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Crime Displacement Effects of CCTV and Smart-City Technology: An Evidence Review

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ABSTRACT

The expansion of closed-circuit television (CCTV) systems and smart-city surveillance technologies has transformed contemporary approaches to urban crime prevention and public safety. This evidence review examines the crime displacement effects associated with CCTV surveillance, predictive policing, integrated sensor systems, and other smart-city technologies. Drawing upon theoretical and empirical literature, the study evaluates whether surveillance interventions reduce crime overall or merely relocate criminal activity across space, time, targets, or methods. The review highlights the relevance of routine activity theory, situational crime prevention, and crime pattern theory in explaining offender adaptation and displacement dynamics. Empirical findings reveal mixed outcomes: while many studies demonstrate significant reductions in crime within monitored zones, evidence also suggests the occurrence of spatial and temporal displacement in adjacent or less protected areas. At the same time, several investigations identify diffusion of benefits, where crime reductions extend beyond surveillance boundaries. Smart-city technologies introduce additional complexities through algorithmic governance, predictive policing, automated license plate recognition, artificial intelligence, and networked surveillance systems, all of which reshape offender behaviour and urban security practices. The review further examines methodological challenges in displacement research, including counterfactual construction, geographical scaling, publication bias, and causal inference limitations. Privacy concerns, public legitimacy, civil liberties, and ethical governance emerge as critical contextual moderators influencing the effectiveness and acceptance of surveillance technologies. The study concludes that crime displacement is neither universal nor inevitable; rather, its extent depends on surveillance design, coverage intensity, integration with broader crime prevention strategies, and community legitimacy. Effective policy responses therefore require balanced frameworks that combine technological innovation with transparency, accountability, ethical safeguards, and context-sensitive urban governance.

Keywords: Crime displacement, CCTV surveillance, Smart-city technology, Predictive policing and Urban crime prevention.

INTRODUCTION

Surveillance by closed-circuit television (CCTV) and other smart-city technologies is becoming both widespread and evidently controversial [1]. Opponents of these technologies often cite fears of privacy loss [2]. Proponents of "smart-cities" and security monitoring cite public safety as a primary justification for deploying these systems, while city officials commonly justify increased surveillance on the basis of crime prevention and public safety.

Concerns regarding CCTV surveillance often refer to the fear of displacement specifically, the idea that crime may simply be displaced from the monitored location to nearby unmonitored locations [1]. However, the ability to track spatial crime displacement around CCTV installations has been hampered not by the lack of spatial data, but by obstacles to establishment of counterfactual scenarios for what would have happened in the absence of the treatment [2]. The evidence that displacement often does not occur or those areas effects sometimes emerge that reduce displacement is proliferating [1].

Theoretical Foundations of Crime Displacement

The extent to which a preventive measure leads to crime displacement, the relocation of crime from the impacted to nonimpacted locations or times ranks among the key criteria for assessing its merits [1]. Effective interventions that harm criminals or diminish the preconditions of crime tend to displace less crime. Such effects are less salient in discussions of closed-circuit television (CCTV), but comprehensive analyses still remain scant. Early systematic reviews concentrated mainly on spatial and temporal considerations associated with CCTV, while recent diverse studies examined the interplay between CCTV and the routine activity theory of crime [2]. Crime displacement effects have received attention in other surveillance sectors. Initial interest focused on networked setup, where CCTV units not stationed at any given site transmit footage of crime occurrence, thereby expanding offenders' opportunities elsewhere. Social media-based outreach toward event offenders, another chain component of routine activities, is considered an opportunity for offending [3]. Spatial displacement linked to commercial robberies is capitalized by surveillance units at alternative premises to fine-tune risks to establishments, with national crime datasets confirming these tendencies. Predictive policing, notwithstanding its objective of crime prevention through elucidation of offender activity patterns, may give rise to displacement and diffusion phenomena, pursuant to mechanistic syllabi employed in the systems [2].In respect of intelligent urban systems, the discourse has gravitated toward designated smart-city technologies, an electronic preoccupation broadly denoting the amalgamation of pre-existing technologies that are each pro-urban [3]. Cameras and monitoring technologies traditionally appear in a civic realm of enforcement yet also play in quasi-surveillance. Embedded in this circle, large potential abides for unintended manifestations such as infringement upon civil liberties [1].

CCTV Surveillance: Empirical Evidence and Interpretations

Crime displacement is the process whereby crime is redirected from one target to another as a consequence of preventive interventions [1]. The concept is extensive and multifaceted, yet some theoretical foundations can be highlighted, along with empirical evidence related to CCTV surveillance and smart-city technologies. Each has pivotal policy implications. For CCTV, evidence and interpretations point to several displacement mechanisms: spatial movements to neighbouring areas or types of establishments; temporal shifts from daytime to evening; and adaptations alongside risks and targets affecting the routine activities of both offenders and victims [2]. The smart-city field of the Internet of Things generates additional and distinct displacement dynamics concerning digital surveillance and policing, algorithmic analyses accompanying automated systems, and the structure of underlying data networks [2]. Decades of research underscore the complexity of crime-displacement processes. It is also clear that knowledge accounts for only part of the challenge. To be effective, policy must address privacy considerations, the perceived legitimacy of interventions, and diverse contextual moderators governing technology, displacement, and crime. Such aspects shape prospective implementation and articulation in places where displacement remains a concern [2].

Spatial Displacement and Area Effects

The spatial displacement literature reports some evidence of area-wide crime increases, even when the focus is on micro-level displacement analysis [2]. Research amalgamating multiple studies across the United Kingdom illustrates crime rises in neighbouring zones alongside decreases in CCTV-implemented sites. These results persist after controlling for wider contextual influences, suggesting that considerable CCTV deployment (i.e., above 30 cameras within a certain radius) is needed before area effects become observable. Although CCTV installation might initially generate net area-wide gains, "doing more" does not necessarily revert the impact back to spatially uniform [2]. Additional analysis distinguishes between three timeframes: pre-installation, initial, and post-maturity. Initially, CCTV investment typically targets high-problem zones, attracting many interventions that discourage crime. An early 1990s evaluation of a three-city scheme reports pronounced declines in the number of recorded crimes, with the strongest reductions in places receiving additional measures [3]. At this juncture, supplementary deterrent mechanisms coexist with the gradual installation of the cameras themselves, blurring interpretation. Subsequently, analysis shows that complete-area effects maintained six years later when additional corrective initiatives ceased and coverage exceeded 30 units, indicating that a stage preceding spatial shift remains attainable [3].

Temporal Displacement and Deterrence

Offenders' access to a greater volume of surveillance video than traditionally available through public broadcasts brings new opportunities for adaptation. To address these concerns, networked surveillance strategies must be developed that incorporate psychological and social legitimacy considerations [1]. Situational crime-prevention programmes must also adjust to account for networked CCTV technology, situational crime-prevention measures requiring physical presence to ensure similar emotional responses, and, therefore, corresponding deterrent effects.

CCTV reduces crime rates significantly more when routine prevention practices are employed than without them at all, in accordance with CCTV's perceived deterrence effect [2]. Advising offenders of additional security precautions may lead to the incorporation of preventive devices without the application of emotional pressure that,

in the presence of common CCTV, can become the more appropriate choice [1]. When networked surveillance is adopted, the surveillance link between perceived overwhelm and capacity rapidly diminishes and expands significantly beyond than when deployed in isolation, suggesting that adjustments to theory and practice will also be required. Such measures must combine aspects of broader scenario approaches with the principles of timely police intervention to offset the potentially narrow view of surveillance or shorter-lived levels of awareness and concern that routine-protection communications elicit [1]. Offenders are also capable of actively monitoring the charts available for downloaded public- and commercial-record durations, further extending pre-offence knowledge beyond that existing at plan formation. Such information also appears on compilation tables publicly broadcast or downloadable via leading social network, still well before active prevention of the repeat offence can commence, indicating minimal if any deterrent effect likely to accompany networked deployment [2]. Daily notifications still arise concerning coverage anticipated up to three hundred sixty-five days in advance for public recorded disposal [3]. Specifying lanes of routine activity that any surveillance-encountering individuals already observe can lead to generally invalid assumptions about which, to what extent, and when a demand for deterring installation exists, thereby enabling straightforward adaptation of practice even when intentioned instead of adherence timing appears[1]. Besides helping to tackle the black box issue of when, why, and how surveillance operates, embedded explanations of operational mechanisms enable the productive cross-boundary transfer of proven good practices [1]. Much of the situational-crime preclusion literature remains silent regarding the temporary or narrowly confined status of designated coverage [1]. Tracking the evolution of prospective crime-scene activity, pursuing predicted future chart stages, and noting non-crime-status shifts are also important forms of the broader, better-deployed approach beginning at plan-formation time. When offenders must operate entirely beyond line-of-sight to avoid same-period interaction with routine codes, they can then freely develop pre-actualised plans entailing definitive avoidance of future conflicting instruction, still satisfying the initial purpose even if enacting pre-full-spectrum installation [3].

Offender Adaptations and Routine Activity Implications

Contemporary theories of crime displacement emphasize the role of both offenders and crime opportunities. Routine activity theory posits equilibrium between motivated offenders and suitable targets, altered by crime prevention measures [3]. Displacement occurs when prevented targets remain attractive and when offenders can adapt. Target suitability depends on the relative effort, risk, and reward [3]. Hence, reductions influence on displacement also depends on situational factors: ease of handling offenders' adaptations can affect adaptation to measures and significance of best remaining targets. In interpreting CCTV effects, such considerations are relevant at both level of areas target system and attributes of particular cameras [2]. Interventions might maintain or create barriers through situational crime prevention techniques; yet unintended increases at other sites and parallel effects later emphasize need for understanding mechanisms regulating measures actual consequences, supporting systems perspective on the issue [2]. Recent evaluations concluded on opportunity-driven rather than pure deterrent mechanisms, framing explained variation in area effects and adaptations subsequent to different types of systems, complementing a focus on spatial-temporal characteristics of incidents nearby [2]. Consequently, remote-operation self-initiated offences gained relevance as driving contributor, deterrent mechanisms rather than expression of general transformation in offenders' motivations and tactics [2].

Smart-city Technologies and Integrated Surveillance: Evidence Synthesis

The application of smart-city technologies for urban management is being fostered by the rise of data and sensor interconnectivity [3]. Complex frameworks often governed by machine learning and artificial intelligence draw on existing data to predict future risk, coupled with integrated surveillance to evaluate the emergence of novel crimes. This approach exemplifies data-driven governance, leveraging metrics generated from public and private participation to enhance operational efficiency [1]. Incurrent feedback and discussions regarding international implementation of predictive policing highlight the difficulties inherent in regulating and controlling related initiatives. Abundant experience with CCTV entails the preservation of certain lessons, which can be broadly bisected into cognitive and contextual components. Scientifically grounded knowledge still appears to exert limited impact on intellectual frameworks and the perception of techno-solutionism [2]. Despite smart-city technologies constituting a major societal evolution, their broad application persists, functioning through several intermediaries within both formal and informal networks [3]. Overall deployment spans vast territories, both geographically and socially; they are typically enacted through potentially formative yet also precarious interventions, which risk unintended consequences together with substantial integration challenges [2]. Urban security and crime prevention constitute traditional objectives of the smart-city agenda; much enthusiasm presently surrounds the utilization of such technologies to promote public safety. Empirical analysis of mixed methodologies across three interconnected smart-city sectors of integrated surveillance, predictive policing, and urban elements suggests the predominant influence of sustained temporal, spatial, and target-oriented factors. The

transition from territorial to functional or sectoral distributive networks within smart-city interventions further underscores sustained displacement tendencies [2].

Networked Surveillance and Mixed-methods Findings

In addition to limitations noted for the MPSA dataset, recent research on networked surveillance offers preliminary insights into both the potential for displacement and specific contextual moderators [3]. Case studies of large-scale deployments alongside automatic license plate recognition (ALPR) and gunshot detection technology in Jersey City have provided rich foundational data [3], while prior findings concerning spatial-temporal capabilities of digital CCTV and the "mixed-methods–indicators" framework suggest additional possibilities. Spatial-temporal analyses revealed that crime volume decreased during the presence of digital CCTV within designated zones but did not persist outside those zones [2]. Through the framework, including exploratory interviews with law enforcement personnel, analysis of operation orders and police reports, and hotspot maps and fieldwork, the authors identified only a modest deterrent prior to the intervention, enabling the isolated investigation of placement through the lens of situational crime-prevention theory [3]. The mixed-method findings may further clarify macro-scale examinations of new area characteristics, provide insights into deployment guidelines for the license-plate-recognition component, hone understanding of collaboration needed for implementation, and suggest the necessity of identifying crime types most appropriately addressed by the proposed technology [2]. Research remains scarce regarding smart technologies and corresponding adaptations. A growing range of CCTV options is technically available, yet additional study would benefit emerging smart-city technologies, police-department practices, and adjustment to multi-camera systems, body-worn cameras, automatic-vehicle-location frames, social-network analysis, and non-surveillance smart tools [3]. The emergence of predictive-policing instruments highlights the likelihood of displacement studies continuing to be timely and relevant across an extensive array of surveillance-level and functioning parameters [2]. Additional lessons may also still be drawn from the CCTV evaluation literature concerning non-surveillance and wider techniques and approaches, a review of which alongside predictive-policing implementations in diverse US cities suggests distinct complementary frameworks. The crossroads at which CCTV, predictive policing, surveillance, and beyond converge constitutes a noteworthy avenue for ongoing enquiry [2].

Predictive Policing and Displacement Dynamics

The existence of criminal networks complicates the relationship between predictive policing and crime displacement in important ways [2]. At the theoretical level, it has been argued that shifting one's criminal activities into areas already subject to enforcement pressure makes little tactical sense for offenders deciding where to commit crime, because the enforcement capacity of agencies is likely concentrated at these locations [3]. In more practical terms, criminal co-offenders may also follow each other through "hot spots," which serves to further delay overall displacement. Such complexities increase the likelihood that targeted deterrence will encourage offenders to switch to different activities or to adopt alternative methods of offending [1].

Privacy, Legitimacy, and Contextual Moderators

Previous research across various camera types (e.g., closed-circuit television (CCTV), automatic number plate recognition (ANPR)) and other smart-city technologies supports the conclusion that broader area coverage makes the likelihood of displacement to adjacent streets lower than focusing on only one type or area [2]. The wider the coverage, the more potential activities for offenders to select with lower perceived risk. For instance, the area surrounding ANPR-enforced streets did not observe an obvious increase in street deliveries although the focus was on smart traffic cameras forbidding them [2]. As illustrated in the predict-punish-react model, four suspects are predicted to commit crimes in a pattern-dependent method depending upon officers' distribution tendency and capture records. Smart technologies include Artificial Intelligence (AI) video cameras, AI audio devices, the Internet of Things (IoT), and approximated machine learning before a crime happens along with COP (Closure, Occupation, Proximity) theory for preventive solution. CCTV systems may help discover early-crime target location via K-means clustering [1].

Methodological Considerations in Displacement Research

Despite the extensive body of research examining crime displacement related to CCTV and smart-city surveillance technologies, several methodological issues remain unaddressed [1]. As a mechanism-based phenomenon, displacement poses specific demands on measurement strategies and the establishment of counterfactuals [2]. Extensive use of a single empirical strategy increases the risk that evidence merely reflects the technical implementation of that method and only becomes a meaningful contribution to knowledge if accompanied by a clear statement of adherence to the rules of that strategy [1]. The absence of sufficient and clear reporting standards prevents proper assessment of the representativeness of the available studies, and, consequently, of the adequacy of the established generalizations and of their relevance for the case studies investigated in detail [3].

Measurement Strategies and Geographical Scales

A crucial design consideration in spatial displacement research involves deciding how closely to match the geography of the displaced and the focused locations [2]. This choice is not merely a formal one; a weak neighbourhood correlate can imply non-spatial mechanisms and yield systematic underestimation of the displacement effect [2]. Matching scales prevents omission of spatially mediated displacement and random error interpretation as a significant impact. Crime tends to be concentrated where it is directly observable; co-distribution at wider scales may reflect spatio-temporal transit rather than direct movement between adjacent locales. For a displacement effect to operate, the crime-productive set must be linked in routines assumed to be locally embedded [2].

Counterfactuals and Causal Inference

Smart-city surveillance technologies offer new opportunities for integrated and automated monitoring but also generate concerns about privacy and civil liberties. Several studies have examined the perceived impacts of such technologies on crime, with mixed findings [3]. A meta-analysis of studies evaluating networked CCTV suggested that coverage alone may not produce area-wide displacement effects, prompting calls for disaggregated reporting [3]. Predictive policing and hotspot policing systems are designed to incorporate a feedback mechanism, and methodological pluralism appears crucial for understanding the broader consequences of smart-city surveillance technologies. Smart-city technologies inform decision-making but risk predicting based on prior actions, constraining perpetrators' responses and potentially creating "displacement triangles" [3]. Displacement refers to offenders' adaptation of techniques, target selection, or timing in response to enforcement strategies [3]. An integrated approach to smart-city messaging and enforcement can expose offenders' escapeways, which vary by crime type and influence choice of location [3]. Predictive policing focuses on times, places, and individuals, with strongly patterned spatiotemporal dynamics facilitating behaviour modification [3]. Perceptions of legitimacy shape routine activities and spatial behaviour, influencing compliance with or evasion of state orders [3]. A mixed-methods study of networked CCTV found that legitimacy and privacy concerns remained in an area with extensive camera coverage, offering insight into incongruities between spatial, temporal, and offender displacement [3].

Publication Bias and Reporting Standards

The potential for publication bias and the quality of reporting in displacement studies limit the inferences that can be drawn from the existing evidence base. The systematic review encountered less-than-ideal adherence to various reporting standards [2], which severely hampered the operationalization of the behavior-focused framework proposed by T. Piza et al. [2]. The continued evolution of reporting standards in systematic review and meta-analysis continues to highlight the necessity for information-rich and transparent presentation of impacts, covariates, and the modeling of time, geography, and displacement mechanisms [2]. The evolution of systematic review and meta-analysis reporting guidelines illustrates the paramount importance of explicitly articulating the units of analysis employed in investigations of displaced crime a crucial determinant of the causal inference [2]. By adopting clear definitions, transparent presentation of chosen units, and openness regarding the implications and limitations of the choices made in the typology, the specificity and interpretability of displacement assessments can be enhanced [2].

Policy Implications and Design Considerations

In crime-free environments, residents feel safer, but this can never be perfect. Coping with emergency conditions in crime-prone environments requires spatial and temporal separation from crime places [3]. CCTV cameras, however, do not provide a permanent solution, and cities must revert to time and place constraints. Security guards and social monitoring can serve as temporally flexible substitutes, expanding the range of fully crime-free times in urban space [2]. Smart-city technology, such as drones and vehicle identification cameras, can also expand available space but has privacy implications. When certain crime types accompany police adaptation, security measures must again search for temporal and spatial flexibility [3]. Policymakers thus need to consider the long-range adaptations of offenders and preventive measures [2]. Mask-wearing, for example, might emerge as a counter-condition to this technology. After close-circuit television installation in Hong Kong's MTR underground railway, the time gap between crime reporting and detection reduced significantly. Most offences remained crime-prone, and time constraints remained unchanged. Offenders adapted to scold CCTV instead, slowing down the crime-sensing speed but still keeping the same amount of crime going [3]. In these types of cities, close-circuit television yielded different adaptation-response phenomena. In urban areas of Southern China where direct booking is mandatory, reports gathered before booking can be adapted as another approach to avoid close-circuit television cover upon crime delivery. Security installations, therefore, tend to yield confined geographical area and urban construction with fewer mixed modes, and thus less rime displacement [2]. Urban residents adopt strategies of shielding, such as fitting vehicles with license plate display devices and equipping other delivery-related devices. Vehicle identification cameras still work, but the location of delivery-sensing and a large number of deliveries restrict adaptation to a significant degree [2]. Tracking devices can temporarily

mitigate long-range crime displacement effects, but strict control is required to avoid gradual entropy of untrustworthy tracking devices. Likewise, after the initiation of online food delivery services in Chinese cities, some senders began to obscure either real addresses or time for vehicles transporting supplies, and thus tracking could not proceed [3]. Transparent containers and close transports reduced this effect, and when not allowed, sealed transport related to ice cream or some industries expedited successful deliveries. After 2019, the use of the mask as a counter-adaptation on a more geographic condition became apparent. In cities confronted with this kind of technology, promoting nation-wide attention might facilitate pandemic control [1].

Gaps in the Evidence and Future Research Directions

Crime prevention through environmental design (CPTED) is a crime prevention approach recommending that the design and use of the environment can reduce crime opportunities and the fear of crime [4]. A number of strategies are suggested but the recommendations hinge on two theoretical foundations: routine activity theory (RAT) and crime pattern theory (CPT). They suggest that any potential for crime can be prevented by decreasing opportunities [5]. Surveillance cameras usually referred to as closed-circuit television (CCTV) are used to facilitate surveillance activity and are recommended by CPTED as a possible intervention [3]. Crime displacement is not a new phenomenon. Clarke and Weisburd highlighted that 'sectioning' or 'displacement' is a common activity of crime 2. Clarke and Weisburd noted that an understanding of the behavior of criminals is important to the crime preventive measure. Crime displacement model asserted the approach behavior of criminals. Various time-spacing estimates of placement are observed for police-response behavior. For every hour an intervention occurs, another an hour off set is later. Four different spatial displacement model choices are examined by Franco and Sawada relative to Gaussian spatial-to-temporal kernels. With sectioning, crime occurrences are occurring in concentrated areas surrounded by a low level of crime [6]. The installation of fixed CCTV surveillance has been applied in various places due to its presumed effectiveness in deterring crime and disorder. The presence of CCTV cameras could enhance the perception of being observed by authority figures, which in turn caused extensive displacement behaviors [7]. CCTV locations tend to concentrate in high crime vicinities along with crime statistics collected and keep the CCTV data scheduled analyzed are equally recommend for city-wide camera every few kilometers under surveillance urban areas. An initial pilot project, CCTV system had been implemented in few selected districts and the police department reported improvements in several crime categories. Visits to the areas under surveillance by wrongdoers are decreased after some time [8-10].

CONCLUSION

The evidence reviewed demonstrates that CCTV surveillance and smart-city technologies occupy a central yet contested position in contemporary crime prevention strategies. Although these technologies frequently contribute to measurable reductions in crime within monitored environments, their effects are rarely straightforward. Crime displacement remains a significant concern, manifesting spatially, temporally, tactically, and across target categories depending on the nature of the intervention and the adaptability of offenders. Nonetheless, the review also reveals that displacement is not an automatic consequence of surveillance deployment. In many cases, diffusion of benefits occurs, producing crime reductions in surrounding areas rather than simple relocation of criminal activities. Theoretical perspectives such as routine activity theory, crime pattern theory, and situational crime prevention provide valuable explanations for these outcomes by emphasizing offender decision-making, opportunity structures, and environmental constraints. Smart-city technologies further complicate these dynamics by integrating predictive analytics, artificial intelligence, digital surveillance networks, and data-driven governance into urban security systems. While such technologies enhance monitoring capacity and operational efficiency, they simultaneously introduce new risks relating to privacy, legitimacy, algorithmic bias, over-policing, and civil liberties. The review also identifies substantial methodological limitations within displacement research, particularly regarding causal inference, counterfactual estimation, reporting transparency, and geographical scaling. These limitations underscore the need for more rigorous mixed-methods approaches capable of capturing the complex interactions between surveillance systems, offender adaptation, and urban social environments. Equally important is the recognition that technological interventions alone cannot guarantee sustainable crime prevention. Surveillance effectiveness is shaped by broader contextual factors, including governance quality, community trust, transparency, public communication, and the integration of social and environmental crime-prevention measures. Future policy frameworks should therefore move beyond narrow techno-solutionist assumptions and adopt balanced, ethically grounded approaches to urban surveillance. Policymakers and city authorities must ensure that surveillance technologies are implemented with robust accountability mechanisms, proportional safeguards, and meaningful public oversight. Integrating CCTV and smart-city systems with community-oriented policing, urban planning, and social interventions may reduce the likelihood of displacement while improving public legitimacy and long-term effectiveness. Ultimately, sustainable urban security depends not only on technological sophistication but also on the capacity to balance crime prevention objectives with democratic values, human rights, and social trust.

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