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TACKLING DISPARITY IN THE CRIMINAL JUSTICE SYSTEM

Testing for disparities in traffic stops: Best practices from the Connecticut model

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Abstract

Connecticut's novel approach to collecting and analyzing traffic stop data for evidence of disparate treatment is widely considered to be a model of best practice. Here, we provide an overview of Connecticut's framework, detail solutions to the canonical empirical challenges of analyzing traffic stop, and describe a data-driven approach to early intervention. Unlike most jurisdictions that simply produce an annual traffic stop report, Connecticut has developed an ongoing system for identifying and mitigating disparity. Connecticut's framework for identifying significant disparities on an annual basis relies on the so-called "preponderance of evidence" approach. Drawing from the cutting-edge of the empirical social science literature, this approach applies several, as opposed to a single, rigorous empirical test of disparity. For departments identified as having a disparity, Connecticut has developed a process for intervening on an annual basis. In that process, policing administrators engage with researchers to conduct an empirical exploration into possible contributing factors and enforcement policies. In Connecticut, this approach has transformed what had once been a war of anecdotes into a constructive data-driven conversation about policy. Variants of the *Connecticut Model* have recently been adopted by the State of Rhode Island, Oregon, and

California. Connecticut's approach provides a useful model and policy framework for states and localities conducting disparity studies of police traffic stops.

KEYWORDS
disparity, racial profiling, traffic stops

1 | INTRODUCTION

Disparities in the criminal justice system, particularly police enforcement, have become a major source of political protest and social unrest in the United States.[1] Motor vehicle enforcement is a frequent focus of the national conversation due to the fact that it is the public's most frequent interaction with law enforcement. Further, many high-profile incidents related to police use-of-force have been precipitated by a motor vehicle traffic stop. The debate surrounding these issues has motivated many states and local jurisdictions to begin collecting and analyzing data on motorist race in police traffic stops.[2] Such data-driven efforts hold the promise of providing a platform for policing administrators to identify and intervene on problematic enforcement activities or individual officers. Although such systems allow for the possibility of a transparent dialogue between the policing and advocacy community, they also have the potential to further fracture and entrench stakeholders. The State of Connecticut's approach to analyzing police traffic stops and their framework for using that data as an early intervention mechanism has overcome this important challenge. Connecticut's approach has recently become a national model of best practice with important lessons for policing administrators and policymakers.

Beginning in 2011, Connecticut began developing a model for collecting and analyzing police traffic stops for evidence of disparity. The challenge for Connecticut, as with many other states, was to develop an analytical system in a fiscally challenging environment that could be replicated annually. Unique to Connecticut's first study (released in 2014) was the application of multiple statistical models for evaluating disparities, rather than a "one size fits all" approach. Such an approach is very similar to so-called *scorecards* that are seen in numerous other policy contexts and recently in other aspects of the criminal justice system (see Measures for Justice, 2017). Relative to other state and local jurisdictions where the conversation often struggled to move beyond the empirical methodology used to identify disparities, Connecticut successfully leveraged the litany of tests to move beyond evaluation and onto intervention. Rather than treating the statistical analysis as evidence of wrongdoing, researchers and policymakers utilized the annual report as an early warning system that begins, rather than the ends, an ongoing and data-driven conversation. In particular, departments identified in the annual report partner with researchers for a comprehensive follow-up intervention, which involves a deeper dive into their data in an effort to identify specific policies and enforcement activities driving the disparities. In Connecticut, the goal is not to simply identify racial disparities in traffic stop data but to collaborate with police and the advocacy community to develop practical solutions.

On an annual basis, the *Connecticut model* consists of researchers carrying out four distinct phases that include:

Phase 1: Continuous data collection throughout the year.

Phase 2: Empirical analysis using multiple techniques to identify the high-disparity policing agencies.
Phase 3: In-depth analyses for identified high-disparity agencies, including an officer-level analysis.
Phase 4: Community forums and conversations between researchers and stakeholders (i.e., policing administrators, advocacy organizations, policymakers, and local residents) to identify and initiate interventions that mitigate the disparity.

From the perspective of policing administrators and policymakers across the country, the *Connecticut model* provides a framework with significant value-added over alternative and more disaggregated approaches. With respect to the Phase 1 data collection, the approach provides a streamlined model for agencies submitting uniform data even when facing the challenge of varying technical systems and data vendors. Relative to the traditional approach of applying a single empirical method, Connecticut's use of multiple statistical methods in Phase 2 provides a more rigorous framework for identifying high-disparity jurisdictions and allows for those disparities to be evaluated across various dimensions of a traffic stop, e.g. disparities in terms of the decision to stop, choice of disposition, or the decision to search. However, the most important and unique aspect of the *Connecticut model* occurs through the iterative process involved in Phases 3 and 4. In Phase 3, an in-depth analysis is conducted that provides a framework for understanding and identifying the specific policies, unique circumstances, and/or individual officers driving the observed disparities in the agency. In Phase 4, the results from this in-depth analysis are used as the basis for a data-driven conversation about enacting interventions to mitigate observed disparities. Connecticut's framework for identifying high-disparity police departments and engaging a broad coalition of stakeholders in a dispassionate data-driven conversation of affect change represents a model of best practice for other states.

In this essay, we provide an overview of the *Connecticut model* and highlight best-practice solutions to challenges that other states and localities may face in evaluating these data and tackling disparity. The *Connecticut model* provides a streamlined framework for identifying disparities and, more importantly, a data-driven conversation between stakeholders about enacting interventions for mitigating disparity. All or part of the *Connecticut model* has recently been adopted by the States of Rhode Island, Oregon, and California.[3] With federal funding continuing to be available through the Fast Act for the purpose of developing traffic stop data systems and publishing analytical reports, the *Connecticut model* provides a proven framework for developing a streamlined state-level system to mitigate disparities in policing.

2 | OVERVIEW OF THE CONNECTICUT MODEL

This section provides a brief history of Connecticut's racial profiling law and the evolution of the model within the state. Connecticut first enacted an anti-racial profiling law in 1999. However, a well-publicized 2011 case of police profiling in East Haven, CT renewed public and legislative attention to the efficacy of the state's existing racial profiling law (see the "Alvin W. Penn Racial Profiling Prohibition Act" (Public Act 99–198). Legislators responded with proposals to put "teeth" into a law largely ignored since a few years after its initial passage in 1999. In particular, the Office of Policy and Management was afforded the ability to withhold funding from departments that were not in compliance with the new law in terms of data collection or enforcement practice. Although the prior law required police to collect and transmit

all their traffic stop data to a centralized repository, only about 25% of departments were actually complying with the law in 2011. Arguably this was to no fault of law enforcement since the technical and analytical capacity did not provide for a very useful or efficient application of the law. Further, Connecticut was able to take advantage of federal funding made available for the purposes of creating a data system to track racial profiling in traffic stops.[4] In 2012, the Connecticut legislature made significant changes to the state law that created a system for evaluating and addressing concerns about racial profiling. An important part of those changes was the establishment of 20-member advisory board to help with the development, implementation, and oversight of the new law. Advisory board members consist of advocates, law enforcement administrators, academics, policymakers, and community members. The board worked with the Institute for Municipal and Regional Policy at Central Connecticut State University to create an efficient data collection system, centralized traffic stop repository, and a rigorous analytical process.

Pertaining to the first phase of the process involving data collection, the board's first task was to design an electronic system that was not overly burdensome to police and to develop a framework to provide information to the general public on an annual basis.[5] Using the state's existing Criminal Justice Information System, Connecticut was able to develop a process to collect universal traffic stop data that could be submitted electronically on a monthly basis. Within 18 months, a new approach to gather 26 data points from Connecticut's roughly 600,000 annual traffic stops was fully operationalized. In particular, the Office of Policy and Management was afforded the ability to withhold funding from departments who were not in compliance with the new law. The total cost to develop and implement the system was approximately $250,000, which was largely paid through federal grant money as well as funds provided by state government. To date, every department in Connecticut in compliance with the law and the data system contains approximately 91 million data points from 3.5 million traffic stops. Over the past 8 years, Connecticut has developed and refined methodologies for analyzing traffic stop records that utilize best practices from the academic literature and adhere to statutory requirements. To date, Connecticut has published five annual public reports and has conducted follow-up interventions with 28 identified police departments.

The impetus for using multiple statistical tests to identify discrimination in the second phase was an insight made by members of the advisory board that most other jurisdictions typically choose a single analytical method for evaluating disparities. The board observed that this choice often divided stakeholders when one group did not agree with the results or assumptions of that particular test, that is, racial disparities exist or not. Such an approach to analyzing traffic stop records only served to further fracture the distrust between law enforcement and communities of color. In contrast, Connecticut developed a series of statistical and descriptive tests that vary in their level of scrutiny to serve as a screening tool by which stakeholders could focus resources on those departments displaying the greatest level of disparity. Colloquially, researchers refer to this as the "preponderance of the evidence" approach since disparities are identified across a number of different dimensions including the decision to stop a motorist, the disposition of the stop, and the decision to search a motorist/vehicle. Although racial and ethnic disparities in any traffic stop analysis do not alone provide conclusive evidence of racial profiling, statistical disparities across a number of different statistical tests provide sufficiently convincing evidence to warrant further analysis and conversation. Thus, the annual analysis was developed in Connecticut as an early warning system that could better target additional resources toward understanding specific policies or enforcement activity driving disparities across the state.[6]

Rather than simply producing an annual report as has become common practice in many other states, the identified high-disparity departments (in Phase 2) are asked to partner with researchers

for an in-depth analysis of their data and traffic enforcement policies. The third phase includes a quantitative and qualitative analysis at the department and individual officer level. These interventions are designed to be a collaborative effort between research staff, the police department, and the community. The analysis is tailored based on the quality of additional data the department can share, and department and community characteristics. In Connecticut, factors such as location of accidents, high call for service volume areas, DUI enforcement, high crime rate areas, and areas with retail and entertainment have all found to be factors driving disparities in specific departments. The final piece of the in-depth analysis moves beyond examining disparities at the department level and examines individual officer information. The officer analysis utilizes an approach by Ridgeway and MacDonald (2009) to better understand if disparities in data are driven by individual officers or groups of officers. The officer-level results are only shared with policing administrators who are requested to review the findings in conjunction with additional officer information not available to researchers. By conducting an in-depth analysis on those departments that meet a set of pre-established criteria, the public can have a better understanding as to why and how disparities exist. This transparency is intended to assist in achieving the goal of increasing trust between the public and law enforcement.

In the fourth and final phase of the *Connecticut model*, stakeholders and community members are invited into the process and encouraged to engage in a dialogue with policing administrators. In cases when there has been a particular stakeholder or advocacy group with concerns about an identified department, they have been invited to participate in the process at an earlier stage, that is, during the in-depth analysis conducted in Phase 3.[7] Following the conclusion of the in-depth analysis, researchers and the advisory board will host a community forum in the identified communities. The forums include a presentation of the research team's findings from Phase 3 as well as a discussion with policing administrators and a period for public comment/question period. Upon request, the research team has also made presentations to city or town councils. By the time the research team hosts these community forums, they have already identified the factors believed to be contributing to the disparity, that is, specific enforcement patterns or (infrequently) subsets of officers. During the forum, the research team outlines an independent set of recommendations for reforms that can be made and allows the public and stakeholders to weigh-in on the relevant issues. Ultimately, the decision to enact the recommended reforms is left to the community and policing administrators. However, the value added of this approach is that it allows for a transparent data-driven dialogue between stakeholders and policing administrators about how specific enforcement policies contribute to observed patterns of disparity.

3 | THE PREPONDERANCE OF THE EVIDENCE APPROACH

In order to provide additional details on the particular techniques used in the analytical phases of the *Connecticut model* (Phases 2 and 3), we detail best practices for identifying disparities in police traffic stops. As noted in the introduction and the prior section, the advantage of Connecticut's so-called "preponderance of evidence" approach to identifying high-disparity jurisdictions and officers is that it (1) identifies departments across a number of different dimension including the decision to stop a motorist, the disposition of that stop, and the decision to search a vehicle/motorists; and (2) identifies disparities using a variety of statistical techniques that vary in their identifying assumptions and provide a compelling portrait of the available empirical evidence. In detailing the specific analytical techniques from Phases 2 and 3, we provide policymakers and policing administrative with a brief guide to understanding the advantages and disadvantages

of the latest empirical tools from the scholarly literature on testing for disparity in police traffic stops. The underlying theme of this section is that no single methodology is able to fully capture all dimensions of disparity. Connecticut's approach of providing the public with a litany of empirical evidence has helped to build stakeholder confidence in the findings and subsequent phases of the process.

The classic challenge faced by Connecticut (and all researchers) when analyzing traffic stop data for evidence of disparity is the lack of a compelling counterfactual, that is, data on the population on the roadway who are at risk of being stopped. In this context, the counterfactual represents what the demographic composition of traffic stops would look like in the absence of police discrimination. Historically, evaluations of disparities in policing data have frequently relied on benchmarking approaches, primarily derived from Census data, to proxy for the counterfactual. Specifically, researchers compare the demographic composition to traffic stops to that of the local population sometimes with adjustments made to account for things like traffic flows between jurisdictions. Although Census benchmarks are intuitively appealing, they implicitly necessitate onerous and untestable assumptions about driving behavior.[8] On the other hand, more rigorous approaches are often difficult for the public to interpret and only able to identify disparities under a very specific set of conditions or within a subsample of traffic stops. Thus, Connecticut's approach has been to treat the analysis as an early warning system and apply a multitude of rigorous statistical tests. This has allowed researchers to identify disparities across several dimensions and present the findings to public using a simplified scorecard-style approach.

As part of Phase 2, Connecticut does include a set of simple comparisons between traffic stops within a given jurisdiction and Census data, which has been adjusted by resident commuter flows. Although less rigorous than other approaches used in Phase 2, these results give the general public a general sense of aggregate patterns of exposure to police within a given community. Although not used by Connecticut, observational approaches have also been proposed to construct a more convincing benchmark for traffic stop data (see Lamberth, 1994; Lange, Blackman, & Johnson, 2001; McConnell & Scheidegger, 2004; Montgomery County, 2002). The difficulty of survey-based approaches is that they are not uniformly representative and can be extremely cost prohibitive for larger geographies like Connecticut (Fridell et al. 2001, p. 22; Grogger & Ridgeway, 2006, p. 879; Kowalski & Lundman, 2007, p. 168). In states where race is collected in traffic accident reports, a federal requirement only for fatalities and something not collected in Connecticut, not-at-fault accidents also provide a useful and cost-effective benchmark (Alpert et al. 2003).[9] Survey and no-at-fault accident benchmarks represent promising additions to Connecticut's Phase 2 approach in locations where these data are already collected (accidents) or there is sufficient funding available (large-scale surveys).

In terms of testing for disparity in the decision to stop a motorist, Connecticut's Phase 2 analysis relies on several cost-effective and well-respected methods from the scholarly literature. With applications in over 18 major cities and four states, Grogger and Ridgeway's (2006) solar visibility analysis, known as the "Veil of Darkness," is widely considered to be best practice.[10] Identification of disparity in this test is predicated on an officer's ability to better perceive the race of a motorist prior to a traffic stop in daylight relative to darkness. Thus, a disparity would exist if the odds of stopping a minority motorist increase relative to the odds of stopping a *White* motorist in daylight versus darkness. To ensure that variation in the odds ratio is attributable specifically to officer visibility, the test is only able to identify disparities within a narrow window of the day when the timing of sunset, and thus visibility, varies throughout the year. Because of this, external validity is harder to establish. Criticism about possible bias in this test has mainly found that it tends to suffer from type two error and is likely conservative in terms of identifying

disparities, for example, see Horace and Rohlin (2016) or Kalinowski, Ross, and Ross (2019a, 2019b, 2019c). However, this approach remains a cost-effective and statistically rigorous method that should not be overlooked by states and localities building systems for identifying traffic stop disparities.

In Phase 2 and as part of the officer analysis in Phase 3, Connecticut also relies on several alternative approaches for testing for disparities in the decision to stop a motorist. These methods build on the intuition of traditional benchmarking approaches but are based around the use of more sophisticated synthetic control methods, that is, propensity scores. These methods examine disparities by building a control group for entire police departments in Phase 2 (Robbins, Saunders, & Kilmer, 2017; Ross, Fazzalaro, Barone, & Kalinowski, 2017a, 2017b, 2018, 2019a, 2019b) or individual officers in Phase 3 (Ridgeway & MacDonald, 2009). The control groups consist of similar types of stops made by like departments or peer officers. In particular, control stops are drawn from peers (department or officers) but weighted by inverse propensity scores such that they resemble the focal department or officer in terms of observable characteristics, for example, enforcement activity, time of day, and location. The resulting synthetic control allow for inferential comparisons in the form of means testing, doubly robust regression, or confidence intervals.

In terms of testing for disparity in decisions that follow an initial encounter, Connecticut's Phase 2 also applies a hit-rate test that is drawn from a rich literature on vehicle searches. The hit-rate test is motivated by a theoretical model of police-motorist interaction that suggests that, in an equilibrium where there is no discrimination, the rate at which police searches yield contraband should be equal across demographic groups (see Knowles et al. 2001). Subsequent studies have pointed out that the hit-rate test suffers from the same problem of unobserved variable bias present in first-stage tests of vehicular search rates (see Antonovich & Knight, 2009; Anwar & Fang, 2006; Dharmapala, Ross, Dharmapala, & Ross, 2004). However, these concerns are mitigated by presenting hit rates alongside search rates since, even in the presence of unobserved factors considered by police officers, disparate treatment should move these statistics in the opposite direction (see the more formal discussion in Anwar & Fang, 2006). If those unobserved factors correlate with race, the bias caused by those factors will often work in opposite directions for the two tests. For example, if the assessment of search rates is biased toward finding discrimination, it is likely that those same unobservable bias hit rate tests away from finding discrimination. Therefore, the strongest evidence on discrimination in police search arises when the evidence from direct assessment of searches and from assessment of hit or success rates are consistent.

In terms of testing for disparities in other post-stop outcomes such as disposition, Connecticut tests for differences in the likelihood of different stop outcomes across race/ethnicity using multinomial logistic regression and conditioning on the motivating factors of the traffic stop (see Ross, Fazzalaro, Barone, & Kalinowski, 2019a, 2019b). Rather than assigning a particular direction to the disparity, that is, that minority motorists should be more or less likely to be given a ticket versus warning in the presence of discrimination, this approach simply examines differences in the distribution of stop outcomes conditional on observable factors associated with a stop. Although not currently included in Connecticut's Phase 2, there are currently several promising approaches which also examine different aspects of stop dispositions. For instance, one line of inquiry examines the speed distribution of stopped minority motorists for evidence of bunching (Anbarci & Lee, 2014; Mello & Goncalves, 2018) or changes in driving behavior across daylight and darkness (Kalinowski et al., 2019a). However, identifying disparities in poststop dispositions (i.e., warning vs. tickets) remains a particularly fruitful area for future scholarship.

For the high-disparity departments identified in Phase 2, the research team applies a more holistic approach in Phase 3 that focuses on working with the department to analyze additional data

provided by the department. In all circumstances, this analysis involves the application of synthetic control (discussed above) at the officer level. In most cases, the research team requests additional data from the identified departments on accidents, specialized enforcement campaigns, calls for service, crime, and granular geographic data to link with traffic stops. Connecticut's research team then combines the data provided by the department with the traffic stop data as well as Census and economic data to provide a brief summary report. The findings from this report are then used as the basis for one or more data-driven conversations with representatives from the identified departments. The purpose of these conversations is to help the research team and the policing administrators to identify and understand the specific enforcement activities or (in rare cases) individual officers that are driving the observed aggregate patterns of disparity. The evidence uncovered in Phase 3 of the *Connecticut model* is an invaluable tool for moving the policing community and advocacy groups beyond a war of anecdotes and into a constructive dialogue centered around effective reforms and interventions. This conversation allows for all stakeholders to gain an enhanced understanding of the factors contributing to disparities and engage in the community dialogues as part of Phase 4, discussed in the subsequent section.

4 | DATA-DRIVEN EARLY INTERVENTION

Based on the fiscal parameters set by Connecticut and a desire to advance the conversation beyond whether racial and ethnic disparities exist, Phases 3 and 4 of the *Connecticut Model* explicitly include a process for investigation and enacting actionable policy change. Upon a collaborative in-depth analysis of a department's data, a set of findings and potential policy solutions is prepared by the research team. In the fourth and final phase of the *Connecticut model*, stakeholders and community members are invited into the process and encouraged to engage in a dialogue with policing administrators. Typically, researchers and the advisory board will host a community forum in the identified communities to discuss the findings. The forums include a presentation of the research team's analysis from Phase 3 as well as a discussion with policing administrators and a period for public comment/question period. During the forum, the research team outlines an independent set of recommendations for reforms that can be made and allows the public to weigh-in on the relevant issues.

Since 2015, Connecticut has conducted interventions for 28 municipal police departments identified as having a disparity in the annual report. The process generally starts by geographically mapping all of traffic stops for a department. Mapping traffic stops helps reconcile population demographics and enforcement activity by allowing researchers to focus on the unique attributes of the specific subsection of a community where enforcement is targeted. Some of the factors identified in Connecticut as contributing to potential disparities for specific towns include locations of accidents, high calls for service, DUI enforcement, crime rates, and retail and entertainment. Researchers also conduct a more comprehensive post-stop data review to examine disparities in stop outcomes, searches and hit rates, and reasons for stops. The final piece of the in-depth analysis moves beyond examining disparities at the department level and examines individual officer information. The officer analysis utilizes an internal benchmarking approach, discussed in Section 3, by Ridgeway and MacDonald (2009) to better understand if disparities in data are driven by individual officers or groups of officers. The officer-level results are only shared with law enforcement administrators who review the findings in conjunction with additional officer information not available to researchers. These interventions have produced important actionable findings that departments have used to utilize to enact positive change.

For example, disparities were found in a predominantly White suburban community outside of the city of New Haven, CT with a police department of approximately 106 officers. In that particular department, Police enforcement was largely focused in the one neighborhood with a high percentage of Black residents. The data showed that this neighborhood had more calls for service and a higher crime rate relative to the rest of the community. The department's crime reduction strategy involved an elevated level of traffic enforcement in this area in an attempt to address these issues. Officers would primarily stop cars for low-level equipment and administrative offenses and request consent to search the vehicle. In particular, 22% of drivers were stopped for equipment violations and 18% for administrative offenses relative to 12% and 9% statewide, respectively. Notably, this strategy was not implemented elsewhere in the community. Based on the traffic stop data, illegal contraband was rarely found in these searches (less than 7% of the time) and drivers were frequently given warnings rather than tickets for the motivating infections. In addition, there was little empirical evidence that these enforcement measures were having any effect on the areas elevated crime rate.

Researchers and community stakeholders engaged the police administration in dialogue about alternative crime reduction tools. Following these conversations, the Chief enacted the following policies: (1) traffic enforcement should be narrowly focused on hazardous driving behaviors, (2) officers should cease consent searches, and (3) officers should implement alternative methods for interacting with the community. A year after implementing these changes, equipment and administrative offenses fell considerably (6% and 9%, respectively) as did consent searches. The department reported that these changes coincided with a falling crime rate (5%) and decreased rate of accidents (10%). Police searches were more successful at finding contraband, that is, a 63 percentage point increase, and the department ceased to be identified as having a disparity in subsequent annual analyses.

Another success story comes from a small urban police department that had been attempting to address a statewide increase in unregistered motor vehicles. The department began deploying license plate reader technology to identify and target drivers of such vehicles. During the follow-up intervention, researchers identified this specific enforcement activity as being the largest contributor to the department's observed disparity. The underlying belief from police administrators was that poverty was the true culprit of this disparity due to increases in the state's registration fees. Thus, most of this enforcement activity was concentrated in lowest income neighborhoods where residents were largely Hispanic. Researchers used the department's geographically mapped traffic stop data to demonstrate that this enforcement activity was the driver of their disparity and that registration violations were actually being found at similar rates in many other areas of their community. As a result of the intervention, the department employed a more broad-based and equitable deployment of their license plate readers that helped to mitigate the disparity in the proceeding years. This department's high search rate and observed disparities in stop outcomes were significantly reduced and this department was not identified in any subsequent reports following the intervention.

A third success story comes from a suburban community located outside of Connecticut's capital city of Hartford. During the intervention, researchers identified that defective lighting violations were a primary driver of the department's disparity. In fact, nearly 40% of the traffic stops in this department were for a defective lighting violation. In discussions with the department, police administrators attributed the lighting violations to a roving DUI patrol largely enacted based on concerns abuot college students from a local university. Researchers presented these administrators with data suggesting only one of the 1,608 traffic stops made for defective lighting violations that year had actually resulted in the driver being charged with a DUI. In fact, drivers

had been significantly more likely to be charged with a DUI offense when stopped for speeding violations. As a result of the intervention, the department altered their DUI strategy, which resulted in both more effective enforcement and mitigated the disparity in subsequent years, and reduced the use of defective lighting violations as a reason to stop cars, specifically to look for drunk drivers. They went from 1,608 defective lighting stops during the study period to 671 in the year following the intervention. Since the disparity was largely driven by a disproportionate number of minorities stopped for defective lighting, the observed disparity was significantly reduced and they were not identified in subsequent reports following the intervention.

These examples highlight the need for researchers to stay at the table to help police administrators and community stakeholders identify the underlying drivers of the disparity and to find strategies to help mitigate it. In Connecticut, engaging stakeholders throughout the intervention process has allowed minority advocates, law enforcement, academics, and government officials to come together in ways unimaginable a decade ago. What previously had been a war of anecdotes has been transformed into a constructive data-driven conversation about policy. Stakeholders and policing administrators now regularly attend panel conversations around the state and speak in similar tones about the statewide effort. The vitriol is gone from most conversations and has been replaced by a focus on what more can be done. Questions as to the practicality and cost of implementing such a system have been answered in Connecticut and should serve as a valuable template to other states going forward. However, a particularly fruitful area for future research surrounds the quantitative evaluation of such interventions as well as developing a more robust understanding of the role that police officer training has in reducing disparity. Such evidence-based policy evaluation surrounding new tools for mitigating disparity could help to ensure the most efficient allocation of resources in this critically important area.

CONFLICT OF INTEREST STATEMENT

The authors confirm that they have no conflict of interest to declare.

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ENDNOTES

[1] In response to recent high profile, police shootings of unarmed minority men, the "Black Lives Matter" movement has emerged to challenge traditional approaches to policing. See Arthur, Dolven, Hamilton, McCann, and Sherman (2017), Goff, Kindy, Fisher, Tate, and Jenkins (2015), and Nix, Campbell, Byers, and Alpert (2017) for recent media coverage on race and police shootings.

[2] Much of the funding supporting the development of these data systems was put in place during the final years of the Bush administration. Beginning in 2006, Section 1906 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU 109-59) incentivized states to enact and evaluate laws that prohibit racial profiling in motor vehicle traffic enforcement. Between FY2005 and FY2009, the Act made a total of $37.5 million in funding available to states that prohibited racial profiling, largely for the purposes of building systems to collect data on traffic stops for the purpose of internal evaluation. Congress renewed funding for SAFETEA-LU programs after the expiration date. After a short gap in funding, the SAFETEA-LU was eventually replaced with the Fixing America's Surface Transportation (FAST) Act. Recent changes to the FAST act include a requirement that states produce a publicly available analytical traffic report that evaluates the extent of potential police racial profiling.

[3] Oregon and California have created online dashboards that leverage state-of-the-art visualizations to highlight key insights from the data. Other states may find that approach especially useful in presenting findings to the general public.

[4] Funding was made available first through the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU 109-59), which was eventually replaced with the Fixing America's Surface Transportation (FAST) Act.

[5] Police agencies in Connecticut varied in their levels of sophistication and technological capacity with respect to how they collect and report data. On average, the data collection process takes officers less than 90 sec per stop.

[6] The five annual reports published by the Institute for Municipal and Regional Policy for Connecticut can be found here: http://www.ctrp3.org/reports/ Three annual reports published by the Institute for Municipal and Regional Policy for Rhode Island using the same methodology can be found here: http://www.dot.ri.gov/community/CCPRA/index.php#

[7] Of the 32 identified departments where there has an in-depth analysis, the community has participated in 10 of those conversations during rather than after Phase 3.

[8] There is a potentially more compelling case to be made for using Census data to evaluate pedestrian stops since movement on foot is inherently more geographically concentrated. Since the pedestrian population is generally less geographically mobile in most jurisdictions, the necessary identifying assumptions are likely more reasonable. However, this seems less likely to be true in locations like New York City where many residents rely on public transportation and do not use a vehicle to commute to work.

[9] One potential challenge with applying this methodology is that accidents are potentially correlated with race because they occur nonrandomly across geographies due to differences in road quality, for example, low-income high minority neighborhoods may have more accidents because of a lack of infrastructure investment. Another issue is that there may be discrimination in the determination of fault for an accident as discussed in West (2018).

[10] As of writing and to the authors knowledge, applications of the test include Grogger and Ridgeway (2006) in Oakland, CA; Ridgeway (2009) Cincinnati, OH; Ritter and Bael (2009) and Ritter (2017) in Minneapolis, MN; Worden, McLean, and Wheeler (2010, 2012) as well as Horace and Rohlin (2016) in Syracuse, NY; Renauer, Henning, and Covelli (2009) in Portland, OR; Taniguchi et al. (2016a, 2016b, 2016c, 2016d) in Durham Greensboro, Raleigh, and Fayetteville, North Carolina; Masher (2016) in New Orleans, LA; Chanin et al. (2016) in San Diego, CA; Criminal Justice Policy Research Institute (2017) in Corvallis PD, OR; Milyo (2017) in Columbia, MO; Smith et al. (2017) in San Jose, CA; and Wallace et al. (2017) in Maricopa, AZ. Statewide studies relying on this test include Ross, Fazzalaro, Barone, and Kalinowski (2015, 2016, 2017a, 2017b, 2018, 2019a, 2019b) in Connecticut and Rhode Island, Racial & Identity Profiling Advisory Board (2020) in California, and Sanchagrin et al. (2019) in Oregon.

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Matthew B. Ross, Ph.D., is an Assistant Professor in the Economic Sciences Department and Computational Justice Lab at Claremont Graduate School as well as a visiting scholar at the Wagner School of Public Service at New York University. Matt is an applied microeconomist whose work has a strong public policy focus and sits at the intersection of urban and labor economics. Matt's work operates within a broad intellectual framework and he frequently collaborates with scholars from across different disciplines. Matt's research agenda is currently focused on two distinct line of inquiry: (1) empirically testing for police discrimination and understanding the role of police officer experience and formalized training; and (2) public policy related to regional labor markets, innovation spillovers, and skills training. Matt's work has been published in peer reviewed journals including *Industrial and Labor*

Relations Review and *Labour Economics* as well as conference volumes for the *American Economic Association* and the *Association for Computing Machinery*. On the topic of testing for police discrimination, Matt has served as a statistical adviser and authored eight analyses examining policing data for evidence of discrimination in Connecticut and Rhode Island. Matt has provided guidance to the States of California and Oregon on building data systems and developing an analytical framework for assessing the extent of discrimination in police traffic stops. Matt's research has been funded by the National Science Foundation and covered by many national and local media outlets including US News, WNPR, Reuters, Wall Street Journal, Marshall Project, New York Times, and the Philadelphia Inquirer. Matt has presented his research at the American Economic Association, National Bureau of Economic Research, Society of Labor Economics, Association for Public Policy Analysis & Management, and Urban Economics Association. Matt received a Ph.D. in Economics from the University of Connecticut and was previously a joint post doc at the National Bureau of Economic Research and Ohio State University.

Ken Barone is currently a Project Manager with the Institute for Municipal and Regional Policy (IMRP) at Central Connecticut State University (CCSU). Since 2012, Ken has managed the Connecticut Racial Profiling Prohibition Project (CTRP3). This project works to implement the state of Connecticut's Alvin W. Penn Racial Profiling law. The Alvin W. Penn law requires law enforcement agencies to collect information on traffic stops and report that information to CCSU. He has co-authored seven reports analyzing municipal and state police data for evidence of discrimination. In addition, he is responsible for staffing the Connecticut Racial Profiling Prohibition Advisory Board, three subcommittees and is the legislative liaison for the project with the Connecticut General Assembly. Ken is also a certified Department of Justice Community Oriented Policing Services "Fair and Impartial Police" trainer. He has trained over 800 law enforcement officers since 2014. Ken has served as a project consultant in California, Oregon, and Rhode Island on the implementation of their statewide traffic stop data collection programs. In addition, Ken also manages the Connecticut law that requires the collection and analysis of incidents involving electronic defense weapons. Ken co-authored a 2016 report on the use of electronic defense weapons by local and state police. He also co-authored a report on the regulation of transportation network companies in Connecticut, and a report on the Connecticut law to raise the age of juvenile offenders to 18. He has provided project assistance to the Juvenile Jurisdiction Policy and Operations Coordinating Council, the Connecticut Re-entry Roundtable Collaborative, and the Institute's Children of Incarcerated Parent's initiative.

Jesse J. Kalinowski, Ph.D., is currently an Assistant Professor in the Economics Department at Quinnipiac University. Jesse's research interests are concentrated in the areas of urban economics and innovation. Recently, Jesse's research has examined how incentives and discriminatory biases affect public safety and the provision of public services. One line of Jesse's research develops structural models of police-motorist interactions used to derive theoretically grounded econometric tests for statistical and taste-based discrimination. His other research agenda focuses on the economics of digitization by applying econometric techniques to investigate questions relevant to multisided platforms and user-generated content. Jesse has served as a consultant on a wide variety of projects and specializes in applying advanced techniques

from the statistics, computer science, and economics literatures to real world problems. His current collaborations include a public–private partnership to develop tools and methodologies to better understand and identify racial profiling by police officers in Connecticut. In the past, Jesse held a project management and analyst position with the CCEA in UConn's School of Business, an institution he still consults for on an ad hoc basis, and an economist position with Connecticut's DECD.

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