An Analysis of Bennington Police Department Traffic Stops for Calendar Year 2016 Data

Submitted to:

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Executive Summary[1]

In 2014, the Vermont Legislature passed Act 193, which mandated that law enforcement agencies collect and publish certain information about every traffic stop including the race of the driver and the outcome of the stop. The law requires that the information collected is published every year to allow the public and researchers to understand if there is racial disparity in the way officers are engaging with drivers. Unfortunately, Act 193 does not require publication of some variables that are crucial to the analysis of racial disparity. This has led to research being conducted and published that does not accurately assess the issue of racial disparity in traffic stops.

Accordingly, the Bennington Police Department consented to provide Crime Research Group, Inc. (CRG) with additional information to conduct the following analysis. These added variables included: time/date of the stop; year, make and model of the vehicle; residency information of the driver; and state of the vehicle registration.

The purpose of this study was to test differing methods of assessing racial disparity in traffic stops for their applicability in Bennington and to determine if using these methods indicate racial bias in Bennington Police Department traffic stops.

Methodology

There are three generally accepted ways to measure racial disparities: 1) Benchmarking stops to an Estimated Driving Population (EDP)[2]; 2) Veil of Darkness Analysis[3]; and, 3) Disparities in post-stop outcomes to determine if minority drivers are treated different than white drivers. All three of these analyses are described below in more detail.

Findings

1. In general, the numbers of stopped minority drivers is very small. This makes analysis using some methodologies difficult if not impossible. In situations where numbers were small and the raw data could be used to show disparities we provided the raw data as well as an explanation of what the data show.

2. The commuting hour analysis pioneered by Connecticut fails when applied to Bennington. Resident driver analysis is useful for understanding how residents of a town may be treated differently than non-residents. It should be included in future analysis of the town.

3. The veil of darkness analysis is the easiest to perform consistently over time, and we recommend that this be the primary analysis going forward. For the year 2016, this analysis did not find evidence of disparities.

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[1] This is part of a larger study of several police departments in Vermont. The purpose of the study is to determine which accepted method of evaluating racial disparities in traffic stop encounters is the most informative for all of Vermont's police jurisdictions.

[2] http://ctrp3viz.s3.amazonaws.com/data/April2015Connecticut0RacialProfilingReport.pdf

[3] Grogger, Jeffrey and Greg Ridgeway, Testing for Racial Profiling in Traffic Stops From Behind a Veil of Darkness. American Statistical Association, 2006. https://www.rand.org/pubs/reprints/RP1253.html.

4. Resident Driver Analysis: using only those who are of age to have a permit or a license (age 15 and up), we estimate that Non-Whites make up 5.44% of the driving population, but account for only 3.59% of the stopped resident drivers. Whites are estimated to make up for 94.55% of the driving population and account for 93.53% of the stopped resident drivers. From this benchmark, it does not appear that Non-Whites are stopped at a disproportionate rate to their estimated driving population. However, the driving population estimate is just that, an estimate. Some of the assumptions made in creating it may not be true. This benchmark is illustrative, but not dispositive.

5. Veil of Darkness Analysis: Although no regression analysis could be performed to try to test for the presence of racial bias due to missing data, after a review of the raw data, the Veil of Darkness analysis does not indicate a bias against minorities, however, too few minorities were stopped during these hours to draw any conclusions.

6. Post Stop Outcomes: Although Black drivers were arrested at a higher rate than White drivers, there were only 3 arrests out of 61 stops (4.9%). Whites were arrested without a warrant on a moving violation 16 times out of 2,145 stops (.75%).

7. Searches and Hit Rates:
   a. KPT Hit Rate: No search was conducted in 98.31% of the stops. No Asian or Native American drivers were searched. The four searches of Black drivers were successful 100% of the time meaning contraband was found in every search. Searches of the 20 White drivers were successful 90% of the time meaning contraband found in 18 cases. It appears from these numbers, even though small, that Bennington is not engaging in fruitless searches. As more jurisdictions are studied, hit rates will be compared across jurisdictions to get a sense of what an average hit rate is defined as how many searches result in a finding of contraband.

   b. Solar Powered Searches: Only those stops occurring between the inter-twilight period are considered. For Bennington, in the evening hours that period is 16:51 to 22:10. As table 13 illustrates, there were no searches of minority drivers during this time.

8. Stops for equipment violations showed a disparity: White males were stopped for equipment violations at a rate of 25.20%, while Black males were stopped for equipment violations at 28.84%. White females were stopped for equipment violations 26.85% of all the stops, while Black females were stopped for equipment violations 16% of the time. Only Whites were stopped for investigatory reasons.

9. A previous study by Seguino and Brooks on Driving Black and Brown in Vermont was conducted using 2005-2015 data. The data issues and incorrect methodology affect the analysis conducted for this study and make the study's conclusions questionable. Because of the numerous flaws in the Seguino and Brooks study, we do not consider their findings and conclusions of racial bias to be conclusive. A more detailed explanation is provided in the report.

Introduction

In 2014, the Vermont Legislature passed Act 193, which mandated that law enforcement agencies collect and publish certain information about every traffic stop including the race of the driver and the outcome of the stop. The law requires that information collected is published every year to allow the public and researchers to understand if there was racial disparity in the way officers were engaging with drivers. Unfortunately, Act 193 does not require publication of some variables that are crucial to the analysis of racial disparity. This has led to research being conducted and published that does not accurately assess the issue of racial disparity in traffic stops.

Accordingly, the Bennington Police Department consented to provide Crime Research Group, Inc. (CRG) with additional information to conduct the following analysis. These added variables included: time/date of the stop; year, make and model of the vehicle; residency information of the driver; and state of the vehicle registration.

Methods for Assessing Racial Disparity in Traffic Stops

There are three generally accepted ways to measure racial disparities: 1) Benchmarking stops to an Estimated Driving Population (EDP)[4]; 2) Veil of Darkness Analysis[5] (described below); and, 3) Disparities in post-stop outcomes to determine if minority drivers are treated differently than white drivers.[6]

For this project, CRG used all three methods to 1) test for their viability for use in Bennington and other Vermont communities and 2) to provide a more holistic approach to understand how the Department interacts with the motorists that are stopped. It is important to acknowledge that statistical tests check for disparities for which there may be many reasons including racial bias. The fact that there are disparities is not proof of racial bias.

Prior Research on Bennington Police Department Traffic and Race

Stephanie Seguino and Nancy Brooks released "Driving While Black and Brown in Vermont" in January, 2017[7]. This was an analysis of 26 police departments' traffic stop and race data, which included Bennington Police Department. Seguino and Brooks found that Bennington Police stopped black drivers almost 250% times the rate the authors determined to be the share of black drivers in their Estimated Driving Population (EDP). The authors also found that Black drivers were searched more than white drivers, although White drivers searched were more likely to have contraband found than Black drivers.

The study, however, was seriously flawed and its conclusions do not stand up to academic rigor. First, the data used included multiple ticket/warnings for events. This means that if a driver received a warning and a ticket at one stop, the study counted it as two separate stops. And if a search was conducted, two separate searches. Second, it is also not clear from the authors how they resolved data

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[4] http://ctrp3viz.s3.amazonaws.com/data/April2015ConnecticutRacialProfilingReport.pdf

[5] Grogger, Jeffrey and Greg Ridgeway, Testing for Racial Profiling in Traffic Stops From Behind a Veil of Darkness. American Statistical Association, 2006. https://www.rand.org/pubs/reprints/RP1253.html.

[6] http://ctrp3viz.s3.amazonaws.com/data/April2015ConnecticutRacialProfilingReport.pdf

[7] https://stephanieseguino.weebly.com/uploads/2/3/2/7/23270372/brooks_and_seguino__final_2.pdf

inconsistencies around searches and hit rates. One agency in that study tried to replicate their findings with their data and found that the authors included inconsistencies. For example, if an officer entered "No Search" but "Contraband Found" it was counted as a "hit" and if the officer entered "Search", but nothing or "no search conducted" in the Search Outcome field that was counted as a fruitless search. Third, the data provided by the Bennington Police Department for this study included stops by officers in towns other than Bennington. Royalton, Springfield, and Brattleboro all appeared in the data. Those stops are possibly moonlighting officers or agency assists. It is not clear from the study if out of town stops were removed. Finally, the data used in that study may have included checkpoint tickets, where the officers have much less discretion on whom they pull over.   These data issues affect the analysis conducted on Bennington Police Department and make the study's conclusions questionable.

The Seguino and Brooks study also uses inappropriate methodology for benchmarking. Bennington Police Department data was compared to the not-at-fault driver population in vehicle crashes in all of Bennington County. This is an incorrect application of the methodology. First, the race of the not-at-fault drivers was missing for 35% of the vehicle crashes in the county. In a prior study of the Vermont State Police, the same authors found a missing rate of 21% unacceptable for analysis of that agency.[8] The only explanation the authors give for using Bennington County is that the crash data had 20 more minorities represented for each group of minorities.[9] Second, although the study that pioneered this methodology was done on the county level - the county only had one police department.[10] Under Seguino and Brooks methodology, drivers visiting the Outlets in Manchester are included in the EDP for Bennington. Only Bennington accidents should have been used to benchmark Bennington Police Department stops. Finally, no effort was made by the researchers to map accidents to ticket locations to test the hypothesis this methodology is based on: that tickets are largely issued in high crash areas. This may be true, however without that step, the methodology is inaccurate when applied to Bennington.

Even if the authors had applied the methodology used for other jurisdictions in Vermont, the results would be questionable. For some other Vermont counties, the authors used the American Community Survey's population estimates. They used the county population to create the EDP for individual towns. The authors only cite themselves as authority for using this methodology. This methodology is also flawed, especially if it had been applied to Bennington. First, the population estimates the authors used included children and infants. Second, in the data provided for our study, we find that in 1,000 of the 3,235 stops, the drivers had residences out of state. An additional 246 drivers had residences in Vermont but outside of Bennington County. This means that one-third of the drivers stopped had no relationship to the demographics of Bennington County.

Because of the numerous flaws in the Seguino and Brooks study, we do not consider their assertion that Bennington stopped Black drivers at a 250% rate higher than white drivers, that they were searched more often than whites, or had a higher hit rate than whites to be a reliable conclusion. We provide a more methodologically appropriate analysis of Bennington's interactions in this report.

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[8] https://stephanieseguino.weebly.com/uploads/2/3/2/7/23270372/brooks_and_seguino_vsp_2010-15_final.pdf
[9] https://stephanieseguino.weebly.com/uploads/2/3/2/7/23270372/brooks_and_seguino__final_2.pdf
[10] Geoffrey P. Alpert, Michael R. Smith, and Roger G. Dunham, *Justice Research and Policy* Vol 6, Issue 1, pp. 43 - 69 First Published June 1, 2004

Analysis of 2016 Bennington Police Traffic Stops

CRG worked with the Bennington Police Department and the Department of Public Safety to extract the data needed for this analysis. The extraction from the Spillman Computer Aided Dispatch/Records Management System produced 3,766 records for the calendar year 2016. The data were then cleaned using the following procedures. First, duplicate entries were removed. Duplicates were identified as entries with the same date time stamp, same location, and same driver demographics. The most serious outcome for the driver was used.[11] The rationale behind this method is that it is unlikely that two drivers, with the exact same demographics were stopped at the exact same moment and the exact location. Second, stops that happened outside of Bennington Town, were excluded. Third, "Externally Generated"[12] stops where excluded, as they do not allow for officer discretion. Finally, we worked with the Bennington Police Department to identify the date, time, and location of checkpoints [13] and excluded those from analysis as there is little officer discretion in checkpoints. These procedures resulted in 3,233 stops during 2016 that could be analyzed.

Descriptive Statistics of Driver and Traffic Stop Characteristics

Of the 3,233 stops, 2,945 (91.09%) involved white drivers. Eighty-one drivers (2.50%) were Black, 45 (1.39%) were Latinx, 36 (1.11%) were Asian, 7 (.22%) were Native American and the race of the driver was unknown or missing in 118 (3.64%) stops.[14] Male drivers accounted for 1,781 (55.08%) of the stops, females accounted for 1,404 (43.42%) of the stops and the gender of the driver was missing or unknown in 48 (1.48%) stops.[15] The age of the driver was missing in all stops. Moving violations accounted for 2,362 stops (73.06%), 828 (25.61%) were for equipment violations, 41 (1.27%) for investigatory reasons and 2 (.06%) for suspicion of driving under the influence.

Table 1 on the next page illustrates the reason for the stop by race and gender of the driver.

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[11] We chose not to use incident number as an identifier of duplicate cases. Police departments across the state use incident numbers for traffic stops differently, and we wanted to create a method that could be used for all agencies.

[12] Externally Generated stops are those stops that are at the request of someone else. Either another agency or a civilian. These stops are excluded because the officer has no discretion.

[13] Checkpoints, such as for DUI or safety checks are governed by strict procedures and the officer has no discretion in who they stop.

[14] Percent does not add up to 100 due to rounding.

[15] Percent does not add up to 100 due to rounding.

Table 1: Reason for Stop by Race and Gender

Gender	Race of Operator	Reason for Stop				
		DUI	Equipment Violation	Investigatory	Moving Violation	Grand Total
Missing	Missing		5		5	10
	Asian				1	1
	Black		1		3	4
	Latinx				1	1
	White		3	1	27	31
Female	Missing		12	1	19	32
	Asian		2		11	13
	Black		4		21	25
	Latinx		2		7	9
	Native American				3	3
	Unkown		3		12	15
	White		351	16	940	1,307
Male	Missing		11	1	40	52
	Asian		5		17	22
	Black		15		37	52
	Latinx		7		28	35
	Native American				4	4
	Unkown		1		8	9
	White	2	405	22	1,178	1,607
Unkown	White		1			1
Grand Total		2	828	41	2,362	3,233

Only White drivers[16] were stopped for DUI[17] or investigatory reasons. Equipment violations accounted for 25.61% of all stops, and that percentage was consistent among the various gender and race combinations, however there are some differences. Stops for equipment violations for White males were 25.20% of all stops for White males, while equipment violations were 28.84% of all stops for Black males. White females were stopped for equipment violations 26.85% of all the stops for White females, while Black females were stopped for equipment violations 16% of the time. Bennington Police should keep an eye on these numbers going forward in any discussion about disparity. The numbers may reflect wealth distribution of drivers and ability to afford car repairs.

Methodologies for Measuring Disparities

Benchmarking History

Interest in using traffic stop data to measure racial disparities began in the mid 1990's. The earliest studies used census data to estimate driving populations in jurisdictions and then those estimates were used as a benchmark against which stops were measured. As the United States Court of Appeals for the 7th Circuit noted in *Chavez vs. Illinois State Police*: "Census data can tell us very little about the numbers of Hispanics and African-Americans driving on Illinois interstate highways, which is crucial to determining the population of motorists encountered by the [ISP] officers." [18]

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[16] One stop for investigatory reasons was marked Unknown race
[17] The number of stops made because of a suspicion of DUI may actually be higher than reported in the data. This is because if a driver is intoxicated, the driver is usually arrested, and a ticket is not issued.
[18] http://caselaw.findlaw.com/us-7th-circuit/1054143.html

The "Gold Standard" for benchmarking is a field observation study, where researchers observe the race of drivers in a jurisdiction over seasons and varying times of day. From those observations, an estimated driving population is constructed for the benchmark. These studies are often cost-prohibitive for small departments. They also need to be repeated over periods of time as demographics change.

In the early 2000's, Northeastern University's Institute on Race and Justice created an estimated driving population using a very sophisticated analysis of census data. First, they identified communities within a 30-minute driving time radius and assumed that those communities would contribute to the driving population of the community. Then, they accounted for vehicle ownership, commute times, retail, and entertainment destinations. Using these factors, they created an estimated driving population.

This methodology is a significant improvement over the use of census data. However, it too is often cost-prohibitive for agencies to undertake. Since Northeastern University's advancement, two other benchmarking techniques have been developed. One uses the not-at-fault driver in two car accidents to estimate the driving population. Because Vermont's crash data is missing race in over 1/3 of all crashes, we don't believe it is a reliable estimate currently, however, if reporting rates improve, we believe this approach holds promise.   The second innovation in determining the estimated driving population came from Connecticut's Institute for Regional and Municipal Policy Planning at Connecticut State University. The Commuting Hours analysis estimates the worker population in a jurisdiction and then looks only at stops made during commuting hours. Connecticut performs an additional analysis on stops in the jurisdiction of residents only. These are the methodologies we used to attempt to create a benchmark driving population for Bennington.

Commuting Population

Connecticut pioneered the use of a database known as the LEHD Origin-Destination Employer Statistics (LODES). LEHD is an acronym for "Local Employer Household Dynamics." This database is made up of unemployment insurance data supplied by the states. Every employee who pays into the unemployment system is captured, along with their work address and home address.   The database also contains the number of jobs by race and other demographics in a jurisdiction. These data come from a variety of sources including census data but it is also supplemented with social security records and federal tax returns.[19]

To construct the estimated commuting population of Bennington, we modified Connecticut's approach slightly. Like Connecticut, we started with the number of jobs reported by the LODES data. These are not an estimate of how many jobs, these are all jobs where the employee pays into the unemployment insurance system.   Connecticut then pulls the demographic data from the census for those 16 and older from the home towns that provided workers to a jurisdiction and begins to construct the population. Since Connecticut pioneered this, the number of jobs by race in a jurisdiction were added to the LODES data.

We then assume that Bennington residents of driving age are all equally likely to be driving during commuting hours not just to work, but for school, errands, and daily life. To avoid double counting

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[19] https://lehd.ces.census.gov/doc/QWI_101.pdf

Bennington residents, we attempted to back out Bennington residents from the workforce. We assumed that their demographics in the workforce are the same as the demographics of the community. It turns out this assumption is false. We show our work here only to show why this method of benchmarking fails for Bennington.

Because the LODES data uses census designated categories for race and treats Latinx as an ethnicity, this analysis is only applied to race and not ethnicity. Vermont police treat Latinx origin as a race category.

Workers in Bennington

Using the LODES data, Bennington employers employed 9,621 workers in 2015, the latest year of data available. Of those workers, 3,304 reside in Bennington. The remaining 6,317 workers live outside of Bennington. Table 2 shows the top 10 towns outside of Bennington that contribute to the workforce.

Table 2: Top Ten Towns Outside of Bennington That Contribute to the Workforce

Town, State	Number of Workers	Share of Work Force
Hoosick Falls Village, NY	367	3.8%
Cambridge Village, NY	132	1.4%
South Shaftsbury, VT	123	1.3%
Rutland City, VT	116	1.2%
Pittsfield City, MA	112	1.2%
Arlington, VT	87	0.9%
Burlington City, VT	55	0.6%
Manchester Center, VT	49	0.5%
New York City, NY	42	0.4%
Troy City, NY	39	0.4%

Bennington employers employ people who reside as far away as California[20] and as close as Shaftsbury. Because of the geographic diversity of workers, the perils of using Bennington town or even county census data as a benchmark alone for all stops becomes clear. Table 3 illustrates the number and percent of jobs by race.

Table 3: Number and Percent of Jobs by Race

Race	Number of Jobs	Percent
White Alone	9,325	96.5%
Black or African American Alone	135	1.4%
Native American or Alaskan Native Alone	23	0.2%
Asian Alone	70	0.7%
Native Hawaiian or Pacific Islander Alone	6	0.1%
Two or More Races	62	0.6%
Total	9,615	99.5%[21]

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[20] Bennington town has a hospital and college. Hospitals often employee traveling nurses or other medical staff who may consider another state home. Likewise, Bennington College attracts students from all over the country, and their residence on a paycheck would likely reflect their home and not their college address.
[21] Numbers do not add to 100% due to rounding.

Drivers in Bennington

The data used to construct the estimated driving population of Bennington residents comes from the American Community Survey 2011-2015 5-year Estimates for Bennington. We use only those residents who are eligible to receive a learners or drivers permit. Therefore, only those 15 and older are counted.

Table 4: Estimated Bennington Resident Driving Population

Race	Number	Percent
White Alone	12,475	94.55%
Black Alone	151	1.14%
Native American or Alaskan Native	22	0.17%
Asian Alone	122	.92%
Hawaiian or Pacific Islander	0	0
Some Other Race	70	.53%
Two or More Races	354	2.68%
Total	13,194	99.99%[22]

Construction of the Commuting Hour Population in Bennington

As stated above, we assumed that Bennington residents work in the workforce at the same racial proportion. There were 3,304 Bennington Residents working within Bennington. Accordingly, the assumed breakdown of workers is presented in Table 5.

Table 5: Assumed Breakdown of Bennington Residents Who Work in Bennington

Race	Number	Percent
White Alone	3,124	94.55%
Black Alone	38	1.14%
Native American or Alaskan Native	6	.17%
Asian Alone	30	.92%
Two or More/Some other Race[23]	106	3.21%
Totals	3,304	99.99%[24]

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[22] Numbers do not add to 100% due to rounding.

[23] We combine the categories of "Two or More" and "Some Other Race" for comparison into the LODES data.

[24] Numbers do not add up to 100% due to rounding.

Table 6 shows where the assumption that Bennington residents contribute to the workforce in equal proportions fails. The LODES data reports 62 jobs held by people who identify as Two or More Races, but calculations show that Bennington would supply 106 workers who identify as Two or More Races.

Table 6: Race by Worker Residence

Race	Total Number of Jobs	Jobs Held by Bennington Residents	Jobs Held by Non-Residents	Percent of jobs by race Held by Non-Residents
White Alone	9,325	3,124	6,201	98.16%
Black or African American Alone	135	38	97	1.54%
Native American or Alaskan Alone	23	6	17	.27%
Asian Alone	70	30	40	.63%
Native Hawaiian or Pacific Islander Alone	6	0	6	
Two or More Races	62	106	-44	-.69%
Total	9,621	3,304	6,317	99.91%[25]

Although this will not be a useful benchmarking tool for Bennington, we hope the discussion provides some insight on who is coming into the town for work, and where they come from. This should be kept in mind with any other benchmarking attempts to measure racial disparities in policing.

Resident Driver Analysis

Analyzing how members of their communities experience the police is useful information for police. If segments of the population are experiencing or even perceiving more negative contact with the police, some of the fundamentals of mutual trust begin to erode. This can lead to a more dangerous policing environment for everyone involved. The following analysis looks at stops of only Bennington residents.

Using the estimated driving population created for the Commuting Hours Analysis, we estimate that the resident driving population looks as follows:

Table 7: Estimated Bennington Resident Driving Population

Race	Number	Percent
White Alone	12,475	94.55%
Black Alone	151	1.14%
Native American or Alaskan Native	22	0.17%
Asian Alone	122	.92%
Hawaiian or Pacific Islander	0	0
Some Other Race	70	.53%
Two or More Races	354	2.68%
Total	13,194	99.99%[26]

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A few caveats about this estimate. First, it assumes that all residents 15 or older have a learner's permit or a license, which is likely untrue, but to what extent we do not know. Second, this estimate is based on the ACS 2011-2015 5-year survey, which does have high margins of error for the non-white population of Bennington.[27] Finally, one will notice that the largest portion of minority residents identify as Two or More Races, which is not a category that Vermont's traffic stop data recognizes. Accordingly, we analyze Bennington's resident drivers as: White, Not-White and Latinx.[28]   Using the table above, we estimate the Non-White Resident Driving Population at 5.44% of the population.

Bennington police pulled over 1,422 Bennington residents during 2016 (43.98% of all stops). Of these stops, 1,330 residents were White, 51 residents were Non-White, 12 residents were Latinx and race was missing for 29 residents.

Table 8 shows the proportions of Bennington residents stopped by race and reason for the stop:

Table 8: Bennington Residents Stopped

Race of Operator (group)	DUI	Equipment Violation	Investigatory	Moving Violation	Grand Total
Latinx		4		8	12
Missing		10	1	18	29
Non-White Not-Lati..		17		34	51
White	1	417	27	885	1,330
Grand Total	1	448	28	945	1,422

We estimate that Non-Whites make up 5.44% of the driving population, but account for only 3.59% of the stopped resident drivers. Whites are estimated to make up for 94.55% of the driving population and account for 93.53% of the stopped resident drivers. From this benchmark, it does not appear that Non-Whites are stopped at a disproportionate rate to their estimated driving population. However, the driving population estimate is just that, an estimate. Some of the assumptions made in creating it may not be true. This benchmark is illustrative, but not dispositive.

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[27] For example, the ACS estimates the total Black Alone population as 154 with a margin of error of +/- 57 meaning that the true population could be anywhere from 97 to 211. The ACS estimates that there are only 3 Black Alone children under the age of 15 in the town.
[28] There are ACS tables that further break down the Two or More races, however they are not broken out by age. Those tables include infants and children who are in the driving population. Connecticut's work around for the Two or More Race was to filter data based on Hispanic/Not Hispanic (although the Census Bureau considers Hispanic an ethnicity, Connecticut's conversations with the Census Bureau they learned that people answering the questions consider Hispanic a race) and then use the race by age tables to construct a better benchmark. We tried to replicate that methodology for Bennington, however it produced no data due to small population sizes.

Residents of a jurisdiction may feel targeted based on the reason for which they were stopped. Table 9 shows resident status by race (all categories) and reason for the stop.

Table 9: Resident and Non-Resident by Reason for Stop

Resident	Race of Operator	Reason for Stop				
		DUI	Equipment Violation	Investigatory	Moving Violation	Grand Total
Non-Resident	Missing		18	1	46	65
	Asian		4		17	21
	Black		8		45	53
	Latinx		5		28	33
	Native American				4	4
	Unkown		2		17	19
	White	1	343	12	1,260	1,616
Resident	Missing		10	1	18	29
	Asian		3		12	15
	Black		12		16	28
	Latinx		4		8	12
	Native American				3	3
	Unkown		2		3	5
	White	1	417	27	885	1,330
Grand Total		2	828	41	2,362	3,233

Table 9 shows that Bennington residents were less like to be pulled over for a Moving Violation than non-residents. Bennington residents accounted for only 40.02% (945) of the Moving Violation stops. Bennington residents were slightly more likely at 54.1% (448 stops) to be stopped for Equipment Violations. This may reflect differing socio-economic factors between residents and non-residents. It may also reflect the driving patterns of residents vs. non-residents. Residents may be more familiar with tricky roadways, lane changes, etc., that a non-resident might have trouble navigating legally. Residents may also be aware of locations where the police are likely to be and change their behavior accordingly. Bennington residents accounted for 68.29% (28) of the Investigatory Stops. This is not surprising since the police would more likely be investigating residents within their jurisdiction for a variety of crimes.

Resident driver benchmarking and analysis of stops gives some insight into how Bennington residents experience interactions with the police. The benchmarking illustrates no disparity based on racial categories. Again, this conclusion is illustrative and not dispositive. There is some disparity based on why residents are stopped versus non-residents. But these disparities may be explained as outlined in the paragraph above.

Veil of Darkness Analysis

The Veil of Darkness analysis was developed in 2002 by researchers in Oakland, California and it does not attempt to benchmark a driving population. The analysis is conducted on a subset of stops. The Veil of Darkness method looks at stops before and after the sun rises or sets on a given day during the inter-twilight of dawn and dusk. It assumes that the driving population at 5 p.m. in January is the same population driving at 5 p.m. in June. Therefore, if there is racial bias by a police department, whether explicit or implicit, one would expect more minorities to be stopped during daylight hours (in June), when officers can see into the vehicle than in the dark during January when officers may not be able to perceive the race of the driver.

This analysis has been used in several jurisdictions and is one of the only methods that begins to test for the presence of racial bias as opposed to benchmarking, which tests for disparities. The testing for racial bias is done through regression modeling. Regression models control for variables that may affect the stop, such as gender, vehicle make and model, and incremental times of day. Unfortunately, we cannot perform a solid regression model because the age of the driver is missing in all cases. Age has been shown to be a contributing factor in traffic stops.[29]

Even without the regression analysis, the raw counts can be indicative of the presence of racial bias or not. Table 10 shows the race of drivers stopped in the evening hours. The earliest civil twilight was at 16:51 in Bennington and the latest was 21:10.[30] Only stops that occurred during those times, throughout the year, are presented.

Table 10: Dusk Veil of Darkness

| | Race of Operator | | | | | | | |
	Missing	Asian	Black	Latinx	Native American	Unkown	White	Grand Total
Light	10	5	11	9	2	6	431	474
Dark	23	3	11	4	3	3	338	385
Grand Total	33	8	22	13	5	9	769	859

As shown in Table 10, Whites, Latinx, and Asian drivers were more likely to be stopped during the daylight hours. And equal number of blacks were stopped during light and dark hours, and Native Americans were slightly more likely to be stopped during darkness. Differences in stop rates may be caused by seasonal variations in commuter, retail, and tourist traffic.

A narrower view of the nighttime stops is presented in Tables 11 and 12. These tables look at the 30 days before and after the switch to and from Daylight Savings Time.

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[29] Rob Tillyer and Robin S. Engel, "The Impact of Drivers' Race, Gender, and Age During Traffic Stops: Assessing Interaction Terms and the Social Conditioning Model," *Crime & Delinquency*, Vol 59, Issue 3, pp. 369 – 395.
[30] Civil Dawn, Dusk, Sunrise and Sunset times were downloaded from the Sun Calendar app for Iphone for Bennington town.

Table 11: Fall Switch to Standard Time

	Missing	Asian	Black	Unkown	White
			Race of Operator		
Light	2	1	2		28
Dark	13	1	6	2	128

Daylight Savings Time ended on November 6, 2016. Table 11 looks at stops from September 6, 2016 to December 6, 2016 between the hours of 16:51 and 21:10. In this table, no Latinx or Native Americans were stopped during these dates and times. Further, now Whites and Black are more likely to be stopped during the dark hours, and Asian drivers were equally spit. This indicates that there are seasonal driving differences that may account for the disparity shown in Table 9. Table 12 is based on the start of Daylight Savings Time.

Table 12: Spring Switch to Daylight Savings Time

	Missing	Asian	Black	Latinx	Native American	Unkown	White	Grand Total
Light	3		3	4	1	1	101	113
Dark	2	1	2	4	2		73	84
Grand Total	5	1	5	8	3	1	174	197

Daylight Savings Time began on March 13, 2016. Table 12 looks at stops from February 13, 2016 to April 13, 2016 between the hours of 16:51 and 21:10. Whites, in this time frame, are stopped at a higher rate during the daylight hours. However, unlike in Table 10 (full year) there is no disparity with Latinx drivers. One more Black driver was stopped during daylight than night.   This again points to seasonal differences in driving patterns in Bennington.

The analysis is repeated and shown in Table 13 with the morning hours. The earliest civil dawn was at 04:38 and the latest was at 06:51.

Table 13: Dawn Veil of Darkness

	Missing	Asian	Black	Latinx	Native American	Unkown	White	Grand Total
Light		2	2	1	1	2	146	154
Dark	2		1	1			81	85
Grand Total	2	2	3	2	1	2	227	239

Too few minorities were stopped during these hours to draw any conclusions. However, once again White drivers were stopped more during the light hours than dark hours. Because too few minorities were stopped, we do not repeat the DST analysis for the morning hours.

Although no regression analysis could be performed to try to test for the presence of bias, the Veil of Darkness analysis does not indicate a bias against minorities. Differences in White drivers stopped may be caused by seasonal differences in travel as illustrated by the DST analysis in Tables 11 and 12.

Post Stop Outcomes

Post Stop Outcomes are an indication of the difference in treatment between minorities who are stopped versus non-minorities who are stopped by the police after the stop. Post Stop Outcomes include issuing tickets and/or warnings, arrests, and searches. These measures do not rely on benchmarking to driving populations. The race of the driver is perceived after the stop when the decision to issue a ticket or the decision to search is made. A weakness in looking at Post Stop Outcomes is that this analysis does not account for the full range of variables that an officer uses when exercising discretion. Several analyses are presented here for descriptive purposes.

Arrests, Tickets and Warnings

The most common outcome from a traffic stop in Bennington was a warning at 95.48% of the stops. Table 14 illustrates the stop outcome by race of the operator and type of violation.

Table 14: Outcome of Stops by Race and Violation Type

Race of Operator	Reason for Stop	Outcome of Stop				
		Arrest	Arrest on Warrant	Ticket	Warning	Grand Total
Missing	Equipment Violation				28	28
	Investigatory				2	2
	Moving Violation			4	60	64
Asian	Equipment Violation				7	7
	Moving Violation	1			28	29
Black	Equipment Violation				20	20
	Moving Violation	3		3	55	61
Latinx	Equipment Violation		1		8	9
	Moving Violation	1		4	31	36
Native American	Moving Violation			1	6	7
Unkown	Equipment Violation				4	4
	Moving Violation			1	19	20
White	DUI				2	2
	Equipment Violation	6		11	743	760
	Investigatory	1		4	34	39
	Moving Violation	16	1	88	2,040	2,145
Grand Total		28	2	116	3,087	3,233

Overall, warnings were issued in 95.48% of the stops, tickets in 3.5% of the stops, arrests without a warrant in .86% of the stops and .06% of the stops resulted in an arrest based on a warrant. Blacks received warnings in 92.59% of the stops, Whites in 95.69% of the stops, Blacks received tickets in 3.70% of the stops, Whites in 3.49% of the stops, and Blacks were arrested in 3.70% of the stops, Whites in .78% of the stops.

White drivers were the only ones to receive a ticket or be arrested for an Equipment Violation. Because no Blacks were arrested for Equipment Violations the next comparison for arrests uses only Moving Violations. Although Black drivers were arrested at a higher rate than White drivers, there were only 3 arrests out of 61 stops (4.91%). Whites were arrested, without a warrant on a moving violation 16 times out of 2,145 stops (.75%). One Latinx driver was arrested without a warrant. Other departments have found that the arrests without a warrant have generally been for Driving on a Suspended License. We do not have that information here, but it may explain the disparity. One Asian driver was arrested, and no Asian drivers received a ticket.

Search and Hit Rates

Researchers have tried to use search and hit rates to measure bias. There are two main methods of doing so, both with their flaws. The first is called the KPT Hit rate. Developed in a series of papers by Knowles, Pearson, and Todd[31], this test looks at the success rates of searches of White drivers and compares them to success rates of non-White drivers. The second method is to apply the Veil of Darkness analysis to post-stop behavior. Both methods are presented here for descriptive analysis only.

KPT Hit Rate Analysis

This model is based on the economic Game Theory. Game theory posits that we all act to maximize our desired outcomes. In the case of police officers, they would act to successfully discover contraband. In the case of criminals, they would act to minimize the risk of being detected. The KPT hit rate argues that if an officer wants to find illicit drugs, and the officer is intentionally biased against Blacks, then he will search Black drivers more, but find more contraband on White drivers. Eventually, the theory argues, there will be equilibrium because Black drivers will begin to carry less contraband and the officer - still wanting to maximize the outcome, will search White drivers more.

The theory is not without its critics. First, it assumes rationality on everyone's part. Given the amount of crime driven by mental illness and addiction, rationality of the defendants may not be the best assumption. Second, it assumes that the types of crimes for which people will be searched and contraband will be found is equal among all crime categories and that all races participate in all crimes equally. It is important to understand the assumptions in the model and know that the data does not allow us to test for these assumptions.

There are problems with applying this theory to Bennington's data. The factors that led to probable cause are not in the data. For example, if an officer can see contraband in plain view, the subsequent successful search has little to do with race. The data in Table 15 are presented as descriptive only.

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[31] Knowles, John and Nicola Persico and Petra Todd. "Racial Bias in Motor Vehicle Searches: Theory and Evidence". Journal of Political Economy. 2001.

Table 15: KPT Hit Rate

Race of Operator	Search Outcome	No Search	Search Reasonable Sus..	Search Warrant	Search- Probable Cause	Grand Total
Missing	No Search Conduct..	94				94
Asian	Null	1				1
	No Search Conduct..	34				34
Black	Contraband Found		1		3	4
	No Search Conduct..	75				75
Latinx	Null	1				1
	Contraband Found				1	1
	No Search Conduct..	43				43
Native American	No Search Conduct..	7				7
Unkown	No Search Conduct..	24				24
White	Null	19				19
	Contraband Found		2	1	15	18
	No Contraband Fou..		1		1	2
	No Search Conduct..	2,902				2,902
Grand Total		3,200	4	1	20	3,225

Eight searches were eliminated due to inconsistencies in the Search Reason and Search Outcome fields. In some cases, an officer indicated a search in the type of search field, but No Search Conducted in the Search Outcome Field. In other cases, the Search Outcome field indicated a search was conducted, but the Search field indicated No Search.

If we were to just rely on the percentages of drivers searched, we would see that Whites were searched .68% of the time (20 searches of 2,941 stops). Black drivers were searched 5.06% of the time (4 searches of 79 stops). However, for the proportions to be equal, essentially no Black drivers could be searched, or an additional 134 White drivers would need to be searched.

No search was conducted in 98.31% of the stops. No Asian or Native American drivers were searched. Searches of Black drivers found contraband in all four searches for a 100% "hit rate." Searches of White drivers found contraband in 18 out of 20 searches for a 90% "hit rate." It appears from these small numbers, that Bennington is not engaging in fruitless searches. As more jurisdictions are studied, we will be comparing hit rates across jurisdictions to get a sense an average hit rate.

Solar Powered Searches

In 2013, Ritter[32] argued that applying the Veil of Darkness Analysis to searches would eliminate some of the problems with the assumptions in the KPT Hit Rate Analysis. He calls his theory Solar Powered Searches. The theory argues that if there are less searches of minority drivers in darkness, shown by using regression analysis, then officers may be pulling over minority drivers when race is visible with the intention of searching them. The analysis is conducted the same as the Veil of Darkness analysis for stops. Only those stops occurring between the inter-twilight period are considered. For Bennington, in the evening hours that period is 16:51 to 22:10. As Table 16 illustrates, there were no searches of minority drivers during this time.

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[32] Ritter, Joseph A. "Racial Bias in Traffic Stops: Tests of a Unified Model of Stops and Searches". University of Minnesota: Minnesota Population Center Working Paper 2013-05. June, 2013.

Table 16: Solar Powered Search

dark	Race of Operator	No Search	Search Reasonable Suspicion	Search Warrant	Search-Probable Cause	Grand Total
Light	Missing	10				10
	Asian	5				5
	Black	11				11
	Latinx	9				9
	Native American	2				2
	Unkown	6				6
	White	429	1			430
Dark	Missing	23				23
	Asian	3				3
	Black	11				11
	Latinx	4				4
	Native American	3				3
	Unkown	3				3
	White	331		1	3	335
Grand Total		850	1	1	3	855

Findings:

1. In general, the numbers of stopped minority drivers is very small. This makes analysis using some methodologies difficult if not impossible. In situations where numbers were small and the raw data could be used to show disparities we provided the raw data as well as an explanation of what the data show.

2. The commuting hour analysis pioneered by Connecticut fails when applied to Bennington. Resident driver analysis is useful for understanding how residents of a town may be treated differently than non-residents. It should be included in future analysis of the town.

3. The veil of darkness analysis is the easiest to perform consistently over time, and we recommend that this be the primary analysis going forward. For the year 2016, this analysis did not find evidence of disparities.

4. Resident Driver Analysis: using only those who are of age to have a permit or a license (age 15 and up), we estimate that Non-Whites make up 5.44% of the driving population, but account for only 3.59% of the stopped resident drivers. Whites are estimated to make up for 94.55% of the driving population and account for 93.53% of the stopped resident drivers. From this benchmark, it does not appear that Non-Whites are stopped at a disproportionate rate to their estimated driving population. However, the driving population estimate is just that, an estimate. Some of the assumptions made in creating it may not be true. This benchmark is illustrative, but not dispositive.

5. Veil of Darkness Analysis: Although no regression analysis could be performed to try to test for the presence of racial bias due to missing data, after a review of the raw data, the Veil of Darkness analysis does not indicate a bias against minorities, however, too few minorities were stopped during these hours to draw any conclusions.

6. Post Stop Outcomes: Although Black drivers were arrested at a higher rate than White drivers, there were only 3 arrests out of 61 stops (4.9%). Whites were arrested without a warrant on a moving violation 16 times out of 2,145 stops (.75%).

7. Searches and Hit Rates:
   c. KPT Hit Rate: No search was conducted in 98.31% of the stops. No Asian or Native American drivers were searched. The four searches of Black drivers were successful 100% of the time meaning contraband was found in every search. Searches of the 20 White drivers were successful 90% of the time meaning contraband found in 18 cases. It appears from these numbers, even though small, that Bennington is not engaging in fruitless searches. As more jurisdictions are studied, hit rates will be compared across jurisdictions to get a sense of what an average hit rate is defined as how many searches result in a finding of contraband.

   d. Solar Powered Searches: Only those stops occurring between the inter-twilight period are considered. For Bennington, in the evening hours that period is 16:51 to 22:10. As table 13 illustrates, there were no searches of minority drivers during this time.

8. Stops for equipment violations showed a disparity: White males were stopped for equipment violations at a rate of 25.20%, while Black males were stopped for equipment violations at 28.84%. White females were stopped for equipment violations 26.85% of all the stops, while Black females were stopped for equipment violations 16% of the time. Only Whites were stopped for investigatory reasons.

9. A previous study by Seguino and Brooks on Driving Black and Brown in Vermont was conducted using 2005-2015 data. The data issues and incorrect methodology affect the analysis conducted for this study and make the study's conclusions questionable. Because of the numerous flaws in the study, we do not consider their findings and conclusions of racial bias to be conclusive.

Conclusion

The purpose of this study was to test differing methods of assessing racial disparity in traffic stops for their applicability in Bennington. As shown above, the commuting hour analysis pioneered by Connecticut fails when applied to Bennington. Resident driver analysis is useful for understanding how residents of a town may be treated differently than non-residents. It should be included in future analysis of the town. The veil of darkness analysis is the easiest to perform consistently over time, and we recommend that this be the primary analysis going forward. For the year 2016, this analysis did not find evidence of disparities.