Probable Causation, Episode 57: Giovanni Mastrobuoni

Jennifer [00:00:08] Hello and welcome to Probable Causation, a show about law, economics and crime. I'm your host, Jennifer Doleac of Texas A&M University, where I'm an Economics Professor and the Director of the Justice Tech Lab.

Jennifer [00:00:18] My guest this week is Giovanni Mastrobuoni. Giovanni is the Carlo Alberto chair at Collegio Carlo Alberto and Professor of Economics at the University of Turin. Giovanni, welcome to the show.

Giovanni [00:00:30] Hi, thanks for having me.

Jennifer [00:00:31] Today, we're going to talk about your research on how predictive policing technology affects crime. But before we get into that, could you tell us about your research expertise and how you became interested in this topic?

Giovanni [00:00:41] Okay, so I see myself as an empirical public and labor economist. So I see criminals as a just a different type of worker that that we analyze. And the way I got into this subject is right after my Ph.D. in 2006, I moved back to Italy, and that happened a few months after, like a massive collective pardon happened. So imagine a third of the prison population got released within a few weeks. And at the same time, the Minister of Justice, his name was Mastella, was arguing that there would be no increase in crime. So my my first reaction was, how can this be? Why would you keep people in prison if you're not expecting any recidivism?

Jennifer [00:01:23] Right.

Giovanni [00:01:23] And so I started looking for for data. I realized that there were no no data other than in sort of in paper format. And after a lot of work, I managed to get this into electronic format. I found out that there had been several collective pardons on average after World War II, one every five years. And so in my first crime paper, I use these pardons to estimate the incapacitation effect of prison time. Now that project then led to additional projects. So the first one was with the Italian Banking Association, and they were interested because after the 2006 pardon sort of bank robberies doubled within a month. So, so they gave me data that allowed me to study bank robberies and that led to tons of paper on the disutility of prison time, which I presented at the Italian Banking Association. And it happened, there was a police officer in the audience and he called me up later in the evening on my cell phone, which was a bit scary. And he told me, look, I have even better data than the one you analyzed. So we started talking and talking and talking. And after a while, sort of he trusted me, shared the data, and that that led to a couple of papers. And one is the paper on predictive policing. The other papers is is one where I sort of estimate that the effect of police presence on the clearance rates.

Jennifer [00:02:46] Yeah. So your paper that we're gonna talk about today is titled, "Crime Is Terribly Revealing: Information Technology and Police Productivity." It was published in the Review of Economic Studies in 2020. So big picture, what is predictive policing?

Giovanni [00:02:58] OK, so the way I see predictive policing is as an evolution of hotspots policing. So the main idea is to use data about the past, about past crimes to predict future ones, and then deploy police forces accordingly. Of course, this can be done with different degrees of, let's call it statistical sophistication and potentially with different goals, mainly deterrence versus incapacitation. So, for example, if the idea is to deter criminals from

committing crimes, you want the police patrols to be highly visible. So this is in a nutshell, what predictive policing is about.

Jennifer [00:03:35] And how common is this sort of technology in police departments?

Giovanni [00:03:38] OK, so this is hard to say. I tried to look into it, but we don't really have reliable statistics on this. You know, it's pretty clear that it's growing fast and it's growing together with statistical models. The kind of data I managed to find is that for the US that we have that between '87 and 2003, the proportion of agencies that use information technology more generally for criminal investigations, dispatch and fleet management went up by a lot—by 11, 9 and, 7 percent in '87 to 59, 58 and 34 percent in 2003. And we know that in 2013, about 90 percent of agencies use information technology to analyze, and several of these also use use sort of mapping strategies. The main issue with sort of measurement here is that rather than being driven by national strategies, the adoption of predictive policing is often in the hands of individual law enforcement agencies. And so there are no statistics on those. What I managed to do in the paper is to simply count the number of news articles that feature of the main market leaders in policing, which are Craig Paul, Angela, and basically I show that it's growing exponentially over time.

Jennifer [00:04:55] So this is pretty common, growing exponentially and it's used. So before this paper, what had we known about whether this technology works, what the effects are on policing outcomes like clearances or crime rates?

Giovanni [00:05:06] So I really couldn't find much. So the main focus in the literature was about the ability to predict crimes. So that's sort of - especially a couple of papers with Mohler and his co-authors that were published in the Journal of the American Statistical Association showing that people sort of which was, by the way, their own product, was better at predicting crime than crime analysts.

Giovanni [00:05:35] So no paper that that sort of looked at crime rates or clearance rates. Of course, they were advertising people that they used in Santa Cruz by saying that people had had managed to sort of reduce crime in people's analysis. So there was no control group or the crime reductions were quite large.

Jennifer [00:05:56] And so that kind of leads into why why do we don't know more than we do? And you're alluding here to the identification challenge. Just looking at pre/post is not going to tell us the answer about whether this particular technology is what caused the change. But so more broadly, like what were the challenges that you had to overcome as you're thinking about how to answer this question? Is it mostly data access or is it mostly identification or both?

Giovanni [00:06:21] OK, I think it's difficult because of several reasons. Now, first of all, we can imagine that the introduction of these new strategies is is acknowledgements, for example, the Santa Cruz Police Department decided to use predictive policing so after an unprecedented crime wave. Now, we know as statisticians that this implies that mean reversion could potentially explain the following reduction. So this is the first issue. So if you don't have a control group that you're not going to solve that issues.

Giovanni [00:06:52] Second, especially we economists are sort of afraid that crime displacement may actually undo the effects of crime. So you introduce predictive policing, you generate deterrence and criminals just go somewhere else. The net effect might be

much, much smaller than the one that you mentioned. And finally, especially with respect to predictive policing, I think there is the issue that the type of arrests that are made could potentially be selected. So meaning that patrols may cherrypicked the more predictable and potentially poorly organized crimes, therefore overstating the effectiveness of predictive policing.

Jennifer [00:07:34] And so in this paper, you're going to focus on a specific predictive policing technology developed by an analyst in Milan, Italy. It's called key crime. So what is key crime do?

Giovanni [00:07:44] So key crime is a bit different from its competitors in that it focuses on incapacitation rather than deterrence. So the main aim is, is is to improve the sort of the officers role, as apprehension agents. And so rather than predicting aggregate crime rates, what key crime does is to try to predict individual robberies through crime linking. So there is a whole procedure to link crimes over time. And they do that by gathering individual characteristics of robbers and their criminal strategies, using both CCTV cameras as well as victim interviews. And so as as as an economist or as a statistician, I think of this as an attempt to build tunnel data of criminal events and use them within group predictions rather than the overall predictions.

Jennifer [00:08:35] And so can you give us some examples about how this this might work in practice? I found this piece of the paper just fascinating. Like you basically are trying to find the individual robbers and match them across crimes. Right?

Giovanni [00:08:48] Right. With words is a key crime allows you to visually see the distribution of crimes on a map and then easily sort of check what kind of what kind of characteristics these individual robberies have, including sort of any any footage that comes from CCTV cameras and then do comparisons with past crimes. And oftentimes it's it's fairly easy to see that two robberies are linked because you see in the picture that the robbery is the same guy. You know, he's dressed in the same way and he potentially has the same weapon. Sometimes the when they don't have CCTV cameras, it's going to be with the help of interviews.

Giovanni [00:09:27] So they they ask a lot of questions about, you know, even sort of little detail that and later help the police generate these things. For example, if someone was wearing a particular watch, you know, like I know a golden watch and at the same time, earrring, I don't know if they see that information in different robberies, they use that to sort of generate these things.

Jennifer [00:09:53] OK, so one question people might have is how good these predictions actually are. It might seem like smart offenders would vary their targets in the days and times they commit their crime to keep the police on their toes. So in the paper, you show the crime is in fact, terribly revealing, a very fitting Agatha Christie quote, and you make the case that if you're a criminal, there are costs to varying your behavior. And so what offenders did in the past does indeed tell you a good amount about what they'll do in the future. So you can look at this in the data. So in the data, how predictable is the second or subsequent offense by particular robbers when you have information on their earlier offenses?

Giovanni [00:10:28] You almost said everything. So it is true that the most prolific criminals are those that are more unpredictable. So you see that in the data. So you see that those, for example, that operate on a wider geographic scale and are less focused

sort of geographically are the ones that manage to sort of commit the largest number of robberies before getting arrested if they get arrested. But as you said, the data are amazing in that they allow me to compare sort of conditional versus unconditional predictions so one can use the past to predict what is going to happen next or not.

Giovanni [00:11:04] OK, and so, for example, you can look at what is the likelihood that a random robber targets? OK, it's about 50 percent and then you can ask yourself, wait a minute. but what is the likelihood that he or she I mean, does target a bank if he or she has targeted bank previously? And that's more like 80 percent. And so what I do in the papers, I compute these probabilities, these different probabilities, let's call them marginal versus conditional probabilities or several I mentioned which is targets -- so the type of business that is targeted, the mode of transportation, the neighborhoods, the day of the week, the time of the day and the week of the month. And to summarize, basically, if police patrols choose to patrol the predicted targets, meaning in a specific neighborhood in a given shift and for several days, and this is because most repeated robberies happen within within a couple of weeks. So you don't have to do this forever. You have an almost twelve point five percent chance of being in the right place at the right time and therefore arrests the offender. While if you do sort of random patrolling so you don't use any information about us, the likelihood is only zero point six percent, which is about 20 times smaller. Okay so information about the past allows you to have predictions which are about 20 times better.

Jennifer [00:12:29] So I guess the question then is whether that additional information, how much value it adds to what the police would have done otherwise? Would they really be patrolling randomly? And maybe they would. But I could imagine some cops listening to this and saying, well, we know that stuff, too. And so the question in all of this is like, all right, so when you look in the data like what is the causal effect on things like how often you going to make an arrest or how much crime goes down? And that tells you what the value add. Is that the right way to think about it?

Giovanni [00:12:58] That's right. That's right. I mean, random patrolling is sort of assuming that that that that the they use no information whatsoever now to see how the use of crime compares to sort of business as usual, kind of patrolling what I do in the data is I compare what what what the Polizia which is the force that uses key crime with respect to what the Carabinieri do, which is the other police force that doesn't have access to key crime.

Jennifer [00:13:27] Yeah. So let's talk more about that. So it turns out that the way policing is done in Milan is a bit unusual. And I think this is one of the first econ of crime papers I saw presented after I finished grad school. And I remember just being blown away by the cool natural experiment you found here. So there is not just one police force in Milan, but two. And as you just said, only one had access to key crime during the period you're studying. So describe the two police forces that have jurisdiction in the city and how they are assigned to cover different areas.

Giovanni [00:13:56] It is indeed unusual, but other countries that have two police forces like Spain or France, so this is mainly for historical reasons. So, for example, the Carabinieri was the police force of the royal family while the Polizia, it was the police force of the government. Now, when when when Italy became a republic, the two forces were sort of operating side by side. And over time they I think also through bargaining and so on, they developed into almost two identical forces. And in the 1990s, to save on costs, they decided to divide the city into sectors.

Giovanni [00:14:35] So and so what you have in Milan, but in most larger cities in Italy is that two sectors are patrolled by the Polizia. And so for Milan, these sectors, you key crime thanks to this police officer who sort of in a Bottom-Up way developed this predictive policing software and one would not, which would be the sector that is patrolled by the Carabiniere and this is great, but I itself would not help them much now.

Giovanni [00:15:06] On top of this division, you have that these sectors rotate every time there's a shift change, OK? And so if criminals are not aware of this rotation mechanism, they cannot target sort of the area that is somehow weaker in terms of law enforcement. And so what you have is sort of an experiment where investigations are almost randomly assigned to one of the two forces. And so there is no cherry picking, there's no selection. And that's one great advantage of sort of this way policing happens to be organized in Italy.

Jennifer [00:15:40] Yeah. And then so when was key crime adopted by the Polizia?

Giovanni [00:15:43] They started in 2008. So end of 2007, sort of. They finished producing the software and then beginning of 2008 they started using it and trying to combat robberies commercial robberies.

Jennifer [00:15:59] OK, so in the first part of the paper, you consider how that adoption of keycrime affected robbery rates in Milan relative to other cities. So walk us through how you do that.

Giovanni [00:16:09] The way I do this is like a synthetic control type of approach. So very simply, by comparing Milan to other Italian cities and the main issue that I that I faced was that sort of similar to what what had happened in Santa Cruz. What I find is that key crime gets adopted after a fairly large increase in robberies.

Giovanni [00:16:32] So like some very strong positive pre-trends. And so in sort of in the synthetic control language, I'm sort of outside of what is called the convex hall of the control cities so what was happening in Milan wasn't happening anywhere else. OK, so this is a little bit of an issue because you have no great comparison city to pick.

Giovanni [00:16:52] And so I had to sort of twist the synthetic control method a bit and allow for pre existing differences in these trends. And what I ended up doing is Lasow regressions with an upward trend. But what you see overall in the picture is that Milan true know it has this amazing increase in robberies. But then once key crime is about that, you have a fairly large reduction.

Jennifer [00:17:19] And once you kind of take advantage or, as you said, use these methods to kind of adjust for that preexisting trend. Yeah, it looks like it's just like flat relative to these comparison cities. And then it just starts declining, which is what you would expect if basically, you know, you've got two thirds of the city covered by this new predictive policing technology and it's working if it's doing something which is sort of what you were trying to show here. And so what data we're using for that piece of paper?

Giovanni [00:17:42] For this part of the paper, since I needed data from before key crime was adopted as well as after I use municipality level bank robbery data, which is data that that I got from the Italian Banking Association. But I also use a yearly province level data on commercial robberies as well as other crimes. So the municipality level data are great

because key crime is used that the municipality level in the municipality of Milan and it's great and they are great because they are monthly.

Giovanni [00:18:12] On the other hand, it's only one type of commercial robbery bank robbery. And so as a robustness check, also look at the province level.

Jennifer [00:18:21] And then how big was that? Was that effect of key crime on robbery rates?

Giovanni [00:18:27] Very low. So what you see is that within within a few years, robbery rates fell by about 80 percent. What I also mentioned is that this could potentially be subject to some bias as well. So there could still be displacements, the one I mentioned before, as well as mean reversion potentially. And so I think this is why it's important that one looks also at individual level data, which is sort of what I do next.

Jennifer [00:18:56] Yes so next. And this is the really cool part. You're going to use this rotation of police assignment to measure the causal effect of predictive policing within Milan. So to do this, you're going to compare clearance rates for the two police forces. So that is the rate at which they're solving the crimes. Basically, you're making arrests and individual robberies. They've got you've got the one police force that uses key crime and one that didn't for offenses where technology should matter compared with offenses where it shouldn't matter if you're going to see a difference in differences design here. So walk us through your empirical approach in this second part of the paper.

Giovanni [00:19:29] You're totally right. So I shift the focus from crime rates to the clearance rates. So why why do we do this? One reason is that having data on repeat offenders again of the day, I can map these changes and clearances into changes in crime. So, you know, if I know with the likelihood that someone repeats an offense and that guy is arrested, I can also check out sort of how many crimes, what kind of reductions in crime we would expect.

Giovanni [00:19:58] And in addition, focusing on clearances bypasses the issue of displacement. Because if, you know, if someone is arrested. I know that is not going to operate somewhere else. And as for the difference in difference design here, the main idea is that key crime is able to prevent crimes, but only once some data have been gathered. And so you need at least one data point. So one robbery to predict the next one. And so if you don't have that first robbery, your prediction is you can't you don't have data so you can't generate a prediction.

Giovanni [00:20:34] And so I use the very first robbery in the data to measure preexisting differences in the productivity of the two forces. So for the very first robbery, I know that key crime hasn't been used. And so I can check of how the Polizia compares to the Carabinieri in the absence of key crime to make sure that there are no preexisting differences between the two forces.

Jennifer [00:20:59] Right. So if you'd seen if you just compared them, you know, a simple comparison, it turned out the Polizia have had higher clearance rates. That might just be because they're better on other dimensions. They're just better at something bad for other reasons. So, yeah. OK, great. So and then what data used for this part of the study?

Giovanni [00:21:15] So these data were the ones that I that I told you about at the beginning. So the one the inventor, the developer of, of key crime gave me so these are

individual level data for each commercial robbery that took place in Milan between 2008 and 2009. I wasn't given the algorithm that they use, but I was given data on how much money was stolen, whether the individual was later arrested and and when he was arrested, as well as information on the type of weapon use, the mode of transportation, the location and the exact time that the robbery took place.

Jennifer [00:21:56] It sounds like an amazing data set. I think you said in the paper they didn't give you the actual photos of the robbers, but they give you everything else.

Giovanni [00:22:02] That's right. Yes. I didn't have the precise description of the robbers.

Jennifer [00:22:08] Got it. Got it. OK, so let's talk about the results here. So the first thing you do is simply compare that baseline difference in clearance rates for the two police forces. So what do you find there?

Giovanni [00:22:18] That's right. So for the first robbery, I find almost no differences in clearance rates between the two forces. After the robbery takes place both forces have about a 12 percent chance of clearing a case and arresting the perpetrator and before the perpetrator commits another robbery. So very similar chance of clearing the case.

Jennifer [00:22:39] Yes. And then next, you compare the effects across police forces for the first and subsequent offenses in that sequence by the same set of robbers. And again, the idea here is key crime should be helpful for making arrests in the subsequent offenses, but not that first offense. So what do you find there?

Giovanni [00:22:54] So what I find is that the likelihood is that for the subsequent robberies, the likelihood that the Carabinieri make an arrest is only seven point four percent. And you can think that this is for two reasons. The pool of repeat offenders or the offenders that decide to get back in action are those that were not arrested to begin with, the ones that probably did a better job to begin with. OK, so it's a select group of criminals. They learn more and they were not arrested. And so the likelihood that the Carabinieri could make an arrest after the subsequent robbery is much lower than after the very first.

Giovanni [00:23:31] But for the Polizia, the force that uses key crime, what you see is that their likelihood of making an arrest is nine percentage points larger than the one of the Carabinieri. They are not hit by this selection effect. So thanks to key crime, it seems they can keep their productivity pretty high.

Jennifer [00:23:50] OK, so that's sort of one big piece of evidence that key crime is working and that this is adding value. And then you also use a different approach to control for baseline differences across the police forces. In this case, you take advantage of a delay. And when information about an offense was added to key crime so that the predictions can be updated. So first, tell us a little bit about that, that information delay. And second, tell us what you find when you use that information.

Giovanni [00:24:15] Yes. So so, you know, somehow luckily what happens after each robbery is that is that the Polizia so the force that uses key crime, they wait until next morning to interview the victims, and that's mainly to reduce the victim's immediate distress and to avoid before any recall bites of the robbery. So the sense is that interviewing the robbery, you know, the victims right after the robbery would not be very useful. And so this is great because I can compare sort of clearances have had of robberies to happen within the same day. And so key crime was not updated because the

victims had not been interviewed yet with clearances that that happened after one day or two days and so on. It's what I see is that the improvement, which is in this case goes up to twelve percentage points happens only once the predictions get updated and also, you know, in addition, what I find is that these these results get larger as more data are acquired.

Giovanni [00:25:14] So as more robberies have taken place so more data and be analyzed. And this is I forgot to mention that this is something I find also in the previous experiment as more data gathered, sort of the productivity gap between the Carabinieri and the Polizia grows.

Jennifer [00:25:29] Excellent ok, and then the last piece of your analysis is that you consider what happened when prosecutors force the Polizia to share the key crime predictions with the Carabinieri to kind of even the playing field in 2010. So first, what are you looking for in that policy change? And what do you find was was the effect of that change?

Giovanni [00:25:51] Yeah, so so basically the way it works is that the Polizia see once an arrest is made, the police we're sharing all the information with the prosecutors. And so at one point the prosecutors told them, well, but you need to inform the Carabinieri of this you need to show them what you're doing. And so this happened in the beginning of 2010. So the Carabinieri we're given these these predictions. And so what I find, indeed, is that the Carabinieri after 2010, they closed the gap right after they get informed about the about these predictions.

Jennifer [00:26:26] So that helps kind of reassure if you think that there's like anything else that your difference in difference wasn't capturing or something. I think this helps reassure you that it really was a key crime that really was the key crime predictions.

Giovanni [00:26:36] But someone still needed additional evidence.

Jennifer [00:26:39] Yeah, exactly. Exactly. So based on your estimates, you consider the costs and benefits of this technology in terms of the number of robberies that key crime helped Milan avoid. So what do you find when you crunch those numbers?

Giovanni [00:26:51] What I can do is I for repeat offenders is I can I can sort of compute our differences and clearance rate map onto the differences in the expected number of robberies.

Giovanni [00:27:04] And it turns out that the expected number of robberies is just one over the clearance rate for repeat offenders. And so if it with a 10 percentage point difference and with this kind of productivity that we see in the data, this implies that the number of expected robberies for a criminal group drops from seventeen point eight to six point four. Now, since each year there are in Milan about eighty five new repeat offenders. So let's remember that these are commercial robberies. So these are really serious crimes.

Giovanni [00:27:43] We expect to have nine hundred fewer robberies per year. In the data I also have information about the haul. I can compute the average haul, which is two thousand eight hundred euros, which is probably something like three thousand two hundred dollars. This generates a total reduction in the direct cost of crime of about 2.5

million euros or probably like two point eight million dollars. So this is without considering any any other costs, the crime rate may generate.

Giovanni [00:28:14] And now, on the other hand, we have that the running cost of key crime are very low. So we're talking about five officers who are paid less than twenty thousand euros a year. And so overall, it's sort of the use of this technology seems seems to pay off.

Jennifer [00:28:31] All right. So that is your paper. Are there any other papers related to this topic that have come out since you first started working on the study?

Giovanni [00:28:37] So, I mean, you're probably better in keeping track of all the papers in the literature. So there aren't many papers, I would say, that estimate the effect of sort of, broadly speaking, technology on police productivity. And you probably wrote most of these papers the one where you and your co-authors look at the effect of DNA databases on crime.

Giovanni [00:29:00] Another paper somehow related I can think of is by a former student of mine, Eva Gavrilova and Vincenzo Bove, where they estimate, the effect of police militarization on crime and find larger reductions, which they be interpreted as a deterrent. I think there have been also other papers that the police militarization. Another paper that is related to this paper on policing is a paper that I'm writing with Jordi Blanes i Vidal , where we basically look at the other side of the effect of random patrolling. And what we find is that random patrolling has almost no effect on crime or to be more precise so we find a very large deterrent effect in the short term, about 30 minutes. It seems that once the police patrols are gone, criminals go back to business very quickly. And so when you when you average over the day, you find fairly small effects on crime.

Jennifer [00:29:56] Well, that's really interesting. Yeah, I agree with you. The technology and policing space is pretty sparse. It's sort of amazing. It's like all the stuff is super interesting and technology is a bigger and bigger part of policing, and they're always fancy new tools that police forces are trying out. And we know so little about whether any of them are having any or adding any value to good space for people to work if they're looking for topics, I think. So what are the policy implications of this paper and the other work in this area? What should policymakers be taking away from this?

Giovanni [00:30:28] My sense of things like, you know, if we want to summarize it brutally, is that law enforcement should embrace statistical methods, broadly speaking, technology. You know, I think it works. So my my feeling is that random patrolling works very little while focused, patrolling and also particularly through incapacitation, works much better.

Jennifer [00:30:55] Yeah especially when you've got that other paper on to compare side by side, is that it is particularly striking how much better the police are, I guess especially looking at robbery. I guess there's still a question of how much value this kind of technology might add or other types of crime. What do you think about about that?

Giovanni [00:31:14] Yes, exactly. I think it's this is still an open question. You know, up until now, I've I've talked about this technology is this of something great, but we know that it was for robberies. We still don't know whether it works or other types of crimes. So we don't know how much other types of crime are predicted. And robberies, by definition, they have at least a victim who is also a witness and it's a witness who will give you a lot of useful information, such predictions. And we also know that robbers tend to be prolific

offenders. So once you have a prediction, you don't have to wait for long before before that individual is back in business. I think for other violent crimes, it might not be that easy, I'd say.

Giovanni [00:32:02] And another open question is whether it works for property crimes.

Jennifer [00:32:06] Yeah, so those are some open questions. What are other big questions on the research frontier, other questions that you and enterpring grad students should be thinking about going forward?

Giovanni [00:32:18] Well, so I think another question, and we haven't talked about this a lot in the news, is about of the relationship between predictive policing and racial bias. So my understanding is that key crime, by focusing on individual predictions of serial criminals, shouldn't be subject to this basis. We know that aggregate predictions main principle, for example, target areas based on crime differences, and these can potentially be correlated with racial differences. But I must admit, I haven't done any research on this yet. It is certainly a challenging research questions.

Jennifer [00:32:58] Yeah. So the idea there is basically if you're sending cops to places where they have made lots of arrests in the past or detected lots of crime in the past, then you could just be sending them back to over already overpoliced communities again and again. And yeah, people get very worried about that for good reason.

Giovanni [00:33:16] Exactly this may happen even if you don't use race at all as one of your. That's right.

Jennifer [00:33:22] On the other hand, it could make you to the extent that, you know, the technology is directing you to places where there is real crime happening that we really care about and is able to sort of redirect police to places they wouldn't have gone otherwise. It could help reduce biases. I agree. I think it's a really interesting empirical question that we just need more work on.

Giovanni [00:33:42] And then more generally, I think, which is sort of the other paper, I think the patrolling and deterrence in general, I think my sense is that the jury's still out on how large those effects are. So we know that study patrolling is very effective in reducing crime. But whether mobile patrolling does the same, I think it's still an open question. It's a tough question because, of course, it's much more difficult to sort of to follow officers that are moving and officers that are that are not, I think, better and better data. For example, ABL that have to computers should allow us to get there.

Jennifer [00:34:22] Yes, I agree. Those data are super cool and I look forward to more papers using them. All right. Well, my guest today is Giovanni Mascheroni from Colegio Carlo Alberto and the University of Turin. Giovanni, thanks so much for talking with me.

Giovanni [00:34:36] Thanks for having me it was a pleasure.

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