



## Position Paper

## Do hotspot policing interventions against optimal foragers cause crime displacement?

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## ABSTRACT

Optimal forager theory (OFT) initially emerged from ecological studies, elucidating how foraging organisms seek resources. In recent decades, this ecological theory has migrated to the realm of criminology, where it is used to identify burglary offenders and inform crime analysis. Several police services employ optimal forager theory-based analysis to guide hotspot patrol interventions aimed at reducing domestic burglary. Crime displacement resulting from hotspot interventions has been a subject of debate, with approximately a quarter of cases experiencing some form of displacement, the underlying reasons for which remain unclear. This study postulates that the presence of the optimal forager typology of offender may be one contributing factor. To test this hypothesis, we analyze the cumulative crime diffusion and displacement effects of ten optimal forager theory-inspired hotspot interventions employing the weighted displacement quotient (WDQ) technique (Bowers and Johnson, 2003) and the Cambridge harm index (CHI) (Sherman et al., 2016). The findings reveal the interventions' marked efficacy in reducing domestic burglary within response areas. However, this reduction is overshadowed by the substantial spatial and offense displacement they induce, encompassing both crime count and harm. These results provide insights into the proportion of hotspot interventions that trigger crime displacement, and policy implications for the choice and selection of crime reduction strategies. Supported by ecological studies of optimal foragers, we argue that this phenomenon stems from the exceptional motivation of foraging offenders and their inclination toward anti-detection behavior, specifically, relocating to alternative crime areas.

## 1. Introduction

The field of crime prevention and reduction has a rich history, leading to the development of situational crime prevention (SCP). Situational crime prevention offers a structured approach to addressing crime and its root causes by diminishing offender motivation, reducing available targets, and bolstering the presence of effective guardians (Cohen and Felson, 1979). Consequently, hotspot policing emerged as a prevalent law enforcement strategy to combat domestic burglary, with general consensus on its effectiveness as a crime reduction method (Braga et al., 2019). Initial concerns about these interventions, including fears of crime displacement to other locations, were swiftly assuaged by several studies (Bowers et al., 2011; Telep et al., 2014). However, the pursuit of deeper insights has

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led researchers down more refined avenues of burglary analysis resulting in innovations such as near-repeat pattern (NRP) victim identification analysis (Townsend et al., 2003).

Additionally, a closer examination of offender behavior spurred the development of optimal forager theory, drawing inspiration from ecology and the study of foraging organisms (Johnson and Bowers, 2004a, 2004b). This has given rise to a potential new classification of burglars, further driving the development of novel crime analysis methods (Halford, 2022). While these methodological advancements have yielded valuable insights, they have also contributed to a trend of increasingly focused police interventions in domestic burglary prevention. Consequently, studies of police implementations using optimal forager theory as their theoretical framework have raised concerns about displacement due to the narrowing geographical scope of domestic burglary interventions. It has always been acknowledged that a small fraction of interventions may lead to crime displacement, and a select number of studies have tentatively pointed toward the possibility that emerging capable guardianship interventions driven by methods such as optimal forager theory might underlie this phenomenon (Halford, 2023a). Therefore, this study represents the first comprehensive exploration of this issue, exclusively examining the aggregate impact of optimal forager hotspot policing interventions that use capable guardianship intervention tactics. Specifically, the study scrutinizes the presence and extent of spatial, offense, and target displacement in an effort to shed light on this matter.

## 2. Background

### 2.1. Deterrence theory

Crime deterrence theory is a concept in criminology that suggests the likelihood of potential criminals to commit crimes can be reduced through the threat of punishment (Beccaria, 1764). It is based on the premise that people are rational beings who weigh the costs and benefits before deciding to commit a crime (Beccaria, 1764; Kennedy, 1983; Paternoster, 2019). The theory is rooted in classical criminology and has been a fundamental principle of criminal justice systems worldwide for a considerable time (Beccaria, 1764; Kennedy, 1983; Paternoster, 2019). Key principles of crime deterrence theory emphasize a focus on the severity, certainty, and swiftness of punishment. Simply, the theory posits that more severe punishments will be more effective in deterring crime (Beccaria, 1764; Kennedy, 1983; Paternoster, 2019). However, this is of course reliant on the criminal being caught and therefore, the certainty of detection and apprehension play a key role. Specifically, the higher the certainty of punishment, the stronger the deterrent (Beccaria, 1764; Kennedy, 1983; Paternoster, 2019). Furthermore, such punishment must be swift, and the theory argues that the more immediate the punishment, the more effective it is in deterring criminals (Beccaria, 1764; Kennedy, 1983; Paternoster, 2019). In this context, there are two general approaches to deterrence, specific deterrence and general deterrence. Specific deterrence aims to prevent an individual who has already committed a crime from reoffending, while general deterrence seeks to prevent the general population from committing crimes by making an example of specific offenders (Farrell, 1985; Piquero et al., 2011). In applying sanctions there are two dominant forms of deterrent, informal and formal deterrence (Apel and DeWitt, 2018). Informal deterrence comes from social factors like family, friends, and community. Formal deterrence is the result of actions by official institutions like the police and the judicial system (Apel and DeWitt, 2018).

### 2.2. Rational Choice Theory

A key foundational principle of deterrence theory is the concept of rational choice theory (RCT). Deterrence theory argues that the decision-making process individuals undergo when contemplating the commission of a crime is a multifaceted endeavor. To conduct this, Rational Choice Theory (Felson, 1986) postulates that offenders engage in a cognitive process in which they weigh the costs against the benefits when making determinations related to criminal behavior (Felson, 1986). Fundamentally, rational choice theory rests on principles of utility maximization, and assumes that offenders make choices oriented toward optimizing their own well-being or utility, often through the acquisition of material goods or gratification (Hakim et al., 2001). Additionally, rational choice theory asserts that criminals possess preferences, acknowledging the presence of constraints—both perceived and actual—that influence their behavior (Opp, 1997). Consequently, rational choice theory posits that an individual's choices are guided by rationality, aiming to maximize self-interest and utility, considering the available information and constraints at the time (Felson, 1986).

### 2.3. Situational crime prevention

Naturally, scholars have built upon these theories, and in doing so developed theoretical models for enhancing the deterrent effect and influencing rational choice making of the would be criminal. Situational crime prevention is one such theory that provides a framework for crime mitigation (Clarke and Felson, 2017; Clarke, 1997) and is commonly adopted by the police in crime prevention and reduction strategies. At its core, situational crime prevention posits that three fundamental factors play a paramount role in the commission of crimes: the presence of motivated offenders, the identification of suitable targets, and the absence of capable guardians (Cohen and Felson, 1979). Situational crime prevention seeks to deter or inhibit criminal conduct by altering the equilibrium among these three factors (Cohen and Felson, 1979; Clarke, 1997). Key strategies employed by situational crime prevention to achieve this objective encompass target hardening—rendering potential targets less appealing or more challenging to access, such as installing security systems, locks, and surveillance cameras to deter burglars (Johnson et al., 2017). It also involves reducing rewards to diminish the profitability of crimes, thereby dissuading individuals from engaging in unlawful activities (Cohen and Felson, 1979; Quinn and Clare, 2021). Methods may include removing valuables from vehicles or using invisible ink to mark valuable electronic devices,

thereby reducing their allure to prospective buyers (Bowers et al., 2003). Lastly, one of the simplest tactics advocated by situational crime prevention is the concept of capable guardianship (Cohen and Felson, 1979).

#### 2.4. Capable guardianship

The concept of capable guardianship constitutes a pivotal element within situational crime prevention, as the presence of certain individuals can have a significant impact on deterring or preventing criminal activities by shifting the balance in a criminal's rational choice making. This occurs as capable guardians can reduce the vulnerability of potential targets and increase the risk of apprehension and therefore, enable a deterrence effect. Capable guardianship has been outlined by Reynald (2011) as simply being the presence of someone who can prevent an offender from committing a crime. Others have sought to define them more rigorously as "the physical or symbolic presence of an individual (or group of individuals) that acts (either intentionally or unintentionally) to deter a potential criminal event" (Hollis-Peel et al., 2011, pp 5). Felson (2016) expands on this by noting that a guardian doesn't necessarily have to be an official authority figure; rather, it could be any regular person who is able to protect a certain area or property. In this context a capable guardian may take various forms—be it an individual, a group, or an entity—possessing both the means and the willingness to intervene in or discourage potential criminal acts (Reynald, 2011). The overarching objective of capable guardianship is to cultivate an environment in which prospective offenders perceive an elevated risk of apprehension or adverse consequences, consequently diminishing the appeal of criminal activities (Hollis-Peel et al., 2011). While, in theory, capable guardians can be anyone, practical manifestations most often include security personnel, volunteer patrols, neighborhood watch programs, local authority-operated CCTV stations (Hollis-Peel et al., 2011), and, naturally, the police.

#### 2.5. Hotspot policing

Around the world, the police have harnessed these theories to combat criminal activity. By leveraging Crime Pattern Theory, police analysts can identify repeating characteristics of criminal behavior within specific geographical areas and timeframes (Brantingham and Brantingham, 2016). In doing so they can better understand the distribution, clustering, and recurrence of crimes in particular locales and employ these insights to predict areas at risk of future criminal acts (Brantingham and Brantingham, 2016), which are often referred to as crime hotspots (Braga et al., 2019). This led to the emergence of Hotspot policing, which deliberately focuses on areas with concentrated criminal activity, identified through crime mapping using a Geographic Information Systems (GIS) which allows the police to visually identify regions with elevated crime rates (Chainey et al., 2008). The primary objective of hotspot policing is to assist the police to allocate resources strategically, enabling a proactive response to deter criminals active in the targeted area. Tactics used in this proactive approach include increased police visibility through vehicular and uniformed foot patrols, targeted covert enforcement efforts like "plainclothes" patrols, and stop-and-search operations (Halford, 2023a). The success of this method of crime reduction is contingent upon the police adopting a capable guardianship role (Cohen and Felson, 1979). The purpose of this role is to influence the offenders' rational decision-making by enhancing both real and perceived risks and increasing the deterrent effect by seeking to raise the certainty, and swiftness of apprehension of criminals in the area, and as a result their subsequent formal punishment. This form of police tactic has been proven to be highly effective in tackling crime hotspots, particularly when responding to issues such as burglary (Braga et al., 2019).

#### 2.6. Optimal Foraging

Independent of the success of hotspot policing, in the first few decades of the 21st century academics began to explore the intricacies of the distribution and behavior of burglary offending in greater detail. As a result, theoretical advancements of the rational choice theory began to take place and one evolution of note came in the form of the introduction of an element of ecology, specifically the theory of optimal foraging, which was transposed into the field of criminology (Johnson et al., 2008). In ecological terms, an optimal forager refers to an organism, often an animal, whose behaviors are finely tuned to maximize efficiency in locating and acquiring resources, typically food (Pyke et al., 1977; Pyke, 2019). These behaviors are shaped by the need to strike a balance between the energy and time expended in resource acquisition and the benefits derived from their consumption (Pyke et al., 1977; Pyke, 2019). An optimal forager's primary objective is to maintain "fitness", which refers to the biological concept of an organism's ability to survive and reproduce (Pyke et al., 1977). To spend more time on their primary objective an optimal forager must maximize its effectiveness by making choices that optimize resource acquisition, all while considering the broader environmental context, which includes the risk of predation (Pyke et al., 1977; Pyke, 2019). Consequently, optimal foragers exhibit a keen sense of selectivity in their foraging grounds, tending to revisit locations where they have previously secured resources with minimal effort and predation risk (Pyke et al., 1977; Pyke, 2019). When the risk of predation becomes unacceptably high, optimal foragers typically respond by shifting to alternate foraging areas, known as patches (Araújo et al., 2011). An important aspect of patch movement is that the patches are non-overlapping and sufficient distance apart to reduce or eliminate the immediate predation risk (Araújo et al., 2011; Pyke et al., 1977). Studies of foraging patch selection has identified that this behavior presents repeating spatial patterns and as a result, ecologists have become adept at predicting them.

Transposing this ecological research into criminology, scholars hypothesized that the decision-making framework of certain criminals may also encompass ecological behaviors akin to foraging animals (Felson, 2014; Vandeviver et al., 2014). Within criminology the focus however has been limited to the predatory aspects of optimal forager theory which form the foundation for the cost-benefit analysis of risk and reward, and explored how this influences the foraging criminal's selection of potential target areas

(Chainey, 2021). Such studies have primarily focused on domestic burglary and suggest that foraging criminals exhibit three core behavioral traits: a pursuit of maximum reward, a quest to minimize time and effort, and heightened vigilance in evading detection (Addis et al., 2021; Johnson and Bowers, 2004a, 2004b). Recent scholarship has taken this exploration further, contending that optimal foragers may constitute a novel typology of criminals (Halford, 2022). This typology of offender are characterized as highly motivated serial offenders who seek to meticulously avoid apprehension, displaying advanced anti-detection behaviors and heightened risk awareness. As we have outlined, within the ecological realm predation risk drives predator avoidance behavior which is played out through a three-tier relationship involving predator, prey, and the prey's resource (Hugie, 1994; Sih, 1998). Within criminology, this translates to the police (predator), criminals (prey), and victims (resource) (Halford, 2023b). As a result of this interaction similar studies of optimal foraging within criminology have begun to elucidate evidence of potential patch movement behaviors among crime patterns of burglars, most likely as they shift foraging patches, which is seen in the form of potential crime displacement (Addis, 2012; Halford, 2023a; Johnson and Summers, 2014).

In addition, studies of the spatial patterns that arise from the crime characteristics of foraging offenders' (Halford, 2022, 2023a) also indicates that they bear striking similarity to near-repeat pattern analysis (Bernasco, 2006, 2009, 2010a; Bernasco et al., 2015; Bernasco and Nieuwebeerta, 2005). Near repeat analysis examines the patterns of burglaries over time and space and is based on the observation that once a single burglary occurs, the probability of subsequent burglaries in the nearby area increases significantly for a limited period, usually around two-weeks, as victimization spreads like a contagion (Townesley et al., 2003). Such patterns are especially prevalent in areas of homogenous housing stock (Townesley et al., 2003) and are suggested to be committed by the same offender or close associates (Bowers and Johnson, 2004). In contrast, patterns discerned using the optimal foraging theory are identified by first locating linked domestic burglaries that are in close geographical proximity, but do not overlap, thereby establishing a foraging 'patch' (Halford, 2023a). This novel approach is then supported using heuristic judgment to predict the subsequent patch at heightened risk (Halford, 2023a).

These two methods are intrinsically linked, but contrast in their methodological approach, with the former being born from environmental criminology (near-repeat analysis), and the latter from classical criminological, specifically rational choice theory. Ergo, an optimal foraging offender will almost certainly commit near-repeat burglary offenses, and near-repeat analysis can be used to help identify a foraging patch, provided it is supported by adequate crime linkage analysis. The key distinction is that optimal forager theory offers a more in-depth theoretical construct of an offender that not only incorporates their decision-making framework, but also provides a spatial, and behavioral typology.

Consequently, in considering the aforementioned, some police services in the UK hypothesized that if the presence of foraging offenders could be identified, then they could respond by combining the principles of optimal foraging with the philosophy of situational crime prevention. To do this they sought to increase the likelihood and swiftness of detection, apprehension and punishment for burglars through capable guardianship interventions, thereby elevating the predation risk and in theory, enhancing the deterrent effect by influencing the rational decision making behavior of foraging criminals with the outcome of reducing or preventing their commission of crime (Addis, 2012; Halford, 2023b; Johnson and Summers, 2014). Acting upon this, several police services in the United Kingdom used the optimal foraging theory to underpin the crime pattern analysis that drove their strategic tasking and coordination. This led to numerous studies highlighting the effectiveness of this method as a means for identifying foraging offenders and anticipating future patches at high-risk of burglary (Addis, 2012; Burgason and Walker, 2013; Chainey, 2021; Johnson and Summers, 2014; Johnson et al., 2008; Johnson et al., 2014; Pyke, 2019; Vandeviver et al., 2021). However, the impact of such interventions remains under-researched, and as we have alluded to, there is incipient evidence suggesting that they may unintentionally lead to crime displacement (Addis, 2012; Halford, 2023b; Johnson and Summers, 2014).

## 2.7. Crime displacement

Crime displacement is a phenomenon characterized by the shifting, relocating, or adaptation of criminal activities from one area or target to another, often because of crime prevention interventions (Repetto, 1976). Displacement can manifest in several ways: spatially, involving a shift to a different geographic area; temporally, with criminals changing the timing of their activities; or tactically, by altering their modus operandi and employing different tactics (Repetto, 1976). Furthermore, displacement can encompass offense displacement, where offenders switch to committing different types of crimes, and target displacement, wherein they select alternative victims or premises (Repetto, 1976).

In contrast to crime displacement, the concept of "diffusion of benefit" is more likely to occur (Guerette, 2009, 2016; Johnson et al., 2014), and this has been evidenced in notable meta-analysis (Braga et al., 2014, 2019). This phenomenon occurs when targeted crime reduction in one area also has a positive impact on nearby or adjoining locations. Guerette's (2009) description of diffusion types illustrates how they contrast with the effects of crime displacement. For example, spatial diffusion entails a reduction in offending near the response area, while temporal diffusion involves crime reduction at times outside the intervention hours (Guerette, 2009). Crime type diffusion occurs when forms of criminality not initially targeted by the intervention also decrease; for instance, a burglary intervention inadvertently reducing vehicle crime (Guerette, 2009).

Despite studies indicating that crime displacement occurs infrequently (Johnson et al., 2014), it still happens in approximately 29% of crime prevention interventions (Guerette and Bowers, 2017), albeit with varying levels of impact. Reviews of police interventions that focused on large geographic "macro" interventions found that crime was reduced in around 46% of cases, with diffusion of benefit observed in 22%, and spatial crime displacement reported in only 11.9% of examined studies (Telep et al., 2014). An even smaller 6% suffered an increase in crime (Telep et al., 2014). In contrast, systematic reviews of geographically focused "micro" policing initiatives, such as hotspot policing interventions (Bowers et al., 2011), indicate that although positive trends in favour of diffusion of benefit do

emerge, regardless of the scale of the geographical area (Bowers et al., 2011), displacement occurs in either the response area or surrounding catchments in approximately 29% of cases (Bowers et al., 2011, p104).

To comprehend why crime displacement occurs in some interventions, it's useful to reconsider the principles of situational crime prevention. As previously discussed, situational crime prevention aims to shift the balance of offender motivation, target availability, and the presence of capable guardians to prevent or reduce crime (Cohen and Felson, 1979). Conversely, crime displacement results from the persistent presence of factors such as offender motivation and opportunities for crime (Guerette, 2009). In some cases, these factors remain unaffected due to the offender's familiarity with the area or potential targets (Guerette, 2009). This is particularly relevant when considering optimal foraging offenders, who are highly motivated, vigilant to apprehension, and employ advanced anti-predator behavior, including shifting their foraging patches (Halford, 2022).

The notion of shifting foraging patches is especially pertinent in the context of domestic burglary interventions, where analytical techniques like near-repeat pattern and optimal forager theory focus on identifying intense, supercritical micro crime hotspots related to a specific form of offending, namely domestic burglary. For instance, traditional crime pattern analysis identifies hotspots within a range of 100–400 m (Porter and Reich, 2012). Near-repeat pattern focuses on areas immediately surrounding previously burgled homes, and optimal forager theory analysis uses hotspots with a radius of 400 m (Halford, 2023a). These factors (hotspot size, type of hotspot, response strategy, and the presence of motivated offenders) contribute to the susceptibility of a crime hotspot to displacement (Bowers et al., 2011; Short et al., 2010; Telep et al., 2014).

Despite these potential factors, previous studies on crime displacement have not provided conclusive explanations for its persistence in roughly a quarter of all police crime intervention programs. For example, Telep et al. (2014) examined 507 publications but found "only limited explanations for why crime may have been displaced," with studies often failing to provide an explanation or attributing it to larger trends in the comparison area (Telep et al., 2014, p532). Studies exploring the use of optimal forager theory by the police in hotspot policing interventions have also insufficiently explained displacement. For instance, a study by Addis (2012) examined displacement at the macro level but did not delve into the underlying reasons, merely noting evidence of spatial and temporal displacement (Addis, 2012). Similarly, studies on predictive risk mapping interventions have demonstrated their positive impact on domestic burglary but have acknowledged they do not add insight on the level of displacement or its impact on associated crime types (Fielding and Jones, 2012). A recent qualitative study on the implementation of optimal forager-inspired crime reduction programs in the United Kingdom has underscored the lack of in-depth theoretical consideration of these interventions as a potential reason for displacement (Halford, 2023a).

## 2.8. Aims of the study

The primary goal of this study is therefore, to investigate the potential crime displacement effects of police hotspot interventions that solely employed the optimal forager crime pattern analysis methodology to target foraging burglary offenders. As previously highlighted, crime displacement is not a common outcome of hotspot crime reduction and prevention interventions. However, exceptions do exist, and we propose that hotspot policing initiatives aimed at addressing foraging burglary offenders might be one such exception.

This hypothesis is grounded in two key reasons.

1. **Micro Hotspots:** Hotspots identified using the optimal forager theory methodology are primarily focused on addressing domestic burglary, and consequently, they tend to identify small, supercritical micro areas with intense offending patterns. Existing literature suggests that such micro hotspots are more likely to experience displacement when subjected to interventions (Short et al., 2010).
2. **Optimal Foragers as an Offender Typology:** These interventions specifically target optimal foragers, a distinct typology of burglary offenders. Optimal foragers are characterized by being highly motivated serial offenders who are acutely aware of the risk of apprehension. As a result, they exhibit advanced anti-predator behavior, notably in response to increased predation risk. This often manifests as a shift in foraging behavior between distinct "patches" that do not overlap (Halford, 2022). Thus, we theorize that hotspot policing interventions designed to address this offender type through risk-enhancing mechanisms, such as high-visibility police patrolling, are more likely to result in crime displacement.

Understanding the answers to these questions is important, especially given recent indications that several UK police services are currently utilizing the optimal forager theory methodology as the foundation for their hotspot policing interventions targeting domestic burglary (Halford, 2023a). While their effectiveness has been loosely assessed in previous studies (Addis, 2012; Fielding and Jones, 2012; Halford, 2023a), no comprehensive research has specifically explored whether these interventions lead to crime displacement or, if they do, why. This is a crucial inquiry because although domestic burglary is a serious crime, it is just one form of criminal activity. Even if optimal forager theory-based interventions prove effective at curbing domestic burglary, they might inadvertently cause offense displacement, prompting foraging burglary offenders to engage in other forms of crime with potentially greater harm implications, such as robbery.

Moreover, these offenders might be compelled to switch their crime locations (spatial displacement), a factor that existing literature suggests may have been previously overlooked (Short et al., 2010). Such displacement means that one community could experience negative effects at the expense of another. Gaining a more comprehensive understanding of these factors will empower police services to better predict the behavior of foraging burglary offenders, both in terms of where they are likely to commit offenses and how they will respond to crime prevention interventions. Consequently, law enforcement agencies will be better equipped to

develop holistic serial crime intervention strategies that are more effective at preventing crime displacement and facilitating a diffusion of benefit.

### 3. Method and data

In accordance with established guidelines for evaluating crime displacement, we have employed the weighted displacement quotient (WDQ) technique developed by Bowers and Johnson in 2003 (Bowers and Johnson, 2003) to assess both crime displacement and the diffusion of benefit. The WDQ technique is widely recognized and accepted as a robust methodology for assessing the outcomes of hotspot policing interventions (Guerette, 2009, 2016). To comprehensively evaluate the presence and extent of crime displacement and diffusion of benefit, as advocated in prior scholarly works (Bowers and Johnson, 2003; Guerette, 2009, 2016), we have leveraged crime data related to three distinct geographical areas: the response area, the displacement and diffusion area, and the control area.

Our analysis centers on 10 case studies of hotspot interventions inspired by optimal forager theory. These case studies draw from data obtained from a single provincial police service in the United Kingdom (UK). The 10 selected case studies represent pre-identified domestic burglary hotspots characterized as optimal forager areas. These hotspots were identified by the police service's crime analysis team, following the methodology outlined earlier, ensuring alignment with the established processes of the police service. Each hotspot served as the operational foundation for capable guardianship interventions, albeit the research team had no control over the specific tactics employed to address foraging burglary offenders. However, we were informed that these interventions primarily consisted of high-visibility police patrolling, both on foot and in vehicles, complemented by covert patrolling conducted by the police service's specialist burglary teams.

Each case study encompasses a 4-week timeframe of crime records, encompassing data from the two weeks preceding the hotspot intervention and the subsequent two weeks following the commencement of the intervention. Geographically, the response areas are defined as circular hotspots with a radius of 400 m. The displacement and diffusion area extends as a 400-m wide ring surrounding the response area. The control area encompasses an additional set of 10 circular hotspots, each with a radius of 400 m, situated within the same division as the intervention sites but located outside the response, displacement, and diffusion zones. These control hotspots cover identical time periods. In total, the 10 case studies encompass data from 2916 crimes. However, it is important to note that the data provided lacks specific address details (only coordinates), victim personal information, or precise offense details such as the time or modus operandi. Consequently, our analysis can only comprehensively assess spatial and offense displacement, with inferential conclusions drawn regarding target displacement.

To evaluate these interventions, we have employed a mixed methods approach, incorporating simple descriptive analysis through percentages and volume counts. In addition to this, we have applied the formulas outlined in the WDQ technique (Bowers and Johnson, 2003) to analyze the aggregate mean effect across all 10 hotspot case study interventions. Specifically, we have examined gross effect (GE), net effect (NE), and the WDQ itself. A detailed explanation of these coefficients is presented in Table 1. In these equations, Ra represents the number of crimes committed in the response area post-intervention, while Rb represents the count before the intervention (Bowers and Johnson, 2003). Similarly, Ca denotes the number of crimes committed in the control area post-intervention, with Cb representing the count before the intervention (Bowers and Johnson, 2003). Finally, Da signifies the number of crimes committed in the displacement and diffusion area post-intervention, while Db corresponds to the count pre-intervention (Bowers and Johnson, 2003). To further enhance our analysis, we have also repeated this process using the Cambridge Harm Index (CHI) as a replacement for simple crime counts, providing a deeper assessment of overall harm impact. We use the CHI to mitigate potential biases that can arise when examining crime counts in isolation as it has been observed that researchers may selectively emphasize specific crime types to craft a narrative about whether crime is improving or worsening (Sherman et al., 2016, p. 182). Therefore, we believe that the CHI will provide a more comprehensive understanding of the overall diffusion of benefit.

Using the aforementioned methodology, we examined 3 individual groups of offenses. First, we included all domestic burglary

**Table 1**  
Measuring displacement and diffusion. Taken from Guerette (2009).

Coefficient	Use	Interpretation	
Gross Effect (GE)	$GE = R_b - R_a$	Determines increase or decrease in response area.	Positive number >0) indicates decrease in crime; Negative number <0) indicates increase in crime. Zero = 0) means there was no change.
Net Effect (NE)	$NE = (R_b/C_b) - (R_a/C_a)$	Determines increase or decrease in response area in relation to changes in control area.	Positive number >0) indicates decrease in crime; Negative number <0) indicates increase in crime. Zero = 0) means there was no change.
Weighted Displacement Quotient (WDQ)	$WDQ = \frac{D_a/C_a - D_b/C_b}{R_a/C_a - R_b/C_b}$	Determines the extent of displacement or diffusion in buffer areas in relation to changes in response and control area.	Positive number >0) indicates there was a diffusion effect and any response effects were amplified; If number is greater than positive one > +1.00) then the diffusion effect was greater than the response effect. Negative number <0) indicates there was displacement. A negative number between zero and negative one <0 > -1.00) means the displacement was not greater than the response effects and the intervention still achieved some benefit. A negative number beyond negative one < -1.00) means the response effect was eclipsed or erased by displacement. Zero = 0) means there was no effect.

offenses, which simply consisted of aggravated and non-aggravated domestic burglary. Second, we examined all other forms of serious acquisitive crime (SAC). This includes a far broader set of offenses which all relate to theft. A full list of these can be found in [appendix Table 1](#). Finally, we examined offenses against the person (OAP), which includes all assaults and public order, excluding sexual offenses. Again, a full list is outlined in [appendix Table 2](#).

#### 4. Results

The results of our analysis conducted solely on the offense of domestic burglary can be seen in [Table 2](#). The gross effect on domestic burglary was that it reduced dramatically in the response areas ( $n-94 = -48\%$ ), and also experienced a positive net effect (0.82). There was also a negligible increase of just 2 crimes in the displacement and diffusion area. As a result, the analysis of the crime count WDQ ( $-0.11$ ) indicates that although minor displacement occurred, it was not greater than the response effects and the interventions were successful overall in reducing domestic burglary crime.

When we explore the harm count a slightly different tale emerges. Harm also decreased in the response area, likely due to the reduced volume of domestic burglary, resulting in a positive net effect (0.05). However, harm increased in the diffusion and displacement area ( $n-236 = +24\%$ ), and our analysis of the WDQ relating to the CHI ( $-5.19$ ) indicates that the response effect was eclipsed by the displacement effect. Investigation of this shift in harm identified it was primarily caused due to a modest rise in aggravated domestic burglary ( $n-3$ ), which carries a significantly higher CHI score of 730, compared to 15 for non-aggravated domestic burglary.

The results from the analysis of all other serious acquisitive crimes, which can be seen in [Table 3](#), shows a similar pattern to that experienced for domestic burglary. Crimes in the response area reduced ( $n-35 = -4\%$ ), resulting in a positive net effect (0.82). However, they rose in the diffusion and displacement area ( $n-214 = 17\%$ ). Therefore, the WDQ ( $-1.21$ ) indicates that the response effect was again eclipsed by displacement. The rise in offending in the displacement area was predominately made up of three crime forms, which included small amounts of robbery ( $n-7$ ), theft from motor vehicles ( $n-69$ ), and importantly, a rise in domestic burglary ( $n-121$ ), which when combined accounted for 197 of the 214 crime increase.

A strong effect was also identified in respect of harm count. Again, gross effect on harm in the response areas reduced ( $n-905 = -14\%$ ), resulting in a positive net effect (0.05). However, the diffusion and displacement area experienced large increases in CHI score ( $n-4140 = +47\%$ ). This shift resulted in a poor WDQ relating to the CHI ( $-2.08$ ), meaning the response effect on harm was also erased by displacement, and no diffusion of benefit was experienced. Investigation of the change in offenses identified that similar to domestic burglary, this was caused due to small rises in high harm crimes, in this case it was the offense of robbery ( $n-7$ ), which carries the second highest harm score of all acquisitive crime types (365). As a result, just 7 offenses accounted for a harm count increase of 2555.

The analysis of offenses against the person, which can be seen in [Table 4](#), identified that the response areas saw an aggregate rise in offenses ( $n-88 = +21\%$ ), which resulted in a negative net effect ( $-0.12$ ). This was predominately made up of assaults with injury ( $n-57$ ) and assaults without injuries ( $n-14$ ). However, the rise was also against the backdrop of increases in OAP offending within the control areas, therefore, the crime count WDQ ( $-0.02$ ) indicates that the effect on OAPs was almost imperceptible in terms of diffusion or displacement effect.

In respect of crime harm, we identified that this also increased in the response area ( $n-3583 = +17\%$ ), outweighing that seen in the control area, resulting in a negative net effect ( $-0.73$ ). This rise was almost exclusively caused by the occurrence of just two offenses of wounding with intent to do grievous bodily harm, which is amongst the highest harm form of OAPs and carries a CHI score of 1460, therefore accounting for 2920 of the identified rise in harm. So although the net effect ( $-0.73$ ) initially indicates that this is a negative result, when we consider the rise in the control areas, and minimal displacement, the effect on OAP crimes is extremely small, and the WDQ relating to the CHI ( $-0.13$ ) indicates this.

**Table 2**  
Aggregate impact on burglary crime.

Pre Vs. Post Intervention			
Response Area	Crime Count	Crime Count Change	-94
		% Change	-48%
	Harm Count (CHI)	CHI Change	-360
		% CHI Change	-12%
Displacement And Diffusion Area	Crime Count	Crime Count Change	+2
		% Change	+2%
	Harm Count (CHI)	CHI Change	+236
		% CHI Change	+24%
Control Area	Crime Count	Crime Count Change	-1
		% Change	-10%
	Harm Count (CHI)	CHI Change	-15
		% CHI Change	-10%
Impact Assessment	Crime Count	Gross Effect (GE)	-94
		Net Effect (NE)	0.82
		Weighted Displacement Quotient (WDQ)	-0.11
	Harm Count (CHI)	Gross Effect (GE)	-360
		Net Effect (NE)	0.05
		Weighted Displacement Quotient (WDQ)	-5.19

**Table 3**  
Aggregate impact on all other acquisitive crime.

Pre Vs. Post Intervention			
Response Area	Crime Count	Crime Count Change	-35
		% Change	-4%
	Harm Count (CHI)	CHI Change	-905
Displacement And Diffusion Area	Crime Count	% CHI Change	-14%
		Crime Count Change	+214
	Harm Count (CHI)	% Change	+17%
Control Area	Crime Count	CHI Change	+4140
		% CHI Change	+47%
	Harm Count (CHI)	Crime Count Change	+80
Impact Assessment	Crime Count	% Change	+7%
		CHI Change	+1110
		% CHI Change	+9%
	Harm Count (CHI)	Gross Effect (GE)	-35
		Net Effect (NE)	+0.08
		Weighted Displacement Quotient (WDQ)	-1.21
Harm Count (CHI)	Gross Effect (GE)	-905	
	Net Effect (NE)	+0.12	
	Weighted Displacement Quotient (WDQ)	-2.08	

**Table 4**  
Aggregate impact on offenses against the person.

Pre Vs. Post Intervention			
Response Area	Crime Count	Crime Count Change	+88
		% Change	+21%
	Harm Count (CHI)	CHI Change	+3583
Displacement And Diffusion Area	Crime Count	% CHI Change	+17%
		Crime Count Change	+7
	Harm Count (CHI)	% Change	+1%
Control Area	Crime Count	CHI Change	-325
		% CHI Change	-1%
	Harm Count (CHI)	Crime Count Change	+10
Impact Assessment	Crime Count	% Change	+1%
		CHI Change	+28
		% CHI Change	-0.5%
	Harm Count (CHI)	Gross Effect (GE)	+88
		Net Effect (NE)	-0.12
		Weighted Displacement Quotient (WDQ)	-0.02
Harm Count (CHI)	Gross Effect (GE)	+3583	
	Net Effect (NE)	-0.73	
	Weighted Displacement Quotient (WDQ)	-0.13	

## 5. Discussion

### 5.1. Burglary crime reduction impact

We initially assessed the outcomes of the interventions to gauge their effectiveness within the response areas. Our findings yielded compelling evidence that targeting foraging burglary offenders through hotspot policing with capable guardianship measures is indeed effective in addressing domestic burglary incidents within the response areas. Furthermore, we observed an immediate diffusion of benefit within the response areas, resulting in a reduction in other serious acquisitive crimes. While these findings are not groundbreaking and align with existing conclusions from systematic reviews on hotspot policing (Braga et al., 2019), they do lend additional support to studies exclusively utilizing the optimal forager theory methodology in hotspot policing (Addis, 2012; Fielding and Jones, 2012; Halford, 2022).

Moreover, our research revealed that such interventions successfully mitigated harm in the response areas as a result of SAC offending, providing further substantiation for emerging research on the positive impact of high-visibility foot patrolling in reducing overall crime harm (Basford et al., 2021). However, we did identify an increase in OAPs within the response areas, coupled with a corresponding rise in crime harm. Nevertheless, we advise against drawing definitive conclusions from this finding as we believe it may be attributed to two factors. Firstly, OAPs in the control areas also experienced an increase, aligning with official statistics that have indicated a rising trend in this form of crime over recent years. Data up to March 2023, for instance, highlighted a 20% increase compared to the pre-coronavirus pandemic year ending March 2020 (Office of National Statistics, 2023). Secondly, harm indexes are particularly sensitive to fluctuations in violent crime (Mitchell, 2019), as evidenced by the impact on the CHI score due to low volumes of high-harm crimes. Therefore, we do not attribute the rise in OAPs directly to the implemented interventions.

## 5.2. Spatial displacement

Compelling evidence suggests the occurrence of spatial displacement. Both domestic burglary and serious acquisitive crime (SAC) incidents exhibited an increase in the displacement areas, corresponding to reductions observed in the response zones. This strongly indicates a spatial shift in the location of criminal activities, moving from the 400m response areas to the surrounding diffusion and displacement rings under investigation. Crucially, neither of these displacements were counteracted by increases in the control areas, as corroborated by the weighted displacement quotient (WDQ). This finding holds particular significance as it sheds light on the 29% of hotspot crime prevention and reduction strategies that lead to displacement, particularly those involving burglary offenses (Bowers et al., 2011).

From a theoretical perspective, ecological studies involving animal foragers demonstrate that they swiftly alter their foraging locations if a second-best area becomes more favorable, with this behavior heavily influenced by predation risk (Pyke et al., 1977). Previous studies that included interviews with potential serial foraging burglars have outlined their highly selective choices in offense locations (Addis et al., 2021). This has led some to argue that they exhibit similar response behaviors when confronted with an increased perception of predation risk, making them equally likely to rapidly shift their criminal activities in response to a perceived or legitimate rise in risk (Halford, 2023a). Our study provides empirical support for this argument.

Furthermore, studies exploring the characteristics of optimal foragers (Addis et al., 2021; Halford, 2022) have identified them as exceptionally motivated individuals, with an average of 17–40 burglary convictions, and a substantial proportion having a history of drug dependency, including substances like opioids (Halford, 2022). This indicates that they are highly motivated and driven offenders. From a criminological perspective, this further reinforces the body of evidence suggesting that offender motivation is one of the most significant factors preceding the likelihood of crime displacement (Cohen and Felson, 1979; Guerette, 2009). Therefore, a key implication of these findings is that police services should exercise great caution in identifying the typology of offenders before determining the appropriate form of intervention. In cases where serial offenders, especially optimal foragers, are identified, interventions aimed at addressing the underlying motivation to commit crimes should be considered in lieu of traditional hotspot policing strategies that primarily focus on increasing real or perceived risk.

## 5.3. Offense displacement

When considering offense displacement, the findings of this study also suggest its presence, albeit primarily for SAC offenses. This is substantiated by the decrease in domestic burglaries within response areas, accompanied by increases in small amounts of robbery (n=7), theft from motor vehicles (n=69), and a rise in domestic burglary (n=121) in displacement areas. Notably, these increases not only offset the reductions in burglary in the response areas but exceeded them, contributing to an overall upsurge in offending and the volume of alternative offense types. In the context of domestic burglary, this represents a novel discovery. While offense displacement has been a subject of extensive discussion since its inception, it's worth noting that relatively few studies have scrutinized it in detail (Johnson et al., 2014). This scarcity of comprehensive examination can be attributed to the predominant focus of crime displacement studies on singular issues or offense types (Telep et al., 2014). Those studies that have encompassed a broader range of offenses have typically been part of investigations centered on alternative forms of crime and disorder, such as violent crime (Braga et al., 1999), public disorder (Braga and Bond, 2008), or drug offenses (Weisburd and Green, 1995). Consequently, they offer limited insights into offense displacement stemming from burglary interventions. Furthermore, we were unable to identify any studies that had specifically explored offense displacement within the context of optimal foraging theory, including those exclusively investigating the impact on burglary (Addis, 2012; Fielding and Jones, 2012).

When considering the reasons behind offense displacement in cases involving optimal forager theory, it's worth recalling that the principles of an optimal foraging offender dictate a desire to minimize the risk of apprehension, as well as the time and effort required to commit a crime, while simultaneously striving to maximize returns (Addis et al., 2021; Johnson and Bowers 2004a, 2004b). We therefore must consider the ecological impact on constraining the abundance and availability of a foragers primary resource (in our context, burglary victims). In an ecological context, ordinarily, it has been said that "if a resource is excluded, it is always ignored, if included, it is always taken ... except when preferred choice is constrained" (Pyke et al., 1977, p141). One way constraint is documented as occurring is through an increase in predation risk, which restricts the availability of resources to the forager. Consequently, less preferred resources now become the primary choice (Araújo et al., 2011). Another forced constraint on availability of the preferred resource caused by increased predation risk pertains to the handling time of resources, which refers to the time it takes to acquire, retrieve, or consume a resource. Faced with increased constraint on their preferred resource, less preferred sources rise in preference due to the fact they may be easier and quicker to handle, which is an effective strategy to mitigate increased danger (Hoyle and Keast, 1987; Persson, 1985). Such a rise in position of less preferred resources also enables optimal foragers to maintain energy return within the given timeframe available (Pyke et al., 1977). Each of these strategies enables the forager to remain focused on their primary goal of maintaining fitness, even in the face of increased predation.

It is reasonable to assume, then, that foraging offenders may exhibit similar behavioral responses. With a heightened focus on police prevention of domestic burglary, the availability of potential victims is likely to decrease, while the risk of apprehension increases. Therefore, if foraging burglary offenders indeed possess similar ecological characteristics, their inclination to switch to alternative forms of crime to obtain smaller items (e.g., items left in motor vehicles or in the possession of robbery victims) and their urgency to rapidly accumulate stolen property, possibly driven by the fear of immediate apprehension, should not come as a surprise. In fact, existing crime research has hinted at such behavioral responses, illustrating how offenders shift to lower-risk forms of crime, such as theft from motor vehicles, to reduce the risk of apprehension (Addis et al., 2021). They also prioritize the speed at which they can

dispose of stolen goods (Stevenson and Forsythe, 1998). Furthermore, when confronted with increased risk, criminals anticipate improved returns (Vandeviver et al., 2014). As studies have shown that some offenders are influenced by the frequency with which they encounter certain targets (Badiora, 2017; Brantingham, 2013), another explanation could be the abundance of alternative targets in the displacement areas, making robbery and theft from motor vehicles more likely. However, it's important to note that this possibility was not explored in our study.

#### 5.4. Target displacement

Target displacement is a phenomenon in which an offender selects a different type of victim or premise for their criminal activities (Repetto, 1976). Regrettably, due to the constraints of the data we had access to, we were unable to conduct a comprehensive examination of the types of premises or the specifics of the victims involved. Consequently, we are unable to draw any definitive conclusions regarding this form of displacement. Nevertheless, we can make certain inferences based on the available data. For instance, the observed offense displacement, which was characterized by increases in thefts from motor vehicles and minor increases in aggravated burglary, does not necessarily suggest a shift in either the choice of premises or victims. It is more plausible that these offenses were situated in areas already frequented or targeted by the offenders as part of their routine criminal activities, thus representing offense displacement. Furthermore, the slight increase in robbery offenses (n=7) is so marginal that, although they could potentially involve a different type of victim, they are distributed across 10 case studies. Consequently, we do not believe these offenses hold significant statistical weight.

Lastly, it's worth noting that while offenses against the person (OAP) increased in displaced areas, this occurred in the context of a general rise in violent crime. As such, it is not accurate to attribute these increases to foraging burglary offenders. Therefore, while recognizing the obvious limitations, we tentatively suggest that there is limited evidence to support the occurrence of target displacement. This inference aligns with recent studies that have highlighted how potential foraging burglary offenders tend to maintain consistency in their choice of target premises and victim profiles, rather than routinely switching to different types (Addis et al., 2021).

#### 5.5. Crime count vs. crime harm

The final issue that warrants discussion pertains to the comparison between crime counts and crime harm. This study has revealed distinct effects associated with targeting optimal foraging burglary offenders, with one of the most significant being the "backfire effect" and offense displacement. While the interventions were successful in achieving significant reductions in crime counts, especially within the response areas, these reductions were counterbalanced by increases in crime harm resulting from more violent forms of offending.

Although OAPs were increasing overall during the periods under examination, particular forms of crime such as aggravated domestic burglary and robbery, both of which are theft-based offenses, cannot be overlooked as potential unintended consequences. This leads to a substantial increase in harm as measured by the CHI. For instance, the increase of three aggravated burglaries can be equated to 146 non-aggravated domestic burglaries, and the seven reported robberies are equivalent to 170 standard domestic burglaries. In terms of the victim count, this ranges from 10 "high harm" victims to 316 "low harm" victims. It is important to note that these figures assume each burglarized home has a single occupant, which is an oversimplification, and the actual victim count could be much higher.

This situation raises a fundamental question: Is it preferable to have fewer 'standard' domestic burglaries, or a smaller number of high-harm, theft-based crimes? On the face of it, most police services would be content with swapping 146 standard burglaries for just a handful of other similar crimes as this represents a significant reduction in overall crime volume. However, the question becomes far more nuanced when the moral complexities of such an outcome are considered. For instance, such a question is considerably easier to answer when the high harm crimes include murder, as most police services and communities would undoubtedly prefer 100 burglaries over 2 murders. However, the equation becomes less clear-cut when considering offenses like robbery or aggravated burglary. This is because, without diminishing the severity of either offense, the level of threat or violence involved in its commission could be relatively low, resulting in limited long-term impact. Conversely, a series of 10 "standard" domestic burglaries committed against elderly vulnerable victims could have enduring financial or psychological effects. Therefore, striking a balance between these decisions is crucial.

Such a dilemma is acknowledged by the creators of the Cambridge harm index (Sherman et al., 2016). However, these findings suggest you could go further and fundamentally question the validity of using the CHI as a complimentary measure for assessing crime displacement. In our view, the incorporation of the Crime Harm Index in displacement studies is not only sensible but crucial for a more nuanced understanding of crime displacement and diffusion dynamics. Traditional crime counts, while useful in quantifying the frequency of offenses, fall short in capturing the severity and societal impact of different types of crimes. The CHI addresses this gap by offering a further metric to provide a more comprehensive perspective on the overall impact of criminal activities, thereby enhancing the understanding of the qualitative shift in crime patterns as a result of similar interventions. This is particularly beneficial for policy decision-making as it enables a more informed evaluation of the trade-offs involved between crime volumes and types, guiding police policymakers towards more effective and balanced decision making to underpin their choice of response strategies, potentially leading to more effective holistic crime reduction approaches.

Furthermore, the use of CHI in displacement studies sheds light on potential shifts in offender behavior in response to policing strategies, offering valuable insights into criminal adaptability and the effectiveness of various crime prevention tactics. In the context

of this study, we suggest such insights include implications for the Optimal Foraging Theory offender typology, and its intersection with crime deterrence theory. Specifically, the shift in criminal behavior towards more high-harm crimes suggests a recalibration of risk and reward assessments by the Optimal Foraging typology of offenders. These offenders, characterized as highly motivated and serial, with a propensity for meticulous evasion, appear to be adapting their strategies in response to police action in a manner in line with the ecological research on predation risk. They are not static in their strategies and are continuously assessing and responding to their perceived risks and rewards, considering both the context of their environment and policing tactics and adapting accordingly to ensure continued offending. This adaptation could be driven by a perceived increase in the reward, a continued belief in their ability to evade detection despite the heightened risk associated with more severe crimes, or the existence of a significant motivational driver that anticipated sanctions are insufficient to negate, such as substance addiction for instance. This is unusual in the context of deterrence theory as one could argue that such a change in behavior may inadvertently increase their risk of apprehension, as high-harm crimes typically garner more attention and resources from the police. As such, this adaptation in the behavior of the Optimal Foraging typology of offenders also presents an intriguing challenge to the principles of crime deterrence theory. Therefore, traditional deterrence methods, grounded in the anticipation of swift punishment, might not suffice in deterring such motivated and adaptive offenders. This situation underscores the necessity for more holistic, adaptive and proactive crime reduction and prevention strategies that evolve in tandem with the changing patterns of criminal behavior.

## 6. Implications and recommendations

The primary implication derived from this study is that it provides evidence supporting the occurrence of crime displacement. More specifically, the study demonstrates that spatial and offense displacement occurs as a response to interventions that specifically target micro, supercritical hotspots in domestic burglary, committed by optimal foraging burglary offenders, and employ capable guardianship tactics. This finding carries significant implications for both research and operational policing.

From a research perspective, the study highlights the importance of not only considering the type of offenses under examination when researching police crime reduction and prevention interventions but also taking into account the typologies of offenders likely responsible for these crimes. This nuanced approach can help researchers draw more accurate conclusions about the reasons behind different forms of displacement, moving beyond traditional generalizations.

In terms of operational policing, the study suggests that law enforcement agencies should carefully consider the typology of offenders active in hotspot areas when selecting the most appropriate intervention strategy. It implies that capable guardianship responses may be less effective in dealing with optimal foraging offenders. Instead, a traditional problem-solving approach that addresses all elements of the issue, aligning with principles of situational crime prevention is recommended. Furthermore, interventions that focus on identifying and managing serial offenders within the locality are likely to yield better results. As previous literature has indicated, a comprehensive, whole-system response that incorporates various forms of intervention and additional offender targeting methods, such as geographical profiling, and offender management and rehabilitation is likely to be the most effective approach in these scenarios (Halford, 2023a).

## 7. Limitations and further research

This study comes with several limitations that should be acknowledged. Firstly, it's essential to recognize that the methodology employed to identify foraging burglary offenders and the optimal forager theory typology of offender are relatively new and emerging concepts. Consequently, there might not yet be universal acceptance of this offender typology and its associated behavioral characteristics within the academic and law enforcement communities. Secondly, this study exclusively examined case studies from a single police service that utilized the optimal forager theory-inspired hotspot policing method. Expanding the study to include case studies from a broader and more diverse pool of data sources may provide additional insights and allow for a more comprehensive understanding of the phenomenon.

From a methodological perspective, we also acknowledge that there exist several limitations in respect of the data analyzed and the methods used. Specifically, we use a 4-week period of data which some would consider too short. Therefore, data that extends beyond this time frame, potentially to include as much as far as 4 weeks either side of the intervention periods may provide different findings. We also focused on data extracted from a 400m ring around the response area, therefore, other parameters may yield different results. In addition, we simply identified crimes that fell within the spatial parameters using the co-ordinates provided, as such, these might not correspond neatly to street addresses. Limitations of this approach also include the fact that real-world spatial behavior does not always follow straight lines due to structural elements such as roads, buildings, or natural features. Using spatial network analysis to identify displacement parameters would enable greater consideration of the actual path's offenders can take in an urban environment and include roads and pathways, which could potentially be more accurate for understanding the behavior of how offenders move around in the area being studied, especially in relation to crime interventions.

Moreover, this research solely focused on hotspot policing interventions that heavily emphasized capable guardianship, particularly those involving increased police patrolling. Consequently, the study cannot definitively assert whether the same findings would hold true under different conditions that involve more holistic and problem-solving intervention approaches. Regarding displacement, the study faced limitations due to the restrictions in the data provided. It was unable to fully investigate target displacement, temporal displacement, or tactical displacement, primarily due to the absence of essential data elements. To thoroughly examine these forms of displacement would necessitate access to victimology data, information on the timing of offenses, and details about the offenders' modus operandi, none of which were available for this study. In light of these limitations, it is recommended that future research

endeavors continue to explore the concept of the foraging typology of offender and aim to address the gaps identified in this study. Doing so has the potential to provide additional insights into why certain forms of police interventions have been less successful in the past, thereby contributing to the ongoing improvement of crime reduction and prevention strategies.

### CRedit authorship contribution statement

**Eric Halford:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. **Mary Giannoulis:** Data curation, Formal analysis. **Camie Condon:** Resources, Writing – review & editing. **Paige Keningale:** Project administration, Resources.

### Appendix 1. Table of Offenses Included in Analysis

**Appendix Table 1**

Table of all Serious Acquisitive Crimes

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AGGRAVATED BURGLARY IN A BUILDING OTHER THAN A DWELLING
AGGRAVATED BURGLARY IN A DWELLING
AGGRAVATED TAKING WHERE THE ONLY AGGRAVATING FACTOR IS CRIMINAL DAMAGE OF £5000 OR UNDER
ALL BURGLARY IN A BUILDING OTHER THAN A DWELLING
BURGLARY WITH THE COMMISSION OF AN OFFENSE TRIABLE ONLY ON INDICTMENT OR WITH VIOLENCE OR THE THREAT OF VIOLENCE.
BURGLARY WITH THE INTENT TO COMMIT AN OFFENSE TRIABLE ONLY ON INDICTMENT GOING EQUIPPED FOR STEALING, ETC.
INTERFERENCE WITH MOTOR VEHICLES
ALL BURGLARY IN A DWELLING
OTHER CRIMINAL DAMAGE TO A DWELLING
OTHER THEFT
ROBBERY
STEALING MOTOR VEHICLE
THEFT FROM A SHOP AND STALLS
THEFT FROM AN AUTOMATIC MACHINE OR METER
THEFT FROM MOTOR VEHICLES
THEFT FROM THE PERSON
THEFT IN A DWELLING OTHER THAN FROM AN AUTOMATIC MACHINE OR METER
THEFT OF A PEDAL CYCLE
THEFT OF MAILBAG OR POSTAL PACKET OR UNLAWFULLY TAKING AWAY OR OPENING MAILBAG

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**Appendix Table 2**

Table of all offenses Against the Person

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Assault with injury
Assault without injury on a constable
Other public order offenses
Assault without injury
Having an article with a blade or point in a public place
Making threats to kill
Possession of offensive weapons without lawful authority or reasonable excuse
Pursued a course of conduct which amounted to harassment
Racially aggravated common assault
Racially or religiously aggravated common assault or beating
Racially or religiously aggravated harassment alarm or distress
Threats to kill
Wounding, etc, with intent to do grievous bodily harm

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