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Ethical challenges and innovations in AI-driven predictive policing: the case of China

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Highlights:

- Examines China's AI-driven predictive policing practices and their ethical implications.
- Identifies major ethical risks: privacy intrusion, algorithmic bias, and legal uncertainty.
- Provides empirical evidence and case-based insights to assess policing effectiveness.
- Proposes China-specific innovations to enhance fairness, transparency, and data governance.

Abstract: Rapid advances in artificial intelligence (AI) are reshaping policing practices around the world. Predictive policing, as an important application of artificial intelligence in the field of public security, has received increasing attention in China. However, although this technology has demonstrated significant advantages in crime prevention and resource optimization, it has also raised many ethical issues, including privacy protection, algorithmic bias, and possible violations of civil rights. This paper explores the current state of predictive policing in the context of China, highlighting the value of technological innovation and the ethical dilemmas it poses, while proposing solutions tailored to China's specific circumstances to balance technology and ethics.

Keywords: predictive policing; artificial intelligence; privacy protection; ethical challenges

1. Introduction

The theoretical origins of predictive policing can be traced back to the 1970s concepts of "hot spot policing" and the "routine activity theory [1]. One of the earliest scholars to systematically propose the idea of predictive policing was Jeff Brantingham and his research team at the University of California, Los Angeles (UCLA). Drawing on crime pattern theory and spatial analysis, they argued that it is possible to forecast the likelihood and location of criminal activity by analyzing historical crime data in conjunction with temporal, spatial, and social variables [2]. This theoretical foundation laid the groundwork for algorithmic modeling and provided an academic basis for the evolution of modern policing technologies.

After the 9/11 attacks, predictive policing rapidly transitioned from theory to practice and became widely adopted by law enforcement and security agencies in the United States. In the context of counterterrorism, as traditional reactive strategies could no longer support a prevention-oriented model of public safety, the government urgently sought new methods for risk prediction and crisis intervention [3]. At this critical moment, advances in information technology and big data fueled the rise of predictive policing, enabling the strategic integration of technological tools into policing operations.

Now, the development of predictive policing worldwide shows a trend of diversification, with different countries and regions exploring distinctive models of smart policing based on their own circumstances. In developed countries, predictive policing has become relatively mature, with technologies such as the PredPol system in the United States, the National Data Analytics Solution (NDAS) in the United Kingdom, and the Pre-Crime Observation System (PRECOBS) in Germany. These countries widely apply big data analysis, artificial intelligence, and machine learning to achieve functions such as crime prediction and surveillance warning. At the same time, they place great emphasis on data security and privacy protection, promoting the healthy development of smart policing [4]. As the fastest-growing developing country, China is experiencing rapid progress in predictive policing. In recent years, public security agencies have actively advanced the informatization of policing, promoting a transition from traditional policing models to intelligent and digital approaches. Through the construction of projects such as the "Skynet Project," the adoption of facial recognition technology, the development of big data combat platforms, and the deployment of drone patrols and intelligent video analysis systems, China has significantly enhanced its capacity for crime control and public safety protection [5].

However, as the application of technology continues to deepen, predictive policing has also sparked widespread discussions regarding ethical and legal issues such as the protection of privacy rights, algorithmic bias, and data misuse [6]. This paper aims to systematically analyze the ethical challenges, and innovation demands faced in the development of intelligent policing in China, and to explore how to strike a sustainable and balanced path between safeguarding public security and respecting individual rights by improving legal regulations, strengthening technological governance, and promoting public participation.

2. Foundations and developments in predictive policing

2.1. Definition and characteristics of predictive policing

Predictive policing refers to the application of technologies such as big data analytics, artificial intelligence, and statistical modeling to forecast the time, location, methods, and potential targets of criminal activity, thereby enabling law enforcement agencies to implement targeted interventions aimed at preventing and reducing crime before it occurs. At its core, predictive policing involves the construction of risk assessment models based on historical crime data, environmental factors, and behavioral patterns, with the objective of optimizing police deployment and resource allocation to enhance operational efficiency and public safety [7]. The key characteristics of predictive policing include: (1) data-driven decision-making, heavily reliant on the collection and analysis of extensive historical and real-time data; (2) a proactive orientation, focusing on preventive measures rather than reactive responses; (3) technological dependence, characterized by the extensive use of advanced information technologies and algorithmic tools; and (4) dynamic adaptability, allowing for real-time

adjustments and continual refinement of predictive models in response to evolving crime patterns and environmental changes.

2.2. The workflow of predictive policing

The workflow of predictive policing can be described as follows: The system first integrates historical crime data, socioeconomic variables, and real-time information. It then utilizes advanced algorithms and machine learning models to assess risk levels and identify potential crime hotspots related to specific geographic areas or individuals. The resulting predictions are typically presented in the form of geospatial visualizations or analytical reports, which serve as a basis for law enforcement agencies to make strategic decisions, such as optimizing police resource allocation, designing patrol routes, and setting operational priorities [8]. Furthermore, the system continuously improves its predictive models by incorporating feedback from actual policing outcomes, thereby enhancing prediction accuracy and the overall effectiveness of law enforcement strategies.

2.3. AI-assisted predictive policing

In modern law enforcement, artificial intelligence (AI) technology has become an important tool for enhancing the efficiency and accuracy of predictive policing. Predictive policing involves analyzing large volumes of historical data and using machine learning and AI algorithms to predict the locations, times, and types of potential crimes, helping the police allocate resources more scientifically and prevent crime. AI can identify complex crime patterns, uncover hidden trends, and accurately pinpoint high-risk areas. For example, by integrating crime records, weather conditions, and demographic data, AI can assist the police in proactively deploying forces, thereby improving response speed and overall public safety management [9].

Globally, many countries have begun exploring the application of artificial intelligence in predictive policing to enhance law enforcement efficiency and crime prevention. As a pioneer in this field, the United States has implemented systems like PredPol in cities such as Los Angeles and Chicago, using historical crime data to predict “hotspot” areas and guide police deployment. However, these systems have sparked significant controversy due to concerns that they may reinforce racial bias and infringe on privacy rights, leading some cities to suspend their use. In contrast, the United Kingdom has placed greater emphasis on data compliance and public acceptance while advancing AI-based policing. British police forces strictly adhere to legal frameworks such as the General Data Protection Regulation (GDPR) and conduct thorough evaluations of the ethical and practical implications of such systems [10]. Germany has adopted a more cautious approach, with limited pilot programs in federal states like Hamburg and Berlin using systems such as Precobs to analyze patterns of residential burglary. German authorities emphasize strong legal safeguards, system transparency, and auditability, aiming to strike a balance between technological innovation and the protection of civil liberties [11]. Compared with these countries, China entered the field of AI-assisted predictive policing at a slightly later stage but has experienced rapid development in recent years. Several regions have begun using big data and AI algorithms to identify potential crime risks, especially in areas such as public security management, surveillance in public spaces, and the monitoring of key populations.

3. Predictive policing and empirical analysis in the Chinese context

3.1. Cases analysis

3.1.1. Specialist team resolves theft case within 24 hours

In 2024, the Yueyahe Police Station of Tianjin Hebei Branch received a report from a citizen, Cui Binbin, claiming that his gold necklace, worn for many years, had been stolen while he was resting at a bath center. Since there was no surveillance in the locker area where the theft occurred, the case posed significant difficulties. Upon receiving the report, Officer Zhou Xinqi reviewed surveillance footage from both the lounge and the main bath hall, identifying a suspicious man who briefly handled the locker tag. However, due to poor image quality, it was difficult to confirm the suspect's identity. Facing these challenges, Zhou sought assistance from the newly established "Zhang Lei Studio," a specialist team integrating traditional investigative methods with modern police technologies under a "professional + mechanism + big data" model. Within 20 minutes, the team completed a technical comparison, confirming with 94% similarity that the same individual appeared in both key video frames. Further analysis traced the suspect's frequent activities near a chess and card club, leading to his successful apprehension the same afternoon. By integrating traditional expertise with modern technologies, "Zhang Lei Studio" effectively overcame limitations of conventional methods and significantly improved case-solving efficiency. As a result, in 2024, Hebei District's resolution rate for public security cases increased by 50.78% year-on-year, while the resolution rate for criminal cases rose by 19.25%, with a substantial reduction in case processing time, contributing to continued improvements in public security [12].

3.1.2. Fast traffic incident response through integrated patrols

In 2024, during the morning rush hour in Keerqin District, Tongliao City, Inner Mongolia, a minor rear-end collision occurred that could have led to prolonged congestion and public disorder. However, within two minutes of the incident, a patrol team under the "integrated traffic-patrol policing" model arrived on motorcycles to manage the scene. They promptly documented the accident, collected evidence, guided the involved vehicles to the roadside, and completed liability determination and site clearance within just five minutes, allowing traffic to resume quickly. This efficient response was made possible by Tongliao's police reform, which broke down barriers between traffic police and patrol police, establishing a unified dispatch and dynamic patrol model under the command of the intelligence center. The main urban area was divided into 62 patrol points based on geography and traffic conditions, with staffing adjusted according to peak and off-peak hours. This reform greatly enhanced the responsiveness and effectiveness of handling emergencies. In the first half of 2024, the rate of traffic violations in the Keerqin District decreased by 15% year-on-year, while traffic accidents dropped by 10%, and road traffic flow improved noticeably. The "integrated traffic-patrol policing" mechanism has shown initial success in ensuring smooth traffic, improving public safety, and enhancing overall law enforcement efficiency.

3.2. Empirical data of predictive policing in crimes

Figure 1 illustrates the types of crimes targeted by predictive policing efforts in the surveyed city, a total of 800 questionnaires were distributed, of which 789 were recovered, resulting in a recovery rate of

98.6%. After screening, 766 valid questionnaires were identified, accounting for 97.1% of the recovered questionnaires. The survey results indicate that the city's predictive policing efforts primarily target crimes such as theft, robbery, and electric bicycle theft. These types of crimes are relatively common and occur frequently, closely associated with socioeconomic factors and the characteristics of the built environment. They exhibit near-repeat patterns and demonstrate significant spatiotemporal regularity, making them more suitable for accurate prediction and prevention through predictive policing technologies. In contrast, crimes such as murder, physical assaults, drug-related offenses, and attacks, although receiving some attention, are generally more influenced by offenders' individual psychological, physiological, and social factors. These crimes occur less frequently and show weaker spatiotemporal patterns, thus posing greater challenges for prediction modeling and reducing the effectiveness of predictive policing strategies for such offenses.

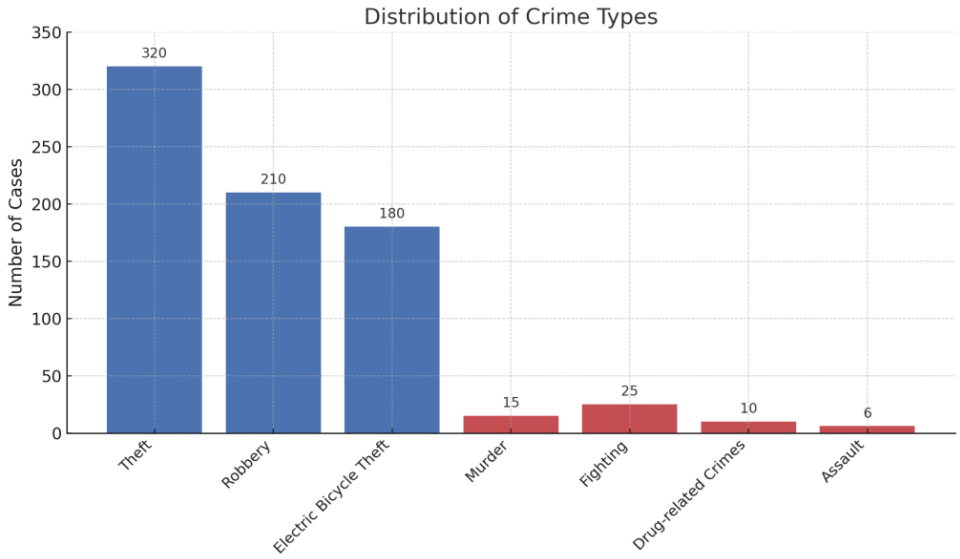

Figure 1. Distribution and predictability of crime types in predictive policing.

3.3. The crime-fighting effectiveness of predictive policing

Predictive policing, through the analysis of historical crime data and the use of algorithms and statistical models, guides police deployment and crime prevention efforts, thereby enhancing the overall effectiveness of crime control [13]. First, the reasonable application of predictive policing technologies contributes to the reduction of crime rates, particularly in cases such as theft, robbery, and violent offenses, with data indicating varying degrees of decline in these types of crimes following implementation. Second, predictive policing optimizes the allocation of police resources, making deployments more precise and efficient, reducing aimless patrols, and improving patrol success rates and emergency response speeds. At the same time, predictive policing emphasizes proactive prevention over reactive response by identifying high-risk areas and individuals in advance and adopting measures such as increasing police presence, strengthening community engagement, and implementing targeted interventions, thereby effectively suppressing the occurrence of criminal activities and reflecting the modern shift in policing toward proactive crime control.

4. The limitations and innovative approaches of predictive policing in China

4.1. Limitations of predictive policing

4.1.1. Algorithmic bias

One significant issue in predictive policing is the potential for algorithmic bias. If the training data used to develop predictive models reflects societal biases (such as racial, socio-economic, or gender biases), these biases can be amplified by the algorithm. For example, in contexts where historical policing practices disproportionately targeted certain racial or ethnic groups, predictive models might continue to focus on these groups, perpetuating cycles of over-policing and systemic discrimination [14]. In the United States, studies have shown that predictive policing tools, such as PredPol, often direct law enforcement resources disproportionately toward minority communities, exacerbating existing inequalities [15].

In China, the application of predictive policing technology has made significant progress in various fields, particularly in public safety and social governance. For example, China has strengthened social security management through big data and artificial intelligence technologies, establishing effective risk warning mechanisms. These technologies play an important role in ensuring social stability and improving public safety. However, algorithmic bias still needs to be addressed with caution. China is a multi-ethnic country, with the Han ethnic group being the majority [16]. In some areas with large ethnic minority populations, predictive policing models may overly rely on data samples predominantly from the Han ethnic group, particularly in the collection and analysis of biometric data. If these models fail to fully consider the unique characteristics of ethnic minority groups, it may lead to biased outcomes, which could affect the effectiveness of social governance in minority regions. Such bias might inadvertently exacerbate social tensions and undermine the fairness and justice of policing efforts [17]. Therefore, ensuring the comprehensiveness and fairness of algorithmic models is a key issue that needs to be addressed.

4.1.2. Accuracy issues

In predictive policing, accuracy is crucial for the effectiveness of the system. However, errors often occur due to insufficient or outdated data, leading to what are known as “false positives” and “false negatives.” A false positive occurs when the system incorrectly predicts criminal activity in a location or group that is not actually at high risk. Conversely, a false negative happens when the system fails to predict criminal activity in a location or group that is at risk. These inaccuracies can undermine the effectiveness of predictive policing, as resources might be misallocated, leading to inefficiency in law enforcement.

4.1.3. Privacy violations and legal disputes

Predictive policing often requires the collection and analysis of large amounts of data, including personal and sensitive information about individuals’ behaviors, movements, and interactions. This can raise significant privacy concerns, as it may involve surveillance without consent or without proper oversight [18]. The widespread monitoring of individuals, particularly in marginalized communities, could infringe on citizens’ privacy rights, potentially violating constitutional protections. Furthermore, the lack of transparency in how data is used, and decisions are made by predictive models can result in a lack of procedural fairness and accountability, leading to legal challenges.

4.1.4. Displacement effect

Predictive policing systems are designed to allocate law enforcement resources more effectively by focusing on areas predicted to experience higher rates of criminal activity. However, one unintended consequence is the potential for the displacement of crime. Criminals may simply relocate to areas not covered by the predictive model, avoiding increased police presence. As a result, while the system may show a decrease in crime in the predicted areas, it might not reflect a true reduction in crime overall [19]. This phenomenon can lead to a shifting of criminal activity, rather than addressing the root causes of crime. It also poses challenges to the long-term effectiveness of predictive policing, as crime may move to new areas without being adequately addressed.

4.2. Innovative approaches of predictive policing

4.2.1. Enhancing data quality and model interpretability

In China, the high error rate in predictive policing systems in certain regions can largely be attributed to limited data sources and delayed updates, particularly at the grassroots level [20]. In contrast, the United States has improved the accuracy and interpretability of predictive models by integrating multi-source data verification mechanisms and establishing model explanation frameworks. The United Kingdom has emphasized standardized data protocols and transparent processing across departments, significantly enhancing the timeliness and adaptability of its models. These experiences suggest that China should promote data standardization nationwide, strengthen technical support for grassroots policing information systems, and establish scientific model validation mechanisms to improve the credibility and practical value of predictive results.

4.2.2. Preventing algorithmic bias and unfair enforcement

China must remain vigilant against the risk that algorithms may amplify implicit biases embedded in historical data, which could result in "labeling" effects and disproportionate policing of certain groups or regions. In the United States, controversies have arisen from biased predictions disproportionately targeting minority communities; corrective measures have included adjusting data input structures and incorporating fairness assessment tools. The United Kingdom has adopted a more cautious policy approach, requiring that algorithmic decisions not replace human judgment. China should draw on these practices by rigorously reviewing data structures during algorithm development and implementation, while also establishing mechanisms for risk assessment and accountability to avoid undermining the legitimacy of law enforcement through technical misuse.

4.2.3. Clarifying legal boundaries and strengthening procedural safeguards

At present, China lacks specialized legislation addressing key issues in predictive policing such as personal data protection, algorithm transparency, and data misuse. This legal gap raises public concerns over potential infringements on privacy rights. By contrast, the United States has enacted various privacy-related laws that define clear boundaries for algorithmic applications, with independent bodies overseeing law enforcement's use of data. The United Kingdom's Data Protection Act sets standards for

lawful data processing and affirms citizens' rights to information and objection, forming a relatively robust legal safeguard framework [21]. China should conduct systematic research on relevant legislation and promote the enactment of forward-looking regulatory mechanisms that clarify compliance requirements at all stages of data collection, processing, and analysis, thereby protecting citizens' legitimate rights from technological overreach.

4.2.4. Addressing the displacement effect through regional collaborative governance

In practice, China has seen that concentrating police resources in high-risk areas can temporarily improve local security, but often leads to the displacement of criminal activities to neighboring regions, undermining overall governance outcomes [22]. The United States has addressed this issue by adopting dynamic police deployment strategies and inter-regional data sharing to balance policing efforts between "hotspots" and surrounding areas. The United Kingdom has promoted the establishment of community policing networks, encouraging resident participation in public safety efforts, which has helped mitigate spatial crime redistribution. China should enhance inter-regional information sharing and resource coordination, optimize the allocation of police forces, and strengthen community engagement to build a broader and more responsive integrated governance system capable of curbing the persistent effects of crime displacement.

5. Conclusion

AI-driven predictive policing in China has demonstrated significant potential in enhancing public safety and resource efficiency. However, it also raises ethical challenges, such as privacy violations, algorithmic bias, and the risk of technological misuse. To balance technology and ethics, China must improve its legal framework for data protection and technological oversight, enhance algorithmic transparency, strengthen public participation and oversight, and engage in international cooperation to share best practices and establish global ethical standards. By adhering to a people-centered approach, balancing technological innovation with ethical responsibility, China can promote the sustainable development of its policing technologies while providing valuable insights for the global application of AI in law enforcement.

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Authors' contribution

Conceptualization, Zhenkang Li; methodology, Zhenkang Li; software, Xiaoyu Wan; formal analysis, Zhenkang Li; writing—original draft preparation, Zhenkang Li; writing—review and editing, Zhenkang Li and Xiaoyu Wan. All authors have read and agreed to the published version of the manuscript.

Conflicts of interests

The authors declare no conflict of interest.

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