason	Result	Search	Search Outcome
2012	6,359	102	161	107	214	49	78	74
2013	5,505	126	330	132	182	90	169	156
2014	6,317	42	276	48	133	59	102	103
2015	5,669	136	368	215	267	80	101	100
<b>Grand Total</b>	23,850	406	1,135	502	796	278	450	433

Source: Authors' calculations based on data provided by Burlington Police Department, February 2016. The data exclude externally generated stops.

Table A.4. Summary of Statistical Tests: P-values and Confidence Intervals for Differences in Proportions for 2012-2015

	Black-White					
	Difference in proportions (Black - White)	Standard Error	Confidence Interval for Difference in Proportions (95%)		z score	p-value
Warnings (white-black)	0.0579	0.0116	0.0351	0.0807	5.31	0.0000
Tickets	0.1042	0.0129	0.0790	0.1294	8.49	0.0000
Arrests for violations	0.0029	0.0033	-0.0035	0.0094	0.97	0.1659
Searches (PC +RS)	0.0209	0.0043	0.0125	0.0292	8.11	0.0000
Searches with contraband found	0.1879	0.0834	0.0245	0.3514	2.31	0.0105
Hit rate (white-black) with warning, ticket, or arrest on violation as outcome	0.3293	0.0795	0.1735	0.4852	4.61	0.0000
Hit rate (white-black) with ticket or arrest on violation as outcome	0.1983	0.0818	0.0380	0.3586	2.34	0.0098
Hit rate (white-black) including where no search recorded but contraband found	0.3460	0.0769	0.1951	0.4968	5.29	0.000

Note: PC is probable cause and RS is reasonable suspicion. All tests of the differences of proportions use a one-tail test. The null hypothesis is that blacks are not treated worse than whites (or, more precisely, the difference in proportions, e.g., difference in arrest rates, is zero). The p-value is the probability of obtaining the difference in proportions found in the data if the null hypothesis is true. Therefore, for example, p-values of less than 0.01 (i.e., 1 percent) allow us to say that it is very unlikely that the differences found between white and black outcomes is due to statistical randomness. If the p-value is less than 5 percent, we identify the difference as statistically significant in Table 4.

Table A.5. Number of Outcomes Per Stop by Race, 2012-15

Number of outcomes per stop	White	Black	Asian	Native American	Hispanic	Unknown	Grand Total
1	17,545	1,591	832	17	139	1,024	21,148
2	1,760	212	69	1	12	80	2,134
3	324	45	11	0	4	22	406
4	88	14	5	0	2	5	114
5	23	4	3	0	1	2	33
6	12	1	0	0	0	2	15
Grand Total	19,752	1,867	920	18	158	1,135	23,850