The 'uberization of policing'? How police negotiate and operationalise predictive policing technology

Ajay Sandhu & Peter Fussey

Routledge
Taylor & Francis Group

The 'uberization of policing'? How police negotiate and operationalise predictive policing technology

Ajay Sandhu [a] and Peter Fussey [b]

aCriminology, Ryerson University, Toronto, Canada; bSociology, University of Essex, Colchester, UK

ABSTRACT

Predictive policing generally refers to police work that utilises strategies, algorithmic technologies, and big data to generate near-future predictions about the people and places deemed likely to be involved in or experience crime. Claimed benefits of predictive policing centre on the technology's ability to enable pre-emptive police work by automating police decisions. The goal is that officers will rely on computer software and smartphone applications to instruct them about where and who to police just as Uber drivers rely on similar technologies to instruct them about where to pick up passengers. Unfortunately, little is known about the experiences of the in-field users of predictive technologies. This article helps fill this gap by addressing the under researched area of how police officers engage with predictive technologies. As such, data is presented that outlines the findings of a qualitative study with UK police organisations involved in designing and trialing predictive policing software. Research findings show that many police officers have a detailed awareness of the limitations of predictive technologies, specifically those brought about by errors and biases in input data. This awareness has led many officers to develop a sceptical attitude towards predictive technologies and, in a few cases, these officers have expressed a reluctance to use predictive technologies. Based on these findings, this paper argues that claims about predictive software's ability to neutralise the subjectivity of police work overlooks the ongoing struggles of the police officer to assert their agency and mediate the extent to which predictions will be trusted and utilised.

Introduction

Predictive policing generally refers to police work that utilises strategies, algorithmic technologies, and big data to generate near-future predictions about the people and places deemed likely to be involved in or experience crime. These predictions are not based upon the intuitions of detectives or the psychic abilities of clairvoyants as is depicted in Hollywood films. Rather predictions are based on the comparatively more mundane mathematics of computer algorithms capable of high speed analysis of 'big data' about crime (Cukier and Mayer-Schoenberger 2013, Schneier 2015, Ferguson 2017). Claimed benefits of predictive policing centre on the technology's ability to enable pre-emptive police work by automating police decisions. This could reduce the overall harms of crime by facilitating early interventions while also bringing efficiency gains during a time of austerity. Given these perceived benefits, many police organisations in the United Kingdom (UK) have

partnered with software developers and information systems managers for early trials of predictive policing technologies.[1] If successfully implemented, such technologies could radically change police work so that officers rely on computer software and smartphone applications to instruct them about where to police just as Uber drivers rely on similar technologies to instruct them about where to pick up passengers. Unfortunately, little is known about how police organisations have accepted this transition from subjective discretion to algorithmic instruction, especially in light of highly publicised criticisms about the accuracy and fairness of predictive technologies (Harcourt 2008, Lum and Isaac 2016, O'Neil 2017). In addition, little is known about the experiences of the users of predictive technologies, including police officers who receive prompts from these technologies about where and when to dedicate their resources. This article helps fill this gap by addressing the under researched area of how police officers engage with predictive technologies.

We draw on the findings of a qualitative study with UK police organisations involved in designing and trialing predictive policing software.[2] Our research findings show that many police officers are aware of the limitations of predictive technologies, specifically those brought about by errors and biases in input data. This awareness has led many officers to develop a sceptical attitude towards predictive technologies and, in a few cases, these officers have expressed a reluctance to use predictive technologies as instructed. In direct contrast with claims about how predictive policing will supplement subjective police discretion with allegedly objective calculation, these research findings highlight the role that police officers' scepticism and discretion will continue to play in an era of technologically enhanced police work. Not only do these officers' resistant attitudes disrupt some of the laudatory claims around predictive policing, they further demonstrate how a technology intended to proceduralise police work has cultivated a new arena for contestation and negotiation. Based on these findings, this paper argues that claims about predictive software's ability to neutralise the subjectivity of police work overlooks ongoing police efforts to mediate how predictions will be trusted and utilised. This paper concludes that studying the impact of predictive policing will require a conceptual shift from what is a dominant focus on the mathematical accuracy of predictions to a techno-social focus on the factors which influence the degree of deference police officers give to algorithmic decision making.

To situate the analysis, this paper will begin with a general overview of predictive policing strategies and technologies as well as a discussion of the main criticisms they have attracted. The paper will then outline the research methods and research findings which inform the conclusions summarised above. Emphasis will be given to findings suggesting that police officers are sceptical about the effectiveness of predictive technologies and intend to maintain discretionary control over police work. The paper will conclude with a discussion about the need for techno-social frameworks when studying predictive policing.

Predictive policing and its progenitors

Predictive policing guides police work by forecasting the places and people that are most likely to be involved in crime (Harcourt 2008, Perry 2013). Linked yet distinct from other police attempts to manage future offending, such as the use of 'risk technologies that tame chance in the landscape of fear' (Ericson and Haggerty 1997), predictive policing uses statistical modelling to create the forecasts that will inform decisions about where and who to police. Such approaches have received interest through analyses of anticipatory policing addressing ideas of 'actuarial justice' (Feeley and Simon 1994), and 'pre-crime' (Zedner 2007, McCulloch and Wilson 2016). Interest in predictive technologies has raised questions about their effectiveness (Maguire et al. 2018) but these tend to be answered with a general optimism about the diversity of ways predictive policing could be used. It is now possible to discern at least four applications for predictive policing technologies: predicting the times and places of future crime, predicting offenders, predicting the profile for perpetrators of a given offence, and predicting victims. Each application is driven by varied methodologies, built around dissimilar assumptions, and have attained disparate levels of development. Despite these

differences the unifying goal of predictive policing is a continuation of an empirical turn in police work so that police decisions are based in technologically enhanced, and therefore objective, analytics rather than human subjectivity and bias (Bachner 2013, Perry 2013, Bennett Moses and Chan 2018, Karppi 2018).

The goals associated with policing's empirical turn are reflective of an ongoing critical discussion of the subjectivity of decision making in policing, among the most controversial aspects of police work (Goldstein 1960). Such discussions are premised on a recognition that the police cannot achieve the 'impossible mandate' of addressing any and all criminal behaviour (Bittner 1990, Manning 2010, Reiner 2010). Accordingly, police officers must make subjective decisions about when and where they will dedicate their time and effort. These practical considerations require police officers to use their subjective discretion to make decisions such as where to locate their patrols, whether or not to stop and search a particular individual, and whether or not to label an incident a 'crime.' This discretion effectively positions the police officer as a gatekeeper who facilitates a criminal incident's entrance into the criminal justice system or, alternatively, determines that the criminal justice system will largely ignore that incident. In this sense, the police 'make crime' (Ericson 1981). Given the discretionary power held by the police officer, concerns about how to regulate and assess police decisions are common. These concerns are often driven by the realisation that police decisions are low visibility, meaning discretion operates in unpredictable circumstances and, therefore, lack oversight leaving errors and biases unaddressed. The result may be that police discretion, which is just as likely to be informed by policy as it is a controversial police culture (Waddington 1999), may enable ineffective and improper decisions not conducive to a consistent and respectable criminal justice system.

To address concerns about police discretion, police organisations sometimes turn to technological solutions which can document, inform, and assess of police decision making. Recent examples include wearable cameras which film interactions between officers and members of the public (Ariel et al. 2017). While there are many utilities for such surveillance technologies, one prominent aim is to cultivate opportunities to scrutinize police work and hold police officers responsible for errors in their decision making. Accordingly, some describe a notable shift in policing from low visibility work to a technologically enhanced 'high visibility' work featuring a greater degree of both internal and external oversight (Goldsmith 2010). Predictive policing has many goals, but among these is the similar aim to reduce improper decision making enabled by subjective police discretion. This goal is achieved not by facilitating new opportunities to scrutinize police decisions as is the case with wearable cameras. Rather, this goal is achieved by supplementing subjective decisions with allegedly objective analytics. For instance, under a predictive policing regime, algorithmic analysis of big data about crime trends is deployed to support or, potentially supplant, officer decision over which locations to patrol. The way law enforcement agents engage with such computational outputs is the focus of this paper.

The theme of replacing subjective police discretion with objective analysis can be tied to the rise of 'intelligence-led policing,' an overarching police tactic which intends to replace previous forms of intuition-led police work (Ratcliffe 2016). Intelligence-led policing emerged in the late 1990s as computer programmers and police organisations began to work together to produce software allowing police officers easy access to data about crime. It was intended that officers would use this data to inform discretionary decisions such as which crimes they should look for and where they should look for them. Among the most well-known of the resulting software was CompStat (short for Compare Statistics), an organisation management tool developed by New York City transit police officer Jack Maple and adopted across the city during the 1990s (Eterno and Silverman 2006). CompStat allowed police officers to document criminal activity in a computer log, eventually producing a large dataset about recent criminal incidents which could then be studied to discover patterns in the geography of crime. Data was often plotted on maps by crime analysts to visually display the 'hot spots' where crime was most common and, accordingly, where police officers should dedicate their attention (Manning 2008, Chainey and Ratcliffe 2013).

Since the 'big data revolution' (Cukier and Mayer-Schoenberger 2013), police organisations have sought to improve 'hot spot policing,' which is now commonly known as 'crime mapping' (Manning 2008), by refining the quality and quantity of information used to produce data about geographical trends in crime (Ferguson 2014). Often focused on domestic burglary, this includes calculations over the increased risk of repeat victimisation following an initial offence (see *inter alia* Bowers and Johnson 2005). In addition, police organisations have sought to incorporate information which may, upon first viewing, seem unnecessary for research about crime, but upon review, may be reliable predictors of crime. For example, predictive software developed by HunchLab[3] analyses information about the locations of bars and transportation hubs, the schedules for sporting events, as well as weather patterns when producing its crime maps. By considering a range of geographical and temporal factors, predictive technologies promise to improve police understandings of what correlates with criminal behaviour and, thus, improve decisions such as where and when to locate police patrols.

A dominant presence in the contemporary predictive policing marketplace is entitled PredPol.[4] As Maguire (2018, p. 142) relays, PredPol was built on assumptions about the structured and habitual patterns of human behaviour,

> Brantingham's anthropological fieldwork [on the environmental adaptations of hunter-gatherers in Northern Tibet] convinced him that the behavioural patterns of humans are less elaborate and more predictable than one might assume. If hunter-gatherer behaviours are based on established patterns then why not attempt to predict the behaviour of an urban forager hunting a Mercedes Benz?

PredPol's predictive algorithm employs data about crime type, location, and time. The software designers have stressed that their algorithm does not rely on demographic data such as the race or ethnicity of offenders to make their predictions. This omission is intended to ensure that Predpol does not make predictions insinuating a relationship between identity and crime. Accordingly, PredPol claims that its technology is non-prejudicial and that it can therefore address issues such as police discrimination by taking certain decisions out of the hands of human, and therefore biased, officers and putting them in the hands of data-based and, therefore unbiased, algorithms. It is this claim about the objectivity of predictive software and the related promises to diminish the influence of human biases that has been among the most contested issues surrounding predictive policing (Ferguson 2014, Gangadharan 2015, Chan and Bennett Moses 2016).

Critiquing predictive policing

Early studies focusing on the relationship between predictive policing and crime rates suggest that software like PredPol may contribute to a drop in 'low-level crime' such as common assaults and anti-social behaviour in trial locations.[5] A measurable, although modest, decrease in crime as well as anecdotes from officers about successfully pre-empting crime in hotspots seem to have persuaded police organisations in the UK to invest in further trials. However, assessments of predictive technologies are ongoing and generalisable conclusions about their effectiveness cannot yet be made. This article aims to contribute to these ongoing studies. Of particular interest is the degree to which police officers play a role in the operationalisation of predictive technologies, including the extent to which they decide to incorporate predictions into their decision making. These topics are of particular importance given police organisations have shown an awareness of significant criticisms of predictive technologies raising questions about extent to which officers will accept them into their daily routines. Most criticisms of predictive policing fall broadly into four categories: concerns about the utility of past data for future predictions, concerns about poor oversight and assessment, practical concerns about the degree to which predictive technologies will be accepted by police officers, and concerns about biased predictions. We summarise each of these criticisms below.

Regarding concerns over the utility of predictions, many have challenged the temporal framing of predictive models (Haberman and Ratcliffe 2012) and the extent to which continuities can be drawn from past events to predict the future (Chan and Bennett Moses 2016). To these we may add a further

criticism from a statistics perspective. Here, unfounded assumptions are repeatedly made between group averages and predictions of individual behaviour; a specific individual's position in an aggregate group (a core methodology for predictive indicators) may say little, if anything, about their propensity for a future behaviour. Regarding oversight concerns, issues of governance and accountability also afflict predictive policing practices. For example, algorithmic decision making technologies are often developed by commercial operators and remain proprietary knowledge and thus unavailable for external scrutiny. Related criticisms stress an inability to assess the predictive algorithms as most software remains a 'black box' creating an indecipherability of computational decision making (Pasquale 2015). There have been increasing calls to enhance the explainability of advancing technology, particularly in relation to advanced forms of machine learning. However, as the technology progresses and AI becomes a more central feature of predictive policing, issues such as semi-autonomous knowledge generation make this aspiration difficult to fulfil. As Bennett Moses and Chan (2014) have argued, ambiguities over how such technologies are deployed are companied by limitations in transparency regarding how predictive technology reaches decisions.[6] Additionally, it is important to note the sheer variety of approaches that underpin algorithmic decision making. Some of these are potentially more decipherable (such as groupings of decision-tree processes like 'forest forecasting') and thus amenable to accountability measures than others (for example, highly complex machine learning algorithms such as convolutional neural network technology). Nevertheless, it is worth noting that many predictive technologies deployed in the UK are not particularly complex. As mentioned, PredPol uses only three data points to produce its crime forecasts.[7] Rather than complexity, it is often the protection of proprietary knowledge that inhibits the explainability of predictive policing and, as a corollary, their accountability.

Additional criticisms of predictive police concern the influence of police discretion over the utilisation of predictive software. Critics have questioned the degree to which predictive software will gain dominance in police decision making processes (Bachner 2013) and the potential cost of reducing the influence of officers' experiential knowledge in decision making (Joh 2014). The ongoing influence of police discretion and existing police structures suggests it is important to resist overly deterministic readings of technology in policing (Manning 2008). Accordingly, questions remain over the residual influence of officer agency when discussing predictive technologies as they are likely to intersect with police discretion in complex and subtle ways. For example, police officers will need to make finely graded judgements over how much they will rely on predictive technologies to guide their patrols as well as the judgements about the legal permissibility of the recommendations made by predictive technologies. In his analysis of the legal basis of stop and search using predictive analytics, Ferguson questions whether 'a Fourth Amendment stop can be predicated on the aggregation of specific and individualised, but otherwise noncriminal, factors' (Ferguson 2012). For Ferguson, predictive technologies generate a space where the case for stop and search based on algorithmic calculations could contrast with legal justifications for such a stop and search. Police officers may use their residual agency to uphold the law and avoid making such stops and searches or, on the other hand, use the alleged objectivity of algorithmic calculations to justify such a stop and search. These issues gain further importance considering how, for decades, police discretion has been an arena of significant contestation, resulting in many legislative, regulatory and jurisprudence interventions, the ur-text of which is the continually revised and (now) sprawling *Police and Criminal Evidence Act* 1984. However, in the current absence of case law regarding the uses of predictive recommendations, important questions arise over the legality of police actions if guided by an algorithm. It is issues regarding the intersection between predictive policing and police discretion which will receive attention in the majority of this paper.

One of the most controversial criticisms of predictive policing is that, in contrast to claims about objectivity made by technology vendors, predictive technology can reinforce bias in police work by creating hotspots which feature an overrepresentation of disadvantaged neighbourhoods with a large population of racial and ethnic minorities as residents (Shapiro 2017). To explain how non-demographic data examined by allegedly objective algorithms can reinforce bias in police work,

one needs to take a closer look at the relationship between the quality of predictions and the quality of input data. Input data refers to the raw information which is logged by police and fed to algorithms so that it can be used to discover crime patterns and produce predictions. As it is input data which is to be analysed to determine predictions, any biases or limitations in this data will influence the conclusions that algorithms produce. In much cited work, Harvard mathematician Cathy O'Neil demonstrates that therein lies a flaw in predictive policing as input data is often built on a number of subjective police decisions about what kinds of people and places are considered 'suspicious.' O'Neil offers the example of stop and frisk decisions in New York City in 2011 which illustrated that most people who are stopped are young, dark-skinned, men in low-income spaces and that most frisks are not linked to serious crimes, but 'anti-social behaviours.' The result is the production of input data reflecting police officers' tendency to target disadvantaged groups for low-level deviance. If fed to an algorithm searching for trends in the data, O'Neil argues, this biased input data is likely to produce biased predictive outputs that encourage police to continue to target young dark-skinned men in disadvantaged neighbourhoods (O'Neil 2017). The result is a feedback loop whereby predictive policing outputs refocus policing attention towards marginalised people and places. To test concerns about feedback loops in predictive policing, Lum and Isaac (2016) studied the impact of biased input data on predictive policing outputs in Oakland California. Their research found that the crime maps produced by predictive algorithms tended to reflect the racial and ethnic biases present in input data. Lum and Isaac concluded that the implications of poor data on prediction is an illustration of an adage that statistics scholars are familiar with; 'garbage in, garbage out' (Lum and Isaac 2016).

The above review is illustrative of the critical commentary that predictive policing has attracted in recent years. Some of this commentary focuses on the technological capability and operational efficacy of predictive policing by pointing to problematic assumptions, data errors, and predictive biases, while other commentary has emphasised the challenges of governance, transparency, accountability, ethics and rights. This paper aspires to build on such commentary but shifts the focus from questions over the statistical accuracy and regulation of predictive technologies to questions over human engagement with predictive technologies. Rather than studying flaws in the production or governance of predictions, this paper aims to understand how predictions are considered, interpreted and operationalised by police officers charged with using predictive technology. Given the prominence of critical commentary of predictive policing and vocal criticisms of the effectiveness and ethics of such technologies, our research questions if police officers will uncritically adopt this contemporary form of intelligence-led policing or if they will display a reluctance to follow predictive prompts and, in doing so, display the persistence of intuition-led policing.

Methodology

This article discusses findings based on interviews conducted in 2017 and 2019. Interviews examined how members of four major UK police organisations were developing predictive technologies, policies and related practices. The utility of this study lies in its contribution to a larger conversation about predictive policing by providing empirical data about how police understand predictive technologies, how they intend to use predictions, and how they intend to address popular criticisms of predictive technologies. Research participants were recruited using a snowballing sampling method (Atkinson and Flint 2001) via the assistance of gatekeepers occupying senior roles at each police force's headquarters. The authors were invited to conduct extensive research in two police force's jurisdictions (which then served as a gateway to another two jurisdictions), which facilitated visits to police headquarters. Researchers also served as members of police ethics panels and conducted observations at police roundtables, workshops and events focused on the development of police strategy concerning the implementation of digital technologies. While resulting observational data is not discussed in the analysis below, it was a vital means for identifying key participants with detailed and relevant knowledge of predictive tools. It also yielded important contextual

understandings around the current and planned uses of predictive technologies in addition to offering the authors familiarity with operational and technical vocabularies to help focus questions and data analysis. Through recruitment, researchers were able to secure a mix of formal audio-recorded interviews as well as opportunistic informal interviews which took place within during operational and social activities (accordingly, the latter were less likely to be recorded and are not quoted directly). A semi-structured approach to interviews was maintained throughout the study and centred on these three research questions: (1) What is predictive policing, and have you ever used a predictive technology? (2) What are the benefits and limitations of predictive policing? (3) How do you intend to address the limitations in predictive policing? The open-ended design of these questions is reflective of researchers' intention to allow participants to answer without excessive limitations or suggestions.

Research participants included a total of 40 members of four major police organisations in the UK. Research participants were made up of thirty-two white males and eight white females, an illustration of the continued dominance of white males in policing despite the recent efforts to diversify police organisations' workforce. Research participants' ages ranged from mid-20s to their early-60s. Research participants' duties ranged from frontline police work, criminal investigations, data collection and analysis, counterterrorism, dispatch, evidence analysis, and individuals responsible for the design of policy and technology related to digital police work. These included members of open source intelligence units who collect data from social media platforms, as well as anti-terror and general intelligence units who manage data from external parties such as internet service providers. Research participants also included predictive policing software developers and police officers in-charge of developing strategies for implementing predictive technologies as well as the development of ethical guidelines for predictive police work. As these officers are directly involved in the collection and analysis of data about crime, they are ideal research participants for a project studying predictive policing.

After each interview, notes and audio recordings were transcribed and then coded according to emergent themes (Yin 2013). This process was repeated until consistent claims could be made about the data. It is worth keeping in mind that that research participants came from a range of police departments, each of which differ in terms of their region and, accordingly, hold slightly different strategies and policies. However, significant differences between departments were not found. As a result, this article's findings are not organised according to differences between police organisations. Over the course of coding, research data became a mix of facts, participants' comments, and researchers' interpretations, highlighting the researchers' roles in the production of the study's findings. Accordingly, researchers took time to reflexively consider how their biases, prior knowledge and methodological decisions contributed to the production of research data (Bourdieu and Wacquant 1992). To limit the influence of biases and capture the most accurate reflection of research participants' views, researchers repeatedly reanalyzed data and conducted follow-up interviews for clarification. However, given the interpretivist character of qualitative research no claims of generalisability or objectivity are made. Having noted that limitation, in what follows, research findings are discussed offering a detailed picture of how police officers perceive and engage with predictive technology. The theoretical and practical implications of these findings are outlined in the discussion and conclusion sections.

The 'Uberization' of police patrols

> We have always had a problem getting police officers to be where we need them when we need them. Our predictive tools will help.
> Chief Inspector, Interviewed October 2017

When asked to articulate why police organisations are interested in adopting predictive technologies, some research participants explained that police decision making is too subjective. In solution, they claimed that predictive policing would help officers objectively determine where and when to

police and, therefore, more effectively achieve the first Peelian principle to prevent crime. Other optimistic readings of predictive policing referenced the potential efficiency gains which would be valuable during a time of austerity involving unprecedented fiscal cuts to policing. Officers in charge of developing predictive strategies were especially vocal in this regard, claiming that predictive policing would inform a more accurate, efficient and objective style of police work. Particularly notable among responses outlining the potential benefits of predictive policing were the comments of a high-ranking Chief Inspector (interviewed in October 2017) who had not only taken part in trials of predictive technologies but participated in the development and deployment of a new predictive software for his police organisation. The Chief Inspector described predictive policing as a technological strategy which, if integrated properly, would help position police officers near to projected criminal events using improved crime maps, reduce unneeded and costly travel during patrols, and allow officers to interrupt crime before serious harms could be done. Such claims over the possible utility of predictive technology were reinforced by predictive software developers who were near-evangelical in their beliefs about the utility of predictive policing, offering little scepticism regarding potential shortcomings of intelligence-led police work. The Chief Inspector also emphasised that predictive technologies would be most effective if they were easily accessible to officers and explained he was working on a predictive software that could be integrated into police officers' smartphones to automatically notify them when they approached a geo-fenced hotspot. He explained that the development of a predictive smartphone application would bring significant change to the nature of police work, with the belief that,

> … smartphones will act as portals to a mass database which not only tell police where to go and what to do, but who they [should be] interacting with.

The Chief Inspector concluded that once such predictive technologies were adopted, police work would no longer rely on an officer's subjective discretion about where and when to patrol. Instead, police work would be guided by algorithmic calculations about where and when crime was most likely to occur. This participant then optimistically envisaged police work resembling the experiences of Uber drivers, akin to receipt of a call for service on their smartphone when a nearby pedestrian sends out a digital request for a ride to a location. Here, police officers would receive a notification on their smartphone based on the calculations of a predictive technology which updates locations and times of projected risk. Officers would then tap their screen declaring their acceptance of a task and,

> the mobile tool would then direct officers to the hotspot, offer them relevant data about the hotspot, and even offer them a specific task like 'conduct a foot patrol in this area for 20 minutes.

Accordingly, the Chief Inspector described the adoption and integration of predictive technology as the 'uberization of policing.' The 'uberization' concept was repeated during multiple interviews with the Chief Inspector highlighting its catchiness and revealing how he imagined police work might change if predictive technologies were adopted fully. Nonetheless, we recognised the limitations of this metaphor. Unlike the Uber driver, the police officer using a predictive app has no immediate financial transaction with the citizens they serve, the officer is not an independent contractor working for a private company, and the officer is not able to sign in or out of their app to being or end their work. Accordingly the uberizing of policing refers mostly to the use of smartphones and algorithms to geographically guide and task police patrols, a less radical transformation as is described in literature on the uberizing of transportation, law, healthcare and labour more generally (Khan 2016, Rosenblat and Stark 2016, Chen et al. 2019, Yao 2019). Despite the limitations of using the Uber analogy, many participants made similar claims that predictive policing amounted to the creation of Uber-style and software-instructed police work. Particularly common among these were positivistic claims emphasising how algorithmically derived calls for service would lessen the exposure of police work to flawed decision making based in human subjectivity and bias. Instead, police work would be guided by data-based predictions and, therefore, uphold objective policing practices. These

perspectives were particularly present among non-police members of these practitioner networks. For example, a software developer working with police to design predictive technologies (interviewed in November 2017) repeatedly asserted the value in delegating decision making to algorithmic analyses over police discretion and emphasised the unbiased nature of police work guided by algorithmic analyses.

In separate interviews, the Chief Inspector and a predictive software developer acknowledged potential resistance to automating police work from officers using the technology. Both assumed that officers would be reluctant to following detailed instruction from software. To address this resistance, both participants offered the technologically inspired solution of 'gamifying' predictive police work. They provided the example of technologies that awarded officers 'scores' for following the instructions given by predictive algorithms. For example, an officer who visits a hotspot might score a point upon arrival and score a further point for completing a task such as checking-in with a local convenience store that has a history of being robbed. This would be aligned to an incentive structure such as the publication of comparable police scores and professional recognition of the highest scoring officers by their superiors. To justify incentivising police work, the Chief Inspector identified how gamification could be used to overcome competing motivations in police work, such as the competition between moving across a city quickly and the need to patrol less conveniently located neighbourhoods,

> The officers like to drive their cars, they like to drive towards city centres, they like to use the main and faster roads. That means they miss all the side road hotspots. Our games nudge their behaviour towards these spots.'

This gamification – a technique conceptualised by Zuboff (2019) as a methodology of behaviour manipulation – represents the lengths taken to replace the subjectivity of policing with allegedly objective predictions. In an expression of techno-determinism, some research participants described such a replacement as a natural evolution as police work as it transitions from intuition-led policing, to intelligence-led policing, to technologically enabled prediction-led policing. Some of these participants admitted to some scepticism about the effectiveness of prediction-led policing and affirmed the value of experiential police knowledge and subjective discretion. Given the overwhelmingly range of roles and responsibilities involved in police work (see *inter alia* Reiner 2010), designers and developers of predictive technologies participants admitted that subjective decision making is likely to remain a feature of police work and further admitted that police strategy should not necessarily be regarded as a binary choice between the presence and absence of police subjectivity. However, these designers and developers remained largely optimistic about the potential to reduce and mostly replace police subjectivity with algorithmic predictive.

Despite the seeming optimism about predictive technologies expressed by some participants, when researchers spoke to officers with experience using these technologies, many claimed predictive policing featured significant problems that were yet to be solved. The result was a sceptical attitude towards predictive policing and a desire to maintain a high level of discretionary control over police work. As elucidated below, this constitutes a deeper beliefs among officers which emphasises the importance of experience knowledge and skill in the 'craft' of police work (Willis 2013). These participants cited two broad categories of concern over predictive policing. The first category concerned the potential for predictive software to simply reproduce existing and obvious knowledge sometimes in patronising fashion. The second category concerned the potential for predictive software to reproduce biases as a result of the 'garbage in, garbage out' phenomenon. The following sections will summarise each of these concerns as well as resulting police efforts to assert police discretion when determining whether or not to follow predictive instructions.

Predicting the obvious

> Prediction is not rocket science and I'm not sure I need an algorithm to tell me where to patrol. I can look at past crime trends and put together my predictions. Do I need dots on maps to tell me that is going to happen?

Police Inspector, Head of Specialised Gangs Unit, Interviewed November 2017

Research participants routinely acknowledged that predictive policing is limited by the role of subjective decision making in the production of input data. For example, many research interviewees claimed that officers make the subjective decision as to how a particular event will be labelled and categorised in police records and, thus, how it will be understood by a predictive technology. The officers regularly cited examples of police discretion involving the choice about whether to detain an individual guilty of a minor offense or whether to 'let someone off with a warning.' Accordingly, a participant (Police officer interviewed in October 2017) with experience in data analytics stated

this means that [police data] is not a reflection of what crime occurs, but a reflection of what crime is categorised in a specific way.

This marks an acceptance over the fallibility of input data, and therefore predictions, based on long-standing critiques of official police data. Research participants were plainly aware that official police data was largely a reflective police activity rather than objective measure of crime prevalence, a process famously characterised by Sumner (2004) and the 'social construction of crime.' The implication of this process for predictive policing is the creation of partial renderings of crime as the affordances of algorithmic decision making. Aware of such shortcomings, officers in an Intelligence unit who were interviewed collectively admitted that this meant predictive technologies were only capable of repeating what the officers had previously told the technologies. Accordingly, many questioned whether the technologies had actually improved their knowledge of crime or simply told them what they already knew. For example, one participant (Head of a digital policing unit interviewed in October 2017) stated that,

Predictive policing has taken off in the last 5 years, some of it is interesting, but some of it just suggests the obvious; it is likely that burglary will continue in [location], that retail theft will be concentrated in shopping malls … Well, no shit!

A participant (Detective Inspector interviewed in October 2017) echoed the above criticism after trialing predictive technologies and noticing that she already knew most of what was being predicted. For example, a predictive technology used to address domestic violence had recommended she focus on the people and spaces she already expected to be involved in domestic violence given their recent criminal history. The inspector admitted that her scepticism about predictive technology made her sound 'old fashioned' but held on to her scepticism nonetheless,

I'm not sure we are into the Minority Report realm. [Predictive technologies] may assist you but I haven't found it helped us yet. Right now, we think 'well no shit, we knew that.' … [we] know who will have domestics, because they always do. Sounds a bit old fashioned (Laughs).

As the previous quotes suggests, scepticism was especially common among officers with an expertise in a particular type of crime. Officers from specialised crime units claimed that predictive technologies tend to struggle when asked to foresee crimes they specialise in as many of these have, historically speaking, been underreported and are, therefore, underrepresented in input data. In addition, optimism surrounding predictive technology was sometimes interpreted as disrespectful by these specialised officers. For example, a participant (Officer with a specialisation addressing domestic violence interviewed in October 2017) noted that he felt disrespected by the idea that his expertise about domestic issues in local communities was being 'replaced by a machine.'

Reservations about predictive policing were not delineated across ranks. Senior officers expressed similar doubts about the utility of predictive technologies. For example, The head of a digital policing unit (interviewed in November 2017) supported his fellow officers' scepticism about predictive technologies, claiming,

I cannot ever envisage a time when we just take that suggestion or answer, or you know, something will pop out of a machine and [we] will just blindly go and do that. There will always be the need for a human being in that process … to be able to say, 'OK, well the computer says this, but actually we need to [do that].' I think it would be completely unacceptable to me … if I was the senior investigating officer investigating a serious offense, I would be really unhappy with following a line of inquiry that was purely based on what a computer saying.

Such comments are reflective of the views of many research participants who believed that predictive technologies need the aid of police officers to be effective, particularly when officers own a unique expertise about specific crimes in their local jurisdiction. Many officers explicitly claimed that without the subjectivity of police decisions, errors in allegedly objective predictions created by limited data or flawed calculations would go unchecked. The human, the officers concluded, is just as necessary as the algorithm.[8]

Predictive bias

Ethics come up pretty much every time we talk about our work. For example, we ask if there is any shitty data in the intelligence we get from the police, especially past data from 1995, that is probably racially biased.
Predictive Policing Software Developer interviewed in November 2017

Several participating officers acknowledged the risk of biased predictions and once again encouraged a high level of scepticism towards the effectiveness and utility of predictive technologies. These officers often referenced the unobjective nature of the input data used to produce predictions of crime patterns. Predictions were once again recognised as being based on input data reflecting how officers had decided to label crime in the recent past, decisions which could be a reflection of structural inequalities. For example, reflecting a criticism often levelled at police by external commentators, a participant (Police officer involved in a digital policing project interviewed in October 2017) noted that using stop and search data to predict where and who was likely to commit crime would reproduce biases against black males,

… we know that a lot of our data is already biased, and we need to ensure that we eradicate that bias. So, if we have poor data in, we'll have poor data out. So, things like stop-search data, for example we know that we disproportionately stop and search young black men, so if we try to predict who we should be targeting for certain crime types in an area and we use stop-search data, well it's disproportionately going to tell us young black men.'

In addition to reflecting biases in input data, research participants were sensitive to the self-reinforcing characteristics of predictive technologies. For example, many research participants noted that when sent a predictive prompt to patrol a specific location, visits to that area would generate more data about that area. This in turn would act as input data for a future prediction, which is likely to tell officers to re-visit that area creating a self-reproducing cycle. As a particularly sceptical officer (Police officer interviewed in November 2017) put it, ' … if you go to hotspots … hotspots get hotter.' Given awareness of their role in the production of input data, several officers acknowledged the socially constructed quality of predictions and, as a result, predictive policing seemed to lose any sheen of objectivity.

Most research participants admitted that police organisations had not mitigated issues of biased predictions. A participant (Data analyst interviewed in October 2017) suggested the ideal response may be to 'throw out old data' if it was determined to reflect racial biases. However, the participant acknowledged that this approach clashed with organisational priorities to exploit the data richness of policing organisations which he claimed were 'obsessed with hoarding as much data as possible.' Other participating data scientists added that predictive software could be improved by introducing partner algorithms that address bias. For example, one participant (Head a digital policing unit interviewed in October 2017) argued that police organisations ' … need to introduce additional algorithms to eliminate the bias' and claimed to be working on such a companion algorithm with a team of data scientists tasked with cleansing biases in predictions. Such claims conform to an emerging trend of seeking technological solutions for technologically generated problems. Indeed, the

ability for partner algorithms to re-weigh variables and reduce biases is an established principle in data science. However, in these instances, such insights were not followed through for the practical implementation of predictive technologies. Accordingly, until such practices can be implemented, some police officers urged caution when using predictive technologies encouraging the re-assertion of subjective discretion. For example, the head of a digital policing unit added that officers would be trained to be critical of predictive technologies so that hotspots are not taken as 'gospel,' and officers always be in-charge of decisions about where and when to search for crime. Referring to officers using predictive technologies to determine where to locate their patrols, one participant stated, 'I wanted the officers or detectives to be making a final decision on these things.' It seemed then, that whereas predictive policing was originally framed as a means of addressing the influence of human bias by reducing police officers' discretionary control over police work, many officers hoped to address biases in predictions by re-empowering the discretionary decision making of police officers. Accordingly, one participant (Police officer interviewed October 2017) concluded, ' … you cannot take the human element out.'

The most sceptical police officers claimed that until issues about biased predictions were addressed, they would ignore or even manipulate predictive technologies to maintain some control over decisions in police work, undermining the incentivization strategies outlined by senior officers above. Some of these officers claimed that they would deactivate predictive technologies and continue to rely on their discretion to decide where and when to patrol. These sceptical officers were expected by developers of predictive software, hence the intention to 'gamify' predictive policing highlighted earlier. Aware of this gamification strategy, some officers responded by expressing a rather tokenistic approach to predictive policing, thus 'gaming' the 'gamification.' These officers claimed they would activate predictive technologies but would rarely follow their guidance. Similarly, some officers claimed they would rely on their discretion to determine the extent to which they would use predictive technologies to inform their patrol decisions. For these officers, scepticism and tokenism were healthy responses to what they considered a biased technology which often told officers what they already knew.

Discussion

Studies of police discretion demonstrate that it is commonly influenced by human errors and biases (Goldstein 1960, Skolnick and Fyfe 1993) and that it can be a vehicle for stereotyping and other partialities (inter alia Bowling and Phillips 2002). Accordingly, much controversy surrounding police in recent years have featured a desire to reduce the subjectivity of police decision making, perhaps by replacing it with alleged objective algorithmic analysis of crime patterns which could then guide police work. A goal of neutralising police subjectivity is theoretically pursued by automating police decision making so that officers resemble Uber drivers who are instructed by smartphone apps about locations of work, routes through space, and then rewarded for following instructions. Consequently, the uberization of policing resonates with the theoretical musings of a 'technological society' involving the delegation of daily decision making to integrated technologies which guide citizens as they proceed to navigate their immediate realities (Ellul 2018). However, as this study reveals, the introduction of technologies aimed at introducing objectivity into police work actually generate new sites of contestation. Police are negotiating the uberization of their work through the assertion of highly subjective and critical responses. Put another way, the attempt to turn to intelligence-led policing has been responded to with an effort to maintain intuition-led policing.

The imagining of objective and automated police work has been heavily criticised for excessive optimism concerning the accuracy of the predictions which would guide police work. While useful, a large body of this criticism essentially focuses on the flawed mathematics of predictive technologies, suggesting that the deficiencies in predictive capability will inevitably be improved by enhancing calculative processes and input data. The underlying assumption is one of technological determinism where the quality of the user's behaviours is predetermined by the quality the

technology which informs it. This assumption ignores the ongoing importance of the social determinants which influence the utilisation of technology, including the user's interpretation of predictive recommendations (Bijker and Law 1992, Bijker 1997). The research findings described above highlight the ongoing role of police discretion in the operation of predictive technologies and challenges the notion the predictive technology essentially replaces human subjectivity with objective prediction. Previous research has made a similar argument by pointing to the socially constructed qualities of predictions (Moses and Chan 2014, Chan and Bennett Moses 2016, Ferguson 2017, Bennett Moses and Chan 2018). This article contributes to this argument by highlighting the discretionary power that police officers continue to hold over the integration of predictions into routine police work. Rather than passively accepting predictions, police officers can carefully reconsider the degree to which predictions will be trusted and utilised. Thus, in contrast with the techno-deterministic claims of the Chief Inspector discussed earlier in this paper, it is unlikely that police work will be automated. Instead, police officers will actively engage with predictive technologies, using their discretion to decide how these predictions will influence police work. These findings reflect an alternative way to understand the prediction-led and larger 'professionalization' movements in policing. As Peter Manning (2008) argued, many view these movements as the uptake of a technologically driven change and scientific-based approach to police work. However, research shows that police officers often view professionalisation as less a matter of technologically driven change, and more a matter of developing their 'craft' through the re-articulation of subjective experience and refinement of practical skills (Willis 2013). The participants in this study exemplify this perspective by challenging the idea that their experience and skills will be replaced by predictive technologies and re-asserting their discretionary control over police work.

Research finding suggests the need for a techno-social lens when studying predictive policing, one which acknowledges partnership between human subjectivity and algorithmic calculation (Bijker and Law 1992, Bijker 1997). Through this lens, predictive technologies can be understood as a form of augmentation rather than automation as it extends the human police officer's capabilities rather than replacing them with technological recommendations. The police officer under a predictive policing regime is therefore reflective of the cooperative merging of human and technology, what is sometimes referred to as a 'cyborg' in techno-social literature (Gray et al. 1995, Gray 2000). The metaphorical police cyborg essentially analyzes crime data using predictive technologies and determines to what extent predictions will be followed using their discretion. Accordingly, this article suggests that police officers will continue to play a central role in the process of 'making crime' (Ericson 1981) by choosing when to utilise predictive technologies and when to ignore them due to obvious or biased suggestions. Accordingly, our findings reinforce Peter Manning (2008)'s recommendation to nuance radical claims about the changes that technologies make in policing by recognizing that police work tends to be slow to change despite technological uptake and tends to reflect the pre-existing rhythms of existing police structures.

Conclusion

This paper contributes to existing understandings of predictive policing by interrogating police uses of predictive technologies. In doing so, it aspires to supplement more technologically focused analyses by drawing out the complex negotiations between predictive software and its operators. As decades of social science analysis of technology have consistently pointed out, technological potential is shaped by the existing social settings into which they are installed. Accordingly, the introduction of predictive technologies is met by pre-existing subjectivities which sometimes translate into new modes of opposition and resistance. As the data above reveals, some predictive technologies are understood by police officers as a flawed technology and, perhaps, a threat in multiple existential dimensions including the potential for machines to replace police officers and the potential to for machines to transform policing by smothering the role of police discretion and tacit knowledge. This latter point aligns with experiences of

those working in other industries experiencing technological innovation, such as that identified in MacKenzie et al.'s (2017) analysis of telecommunications engineers' paradoxical pride in technological innovation coupled with lamentation of the skills lost as a result of such advances. Such losses are perhaps harder to bear among police given the view that predictive technologies do little more than reproduce existing and obvious knowledge. Awareness of these issues, as well as related concerns about the potential for predictive policing to reinforce biased policing, often translates into a distrust of predictive technologies and a tendency to defend the need for police discretion. In some cases, distrust of predictive policing inspires elaborate attempts to resist predictive instructions and to re-assert police discretion.

Such findings highlight the need for caution over claims that policing is poised for a widespread embrace of predictive technologies and that predictive technologies will simultaneously serve as an answer to the problems of subjective bias and error in police decision making. Ultimately, these dynamics illustrate a range of fissures that can occur as police officers are expected to utilise predictive policing technologies which they may find flawed. As is the case with other technologies such as the wearable camera (Ariel et al. 2016), the role of police discretion over when and how to use technologies are used should must be addressed. Even as police organisations attempt to 'gamify' the policing process to incentivise reluctant colleagues, ideas of an uberized and, ultimately, objective and automated police patrol are worthy of ongoing scepticism.

Notes

1. For example, Kent Police's trial of PredPol software has become among the most publicised studies of predictive policing software. For more information about this study (see http://www.predpol.com/tag/kent-police/). However, and as a foretaste of some of the police opposition to predictive technology rehearsed identified in the data below, Kent Police did not renew their licence to use PredPol following their initial uses of the technology (research interview with Predictive Policing Operators June 2017).
2. This research was conducted as part of the *Economic and Social Research Council* (ESRC) funded *Human Rights, Big Data, and Technology* (HRBDT) Project (ES/XXXXXXXXX). The authors would like to thank the ESRC for its support.
3. See Hunchlab website: https://www.hunchlab.com
4. See PredPol website: http://www.predpol.com
5. See Is Kent's Predictive Policing project the future of crime prevention?, Kent Online: http://www.kentonline.co.uk/sheerness/news/what-if-police-could-detect-93715/
6. It is worth emphasising an important distinction between transparency and accountability in this debate. For example, in early 2018 New York City enacted the world's first 'algorithmic accountability' law, stipulating that the source code of algorithmic decision-making had to be published if it was used by a public body to make decisions over citizens of the city. Whilst this marks a commitment to transparency, the indecipherability of source code to those affected means the process does not necessarily engender accountability (PF to REF).
7. See PredPol's about webpage: https://www.predpol.com/about/
8. Of further note here is the role of data protection law in relation to these human-computer interactions. Under Section 3 of The Data Protection Act 2018 – the UK's transposition (and, following Brexit, likely replacement) of the EU's GDPR into domestic law – meaningful human interaction is a legal requirement of any algorithmic decision making. On one level, it is notable that automatic human responses to algorithmic prompts would contravene this law. Given the varied responses to, and outcomes of, predictive decision making identified here, questions over the type of human scrutiny and the degree to which it is meaningful become increasingly pertinent.

Disclosure statement

Funding

ORCID

Ajay Sandhu 🆔 http://orcid.org/0000-0003-4154-308X
Peter Fussey 🆔 http://orcid.org/0000-0002-1374-7133

References

Ariel, B., *et al.*, 2016. Report: increases in police use of force in the presence of body-worn cameras are driven by officer discretion: a protocol-based subgroup analysis of ten randomized experiments. *Journal of experimental criminology*, 12 (3), 453–463.

Ariel, B., *et al.*, 2017. "Contagious accountability" a global multisite randomized controlled trial on the effect of police body-worn cameras on citizens' complaints against the police. *Criminal justice and behavior*, 44 (2), 293–316.

Atkinson, R., and Flint, J., 2001. Accessing hidden and hard-to-reach populations: Snowball research strategies. *Social research update*, 33 (1), 1–4.

Bachner, J., 2013. *Predictive policing: preventing crime with data and analytics*. Washington, DC: IBM Center for the Business of Government.

Bennett Moses, L., and Chan, J., 2018. Algorithmic prediction in policing: assumptions, evaluation, and accountability. *Policing and society*, 28 (7), 806–822.

Bijker, W.E., 1997. *Of bicycles, bakelites, and bulbs: Toward a theory of sociotechnical change*. Cambridge, MA: MIT Press.

Bijker, W.E. and Law, J., 1992. *Shaping technology/building society: studies in sociotechnical change*. Cambridge, MA: MIT Press.

Bittner, E., 1990. *Aspects of police work*. Boston: Northeastern University Press.

Bourdieu, P. and Wacquant, L.J., 1992. *An invitation to reflexive sociology*. Chicago, IL: University of Chicago Press.

Bowers, K.J. and Johnson, S.D., 2005. Domestic burglary repeats and space-time clusters: the dimensions of risk. *European journal of criminology*, 2 (1), 67–92.

Bowling, B. and Phillips, C., 2002. *Racism, crime and justice*. Pearson Education.

Chainey, S. and Ratcliffe, J., 2013. *GIS and crime mapping*. Chichester, West Sussex: John Wiley & Sons.

Chan, J., and Bennett Moses, L., 2016. Is big data challenging criminology? *Theoretical criminology*, 20 (1), 21–39.

Chen, M.K., *et al.*, 2019. The value of flexible work: evidence from Uber drivers. *Journal of political economy*, 127 (6), 2735–2794.

Cukier, K., and Mayer-Schoenberger, V., 2013. The rise of big data: how it's changing the way we think about the world. *Foreign affairs*, 92, 28.

Ellul, J., 2018. *The technological system*. Eugene, OR: Wipf and Stock Publishers.

Ericson, R.V., 1981. *Making crime: a study of detective work*. Toronto: Butterworths.

Ericson, R.V. and Haggerty, K.D., 1997. *Policing the risk society*. University of Toronto Press.

Eterno, J.A., and Silverman, E.B., 2006. The New York city police department's compstat: dream or nightmare? *International journal of police science & management*, 8 (3), 218–231.

Feeley, M. and Simon, J., 1994. Actuarial justice: the emerging new criminal law. *The futures of criminology*, 173, 174.

Ferguson, A.G., 2012. Predictive policing and reasonable suspicion. *Emory law journal*, 62, 259.

Ferguson, A.G., 2014. Big data and predictive reasonable suspicion. *University of Pennsylvania law review*, 163, 327.

Ferguson, A.G., 2017. *The rise of big data policing: surveillance, race, and the future of law enforcement*. New York: NYU Press.

Gangadharan, S. 2015. Predictive algorithms are not inherently unbiased. *The New York Times*. Available from: http://www. nytimes. com/roomfordebate/2015/11/18/can-predictive-policing-be-ethical-and-effective Google Scholar.

Goldsmith, A.J., 2010. Policing's new visibility. *The British journal of criminology*, 50 (5), 914–934.

Goldstein, J., 1960. Police discretion not to invoke the criminal process; low-visibility decisions in the administration of justice. *The Yale law journal*, 69, 543.

Gray, C.H., 2000. *Cyborg citizen: politics in the posthuman age*. New York: Routledge.

Gray, C.H., Figueroa-Sarriera, H.J., and Mentor, S. 1995. "The cyborg handbook".

Haberman, C.P., and Ratcliffe, J.H., 2012. The predictive policing challenges of near repeat armed street robberies. *Policing: a journal of policy and practice*, 6 (2), 151–166.

Harcourt, B.E., 2008. *Against prediction: profiling, policing, and punishing in an actuarial age*. Chicago: University of Chicago Press.

Joh, E.E., 2014. Policing by numbers: big data and the fourth amendment. *Washington law review*, 89, 35.

Karppi, T., 2018. "The computer said so": on the ethics, effectiveness, and cultural techniques of predictive policing. *Social media+ society*, 4 (2), 2056305118768296.

Khan, F., 2016. The uberization of healthcare: the forthcoming legal storm over mobile health technology's impact on the medical profession. *Health matrix*, 26, 123.

Lum, K., and Isaac, W., 2016. To predict and serve? *Significance*, 13 (5), 14–19.

MacKenzie, R., Marks, A., and Morgan, K., 2017. Technology, affordances and occupational identity amongst older tele-communications engineers: from living machines to black-boxes. *Sociology*, 51 (4), 732–748.

Maguire, M., 2018. Policing future crimes. *In*: *Bodies as evidence: security, knowledge, and power*, 137–158.

Maguire, M., Rao, U., and Zurawski, N., 2018. *Bodies as evidence: security, knowledge, and power*. Durham, NC: Duke University Press.

Manning, P.K., 2008. *The technology of policing: crime mapping, information technology, and the rationality of crime control*. New York: NYU Press.

Manning, P.K., 2010. *Policing contingencies*. Chicago, IL: University of Chicago Press.

McCulloch, J. and Wilson, D. 2016. *Pre-crime*.

Moses, L.B., and Chan, J., 2014. Using big data for legal and law enforcement decisions: testing the new tools. *University of New South Wales law journal*, 37, 643.

O'Neil, C., 2017. *Weapons of math destruction: how big data increases inequality and threatens democracy*. New York: Broadway Books.

Pasquale, F., 2015. *The black box society*. Cambridge, MA: Harvard University Press.

Perry, W.L., 2013. *Predictive policing: the role of crime forecasting in law enforcement operations*. Santa Monica, CA: Rand Corporation.

Ratcliffe, J.H., 2016. *Intelligence-led policing*. New York: Routledge.

Reiner, R., 2010. *The politics of the police*. New York: Oxford University Press.

Rosenblat, A., and Stark, L., 2016. Algorithmic labor and information asymmetries: a case study of Uber's drivers. *International journal of communication*, 10, 27.

Schneier, B., 2015. *Data and Goliath: the hidden battles to collect your data and control your world*. New York: WW Norton & Company.

Shapiro, A., 2017. Reform predictive policing. *Nature news*, 541 (7638), 458–460.

Skolnick, J.H., and Fyfe, J.J., 1993. *Above the law: police and the excessive use of force*. New York: Free Press.

Sumner, C., 2004. The social nature of crime and deviance. *In*: C. Sumner, ed. *The Blackwell companion to criminology*. Oxford: Blackwell, 3–31.

Waddington, P.A., 1999. Police (canteen) sub-culture. An appreciation. *The British journal of criminology*, 39 (2), 287–309.

Willis, J.J., 2013. Improving police: what's craft got to do with it. *Ideas in American policing*, 16, 1–13.

Yao, Y., 2019. Uberizing the legal profession? Lawyer autonomy and status in the digital legal market. *British journal of industrial relations*.

Yin, R.K., 2013. *Case study research and applications: design and methods*. Thousand Oaks, CA: Sage Publications.

Zedner, L., 2007. Pre-crime and post-criminology? *Theoretical Criminology*, 11 (2), 261–281.

Zuboff, S., 2019. *The age of surveillance capitalism: the fight for a human future at the new frontier of power*. London: Profile Books.