Does Race Matter for Police Use of Force? Evidence from 911 Calls

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Abstract

While there is much concern about the role of race in police use of force, identifying causal effects is difficult. This is in part because of selection, and in part because researchers often observe only interactions that end in use of force, necessitating nontrivial benchmarking assumptions. This paper addresses these problems by using data on officers dispatched to over two million 911 calls in two cities, neither of which allows for discretion in the dispatch process. Using a location-by-time fixed effects approach that isolates the random variation in officer race, we show white officers use force 60 percent more on average than black officers, and use gun force twice as often. To examine how civilian race affects use of force, we compare how white officers increase use of force as they are dispatched to more minority neighborhoods, compared to minority officers. Perhaps most strikingly, we show that while white and black officers use gun force at similar rates in white and racially mixed neighborhoods, white officers are five times as likely to use gun force in predominantly black neighborhoods. Similarly, white officers increase use of any force much more than minority officers when dispatched to more minority neighborhoods. Consequently, difference-in-differences estimates from individual officer fixed effect models indicate black (Hispanic) civilians are 30 – 60 (75 – 120) percent more likely to experience any use of force, and five times as likely to experience gun use of force, compared to if white officers scaled up force similarly to minority officers. These findings highlight the importance of race as a determinant of police use of force, including and especially lethal force.

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1 Introduction

There are widespread concerns regarding police officer treatment of minorities. These concerns are rooted in a long history of police mistreatment of black Americans, and are reflected by the fact more blacks report having "no confidence" in local police (24 percent) than have "a lot of confidence" (14 percent). This distrust of police is perhaps strongest with respect to police use of force, as only 33 percent of blacks believe officers use the right amount of force for the situation, and only 35 percent believe police treat racial and ethnic groups equally (Pew Research Center, 2016). Concerns over the role of race in police use of force have been voiced most forcefully in the protests over police shootings of unarmed black civilians and by the Black Lives Matter movement. Importantly, this distrust has important efficiency implications in that reduced civilian cooperation likely leads to less effective policing and higher social costs of crime.

However, documenting whether race matters for police use of force is difficult. This is in part because researchers often do not observe interactions in which force was not used. As a result, researchers must make assumptions regarding the appropriate "benchmark", such as violent crime rates or arrests. In addition, it is difficult for researchers to observe whether the underlying risk of situations involving white and minority civilians, or white and minority officers, is similar in terms of whether force was merited. It is also unclear whether controlling for observed contextual factors is sufficient to overcome bias due to selection.

In this paper, we use a fundamentally different approach we believe most closely mirrors the ideal thought experiment. Specifically, we observe settings in which white and minority officers are as-good-as-randomly sent to otherwise similar situations, and where the same black and white officers are observed responding to situations in white and minority neigh-

borhoods. We do this using administrative data on over two million 911 calls, which enables us to observe police use of force for a defined set of interactions, independent of whether the interaction involved use of force. Importantly, the data come from two cities in which the dispatch protocols allow for no discretion on the part of the officer or the operator with respect to which officer is dispatched. Rather, in the first city, the dispatcher observes on her computer screen whether the officer on duty for that beat is available and if so, dispatches that officer. If the dispatcher's monitor indicates the beat officer is unavailable—which happens if, for example, the beat officer is currently engaged in a traffic stop—then she dispatches the available officer observed to be closest to the call's location. The protocol for the second city requires that the operator dispatch the available officer who is closest geographically to the location. Both protocols imply that conditional on police beat-by-time fixed effects, the variation in the race of the officer dispatched is as good as random. Our interviews with dispatchers indicate they follow the protocol. We also show empirically that officer race in both cities is uncorrelated with exogenous call characteristics and with predicted use of force based on those covariates once we condition on the beat-by-time fixed effect.

We use this conditionally-random variation in police officer race to answer two questions. The first is whether white officers use force at higher rates than minority officers when responding to otherwise similar calls. The second is whether officers are more likely to use force on opposite-race civilians. We answer this second question by asking whether white officers increase their use of force more then minority officers as they are dispatched to more-minority neighborhoods. We do so by controlling for both individual officer and beat-by-time fixed effects in a difference-in-differences style framework similar to the Price and Wolfers (2010) study on racial bias by NBA referees. The advantage of this approach

is we avoid imposing selection-on-observables assumptions in comparing interactions across civilian race. Rather, we assume that in the absence of an opposite-race effect, white and minority officers should increase use of force by a similar amount as they are dispatched from white to minority neighborhoods. The limitation is that as in all police use of force studies, we do not observe the proper amount of force. As a result, our measure of whether civilian race matters is necessarily a relative one: how would black civilians have fared if the white officers had scaled up their use of force the same as black officers?

Our data include the universe of 911 calls made in two cities linked to police officer race and use of force. As a condition of acquiring the data, we cannot disclose the names of the cities. The first city has a population and police force composed primarily of whites and blacks. It has a population of more than 240,000 and a homicide rate that ranks in the top 20 among the nation‘s largest 100 cities. In this city, we have administrative records on over 1.2 million 911 calls over a three to five year period starting after 2010.[1] These calls resulted in 1,300 police uses of force, 94 of which involved the discharge of an officer's gun. The data include the time and date of the call, the priority score assigned to the call by the 911 operator, a short description of the call, the first officer(s) dispatched to the scene by the operator, and whether or not force was used (and by which officer) at the scene. Importantly, we observe the first officer(s) dispatched to the scene, even if other officers also arrive after the dispatched officer arrives. In addition, we observe the address from which the call originated, which we geocode into a Census Block Group to assign civilian race. In the second city, we have data on just under one million 911 calls. This city is composed primarily of white and Hispanic civilians and police officers. This city has a population of more than 150,000, and the call records include similar information. There are just under

[1]We do not report the exact years to protect the anonymity of the city.

3,000 incidents of police use of force linked to these calls. We do not observe the type of force used in this city.

Results indicate that white officers use force 60 percent more often than black officers on average, and use gun force more than twice as often. In both cases estimates are highly significant, and demonstrate the difference in propensity to use force between black and white officers. We also estimate (shrunken) random effects for individual officers, which show that the overall differences by officer race are driven by a shift in the distribution, rather than differences in the tails. This suggests that the type of white person attracted to the police force is systematically different than the typical black person when it comes to likelihood of using force. In contrast, we find no evidence of an overall difference in the second city, where white and Hispanic officers use force at the same rate, on average.

Importantly, police use of force in both cities varies systematically by civilian race. Perhaps most strikingly, we show that while white and black officers use gun force at approximately the same rate in white and racially mixed neighborhoods, white officers use gun force five times as often in neighborhoods that are 80+ percent black. That is, while black officers use gun force at most modestly more when they are dispatched to calls in more black neighborhoods, white officers use gun force much more often when they are dispatched to predominantly black neighborhoods. This pattern holds even when controlling for individual officer fixed effects. As a result, ordinary least squares (OLS) estimates indicate dispatching a white officer to a call in a black neighborhood increases the use of gun force by four to five times; logit estimates are even larger. In addition, we find a similar pattern for all use of force. Results indicate that dispatching an opposite-race officer increases use of force by 30 to 60 percent, though only OLS estimates are significant at conventional levels. These

estimates are driven by the fact that white officers increase their use of force significantly as they are dispatched to calls in more black neighborhoods. In contrast, black officers use force at most modestly more as they are dispatched to calls in more black neighborhoods. As with the gun force findings, estimates for all use of force are similar when controlling for individual officer fixed effects.

Results from the second city indicate even though white and Hispanic officers use force at the same overall rate, the use of force is disproportionately concentrated in different-race neighborhoods. Specifically, we show that white officers increase their use of force more when dispatched to more Hispanic neighborhoods, compared to Hispanic officers. Estimates indicate that dispatching an officer of a different race roughly doubles the likelihood that force will be used.

We show these results are robust to the inclusion of controls for call characteristics, which is consistent with the as-good-as-random assignment of calls conditional on location-by-time fixed effects. We also show that the officer race effects (e.g., white vs. black) are robust to controlling for whether this is the officer‘s home beat, as proxied by the beat to which he is most frequently dispatched. Similarly, difference-in-differences estimates are shown to be robust to the inclusion of home beat and home beat interacted with officer race, in addition to individual officer fixed effects. This suggests effects are not driven by a familiarity effect. We also examine the extent to which our opposite-race results can be explained by the inclusion of all observed call characteristics interacted with officer race, and find such effects could explain only a small fraction of our findings. Finally, we show estimates in the first city are robust to whether we define use of force at the call level (i.e., assign use of force to the dispatched officer even if another officer was the one to use force) or at the level of the

officer who used the force.

The main contribution of this paper is to identify the effect of race on use of force by exploiting conditionally random variation in officer race and within-officer variation in civilian race to overcome the benchmarking and selection problems. In doing so, this paper joins a larger literature examining the impact of race in the criminal justice system. It is related to work on racial bias in police vehicle searches (e.g., Anwar and Fang, 2006; Persico and Todd, 2006; Antonovics and Knight, 2009). To address the issue of officer selection into interactions with civilians, this literature tests for racial bias by modeling police behavior and implementing tests based on vehicle search "hit rates" relative to a benchmark encounter rate. A related literature addresses the difficulty of assessing the benchmark encounter rate by exploiting changes in ambient light to test for racial profiling in traffic stops (Grogger and Ridgeway, 2006; Horrace and Rohlin, 2016). This paper complements these literatures by taking a substantively different approach to solving problems created by endogenous police-civilian interactions. In doing so, this paper is more closely related to work by Weisburst (2017), who uses 911 calls to estimate the value-added of individual police officers, and West (2018), who tests for racial bias in traffic citations using conditionally-random variation in the race of officers called to traffic accidents. The advantage of this paper relative to West (2018) is we examine the impact of race in arguably a more important context with more important outcomes—911 calls and police use of force. The advantage of West (2018) is he has objective information on whether certain citations were merited, which is not possible for use of force. In addition, this paper also complements research on racial bias in the criminal justice system more generally, including racial bias by prosecutors (Sloan, 2019; Tuttle, 2019), juries (Anwar, Bayer, and Hjalmarsson, 2012; Flanagan, 2018) and judges

(Arnold, Dobbie, and Yang, 2018; Bielen, Marneffe, and Mocan, 2018).[2]

In assessing the effect of officer and civilian race on use of force, this paper is most similar to work by Fryer (forthcoming) and Johnson et al. (2019). Fryer (forthcoming) uses an impressive range of data sets including detailed data on all interactions from Stop and Frisk in New York City. In addition, he uses data on officer-involved shootings in several other cities and counties, which he benchmarks using arrests. Using these data, he implements a selection-on-observables design to control for contextual factors. He concludes that blacks and Hispanics are more likely to experience non-lethal force all else equal, but not more likely to experience an officer-involved shooting. Weisburst (2019) extends this work using data on use of force and arrests from Dallas, and similarly reports that conditional on arrest there is no racial difference in use of force. Johnson et al. (2019) use data on fatal officer-involved shootings across counties and conclude there is little evidence of bias, though others have criticized the underlying assumptions in the analysis (Knox and Mummolo, 2019; Knox, Lowe, and Mummolo, 2019). The main advantage of this paper relative to this prior work is we are able to estimate the effect of race in a context where black and white officers are as-good-as-randomly dispatched to similar situations, and where each officer is as-good-as-randomly dispatched to calls in more and less black neighborhoods. In this way, we avoid making potentially problematic assumptions about the appropriate benchmark. In addition, by assessing the impact of civilian race by comparing how white and black officers scale up use of force as they are dispatched from white to black neighborhoods, we avoid concerns about whether we control for enough contextual factors that may differ across civilian race. Similarly, we avoid potentially over-controlling for factors described by the officer after force

[2]More generally, it also complements a broader literature on own-group bias in education, labor, housing, and product markets (e.g., Feld, Slamanca, and Hamermesh, 2015; Ayres and Siegelman, 1995; Dahl and Moretti, 2008; Goldin and Rouse, 2000; Lavy, 2008; Neumark, Bank, and van Nort, 1996; Moss-Racusin, Corinne, Dovidio, Brescoll, Graham, and Handelsman, 2012; Price and Wolfers, 2010; Parsons, Sulaeman, Yates, and Hamermesh, 2011.)

was used (e.g., in an arrest report), which would lead to understating effects The limitations of our approach are that our difference-in-differences estimate of whether race matters is necessarily a relative one, and we address this question in only two cities.

Our results have important implications for policing in the United States. Perhaps most importantly, they provide rigorous evidence in support of the common civilian perception of that race is an important determinant of police use of force. The results of this paper suggest that at least in the contexts studied here this belief seems warranted, especially with respect to the use of lethal force. In addition, this study demonstrates that race matters even in a time and context during which police departments generally, and white officers in particular, know they are under close scrutiny by the media and the public.

2 Background and Data

2.1 Background and Dispatch Procedures

As noted above, the protocol for dispatching officers to the scene of 911 calls is critical for our research design. For this reason, we contacted police departments in more than a dozen cities inquiring about their system for dispatching officers to calls, as well as the availability of data. In particular, we needed to be able to observe and link the race of the police officer to 911 calls and use of force. We were able to obtain data in two cities that met both criteria.[3] As part of the agreement to obtain the necessary data, which includes officer identifiers, we were required not to disclose the names of the cities. However, we can state that the first city we study has large populations of both blacks and whites, a total population of over

[3]We also obtained data from a third city that we were told used a protocol in which officers and operators had no discretion. However, upon receiving the data we discovered that did not appear to be the case, and thus do not use that city in this analysis.

240,000 and has a homicide rate that ranks in the top 20 among the nation's 100 largest cities. We note this set of cities does not overlap with those studied by Fryer (2019) and Weisburst (2019), none of which have a homicide rate that ranks in the top 20 among the nations's largest cities.

In this city, a civilian's 911 call is given to the first dispatcher available. The dispatcher then records important aspects of the call and assigns the call to a primary unit. Specifically, the computer system used by dispatchers records the time, exact location, and police beat of the call. The dispatcher will then ask the caller about details surrounding the call, categorize the seriousness and urgency of the call and rate it from highest priority (1) to low priority (higher values). The dispatcher also records a short description of the call. For example, a dispatcher may record a call as a "domestic disturbance" and then assign it priority of 2. Calls are then dispatched based on the priority of the call. This means more urgent calls, like assaults or crimes in progress, will be dispatched first, while less serious calls, like stolen cars, will be given lower priority and dispatched later.

After recording the above aspects of the call, the dispatcher assigns a primary unit to the call. The majority of calls (98 percent) in the first city are assigned only one primary unit. In 1.2 percent of calls, two primary units are dispatched, while in the remaining calls there are three to five primary units. To dispatch a primary unit, the police dispatcher will refer to her computer screen, which displays the location of all available police officers. An officer will not be available if they are responding to another call for service or a self-initiated event. For example, if an officer makes a traffic stop, they will use their in-car computer to communicate that they are not available, in which case they will not appear on the police dispatcher's screen for that period of time. If the beat officer for the beat of the call is

available, then the call will be dispatched to that unit.[4] If the beat officer is not available, the closest officer (geographically) will be dispatched. Importantly, in this setting, officers do not select the calls to which they respond.[5] After the primary unit is dispatched, other officers may observe the call on their police car computer and respond to the call. We do not observe these officers in our data, and assign only the primary dispatched officer(s) to each call. In this way, we perform an intent-to-treat analysis. Given the dispatch procedure, we need only condition on police beat-by-time fixed effects to isolate as good as random variation in police officer race. In Section 4, we show empirical evidence consistent with this identifying assumption.

Once a primary unit is dispatched to a call they may encounter a situation that leads to use of force. If an officer uses any type of force, police department administrative procedure dictates they must immediately file a report describing the details of the incident and the use of force type. This report number will be recorded in the officer in-car computer and linked to the call for service where the use of force occurred. Even if the use of force report is made later—for example, after the officer has been dispatched to another call—we are still able to link this use of force to the call for service using the police report number. A use of force report must be recorded even in events where non-deadly force (punches/kicks, etc.) is used. In the event an officer discharges his gun, he must allow the ranking officer on the scene to inspect the weapon and issue replacement ammunition. If an officer has shot someone, a detective or internal affairs investigator will take possession of the weapon. All use of force reports are reviewed quarterly by a community use of force committee, which makes recommendations about the use of force policy to the Chief of Police.

[4]For each shift a beat is assigned a beat officer. If a beat officer if not on a call for service, they are expected to patrol their beat. Our city has over 50 beats.

[5]These data do not include officer-initiated incidents where officers observe an incident, call it in, and have the dispatcher assign them to that incident.

We also study use of force in a second city, where the population is more than 95 percent Hispanic or white, and less than 10 percent black. This city has a population of more than 150,000, which ranks in the largest 300 cities in the country. The protocol for dispatching officers to calls is similar to the city described above in that calls are dispatched according to a protocol that does not allow for discretion on the part of the operator or officer. However, in this city, the operator first dispatches the geographically closest available officer to the call. In addition, in this city it is more common to have more than one officer initially dispatched. Specifically, 44% of calls have one unit assigned, 31% have two units assigned, and 25% have three or more units assigned initially. As with the first city, after any use of force, department procedure dictates that the officer record the incident report electronically, and that their supervisor review the report.

2.2 Data

The police administrative dataset for the first city includes all calls for service from a three to five year period after 2010 where at least one officer was dispatched. For each call in our dataset, we observe the primary unit, beat, priority, time between call and dispatch, latitude, longitude, time of the call, time of dispatch, and date of the call. There are over 50 beats in our city.[6] We also observe the race, gender, and years of experience of each police officer. Because Hispanics make up less than five percent of police officers in our city, we exclude those officers from the sample. Additionally, we observe if the call resulted in use of force and the type of use of force. Type of force is recorded by the police officer, including whether the force was a gun. According to the police department records division, nearly all of the incidents of gun force are the discharging of the gun. We classify use of force in two different

[6]In order to protect the anonymity of the cities, we are not revealing the exact time period or number of beats.

ways, and show results for each. The first is to classify all officers in the assigned primary unit(s) as having used force if any officer assigned to the call used force. For example, if two officers are dispatched to the same event, but only one uses force, in this approach we assign both officers as having used force. We use this event-level assignment procedure in order to account for the joint decision-making process of responding officers. For example, one officer could fail to deescalate a situation, causing another responding officer to use force. The second way we classify use of force is to assign it at the officer level, in which an officer is only assigned use of force if that officer used force.

In the first city, we assign civilian race as the proportion of the population that is black from the Census Block Group from which the call originated. We do so using the 2010 Census for each of the several hundred different Census Block Groups from which calls in our city originated. We classify civilians as black if they are only black, and white if they are only white. This results in the classification of over 90 percent of this city's citizens as only black or only white. Hispanics make up less than 5 percent of the population in this city. In the second city, we assign civilian race as the proportion of the population that is minority (e.g., black or Hispanic), noting that less than five percent of the population in that city is black.

As with many cities in the U.S., there is significant sorting by race across neighborhoods. For example, in the first city about 35 percent of our census block groups are more than 75 percent black and about 25 percent of our census block groups are more than 75 percent white. This is also evident in the distribution of 911 calls. This distribution is shown in Figure 1, where proportion black for the Census Block Group of the originating call is shown on the x-axis and varies from 0 to 1. It is clear that while there are calls originating from

all types of neighborhoods, we have a significant number of calls originating from nearly-all-white or (especially) nearly-all-black neighborhoods. Panels b and c of Figure 1 shows that black and white officers are dispatched to both types of neighborhoods, as well as neighborhoods of mixed race.

Summary statistics for the first city are shown in Table 1. The sample includes 1.2 million calls for service. There were over 1,300 incidents of police use of force representing 0.109 percent of all calls, of which 94 (0.0076 percent) involved a gun. Thirty-eight percent of responding officers were black, and 16 percent were female. Average officer experience was 10 years. On average 58.6 percent of callers were black. It takes 6.5 minutes for a primary unit to be dispatched to a call.

In columns 2 and 3 we show summary statistics separately for black and white responding officers, respectively. We note that this comparison does not reflect our research design since it does not account for potential of officer selection by race into different police beats. However, given these data only include use of force resulting from 911 calls, and since officers of both races respond to calls in all neighborhoods at roughly the same rates (as shown in Figure 1) and have no discretion in how they are dispatched, we find it instructive nonetheless. Columns 2 and 3 show that black officers are somewhat more likely to be female (18.9 versus 14.2 percent), have more experience (10.5 versus 9.9 years), and respond to calls in slightly more black neighborhoods (0.603 versus 0.575). Black and white officers respond to calls of similar priority and are dispatched similarly quickly (6.51 versus 6.46 minutes) and to locations with similar x and y coordinates. However, use of force is quite different across officer race. While black officers use force 7.8 out of every 10,000 calls, white officers use force 12.8 times per 10,000 calls. White officers use gun force approximately 1 out of

every 10,000 calls, which is more than twice as often as black officers.

Summary statistics for the second city are shown in Appendix Table A4. Eighty-five percent of civilians are minority, and 81% are Hispanic. The police force reflects these demographics, as 86 and 83 percent are minority and Hispanic, respectively. We observe just under 3,000 incidents of force linked to 911 calls. Unfortunately, we were not able to acquire information on the type of force used. White and minority officers use force at a similar rate of around 3 in 1,000.

3 Research Design and Methodology

Our identification strategy in both cities relies on the as-good-as-random variation in officer assignment to 911 calls. However, for ease of exposition, below we discuss our estimation approach as it relates to the first city in our analysis, though the approach is similar for the second (Hispanic/white) city.

To estimate the racial differences between white and minority officers in overall use of force, we estimate the following equation:

$$UseofForce_c = \beta_0 + \beta_1 I(WhiteOfficer)_c + Beat * Year * Week * Shift_c + X_c + \epsilon_c \quad (1)$$

Use of force is a binary variable equal to one when a call c ends in a use of force and zero for calls that do not involve a use of force. $White\ Officer$ takes on a value of one when the police officer is white and zero otherwise. β_1 captures the difference in the probability of force across officer race. X_c includes control variables at the call-level. Specifically, X_c includes controls for officer gender, priority of call, latitude, longitude, and time between call

and dispatch, as well as fixed effects for day of the week, call description, and call taker. All specifications include $Beat{*}Year{*}Week{*}Shift$ fixed effects.

To estimate the effect of opposite-race officers on use of force, we use a difference-in-differences style approach. Formally, we estimate the following for the first city in our analysis:

$$UseofForce_{ic} = \beta_0 + \beta_1(ProportionBlackCivilians)_c + Officer_i + \beta_2 I(WhiteOfficer * ProportionBlackCivilians)_{ic} + Beat * Year * Week * Shift_c + X_c + \epsilon_{ic} \quad (2)$$

where $Officer_i$ is an individual officer fixed effect and captures time-invariant officer characteristics including officer race. $Proportion\ Black\ Civilians_c$ is the proportion of black civilians in the Census Block Group of the call, and controls for differences in probability of use of force across neighborhoods of different racial compositions. The variable of interest is the interaction between $Proportion\ Black\ Civilians_c$ and $White\ Officer_i$. We interpret the coefficient, β_2, as the effect of dispatching an opposite-race officer on use of force. As discussed earlier, this measure is necessarily a relative one. It provides an estimate of how much additional force is used by white officers on black versus white civilians, compared to if white officers increased their use of force the same as black officers. We also note that because we do not observe—and view as unknowable—whether force emphshould have been used on a given call, without imposing additional assumptions we cannot know whether a nonzero effect means white officers used too much force on black civilians, or too little on white civilians, or whether black officers used too much force on white civilians, or too little on black civilians. The coefficient β_2 captures the sum of those effects.

We note that in equations 1) and 2), we identify effects using only the race of the dispatched officer(s), even though others may choose to respond to the call as well. In this way, we implement an intent-to-treat analysis. Relatedly, for the analysis of the first city we observe whether force was used by the dispatched officer, or by another officer who also responded to the same call.[7] Our main analysis assigns use of force to a dispatched officer if force was used by any officer on that call. However, in Appendix Tables A.1 and A.2 we show estimates are almost identical when use of force is defined as force used by that dispatching officer.

In addition to estimating each equation with ordinary least squares, we also estimate using a logit model and report odds ratios. However, we note that doing so has two disadvantages. First, in order to attain convergence of the logit model, we are only able to control for police area and time fixed effects, rather than beat-by-time fixed effects. Police areas are roughly five times as big as a beat in the first city, and more than ten times as large in the second city. We do this in order to attain convergence of the logit model. Perhaps more problematically, given a fixed number of observations in each group, the logit estimator is not consistent as the number of groups increases (Chamberlain, 1980; Heckman, 1987). As a result, while we show logit estimates for the sake of completeness, we strongly prefer OLS estimates, particularly in models that include individual officer fixed effects.

For both approaches, we report standard errors that are clustered at the officer level to allow observations to be correlated across cases for a particular officer. In addition, for ordinary least squares (OLS) specifications we also report [in square brackets] standard errors that are two-way clustered at the officer and beat levels. In addition, for baseline specificiations we also report empirical p-values from randomization inference. Specifically,

[7]For the second city, we only observe whether the dispatched officer used force.

we randomly assign race to each officer in our sample. We do so using the actual proportion of officer race in our sample, such that the resulting distribution of officer race is identical to that observed in the data. We then estimate and record the coefficient of interest. We repeat this exercise for 5,000 iterations and report the empirical p-value, which is the fraction of randomized estimates more extreme (i.e., larger in absolute value) than our estimate from the real data. We report these empirical p-values in the note below each table.

Intuitively, this difference-in-differences approach compares differences in the probability of use of force between black civilians and white civilians for black officers and white officers. Importantly, this model allows for encounters with black civilians to merit more or less force than interactions with white civilians. In this way, our approach differs significantly from approaches that rely on controlling for observable contextual factors to account for selection in the type of interactions with white versus black civilians. Rather, we identify opposite-race effects by comparing how a given white officer's use of force differs when he is dispatched to a more black versus less black neighborhood, compared to what happens when a given black officer is dispatched to more and less black neighborhoods. In short, we include beat-by-time fixed effects to ensure white and black officers are dispatched to similar calls, and individual officer fixed effects to ensure differences in use of force across civilian race are not driven by nonrandom sorting of officers across neighborhoods.

There are several mechanisms through which opposite-race police officers can affect use of force, as measured by our coefficient of interest β_2. The first is racial bias by police officers. For example, if officers receive utility from using force on opposite-race civilians, the threshold for using force will be lower. This bias will then be reflected in β_2. In addition, it is also possible that officers are less skilled at interacting with members of different races.

If, for example, black officers are better at de-escalating situations involving black civilians compared to white officers, this will generate a nonzero estimate of β_2. Similarly, if white officers misperceive behavior by black civilians as being threatening, while black officers correctly perceive that same behavior, that misperception could drive any effects we estimate. Finally, we note our estimate of the effect of opposite-race police officers will also capture differential civilian response to opposite-race police officers. Importantly, for this response to drive a nonzero estimate of β_2, it must be the case that civilians behave differently for opposite-race officers than for same-race officers. In contrast, any overall racial difference in civilian behavior is accounted for in the beat-by-time fixed effect.[8]

Both the cross-sectional approach and the difference-in-differences approach rely on the assumption that conditional on the beat-by-time fixed effect, the variation in police officer race is as good as random. Given our understanding of dispatch protocol in both cities, we believe there are *ex ante* reasons to believe this assumption is valid. In addition, we also empirically assess the validity of our research design. First, when we estimate effects, we will examine the extent to which adding controls affects our estimates of interest. Specifically, we add call characteristics including call priority, latitude, longitude, time between call and dispatch, as well as fixed effects for day of the week, call description, call taker. We also add controls for officer gender and years of experience. If our identifying assumption is valid, we expect adding these controls should not affect our coefficient of interest.

The second way in which we assess the validity of our research design is to examine directly the correlation between call characteristics and officer race, conditional on a police beat by

[8]Our view is that it is difficult to assess the importance of civilian response without detailed data on the actions, body language, and speech of the officer and civilian. While this is difficult, to our knowledge the best evidence to date comes from Voigt et al. (2017), who analyze officer speech from officers' body cam footage in Oakland during traffic stops. They report that officers speak more disrespectfully to blacks than whites, controlling for observed contextual factors. The authors note it is possible for some of this effect to be caused by civilian behavior, though they argue it is unlikely all due to civilian behavior given the difference is present in the first five percent of words spoken by the officers, and is judged to be present even when evaluated in the context of what was said by the civilian.

time fixed effect. Under the identifying assumption, officer race should be uncorrelated with the race of the caller, the call priority, time between call and dispatch, the geographic location of the call (i.e., X and Y coordinates), whether the call came from an officer's home beat, and other Census Black Group characteristics (i.e. per capita income, proportion unemployed, and proportion with less than a high school degree). We formally test this in Table 2, which regresses each of these characteristics on a beat-year-week-shift fixed effect and an indicator for whether the officer was white. One of the nine estimates is statistically significant at the 10 percent level; none are significant at the 5 percent level. In addition, point estimates are economically small. For example, compared to black officers, white officers respond to calls that are dispatched 0.11 minutes faster and 0.01 points lower priority, and to neighborhoods that are 0.13 percentage points less black. The small magnitude of these correlations is consistent with the identifying assumption of our study.

In addition, the third way in which we assess our research design is to use all call characteristics to predict officer use of force. Specifically, we first regress police use of force on beat-year-week-shift fixed effects. We then regress these residuals—which capture the deviation from the average use of force for that beat and time—on every covariate we observe for each call. These include proportion black civilians in the block group, call priority, latitude, longitude, time between call and dispatch, home beat, per capita income, proportion of civilians with less than high school degree and proportion unemployed, as well as fixed effects for call description and call taker. We use the resulting regression equation to predict the likelihood force would be used for each officer on each call. Intuitively, this produces a linear combination of exogenous call characteristics, where the weights are chosen as to best predict the likelihood of force being used. We then ask whether white and black officers are

dispatched to calls of similar underlying danger when assigned to a neighborhood of a given racial composition. If the identifying assumption of our approach is valid, predicted use of force should be the same for white officers as black officers.

We show results of this test graphically for the first (black/white) city in Figure 2. Panel a shows results for all use of force, while panel b shows results for only gun use of force. In both cases, results demonstrate that conditional on the police beat-year-month-week-shift of the call, white and black officers are dispatched to calls that are of similar underlying risk. This is consistent with the identifying assumption, and with our understanding of how officers are dispatched.

Finally, for the difference-in-differences approach, we also add controls for interactions between officer race and all call characteristics. We do so in order to shed light on the mechanism underlying the opposite-race effects. In particular, we test whether the effect can be explained by officers having an increased propensity to use force for the type of calls that occur in opposite-race neighborhoods. For example, if white officers were more likely to use force when dispatched to domestic disturbance incidents, and if domestic disturbance incidents were more likely to occur in black neighborhoods, that could generate a nonzero difference-in-differences estimate. It is important to note, however, that because this behavior has a disparate impact on opposite-race civilians, the effect is the same as explicit bias.

4 Results

We begin by showing results for the first city graphically. Results for all use of force are shown in Figure 3. Each graph shows local averages of use of force by race of officer,

as represented by the blue circles (white officers) and red squares (black officers). Each circle/square includes the same number of calls. We also fit lines to the underlying data, by officer race.

Panel a of Figure 3 shows actual use of force, while panel b shows residualized use of force, after first regressing use of force on beat-by-year-by-week-by-shift fixed effects. We show residualized use of force since it closely corresponds to the variation we use to estimate across-race effects. More precisely, while graphing actual use of force against neighborhood racial composition as in Figure 3a overcomes many potential selection problems, Figure 3b additionally addresses the potential problem of non-random assignment of officers across beats of a given racial composition.[9]

Results in Figure 3 reveal two main takeaways. The first is that regardless of the racial composition of the neighborhood, white officers are more likely to use force than black officers. This demonstrates that the differences shown in Table 1 were not due to differences in racial composition of neighborhoods or non-random sorting of officers, but instead reflects racial differences in the underlying propensity to use force. Thus suggests that with respect to the likelihood of using force, white officers seem to be drawn from a different distribution than black officers.

The second main takeaway from Figure 3 is that while the propensity of black officers to use force increases only modestly as they are dispatched to neighborhoods with higher proportions of black civilians, white officers use significantly more force as they are dispatched to more black neighborhoods. This suggests that having an opposite-race officer dispatched

[9]For example, if conditional on being assigned to beats of similar racial composition, white officers were systematically assigned to the more dangerous beats within that set, Figure 3a could be misleading. As it turns out, this type of selection seems unimportant for the black/white city as panels a and b of Figure 3 show qualitatively the same result. However, we do find some evidence of this type of sorting for the second Hispanic/white city, where controlling for beat-by-time effects makes the opposite-race effects more clear.

to a scene seems to have a large effect on the likelihood of force. For example, if officer race (white versus black) mattered for use of force, but having an officer of opposite-race did not, we would expect parallel slopes for white and black officers in both panels of Figure 3. The difference in slopes suggests that dispatching an opposite-race officer to a call results in a higher likelihood of police use of force.

Figure 4 shows results for use of force with a gun. It shows that while black and white officers have roughly similar propensities to use gun force when assigned to majority-white neighborhoods, they differ significantly when dispatched to neighborhoods with 80+ percent black residents. In those neighborhoods, white officers are roughly five times more likely to use gun force compared to black officers. Again, this suggests that white officers are more likely to use force overall. In addition, it suggests that they are especially likely to use more force in mostly-black neighborhoods, suggesting large opposite-race effects.

We note that the opposite-race effects apparent in Figures 3 and 4 include the impact of any potentially non-random sorting of white and black officers across neighborhoods of different race. While the impact of such nonrandom sorting may be of interest in its own right—for example, the allocation of the most aggressive white officers to predominantly black neighborhoods could itself drive disparities—in the results below we also estimate opposite-race effects controlling for individual officer fixed effects.

4.1 The Effect of Officer Race on Use of Force

Estimates of the average effect of exposure to a white officer (compared to black) are shown in Table 3, where each column represents a different regression. Panel A shows coefficients from OLS estimation, while Panel B shows odds ratios from a logit regression. Column

1 in Panel A controls only for beat-by-year-by-week-by-shift fixed effects, while Panel B (logit) controls for beat fixed effects. Column 2 includes controls for call characteristics, including call priority, latitude, longitude, time between call and dispatch, per capita income, unemployment, proportion with less than a high school degree, home beat and fixed effects for day of the week, call description, and call taker for OLS specifications. Column 2 for logit specifications includes controls for priority, officer gender, per capita income, unemployment, and proportion with less than a high school degree.

Results in column 1 of Panel A indicate that white officers are 0.0507 percentage points less likely to use force than black officers. Given the average use of force of 0.106 percent, this suggests that white officers are 48 percent more likely to use force relative to the mean, and 65 percent more likely relative to mean for black officers of 0.078 percent, as shown in Table 1. The estimate in column 2 changes only slightly to 0.0429 percentage points, implying a 55 percent increase relative to black officers. Both estimates are statistically significant at the one percent level. Odds ratios from a logit specification are similar; estimates in the first two columns indicate white officers are 1.66 and 1.61 times as likely to use force as black officers. Both estimates are significant at the one percent level. In addition, the two-sided p-value from randomization inference for the estimate in column 1 of Panel A is only 0.0002, suggesting that this large a difference between two groups of officers is highly unlikely to occur due to chance.

Estimates in columns 3 and 4 show results for beats with above-average and below-average rates of use of force. In both cases white officers are estimated to be more likely to use force than black officers. Estimates in Panel B indicate that white officers are 1.48 and 2.06 times as likely to use force in high- and low-use-of-force police beats; both estimates are significant

at the one percent level.

Columns 5 through 8 show the same specifications for use of force in which a gun was used by the officer. Estimates in columns 5 and 6 of Panel A are 0.0000518 and 0.0000462, both of which are significant at the five percent level using conventional inference; the two-sided empirical p-value from randomization inference for column 5 is 0.0629. The estimates indicate 65 to 73 percent increases in gun force by white officers relative to the mean, and 109 to 122 percent increases relative to the mean for black officers. Logit estimates in Panel B are similar, indicating white officers are 2.2 to 2.4 times (or 120 to 140 percent) more likely to use gun force as black officers. Estimates in columns 7 and 8 show effects for above- and below-average-gun-force beats, and indicate similar relative increases for white officers in both.

In short, results from Table 3 indicate that white officers use force 55 to 65 percent more often than black officers when attending otherwise similar calls, and use gun force approximately twice as often as black officers. In addition, results in Figure 2 suggest that the difference in the likelihood of using lethal force is largely due to differences in predominantly black neighborhoods from which a large fraction of 911 calls originate.

4.2 The Effect of Opposite-Race Officers on Use of Force

We now turn to estimating the effect of opposite-race police officers on use of force. Results are shown in Table 4, which is similar to Table 3 in that column 1 includes only beat-by-year-by-week-by-shift fixed effects, officer race fixed effects, and a control for the proportion of black civilians in the block group. Column 2 adds individual officer fixed effects in order to account for any nonrandom assignment of police officers across different neighborhoods.

Column 3 adds call controls, and column 4 adds controls for the home beat of the officer (as proxied by the beat in which the officer responds to the most calls) and an interaction between officer race and home beat.

Results indicate that opposite-race officers are significantly more likely to use force. Estimates in columns 1 - 4 of Panel A are 0.000566, 0.000613, and 0.000629, and 0.000617, all of which are significant at the five percent level. The empirical p-value from randomization inference is somewhat larger for the estimate in column 1 (p=0.1011), though none of the 5,000 iterations were more extreme than the estimate in column 2 (p=0.0000). Estimates indicate that opposite-race officers are 0.057 to 0.063 percentage points more likely to use force. Given a mean use of force rate of 0.106 percentage points, these estimates suggest increases of 54 to 59 percent. Corresponding odds ratios from logit regressions that include individual officer fixed effects in columns 2 and 3 of Panel B are 1.6 and 1.4, respectively, although only column 2 is significant at conventional levels.

In column 5, we include interactions between officer race and each observed call characteristics. We do so in order to assess the extent to which the estimated effect in columns 1 - 4 is picking up the response of officers to a call characteristic that is correlated with civilian race of the opposite race. The estimate in Panel A is 0.000399, which suggests that this differential response can explain roughly one-third of the overall effect. We note, however, that even if part of the overall effect is due to officers responding more harshly to calls that tend to come from opposite-race neighborhoods, that still represents the type of policy-relevant disparate impact interested groups are worried about.

In columns 6 and 7, we show effects for neighborhoods with above- and below-average rates of use of force. Results indicate that opposite-race effects seem driven by effects in high

use of force beats. The OLS and logit estimates in column 6 suggest increases of 94 and 82 percent, respectively. The OLS estimate is significant at the five percent level.

In summary, results in Table 4 indicate that there is suggestive evidence of opposite-race effects on overall use of force. OLS estimates from officer fixed effect models range from 55 - 60 percent and are significant at the 5 percent level, while logit estimates are of similar magnitude (40 - 50 percent) but are not generally significant at conventional levels.

4.3 The Effect of Opposite-Race Officers on Gun Use of Force

Next, we estimate the effect of opposite-race police officers on gun use of force. Results are shown in Table 5, which takes the same form as Table 4, except that we do not show estimates for below-average use of force beats, given how rare gun use of force is in those beats.

The estimate in column 1 indicates opposite-race officers are 0.0171 percentage points more likely to use gun force, and is significant at the one percent level using conventional inference, and has an empirical p-value of 0.0715 from randomization inference. Given the baseline rate of 0.0071 percentage points, this suggests that opposite-race officers are 240 percent more likely to use gun force. The corresponding odds ratio indicates that opposite-race officers are 5.4 times as likely to use force, which is significant at the 10 percent level. Notably, estimates are larger when individual officer fixed effects are included, as in columns 2 - 7. OLS estimates in columns 2 - 5 range from 0.000299 to 0.000379; all are significant at the one percent level, and the empirical p-value for the estimate in column 2 is 0.0000. These estimates imply dispatching an opposite-race officer results in a 420 to 530 percent increase in the likelihood of gun force relative to the mean. Equivalently, estimates indicate

an opposite-race officer is 5.2 to 6.3 times as likely to use force as a same-race officer. Logit estimates are even larger when officer fixed effects are included, with odds ratios of 14.9 (column 2) and 10.2 (column 3). These are significant at the ten percent level, though we interpret these estimates cautiously in light of the incidental parameters problem with the logit estimator in cases like this (Chamberlain, 1980; Heckman, 1987).

The estimated effect of opposite-race officers is robust to controlling for call characteristics (column 3), a proxy for home beat and home beat interacted with officer race (column 4), and interactions between call characteristics and officer race (column 5). This suggests that the effect of opposite-race officers on gun use of force is not driven by bad luck in dispatches, lack of familiarity with the police beat, or differential response to certain types of calls that are more prevalent in opposite-race neighborhoods.

In summary, results in Table 5 indicate there is strong evidence that dispatching an opposite-race police officer to the scene results in much higher probabilities that gun force will be used. Estimates from officer fixed effect specifications indicate opposite-race officers are at least five times as likely to use gun force. In addition, as shown in Figure 3, effects seem largely driven by the much higher rates of gun force used by white officers in mostly-black neighborhoods, compared to black officers.

4.4 Individual Officer Effects

Given the findings discussed above, it is natural to ask whether the differences by race are due to only a handful of officers, or if they are more systemic. Put differently, are the effects we find due to differences in the middle of the distribution, or are they due to differences in the tails? To address this question, we estimate an individual officer random effects model, and

then compute and graph the distribution of (shrunken) effects for white and black officers. We begin by regressing use of force on beat-by-time fixed effects as in column 1 of Tables 3 - 5, and keep the residuals. We then use those residuals and the Stata command *mixed* to estimate a random effects model, and then compute the (shrunken) random effect for each officer. We do so only for officers who respond to at least 500 calls, which limits the sample to 46% of officers in our sample, though those officers respond to 91% of the calls. After estimating officer effects, we trim the 5% most extreme officers in the far tails so the reader can visualize any differences in the distributions.[10]

Results comparing black and white officers are shown in Figure 5a, which shows a kernel density plot of both white and black officers. We also show a histogram version of this plot in Appendix Figure A3, the main advantage of which is it enables a viewer to see approximately how many officers are in different parts of the distribution. Both figures show a rightward shift in the distribution of white officers, compared to black officers. This suggests that the increased propensity to use force by white officers is not driven by a handful of officers, but is rather due to an increased propensity across a significant fraction of white officers.

Figure 5b shows the distributions of white officers in white and black neighborhoods, while Figure 5c shows the distribution of black officers in white and black neighborhoods. In each case we define white neighborhoods as those in the bottom quartile of neighborhoods in the call data by percent black, and define black neighborhoods as the top quartile. Figure 5b shows a slight leftward shift of the distribution of white officers compared to black officers in white neighborhoods. Figures 5b and 5c both show a wider distribution for calls in black neighborhoods. However, while Figure 5c shows at most a modest rightward shift

[10] Without trimming, the resulting figures are so "zoomed out" that it is impossible to distinguish between the distributions even when there are meaningful differences.

among black officers in black versus white neighborhoods, Figure 5b shows a much larger rightward shift for white officers. The shift in the distribution suggests the opposite-race effects documented in Table 4 are likely due to differences among more than a handful of officers.

In summary, Figure 5 suggests that the increased overall propensity of white officers to use force is due to differential behavior by a nontrivial number of white officers, rather than a few. Similarly, the differential scaling up of use of force by white officers in black-versus-white neighborhoods, compared to black officers, also seems to be driven by the mass of the distribution, rather than the tails.

4.5 Results from the Second City: Whites and Hispanics

In addition to studying the effects of police officer race in a city in which citizens and officers are mostly white or black, we also study it in the context of a second city composed primarily of whites and Hispanics. Figure 6 shows the distribution of calls across neighborhoods of differing race. As shown there, the vast majority of 911 calls in this city originate from neighborhoods in which at least half of the population is Hispanic. However, within those neighborhoods, minority (i.e., mostly Hispanic) and white officers are dispatched to neighborhoods that range from 50 to 100 percent Hispanic.

The correlation between call characteristics and officer race are shown in Appendix Table A5, which follows the form of Table 2. None of the twelve coefficients are significant at the 10 percent level, which is consistent with our understanding of how 911 calls are dispatched. Perhaps more meaningfully, we also graph predicted use of force against the proportion of minorities in the Census Block Group. Specifically, we regress use of force on every call

characteristic that we observe, except for the race of the officer dispatched. Results in Figure 7 indicate that white and minority officers were dispatched to calls that had a similar underlying level of danger. This provides evidence that the variation in officer race across calls is as good as random, consistent with the identifying assumption. We note also that the scale of the x-axis in Figure 7 goes from 60 percent minority to 100 percent minority. This reflects the fact there are few mostly-white neighborhoods in this particular city.

Figure 8 shows actual use of force by officer race. Panel a shows the raw data, while panel b shows residualized use of force after removing beat-by-year-by-month and beat-by-shift fixed effects. Two main findings are evident in Figure 8. The first is that white and Hispanic officers do not seem to differ in their overall propensity to use force. This contrasts with Figure 3, which showed that white officers were much more likely to use force than black officers.

The second finding is that as officers are dispatched to more minority/Hispanic neighborhoods, white officers seem to increase their use of force more than Hispanic officers. This is particularly evident in panel b of Figure 8, which shows residualized use of force.[11] This suggests that dispatching officers to a different-race neighborhood results in increased use of force.

Corresponding estimates are shown in Tables 6 and 7. Estimates in Table 6 confirm the visual evidence in Figure 8 that there is almost no difference between the rate at which force is used by white and Hispanic officers. Logit estimates indicate that white officers are 1.06 to 1.1 times more likely to use force than Hispanic officers; none of the logit or OLS estimates are significant at conventional levels

[11] The increased difference between the slopes in panels a and b is evidence that in this city, conditioning on neighborhood racial composition by binning neighborhoods is not sufficient to overcome non-random sorting of officers across beats.

In contrast, Table 7 provides evidence that while overall rates of use of force may be similar across officer race, that force is disproportionately used in neighborhoods of a different race. Estimates in column 1, which include only beat-year-month and beat-shift fixed effects, indicate that opposite-race officers are 0.08 percentage points (89 percent, OLS, significant at the 5% level with clustered standard errors and an empirical p-value of 0.1076) and 160 percent (logit) more likely to use force. Estimates from the remaining columns in which officer fixed effects are included are somewhat smaller; OLS estimates in columns 2 - 4 suggest 75 percent increases relative to the mean, whereas odds ratios in Panel B suggest 120 percent increases. All estimates in columns 2 - 4 are significant at the 10 percent level, though the empirical p-value for the estimate in column 2 is 0.1808. Additionally controlling for interactions of officer race and call characteristics reduces estimates by around half (column 5).

In summary, our analysis of the second city that is populated primarily by Hispanics and whites yields two findings. First, white and Hispanic officers use force at similar overall rates. Second, that overall similarity in the use of force disguises the fact that force is disproportionately used in different-race neighborhoods. Results suggest that the rate at which white officers use force increases by more as those officers are dispatched to more Hispanic neighborhoods, compared to Hispanic officers. As a result, we estimate that minority citizens are roughly twice as likely to experience use of force when interacting with a white officer, compared to if white officers were scale up use of force similarly to Hispanic officers.

5 Discussion and Conclusion

In this paper, we examine the impact of officer and civilian race on use of force by exploiting as-good-as-random variation in the race of officers dispatched to more than two million 911 calls in two different cities. In doing so, we answer two questions: Do white officers use force more often than minority officers in otherwise-similar situations? And are encounters with an officer of a different race more likely to result in use of force?

Results provide strong evidence that race matters. We show that white officers use force 55 to 65 percent more than black officers when responding to similar calls, and that these differences are due differences in behavior by a nontrivial proportion of white officers, rather than only a few. Moreover, we show that while white officers increase their use of force significantly as they are dispatched to more black neighborhoods, black officers do so at most modestly. This is true both in the aggregate, and when comparing within individual police officers using officer fixed effects. As a result, we estimate that interacting with an opposite-race officer results in a 30 to 60 percent increase in the use of force. We find somewhat larger effects in a second city consisting primarily of whites and Hispanics. There, interacting with an officer of a different race roughly doubles the likelihood force will be used.

The importance of race in white versus black neighborhoods is even more pronounced when it comes to the likelihood the officer will fire his gun. While black and white officers use gun force at approximately the same rate when responding to calls in white neighborhoods, white officers are five times as likely to fire their gun when dispatched to a call in predominantly neighborhoods. As a result, we estimate that white officers are twice as likely to use gun force overall, and dispatching an opposite race officer increases the probability

he will fire his gun by a factor of five. This finding contrasts significantly with previous work by Fryer (forthcoming) and Weisburst (2019), who find black civilians are no more likely to experience gun force. There are several explanations for the difference. The first is that effects may be present when police respond to 911 calls, but not when police interact with civilians in other contexts. Alternatively, results could differ due to differences in the cities and neighborhoods studied. As shown in Figure 4, our findings on gun force are driven by police behavior in the most black neighborhoods of the city, where a disproportionate amount of crime occurs and 911 calls originate. In addition, the city itself has a homicide rate that ranks in the top 20 nationwide among large cities, a set that does not include any of the cities studied by this previous work. This suggests that just as effects are not evident in many of the neighborhoods shown in Figure 4, effects may also not be present in the black neighborhoods found in less dangerous cities. Finally, the contrast in findings could be due to differences in research design. Fryer (forthcoming) uses arrests as a benchmark and a selection-on-observables design to account for differences across interactions, while we exploit exogenous interactions and compare changes in force across neighborhood race for the same black and white officers. The former approach could understate effects in our context if white officers were to arrest at higher rates in the predominantly black neighborhoods in Figure 4, or if white officers described those encounters as more dangerous than black officers would have described identical situations. It is also possible that a selection-on-observables approach understates the impact of race compared to the difference-in-differences approach used here, perhaps because the context of the encounter is described in the arrest report after force is used.

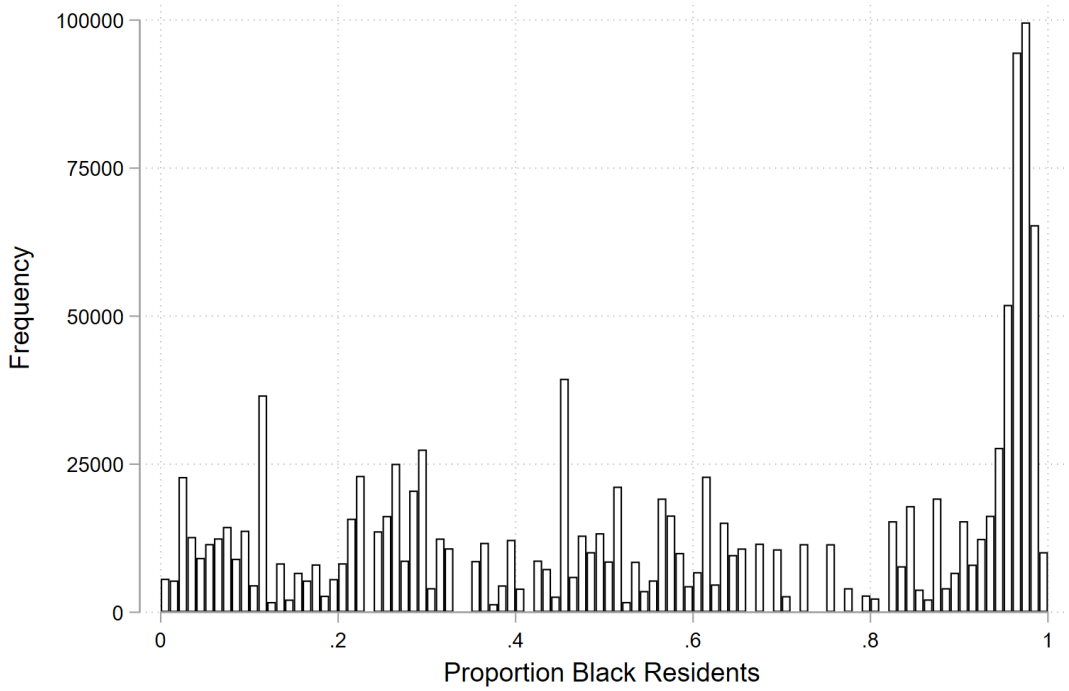
Overall, our findings indicate that race is an important determinant of use of force. While

it is difficult to know if these findings extend to other cities, these results do corroborate the distrust of police among minorities in the U.S. In particular, this study shows that white officers are more likely to use force than black officers when dispatched to otherwise-similar situations. In addition, results demonstrate that white officers are especially more likely to use force—including and especially gun force—in minority neighborhoods, compared to minority officers. This suggests use of force depends in large part on whether the officer is the same race as the civilians. In short, these findings suggest there is indeed a race problem with respect to police use of force, and thus much work remains to develop the civilian trust and cooperation necessary to maximize policing effectiveness.

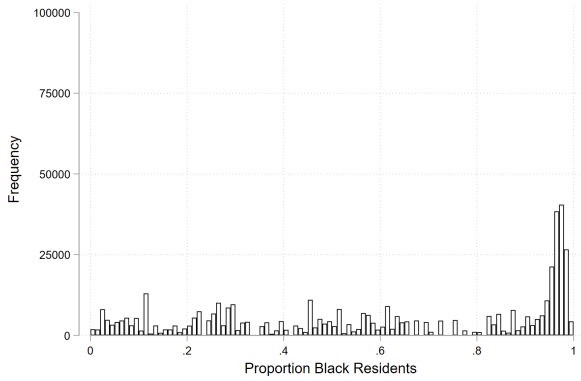
6 Tables and Figures

Figure 1: Distribution of 911 calls across Census Block Groups

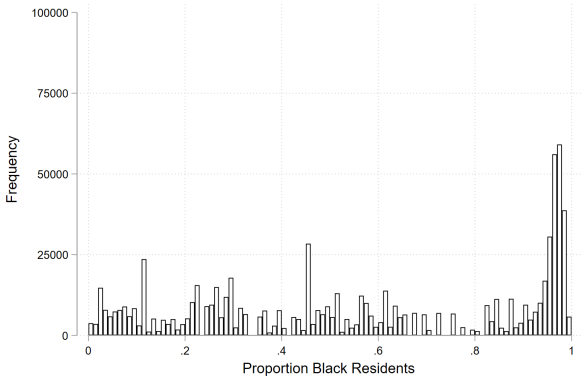
(a) Entire Sample



(b) Black Officers



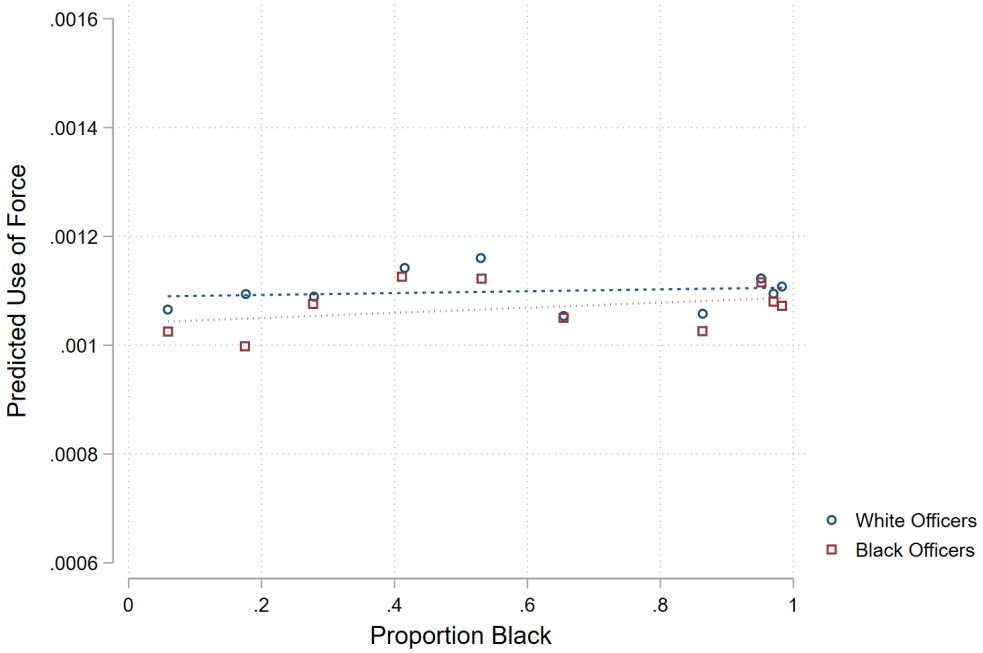
(c) White Officers



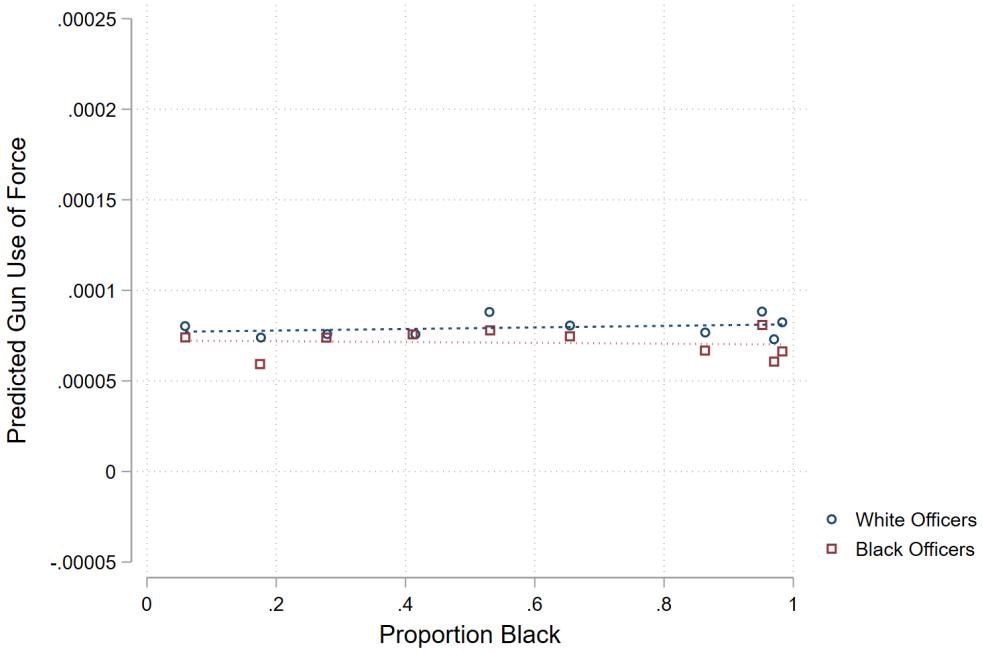
Notes: These figures report the distribution of proportion black residents for calls for service. Each histogram uses 0.01 size bins. Panels (b) and (c) report the histogram for calls where only black or white officers are dispatched, respectively.

Figure 2: Predicted Outcomes for Black and White Officers

(a) Predicted Use of Force



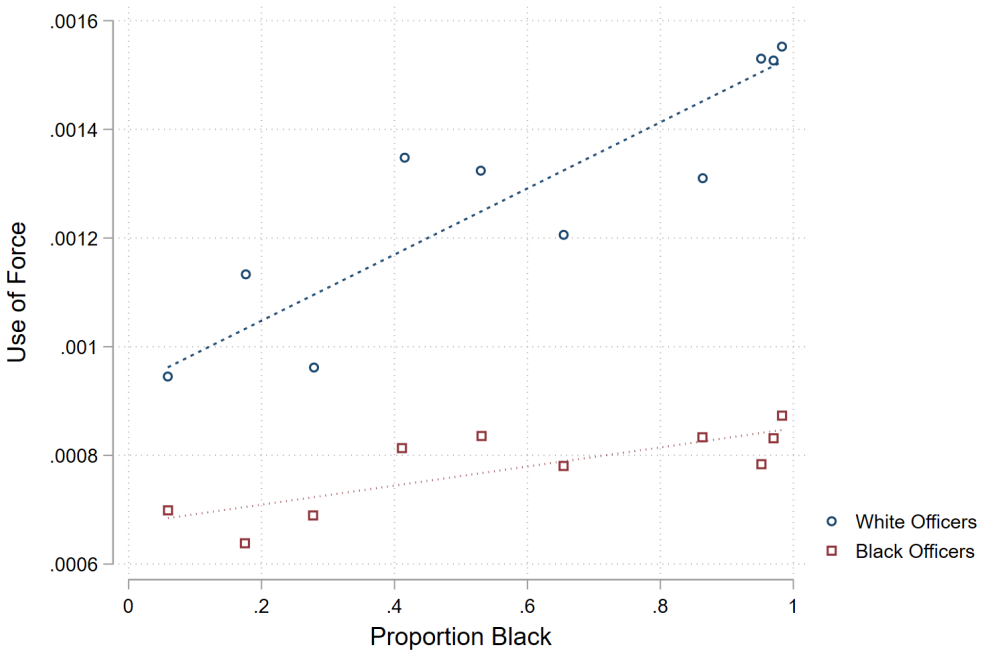
(b) Predicted Gun Use of Force



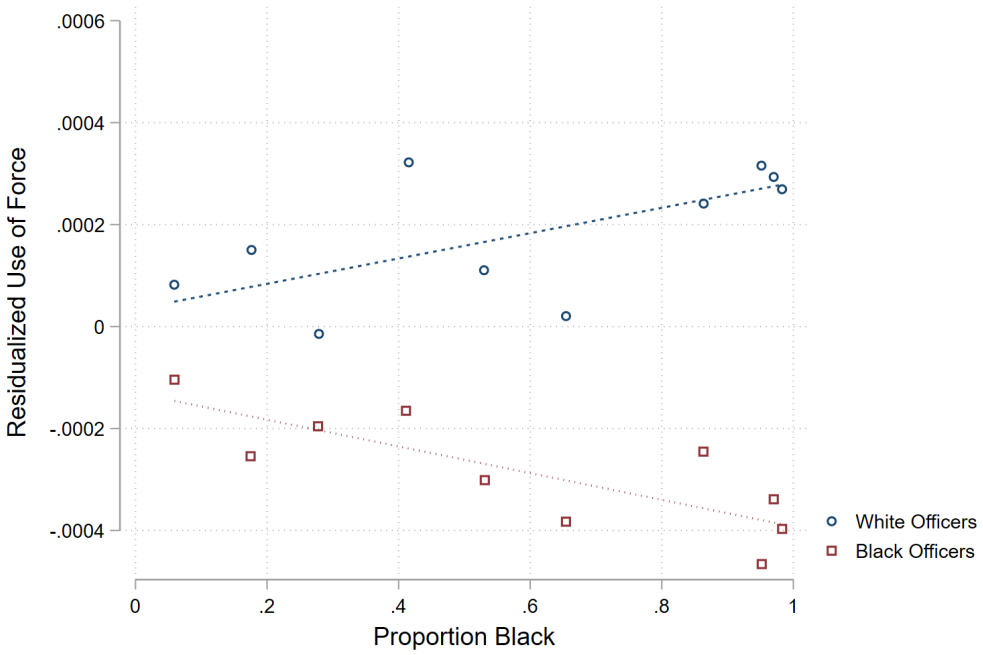
Notes: In Panels (a) and (b), we predict probability of use of force or gun use of force using all observable call characteristics for each call for service. Specifically, we predict (after removing beat-year-week-shift fixed effects) using proportion black civilians, unemployment, per capita income, proportion high school drop outs, call priority, latitude, longitude, and time between call and dispatch, as well as fixed effects for day of the week, call description, home beat, and call taker using a linear probability model. Observations are grouped so that each point includes an equal number of calls. The fitted line is a linear fit across all predicted use of force rates.

Figure 3: Actual Use of Force for Black and White Officers

(a) Use of Force



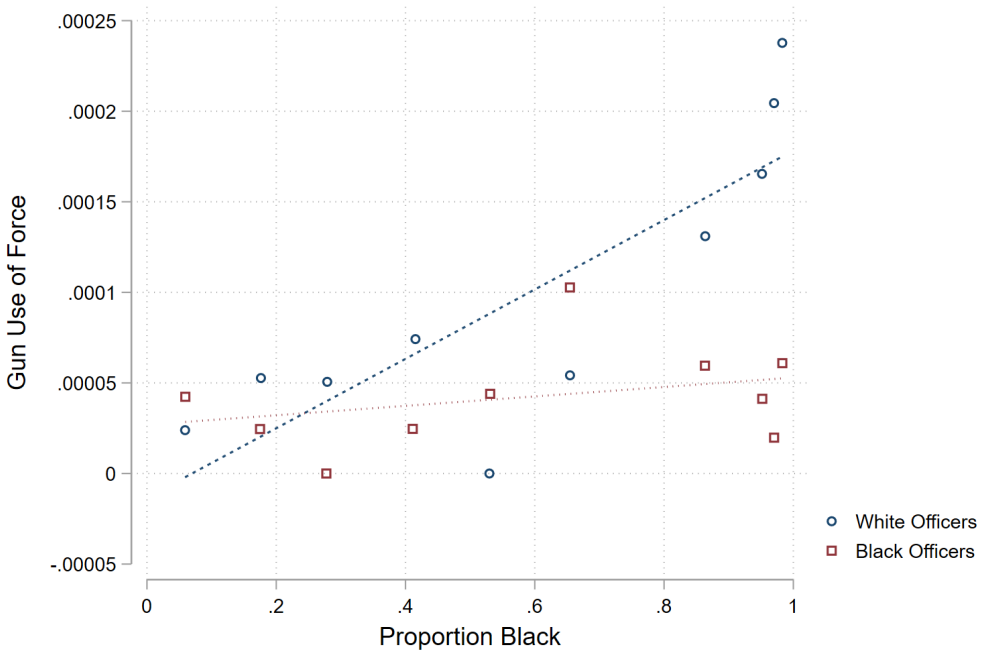
(b) Residualized Use of Force



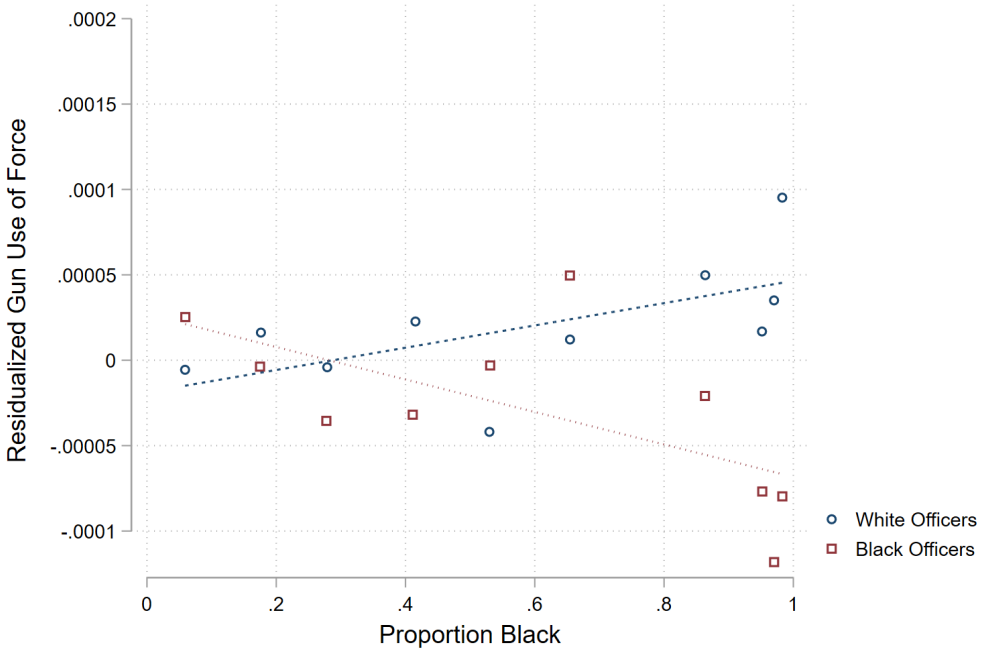
Notes: In Panel (a) we plot use of force. In Panel (b) we plot residualized (beat-year-week-shift fixed effects are removed) use of force. The fitted line is a linear fit across all use of force rates. Observations are grouped so that each point includes an equal number of calls.

Figure 4: Actual Gun Use of Force for Black and White Officers

(a) Gun Use of Force



(b) Residualized Gun Use of Force

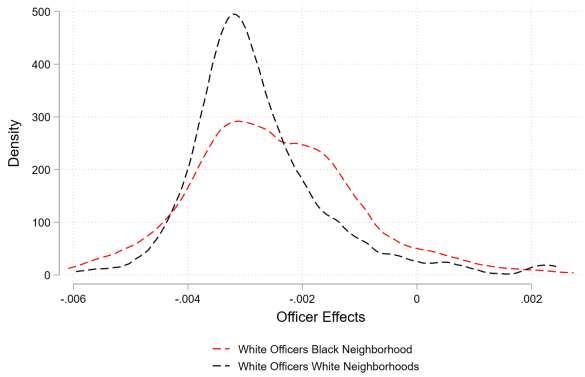


Notes: In Panel (a) we plot gun use of force. In Panel (b) we plot residualized (beat-year-week-shift fixed effects are removed) gun use of force. The fitted line is a linear fit across all gun use of force rates. Observations are grouped so that each point includes an equal number of calls.

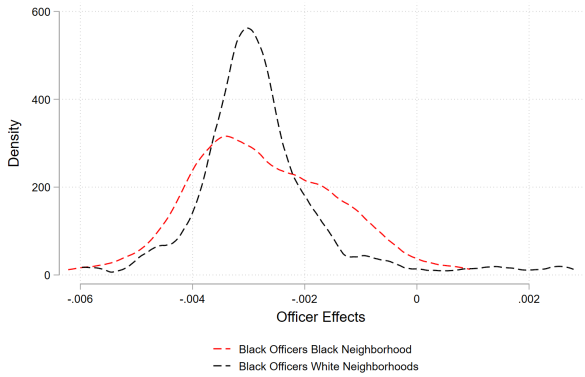
Figure 5: Distribution of Individual Police Officer Effects by Officer Race

(a) White and Black Officer Effects

(b) White Officer Effects by Neighborhood

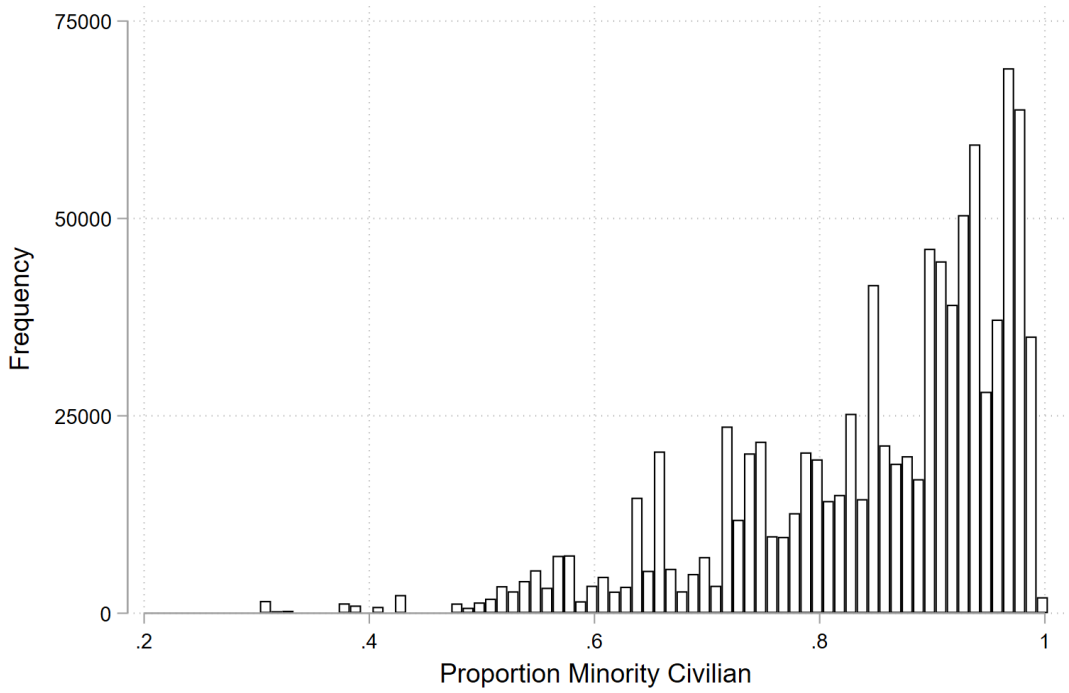


(c) Black Officer Effects by Neighborhood

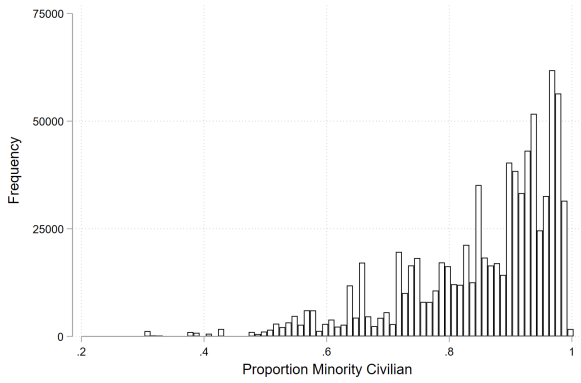


Notes: Figures represent the distribution of individual police officer effects (Bayes shrinkage) by police officer race and neighborhood race.

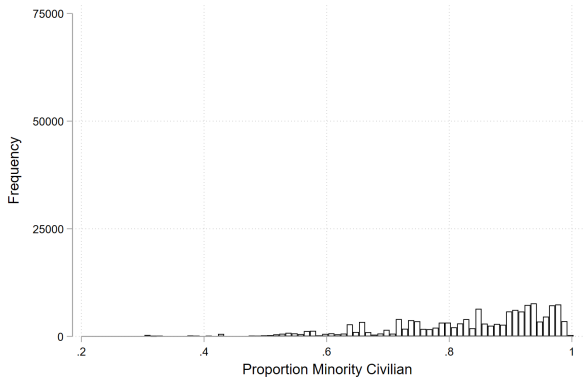
Figure 6: **Second City** Distribution of 911 calls across Census Block Groups



(a) Entire Sample



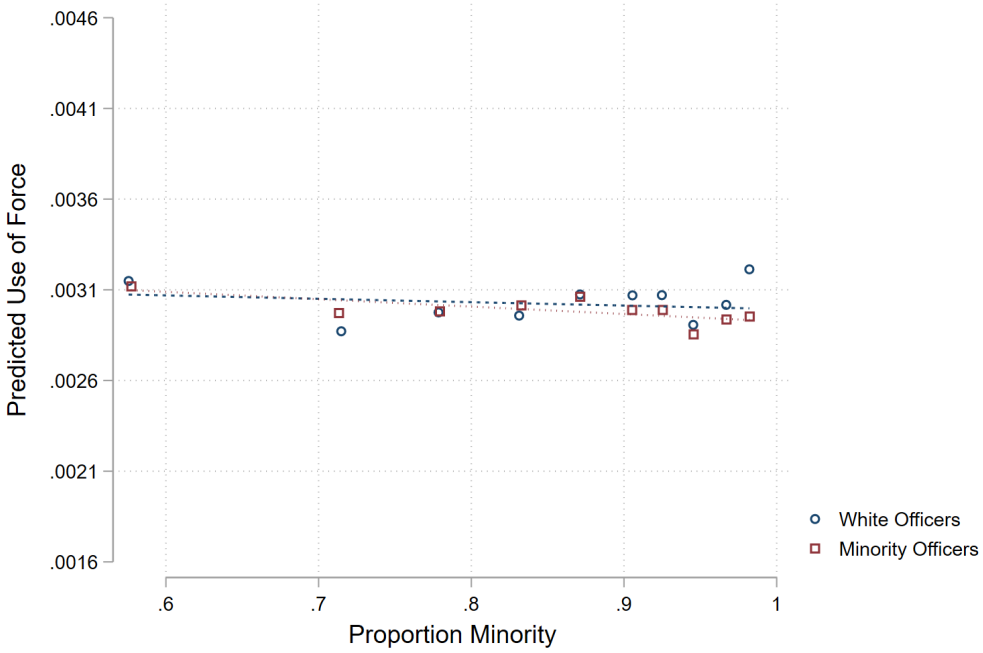
(b) Minority Officers Only



(c) White Officers Only

Notes: These figures report the distribution of proportion minority civilians for calls for service. Each histogram uses 0.01 size bins. Panels (b) and (c) report the histogram for calls where only minority or white officers are dispatched, respectively. 97% of minority officers are Hispanic. 96% of minority civilians are Hispanic.

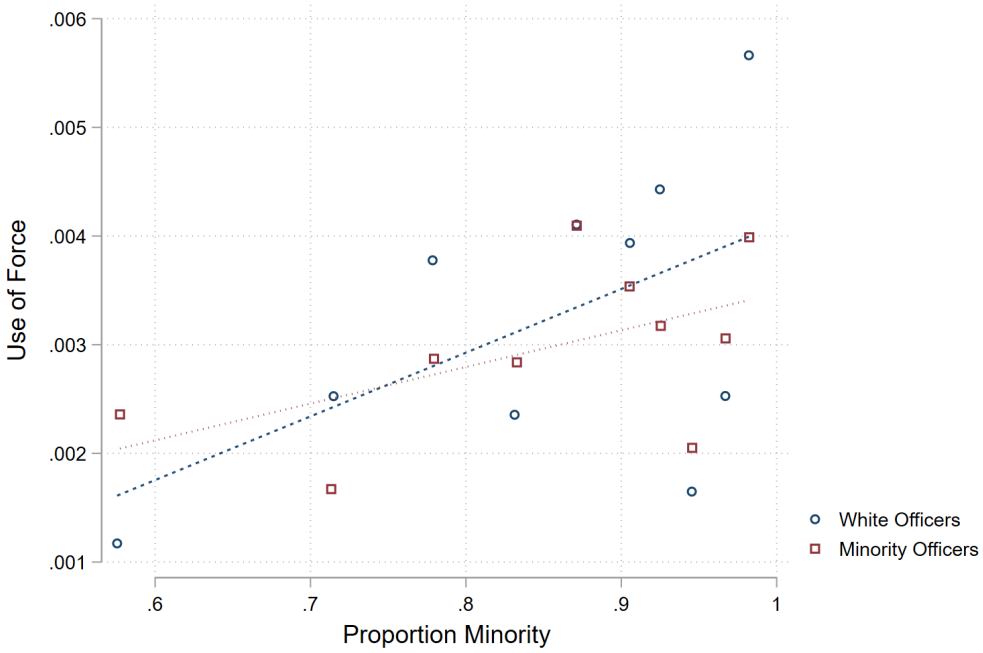
Figure 7: **Second City** Predicted Use of Force for Minority and White Officers



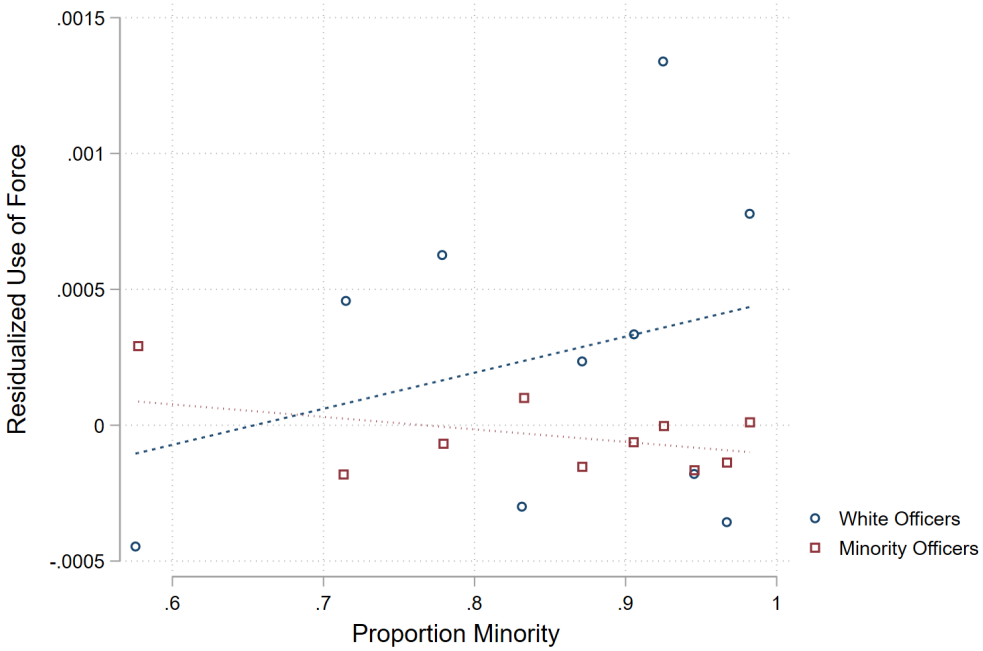
Notes: Here we predict probability of use of force using all observable call characteristics for each call for service. Specifically, we predict (after removing beat-year-month and beat-shift) using proportion minority civilians, call priority, latitude, longitude, per capital income, unemployment, and proportion with less than a high school degree, and dispatch time, as well as fixed effects for day of the week, call description, officer's home beat and call source. Observations are grouped so that each point includes an equal number of calls. The fitted line is a linear fit across all predicted use of force rates. 97% of minority officers are Hispanic. 96% of minority civilians are Hispanic.

Figure 8: **Second City** Actual Use of Force for Minority and White Officers

(a) Use of Force



(b) Residualized Use of Force



Notes: Here we plot the average use of force for 10 bins in panel (a) or residualized (beat-year-month, and beat-shift are removed) use of force in panel (b). The fitted line is a linear fit across all use of force rates. Observations are grouped so that each point includes an equal number of calls. 97% of minority officers are Hispanic. 96% of minority civilians are Hispanic.

Table 1: Summary Statistics

	(1) Entire Sample	(2) Black Officers	(3) White Officers
Outcomes			
Use of Force	0.00109	0.000780	0.00128
Gun Use of Force	0.0000762	0.0000426	0.0000969
Call Characteristics			
Proportion Black Civilians	0.586	0.603	0.575
	(0.333)	(0.333)	(0.333)
Per Capita Income	23280.1	22796.2	23577.3
	(14849.2)	(14559.2)	(15016.8)
Proportion Unemployed	0.139	0.143	0.137
	(0.111)	(0.112)	(0.110)
Proportion Less than HS Degree	0.185	0.187	0.184
	(0.118)	(0.117)	(0.118)
Black Officer	0.380	1	0
Female Officer	0.160	0.189	0.142
Years of Experience	10.11	10.52	9.858
	(7.980)	(7.969)	(7.976)
Priority of Call	2.838	2.838	2.838
	(0.757)	(0.754)	(0.758)
Call from Home Beat	0.180	0.183	0.177
Time Between Call and Dispatch	6.479	6.509	6.460
	(63.24)	(23.06)	(78.28)
X Coordinate	87.31	87.31	87.30
	(0.808)	(0.788)	(0.820)
Y Coordinate	111.6	111.7	111.6
	(1.685)	(1.672)	(1.691)
Observations	1233139	469170	763969

Standard deviations in parentheses

Notes: This table reports mean, standard deviation, and number of observations for each variable. Use of force is measured at the call level and takes on a value of one if the call ended in a use of force. The same is true for gun use of force. Priority, latitude, and longitude have been altered (multiplied by a random number) to protect the anonymity of the city.

Table 2: Correlation Between Call Characteristics and Officer Race

	(1) Proportion Black Civilians	(2) Per Capita Income	(3) Proportion Unemployed	(4) Proportion Less than HS Degree	(5) Call Priority	(6) Time Between Call and Dispatch	(7) Call from Home Beat	(8) X Coordinate	(9) Y Coordinate
White Officer	-0.00128*	52.40	-0.000247	-0.000208	-0.0105	-0.108	-0.00582	758.7	339.2
	(0.000662)	(43.57)	(0.000246)	(0.000254)	(0.00857)	(0.144)	(0.00374)	(1103.3)	(1157.6)
Observations	1233139	1233139	1233139	1233139	1233139	1233139	1233139	1233139	1233139
Outcome Mean	0.586	23281.7	0.139	0.185	2.839	6.490	0.180	87304866.5	202240062.9

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: This table reports the coefficient on $White\ Officer$ from separate regressions of call characteristics on a binary variable representing officer race. Each column includes beat-year-week-shift fixed effects. Standard errors are clustered at the officer level. Priority, latitude, and longitude have been altered (multiplied by a random number) to protect the identity of our city.

Table 3: The Effect of Police Officer Race on Use of Force and Gun Use of Force

	(1) Use of Force	(2) Use of Force	(3) Use of Force	(4) Use of Force	(5) Gun Use of Force	(6) Gun Use of Force	(7) Gun Use of Force	(8) Gun Use of Force
Panel A: OLS								
White Officer	0.000507***	0.000429***	0.000430***	0.000445***	0.0000518**	0.0000462**	0.0000607*	0.0000203
	(0.0000819)	(0.0000792)	(0.000108)	(0.0000888)	(0.0000219)	(0.0000228)	(0.0000322)	(0.0000176)
	[0.0000798]	[0.0000789]	[0.000108]	[0.0000928]	[0.0000224]	[0.0000234]	[0.0000340]	[0.0000174]
Observations	1233139	1233139	782767	450372	1233139	1233139	782767	450372
Outcome Mean	0.00106	0.00106	0.00125	0.000739	0.0000710	0.0000710	0.0000900	0.0000380
Beat-year-week-shift FE	Y	Y	Y	Y	Y	Y	Y	Y
Officer and Call Controls	-	Y	Y	Y	-	Y	Y	Y
High Use of Force Beats	-	-	Y	-	-	-	Y	-
Low Use of Force Beats	-	-	-	Y	-	-	-	Y
Panel B: Logit (Odds Ratio)								
White Officer	1.658***	1.607***	1.482***	2.058***	2.372***	2.151**	2.069**	2.611
	(0.136)	(0.129)	(0.135)	(0.286)	(0.765)	(0.680)	(0.695)	(1.659)
Observations	1233128	1233106	782753	401446	1208695	1093835	700541	308881
Outcome Mean	0.00109	0.00109	0.00128	0.000847	0.0000778	0.0000859	0.000108	0.0000583
Police Area FE	Y	Y	Y	Y	Y	Y	Y	Y
Additional Controls	-	Y	Y	Y	-	Y	Y	Y
High Use of Force Beats	-	-	Y	-	-	-	Y	-
Low Use of Force Beats	-	-	-	Y	-	-	-	Y

Exponentiated coefficients; Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: This table reports the coefficient on *White Officer* from the regression of *Use of Force* or *Gun Use of Force* on an indicator for officer race. For OLS specifications, columns 2 and 6 add controls for latitude, longitude, time between call and dispatch, per capita income, unemployment, and proportion with less than a high school degree, as well as fixed effects for day of the week, priority of call, call description, call taker, officer gender, officer years of experience, and officer home beat, as proxied by the beat to which he responded to the most calls. For Logit specifications, columns 2 and 6 add controls for per capita income, unemployment, and proportion with less than a high school degree, as well as fixed effects for officer gender and priority of call. Robust standard errors clustered at the officer level are reported in parentheses and two-way clustered (officer and beat) standard errors are reported in brackets. The empirical two-sided p-values from randomization inference for estimates in columns 1 and 5 of Panel A are 0.0002 and 0.0629, respectively.

Table 4: The Effect of Opposite Race Police Officers on Use of Force

	(1) Use of Force	(2) Use of Force	(3) Use of Force	(4) Use of Force	(5) Use of Force	(6) Use of Force	(7) Use of Force
Panel A: OLS							
Opposite-Race Officer							
(White Officer*Pr Black Civilian)	0.000566***	0.000613**	0.000629**	0.000617**	0.000399	0.000948**	-0.000122
	(0.000194)	(0.000277)	(0.000275)	(0.000275)	(0.000303)	(0.000381)	(0.000335)
	[0.000183]	[0.000284]	[0.000270]	[0.000270]	[0.000294]	[0.000355]	[0.000338]
Observations	1233139	1233139	1233139	1233139	1233139	782767	450372
Outcome Mean	0.00106	0.00106	0.00106	0.00106	0.00106	0.00125	0.000739
Beat-year-week-shift FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	-	Y	Y	Y	Y	Y	Y
Officer & Call Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	Y	-	-	-
Interactions	-	-	-	-	Y	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y
Panel B: Logit (Odds Ratio)							
Opposite-Race Officer							
(White Officer*Pr Black Civilian)	1.298	1.598*	1.434	-	-	1.843*	0.824
	(0.268)	(0.454)	(0.398)	-	-	(0.633)	(0.454)
Observations	1233128	829428	829428	-	-	474032	161806
Outcome Mean	0.00109	0.00162	0.00162	-	-	0.00211	0.00209
Police Area FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	-	Y	Y	Y	Y	Y	Y
Additional Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	Y	-	-	-
Interactions	-	-	-	-	Y	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y

Exponentiated coefficients; Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: This table reports the coefficient on the interaction of *White Officer* and *Proportion Black Civilian* from the regression of *Use of Force* on indicators for officer race, proportion citizen black, and the interaction term. For OLS specifications, column 3 adds controls for latitude, longitude, time between call and dispatch, per capita income, unemployment, and proportion with less than a high school degree, as well as fixed effects for day of the week, priority of call, call description, and call taker. For Logit specifications, column 3 adds controls for per capita income, unemployment, and proportion with less than a high school degree, and fixed effects for priority of call. Column 4 includes controls for home beat and the interaction of home beat and officer race. Column 5 adds interactions for every call characteristic added in column 3 interacted with officer race. Robust standard errors clustered at the officer level are reported in parentheses and two-way clustered (officer and beat) standard errors are reported in brackets. The empirical two-sided p-values from randomization inference for estimates in columns 1 and 2 of Panel A are 0.1011 and 0.0000, respectively.

Table 5: The Effect of Opposite Race Police Officers on Gun Use of Force

	(1) Gun Use of Force	(2) Gun Use of Force	(3) Gun Use of Force	(4) Gun Use of Force	(5) Gun Use of Force	(6) Gun Use of Force	(7) Gun Use of Force
Panel A: OLS							
Opposite-Race Officer							
(White Officer*Pr Black Civilian)	0.000171***	0.000379***	0.000368***	0.000367***	0.000299***	0.000424***	0.000150*
	(0.0000601)	(0.000133)	(0.000133)	(0.000133)	(0.000105)	(0.000142)	(0.0000777)
	[0.0000564]	[0.000143]	[0.000143]	[0.000143]	[0.000113]	[0.000157]	[0.0000923]
Observations	1233139	1233139	1233139	1233139	1233139	782767	450372
Outcome Mean	0.0000710	0.0000710	0.0000710	0.0000710	0.0000710	0.0000900	0.0000380
Beat-year-week-shift FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	-	Y	Y	Y	Y	Y	Y
Call Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	-	Y	-	-
Interactions	-	-	-	Y	-	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y
Panel B: Logit (Odds Ratio)							
Opposite-Race Officer							
(White Officer*Pr Black Civilian)	5.391*	14.86**	10.24**	-	-	21.10**	21.00*
	(4.705)	(15.78)	(11.69)	-	-	(26.68)	(38.62)
Observations	1208695	71418	71418	-	-	38177	8306
Outcome Mean	0.0000778	0.00132	0.00132	-	-	0.00199	0.00217
Police Area FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	-	Y	Y	Y	Y	Y	Y
Additional Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	Y	-	-	-
Interactions	-	-	-	-	Y	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y

Exponentiated coefficients; Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: This table reports the coefficient on the interaction of *White Officer* and *Proportion Black Civilian* from the regression of *Gun Use of Force* on indicators for officer race, proportion citizen black, and the interaction term. For OLS specifications, column 3 adds controls for latitude, longitude, time between call and dispatch, per capita income, unemployment, and proportion with less than a high school degree, as well as fixed effects for day of the week, priority of call, call description, and call taker. For Logit specifications, column 3 adds controls for per capita income, unemployment, and proportion with less than a high school degree, and fixed effects for priority of call. Column 4 includes controls for home beat and the interaction of home beat and officer race. Column 5 adds interactions for every call characteristic added in column 2 interacted with officer race. Robust standard errors clustered at the officer level are reported in parentheses and two-way clustered (officer and beat) standard errors are reported in brackets. The empirical two-sided p-values from randomization inference for estimates in columns 1 and 2 of Panel A are 0.0715 and 0.0000, respectively.

Table 6: **Second City** The Effect of Police Officer Race on Use of Force

	(1) Use of Force	(2) Use of Force	(3) Use of Force	(4) Use of Force
Panel A: OLS				
White Officer	0.0000956	0.0000869	0.000253	0.0000143
	(0.0000824)	(0.0000779)	(0.000188)	(0.0000631)
	[0.0000826]	[0.0000781]	[0.000182]	[0.0000668]
Observations	938562	938562	345195	593367
Outcome Mean	0.000940	0.000940	0.00210	0.000277
Beat-year-month, Beat-shift FE	-	Y	Y	Y
Officer and Call Controls	-	-	Y	-
High Use of Force Beats	-	-	Y	-
Low Use of Force Beats	-	-	-	Y
Panel B: Logit (Odds Ratio)				
White Officer	1.102	1.063	1.082	0.982
	(0.0783)	(0.0735)	(0.0790)	(0.191)
Observations	937796	937796	345195	588739
Outcome Mean	0.00299	0.00299	0.00740	0.000430
Police Area FE	Y	Y	Y	Y
Additional Controls	Y	Y	Y	Y
High Use of Force Beats	-	-	Y	-
Low Use of Force Beats	-	-	-	Y

Exponentiated coefficients; Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: This table reports the coefficient on $White\ Officer$ from the regression of $Use\ of\ Force$ on an indicator for officer race. Each column includes beat-year-month and beat-shift fixed effects. For OLS specifications, column 2 adds controls for latitude, longitude, per capita income, unemployment, proportion with less than a high school degree, and officer hire date, as well as fixed effects for day of the week, hour of dispatch, priority of call, call description, call source, multi-agency call, officer gender, and officer home beat, as proxied by the beat to which he responded to the most calls. For Logit specifications, column 2 adds controls for per capita income, proportion with less than a high school degree, and officer hire date, as well as fixed effects for officer gender, call priority, and day of week. Columns 3 and 4 only include calls from high use of force beats and low use of force beats, respectively. Robust standard errors clustered at the officer level are reported in parentheses and two-way clustered (officer and beat) standard errors are reported in brackets. The empirical two-sided p-value from randomization inference for the estimate in column 1 of Panel A is 0.1488.

Table 7: **Second City** The Effect of Different Race Police Officers on Use of Force

	(1) Use of Force	(2) Use of Force	(3) Use of Force	(4) Use of Force	(5) Use of Force	(6) Use of Force	(7) Use of Force
Panel A: OLS							
Opposite Race Officer							
(White Officer*Pr Minority Civilians)	0.000840**	0.000694*	0.000691*	0.000689*	0.000349	0.000550	0.000360
	(0.000393)	(0.000398)	(0.000393)	(0.000396)	(0.000544)	(0.00122)	(0.000316)
	[0.000407]	[0.000407]	[0.000412]	[0.000407]	[0.000588]	[0.00116]	[0.000363]
Observations	938562	938562	938562	938562	938562	345195	593367
Outcome Mean	0.000940	0.000940	0.000940	0.000940	0.000940	0.00210	0.000277
Beat-year-month, Beat-shift FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	Y	Y	Y	Y	Y	Y	Y
Officer and Call Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	-	Y	-	-
Interactions	-	-	-	Y	-	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y
Panel B: Logit (Odds Ratio)							
Opposite Race Officer							
(White Officer*Pr Minority Civilians)	2.628**	2.231*	2.228*	-	-	1.599	14.76*
	(1.089)	(0.962)	(0.984)	-	-	(0.780)	(22.43)
Observations	937796	863920	863920	-	-	315075	217170
Outcome Mean	0.00299	0.00325	0.00325	-	-	0.00810	0.00116
Beat FE	Y	Y	Y	-	-	Y	Y
Officer and Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	Y	Y	Y	Y	Y	Y	Y
Additional Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	-	Y	-	-
Interactions	-	-	-	Y	-	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y

Exponentiated coefficients; Standard errors in parentheses

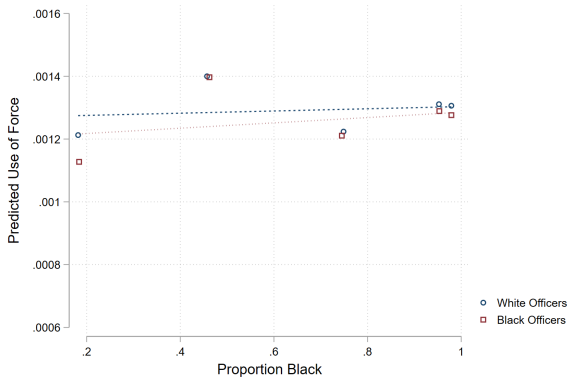
* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: This table reports the coefficient on the interaction of *White Officer* and *Proportion Minority Civilians* from the regression of *Use of Force* on indicators for officer race, proportion citizen black, and the interaction term. For OLS specifications, column 3 adds controls for latitude, longitude, per capita income, unemployment, proportion with less than a high school degree, and officer hire date, as well as fixed effects for day of the week, hour of dispatch, priority of call, call description, call source, and multi-agency call. For Logit specifications, column 3 adds controls for per capita income, proportion with less than a high school degree, and officer hire date, as well as fixed effects for call priority and day of week. Column 4 adds controls for an officer's home beat and home beat interacted with officer race. Column 5 adds interactions for every call characteristic added in column 3 interacted with officer race. Robust standard errors clustered at the officer level are reported in parentheses and two-way clustered (officer and beat) standard errors are reported in brackets. The empirical two-sided p-values from randomization inference for estimates in columns 1 and 2 of Panel A are 0.1076 and 0.1808, respectively.

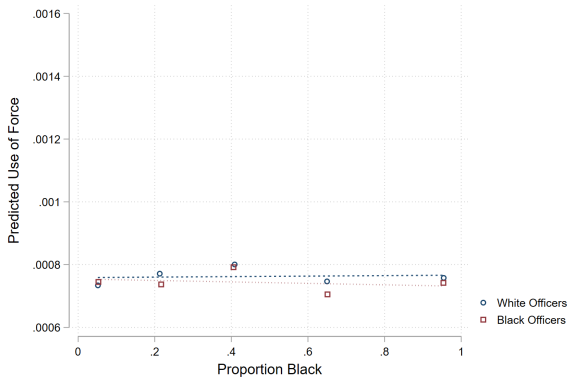
A Appendix (For online publication)

Figure A1: Predicted Outcomes for Black and White Officers

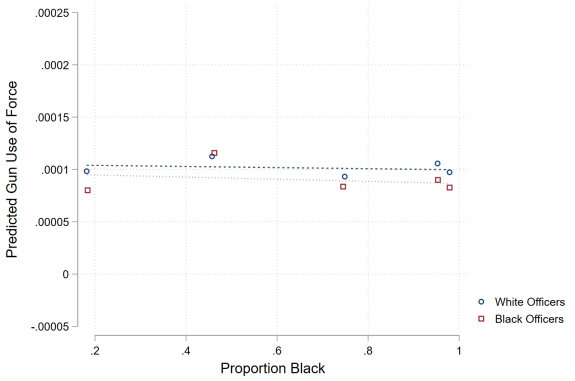
(a) Predicted UOF in High UOF Beats



(b) Predicted UOF in Low UOF Beats



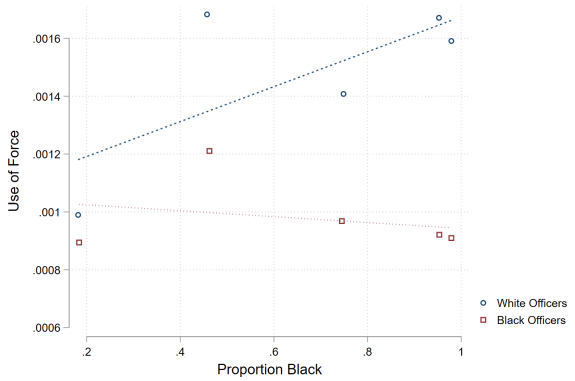
(c) Predicted Gun UOF in High UOF Beats



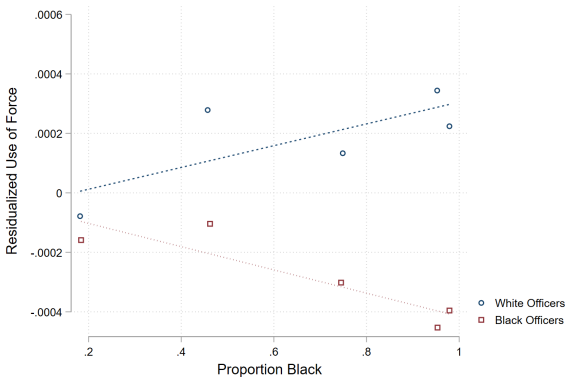
Notes: In Panels (a) and (b), we predict probability of use of force or gun use of force using all observable call characteristics for each call for service. Specifically, we predict (after removing beat-year-week-shift fixed effects) using proportion black civilians, call priority, latitude, longitude, unemployment, proportion with less than a high school degree, home beat, per capita income, and time between call and dispatch, as well as fixed effects for day of the week, call description, and call taker using a linear probability model. Observations are grouped so that each point includes an equal number of calls. The fitted line is a linear fit across all predicted use of force rates. High Use of Force Beats are police beats with above average use of force. Low Use of Force Beats are police beats with below average use of force.

Figure A2: Actual Outcomes for Black and White Officers (Subgroup)

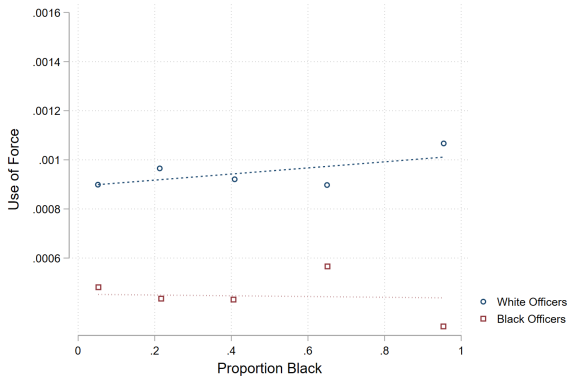
(a) Use of Force in High UOF Beats



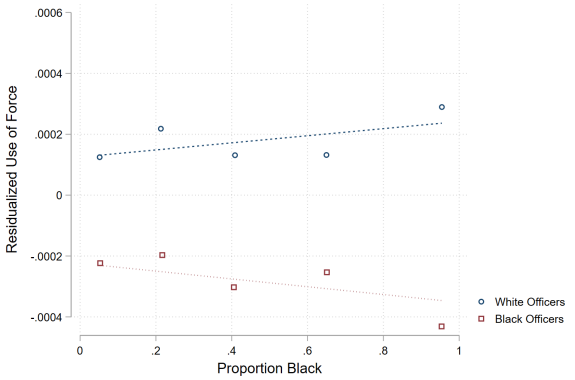
(b) Residualized Use of Force in High UOF Beats



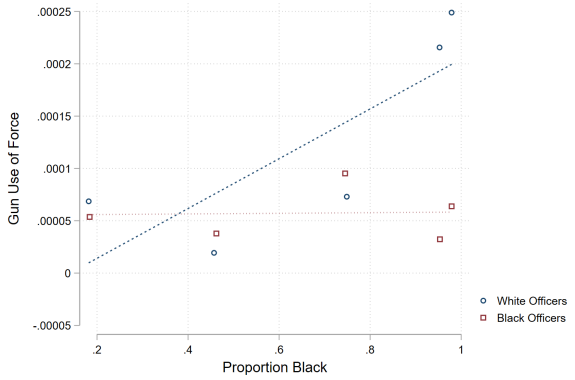
(c) Use of Force in Low UOF Beats



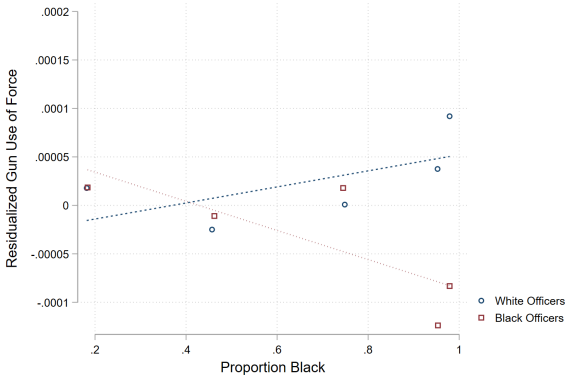
(d) Residualized Use of Force in Low UOF Beats



(e) Gun Use of Force in High UOF Beats



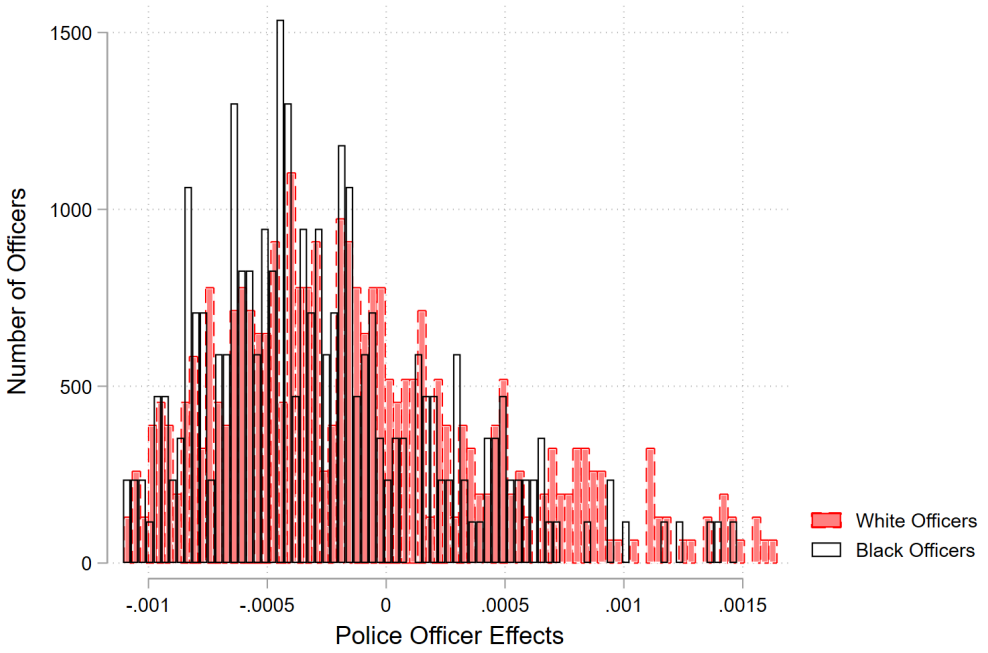
(f) Residualized Gun Use of Force in High UOF Beats



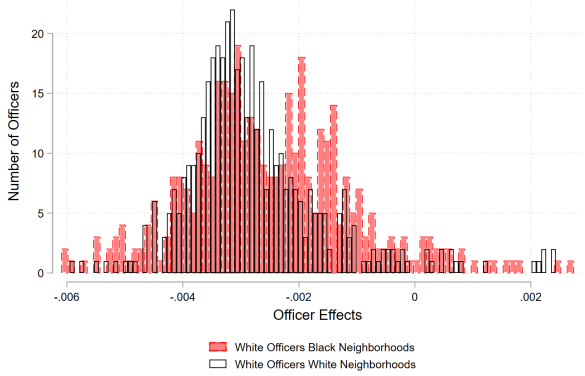
Notes: In panels (a), (c), and (e) we plot use of force or gun use of force. Panels (b), (d), and (e) show residualized (removing beat-year-week-shift fixed effects) use of force or gun use of force. The fitted line is a linear fit across all use of force rates. Observations are grouped so that each point includes an equal number of calls.

Figure A3: Distribution of Individual Police Officer Effects by Officer Race

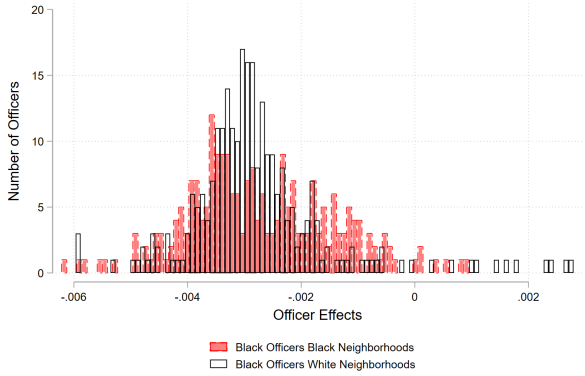
(a) White and Black Officer Effects



(b) White Officer Effects by Neighborhood



(c) Black Officer Effects by Neighborhood



Notes: Figures represent the distribution of individual police officer effects (Bayes shrinkage) by police officer and neighborhood.

Table A1: Individual Officer Level Results– The Effect of Opposite Race Police Officers on Use of Force

	Use of Force	Use of Force	Use of Force	Use of Force	Use of Force	Use of Force	Use of Force
Panel A: OLS							
Opposite Race Officer							
(White Officer*Pr Black Civilian)	0.000543***	0.000579**	0.000603**	0.000591**	0.000359	0.000930**	-0.000160
	(0.000193)	(0.000276)	(0.000274)	(0.000274)	(0.000301)	(0.000378)	(0.000334)
Observations	1233139	1233139	1233139	1233139	1233139	782767	450372
Outcome Mean	0.00104	0.00104	0.00104	0.00104	0.00104	0.00123	0.000729
Beat-year-week-shift FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	-	Y	Y	Y	Y	Y	Y
Officer & Call Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	Y	-	-	-
Interactions	-	-	-	-	Y	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y
Panel B: Logit (Odds Ratio)							
Opposite Race Officer							
(White Officer*Pr Black Civilian)	1.310	1.551	1.404	-	-	1.845*	0.784
	(0.276)	(0.447)	(0.396)	-	-	(0.642)	(0.435)
Observations	1223413	819937	819937	-	-	467330	160865
Outcome Mean	0.00106	0.00158	0.00158	-	-	0.00207	0.00205
Police Area FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	-	Y	Y	Y	Y	Y	Y
Additional Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	Y	-	-	-
Interactions	-	-	-	-	Y	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y

Exponentiated coefficients; Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: We define use of force at the individual officer level (as opposed to call level). This table reports the coefficient on the interaction of *White Officer* and *Proportion Black Civilian* from the regression of *Use of Force* on indicators for officer race, proportion citizen black, and the interaction term. For OLS specifications, column 3 adds controls for latitude, longitude, time between call and dispatch, per capita income, unemployment, and proportion with less than a high school degree, as well as fixed effects for day of the week, priority of call, call description, and call taker. For Logit specifications, column 3 adds controls for per capita income, unemployment, and proportion with less than a high school degree, and fixed effects for priority of call. Column 4 includes controls for home beat and the interaction of home beat and officer race. Column 5 adds interactions for every call characteristic added in column 2 interacted with officer race. Robust standard errors are clustered at the officer level.

Table A2: Individual Officer Level Results – The Effect of Opposite Race Police Officers on Gun Use of Force

	Gun Use of Force	Gun Use of Force	Gun Use of Force	Gun Use of Force	Gun Use of Force	Gun Use of Force	Gun Use of Force
Panel A: OLS							
Opposite Race Officer							
(White Officer*Pr Black Civilian)	0.000161***	0.000368***	0.000361***	0.000360***	0.000286***	0.000413***	0.000136*
	(0.0000586)	(0.000132)	(0.000133)	(0.000133)	(0.000103)	(0.000140)	(0.0000762)
Observations	1233139	1233139	1233139	1233139	1233139	782767	450372
Outcome Mean	0.0000681	0.0000681	0.0000681	0.0000681	0.0000681	0.0000861	0.0000368
Beat-year-week-shift FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	-	Y	Y	Y	Y	Y	Y
Officer & Call Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	Y	-	-	-
Interactions	-	-	-	-	Y	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y
Panel B: Logit (Odds Ratio)							
Opposite Race Officer							
(White Officer*Pr Black Civilian)	3.903*	15.29**	10.40*	-	-	20.95**	20.29
	(3.048)	(17.68)	(13.20)	-	-	(28.85)	(37.37)
Observations	739115	65584	65584	-	-	33806	8228
Outcome Mean	0.000118	0.00133	0.00133	-	-	0.00207	0.00207
Police Area FE	Y	Y	Y	Y	Y	Y	Y
Officer & Civilian Race Controls	Y	Y	Y	Y	Y	Y	Y
Officer FE	-	Y	Y	Y	Y	Y	Y
Additional Controls	-	-	Y	Y	Y	Y	Y
Home Beat Controls	-	-	-	Y	-	-	-
Interactions	-	-	-	-	Y	-	-
High Use of Force Beats	-	-	-	-	-	Y	-
Low Use of Force Beats	-	-	-	-	-	-	Y

Exponentiated coefficients; Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: We define use of force at the individual officer level (as opposed to call level). This table reports the coefficient on the interaction of *White Officer* and *Proportion Black Civilian* from the regression of *Gun Use of Force* on indicators for officer race, proportion citizen black, and the interaction term. For OLS specifications, column 3 adds controls for latitude, longitude, time between call and dispatch, per capita income, unemployment, and proportion with less than a high school degree, as well as fixed effects for day of the week, priority of call, call description, and call taker. For Logit specifications, column 3 adds controls for per capita income, unemployment, and proportion with less than a high school degree, and fixed effects for priority of call. Column 4 includes controls for home beat and the interaction of home beat and officer race. Column 5 adds interactions for every call characteristic added in column 2 interacted with officer race. Robust standard errors are clustered at the officer level.

Table A3: Alternative Specifications

	Use of Force	Use of Force	Use of Force	Use of Force
Panel A: Use of Force				
Opposite Race Officer (White Officer*Pr Black Civilian)	0.000613**			
	(0.000277)			
Opposite Race Officer (Black Officer*Pr White Civilian)		0.000700**		
		(0.000297)		
Same Race Officer (Black Officer*Pr Black Civilian)			-0.000613**	
			(0.000277)	
Same Race Officer (White Officer*Pr White Civilian)				-0.000700**
				(0.000297)
Observations	1233139	1233139	1233139	1233139
Outcome Mean	0.00106	0.00106	0.00106	0.00106
	Gun Use of Force	Gun Use of Force	Gun Use of Force	Gun Use of Force
Panel B: Gun Use of Force				
Opposite Race Officer (White Officer*Pr Black Civilian)	0.000379***			
	(0.000133)			
Opposite Race Officer (Black Officer*Pr White Civilian)		0.000383***		
		(0.000141)		
Same Race Officer (Black Officer*Pr Black Civilian)			-0.000379***	
			(0.000133)	
Same Race Officer (White Officer*Pr White Civilian)				-0.000383***
				(0.000141)
Observations	1233139	1233139	1233139	1233139
Outcome Mean	0.0000710	0.0000710	0.0000710	0.0000710

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: This table reports the coefficient for each possible interaction term. Every specification includes the relevant officer and civilian race controls (For example, in the second row the regression includes a control for proportion white civilians). Each column represents a separate regression. All specifications include beat-year-week-shift and individual officer fixed effects. Robust standard errors are clustered at the officer level.

Table A4: **Second City** Summary Statistics

	(1) Entire Sample	(2) Minority Officers	(3) White Officers
Outcomes			
Use of Force	0.00299	0.00297	0.00311
Call Characteristics			
Proportion Minority Civilian	0.849	0.852	0.831
	(0.125)	(0.124)	(0.130)
Proportion Hispanic Civilian	0.813	0.817	0.789
	(0.147)	(0.145)	(0.155)
Proportion Black Civilian	0.0362	0.0352	0.0423
	(0.0357)	(0.0349)	(0.0400)
Per Capita Income	19142.9	19093.2	19438.5
	(9587.6)	(9574.8)	(9658.3)
Proportion Unemployed	0.0834	0.0835	0.0824
	(0.0623)	(0.0625)	(0.0610)
Proportion Less than HS Degree	0.251	0.254	0.235
	(0.172)	(0.173)	(0.163)
Minority Officer	0.856	1	0
Hispanic Officer	0.829	0.969	0
Black Officer	0.0268	0.0313	0
Longitude	-211.3	-211.3	-211.3
	(0.185)	(0.186)	(0.182)
Latitude	31.07	31.07	31.08
	(0.0583)	(0.0575)	(0.0609)
Hour Dispatched	12.93	12.98	12.62
	(7.386)	(7.311)	(7.810)
Priority	5.338	5.340	5.329
	(1.896)	(1.893)	(1.914)
Multi-Agency Call	0.852	0.852	0.854
Observations	938562	803494	135068

Standard deviations in parentheses

Notes: This table reports mean, standard deviation, and number of observations for each variable. Use of force is measured at the call level and takes on a value of one if the call ended in a use of force. Priority, latitude and longitude have been altered (multiplied by a random number) to protect the identity of our city. Multi-Agency takes on a value of one if other agencies (e.g. Fire Department) were dispatched to a call.

Table A5: **Second City** Correlation Between Call Characteristics and Officer Race

	(1) Proportion Minority	(2) Proportion Hispanic	(3) Proportion Black	(4) Per Capita Income	(5) Proportion Unemployed	(6) Proportion Less than HS Degree	(7) Home Beat	(8) X Coord.	(9) Y Coord.	(10) Time Dispatched	(11) Call Priority	(12) Multi Agency
White Officer	0.733	1.493	-0.766	71226.0	-0.355	0.976	36.85	-0.353	-0.219	-272.8	-26.19	-10.82
	(28515.9)	(33205.0)	(9448.9)	(3.56914e+09)	(31280.1)	(87793.4)	(318525.4)	(9156.3)	(3257.2)	(15754781.2)	(3763753.1)	(666544.6)
Observations	938562	938562	938562	938562	938562	938562	938562	938562	938562	938562	938562	938562
Outcome Mean	0.848	0.812	0.0365	19169.1	0.0836	0.251	0.0268	-211.3	31.07	13.09	5.575	1.112

Standard errors in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: This table reports the coefficient on $White\ Officer$ from separate regressions of call characteristics on a binary variable representing officer race. Each column includes beat-year-month and beat-shift fixed effects. Standard errors are clustered at the officer level. Priority, latitude, and longitude have been altered (multiplied by a random number) to protect the identity of our city.