Making inferences about racial disparities in police violence

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A recent *PNAS* article, Johnson et al. (2019), examines the role of race in police violence using data on fatal officer-involved shootings. The study predicts civilian race as a function of police-citizen encounter attributes, X, including officer race and local demographics, and claims "racial disparities" in this analysis are "a necessary but not sufficient requirement for the existence of racial biases"—i.e. if no anti-black disparity is found, no anti-black bias exists (Johnson et al., 2019, 1).

A logical fallacy renders this analysis uninformative for the study of racially biased policing. Anti-black bias in police shootings is defined as $\Pr(\text{shot}|\text{civilian black}, X) > \Pr(\text{shot}|\text{civilian white}, X)$—all else equal, black civilians have a greater chance of being shot by police than white civilians. The relationship between this quantity and the estimand in Johnson et al., $\Pr(\text{civilian race}|\text{shot}, X)$, is given by a simple application of Bayes' rule (Bayes, 1763):

$$\begin{aligned}&\Pr(\text{shot}|\text{civilian race}, X)\\ &\quad = \Pr(\text{civilian race}|\text{shot}, X)\ \frac{\Pr(\text{shot}|X)}{\Pr(\text{civilian race}|X)}.\end{aligned} \tag{1}$$

The numerator in the right-hand fraction can be absorbed into a proportionality constant, but the analyst can only ignore the denominator (as Johnson et al. does) if $\Pr(\text{civilian black}|X) = \Pr(\text{civilian white}|X)$—i.e., if officers encounter equal numbers of black and white civilians in every setting, X.

Because Johnson et al. claim to test a necessary condition for bias, they argue that if fewer black civilians are killed, $\frac{\Pr(\text{civilian black}|\text{shot},X)}{\Pr(\text{civilian white}|\text{shot},X)} \leq 1$, then anti-black bias cannot exist, i.e. $\frac{\Pr(\text{shot}|\text{civilian black},X)}{\Pr(\text{shot}|\text{civilian white},X)} \leq 1$. Equation 1 shows this to be false. In fact, to rule out anti-black bias, the analyst must show $\frac{\Pr(\text{civilian black}|\text{shot},X)}{\Pr(\text{civilian white}|\text{shot},X)} \leq \frac{\Pr(\text{civilian black}|X)}{\Pr(\text{civilian white}|X)}$. That is, under circumstances X, black civilians are underrepresented in police killings, relative to police encounters.

This "benchmark" encounter rate is notoriously difficult to estimate. Johnson et al. claim to develop "an approach that sidesteps the benchmark debate" (Johnson et al., 2019, 1), but in truth merely replace all reasonable proxies with the unjustifiable assumption that black and white civilians are encountered in *equal* numbers given X.

A simple thought experiment provides further clarity. Imagine police encounter 100 civilians—10 black and 90 white—in identical circumstances. Due to anti-black bias, they shoot five black civilians (50%), and nine white civilians (10%). The approach in Johnson et al. would show a much higher chance the victim is white, conditional on being shot (9/14 = .64), than black (5/14 = .36), and erroneously conclude no anti-black bias.

Johnson et al. invokes the same fallacy when analyzing officer characteristics. Table 2 (Johnson et al., 2019, 3) shows the relationship between Pr(civilian black|shot, officer race, X) and Pr(civilian white|shot, officer race, X) is not significantly different between white and black officers. From this, the study concludes: "white officers are not more likely to shoot minority civilians than non-white officers," (Johnson et al., 2019, 1).

Again, this inference only follows under the strong, unstated assumption that black and white officers encounter black civilians in equal numbers. But consider another hypothetical. Suppose black officers encounter 90 black civilians and 10 white, while white officers encounter the reverse. Among these, black and white officers both shoot five black civilians and nine white. Clearly, black and white officers exhibit very different biases. Examining fatal shootings alone, these biases are entirely concealed.

References

Bayes, Thomas. 1763. "An Essay towards Solving a Problem in the Doctrine of Chances." *Philosophical Transactions of the Royal Society of London* 53:370–418.

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