UNDERSTANDING VARIATION IN DISTANCE TO CRIME FROM WITHIN THE RATIONAL CHOICE PERSPECTIVE

Christophe Vandeviver

Thesis submitted in fulfillment of the requirements for the degree of Doctor of Philosophy in Criminology (Doctor in de Criminologische Wetenschappen)
“If you succeed with one dream, you come back to square one and it’s not long before you’re conjuring up another, slightly harder, a bit more ambitious”

Joe Simpson, Touching the Void
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Dutch translation of the title:

Variatie in de afstand van criminele verplaatsingen begrepen vanuit het rationele-keuze-perspectief

Cover photo:

Kernel density plot of distance-to-crime distribution of burglars living and offending in East Flanders (N = 650)
Abstract

English

Previous journey-to-crime research has resulted in a number of recurrent findings: offenders typically travel only short distances to commit their offences and the likelihood of a location being selected as a crime site decreases with the distance from the offenders’ home areas. These recurrent findings are understood from within the rational choice perspective. This perspective propagates the view that offenders balance the costs and benefits of their decisions against each other. Offending behavior and offenders’ decision-making are governed by profit maximization and effort minimization. The short journey-to-crime distances that are typically observed illustrate offenders’ inclination to minimize efforts as much as possible. However, earlier journey-to-crime studies may have been biased towards finding short journey-to-crime distances because they typically focused on a limited geographic range to study offender mobility and ignored non-local offending patterns. Furthermore, recent studies into offender mobility increasingly suggest that not all offenders may be inclined to minimize their efforts and travel short distances to offend. Some offenders select targets much further away from home. Consequently, their crime trips are much longer. These observations raise a number of questions with regard to the journey to crime and with regard to the occurrence of longer crime trips in relation to the rational choice perspective: which distances do offenders typically travel to offend? How can variation in distance to crime be explained? Does the outcome of offenders’ target selection process, in particular in the case of remote target selection, suggests that offenders may balance the costs and benefits of their target decisions?

This dissertation addresses these questions and attempts to understand why some journeys to crime are longer than others. It builds upon the rational choice perspective to reframe the occurrence of long crime trips as purposeful behavior that is the outcome of a process in which costs and benefits are balanced. It studies offender mobility and the journey to crime within multiple large geographic areas. First, an analysis of five-year (2006-2010) public prosecutor data on property offences (N = 10,478) in the greater Ghent area, Belgium allows to confirm the existing knowledge with regard to journey-to-crime research and underlines that the occurrence of long crime trips is less exceptional than previously believed. Crime trips are typically short but one in three crime trips are longer than 10 km. Second, a negative binomial regression analysis of six-year (2006-2011) local police recorded crime data (N = 2,387) on residential burglaries committed in East and West Flanders, Belgium demonstrates that environmental attributes at the municipality level help to explain variation in distance to crime, corroborating one of the central tenets of the rational choice framework. Finally, a discrete spatial choice analysis
of seven-year (2006-2012) Federal Police recorded crime data (N = 650) on residential burglaries in East Flanders, Belgium with the residence as the spatial unit of analysis highlights that a reduction in risk exposure may help offenders to compensate for increased travel costs.

Although confirmation is found for some of the central arguments contained within the rational choice perspective, the combined results stress that some of these arguments need reconsideration. In particular, the hypothesized importance of reward-related information could not be established and risk-related information is of major importance for understanding increases in crime trip length. The difficult relationship between the rational choice perspective and empirical research is discussed.
Eerder onderzoek naar crimineel reis- en verplaatsingsgedrag heeft herhaaldelijk vastgesteld dat criminelen over het algemeen slechts korte afstanden reizen voordat zij hun feiten plegen en dat de waarschijnlijkheid dat een bepaalde locatie als pleegplaats zal dienen, afneemt naarmate zij verder afgelegen is van de verblijfplaats van de dader. Deze terugkerende onderzoeksresultaten worden doorgaans begrepen vanuit het rationele keuzeperspectief. Dit perspectief stelt dat criminelen de kosten en baten van hun beslissingen afwegen. Het criminele beslissingsproces en crimineel gedrag worden beheerst door winstmaximalisatie en inspanningsminimalisatie. De korte criminele verplaatsingen die doorgaans worden geobserveerd in onderzoek, illustreert de geneigdheid van criminelen om hun inspanningen zoveel mogelijk te beperken. Niettemin dringen er zich kanttekeningen op. Eerder onderzoek bestudeerde crimineel reisgedrag vooral in kleine studiegebieden en liet bovenlokaal verplaatsingsgedrag doorgaans buiten beschouwing, waardoor deze onderzoeken sneller tot de bevinding kunnen komen dat criminelen zich niet ver verplaatsen om hun feiten te plegen. Bovendien suggereert recent onderzoek alsnog vaker dat niet alle criminelen geneigd lijken te zijn om hun inspanningen te beperken en slechts korte criminele verplaatsingen af te leggen. Sommige criminelen kiezen verder afgelegen doelwitten en leggen daardoor grotere verplaatsingen af. Deze vaststellingen geven aanleiding tot een aantal vragen met betrekking tot het crimineel reis- en verplaatsingsgedrag in het algemeen en met betrekking tot het voorkomen van langere criminele verplaatsingen in verhouding tot het achterliggende rationele keuzeperspectief in het bijzonder: over welke afstanden verplaatsen criminelen zich doorgaans om hun feiten te plegen? Hoe kan variatie in de afstand van criminele verplaatsingen verklaard worden? Suggereert de uitkomst van het criminele locatiekeuzeproces, in het bijzonder wanneer er voor verder afgelegen doelwitten wordt gekozen, dat criminelen een kosten-batenanalyse met betrekking tot hun doelwetten maken?

Deze verhandeling verkent deze vragen en probeert tot een beter begrip te komen waarom sommige criminale verplaatsingen langer zijn dan andere. De verhandeling hanteert de centrale argumenten van het rationele keuzeperspectief en herformuleert het voorkomen van langere criminele verplaatsingen als doelbewust gedrag dat het resultaat is van een kosten-batenanalyse. Crimeel reis- en verplaatsingsgedrag worden bestudeerd in meerdere grotere studiegebieden. In eerste instantie bevestigt een analyse van vijf jaar (2006-2010) parketdata (N = 10.478) voor het voormalig gerechtelijke arrondissement Gent de bestaande inzichten met betrekking tot het verplaatsingsgedrag van criminelen, maar deze analyse maakt ook duidelijk dat langere criminele verplaatsingen niet uitzonderlijk zijn. Hoewel criminelle verplaatsingen over het algemeen kort zijn, is één op drie van alle verplaatsingen toch langer dan 10 km. Ten tweede toont een negatief binomiaal regressieanalyse van zes jaar (2006-2011) lokale politiedata (N = 2.387) met betrekking tot woninginbraken gepleegd in Oost- en West-
ABSTRACT


De resultaten bieden ondersteuning voor sommige van de centrale argumenten van het rationele keuzeperspectief. Toch moeten bepaalde argumenten van dit perspectief heroverwogen worden. In het bijzonder kon er geen bevestiging gevonden worden voor het belang van winst-gerelateerde informatie en bleek risico-gerelateerde informatie van groter belang te zijn om variatie in de afstand van crimineel reisgedrag te begrijpen dan wat op basis van het rationele keuzeperspectief verwacht kon worden. De moeilijke verhouding van het rationele keuzeperspectief ten opzichte van empirische criminologisch onderzoek wordt bediscussieerd.
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Preface

I set out on this task in November 2011. Now, three and half years later, it has come to an end. Although writing a PhD dissertation is above all a personal challenge and task, many people have knowingly and unknowingly contributed to the successful completion of this dissertation. I would like to express my most sincere gratitude to those people and briefly address them on the following pages.

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Ghent, February 2015
Introduction
Introduction

Crime is not randomly nor uniformly distributed in space. Some locations experience more criminal events than others. A recurring observation in the study of crime and place is that most offences take place close to where the offenders live (McIver, 1981; Wiles & Costello, 2000). Journey-to-crime studies have previously established that offenders typically travel only short distances to commit their offences and that faraway locations are unlikely to be targeted by offenders for their offences.

The rational choice perspective offers a framework that helps to understand why offenders prefer to commit their offences close to their home (Bernasco, 2014). From within this perspective, it is argued that offenders balance the costs and benefits of their decisions against each other. Profit maximization and effort minimization in particular characterize the many choices and decisions that underlie offender behavior and shape the offender’s journey to crime (Pettiway, 1982; Van Koppen & Jansen, 1998). Offenders selecting targets nearby their home and the resulting short crime trips, illustrate offenders’ tendency to minimize efforts as much as possible.

Interestingly, a number of studies highlight that not all offenders avoid selecting faraway targets at all costs and travel to crime may be much more widespread than previously reported in research. A substantial portion of offenders actually commit their offences further away from their home and, consequently, their crime trips are much longer (e.g., Gabor & Gottheil, 1984; Morselli & Royer, 2008; Polisenska, 2008; Rattner & Portnov, 2007; Van Daele, Vander Beken & Bruinsma, 2012; Van Koppen & Jansen, 1998). These offenders do not look for target in the direct proximity of their home areas but are prepared to travel to other neighborhoods and cities to commit their offences. Since offenders are expected to minimize efforts as much as possible and travelling longer distances requires more time, money, effort and energy, this raises a number of questions. For instance, how often do offenders select targets that lie further away from home and how common are long crime trips? Why are some offenders prepared to suffer increased travel costs and which particular benefits may play a role in offenders’ struggles to keep profits and efforts in balance? And, most importantly, to what extent can variation in crime trip length be reconciled with the central tenets of the rational choice perspective?

This PhD dissertation not only raises, but addresses these questions and attempts to offer an insight as to why some crime trips are longer than other crime trips. This research builds upon the rational choice perspective to study both the way in which and the reasons offenders decide to increase the travel efforts of their offences by selecting remote targets. Its general aim is to advance the current understanding of offender mobility and offenders’ target selection process.
This introduction is structured as follows. First, the theoretical framework that underpins this PhD study is discussed. Second, the central research question and the related guiding research questions of this PhD study are outlined. This is followed by a section that addresses the used data sources and describes the study areas, discusses the applied methods and presents this study’s operationalization of ‘long’ crime trips. Finally, the overall structure of the PhD study is clarified and the links between the three papers that constitute the body of this PhD study are explained.

Theoretical framework

Theories that seek to explain crime commonly address one of two questions (Braga & Weisburd, 2010; Eck & Weisburd, 1995): why crime occurs and where it occurs. Up to the late 1970s, criminology was predominantly occupied with answering and explaining the first question. This question and the many possible answers it triggered profoundly shaped the development of contemporary criminology and have been explored in-depth in criminological research (Clarke, 1980; Smith, Bond & Townsley, 2009). Recently there is a profound rise of interest in the latter question (Braga & Weisburd, 2010). Although this recent interest might appear to be novel, attempts to understand where crime occurs can be traced back directly to the early days of the budding field of criminology (e.g., Guerry, 1833; Quetelet, 1842). These attempts matured in the early 1980s within the routine activity theory (Cohen & Felson, 1979) and the development of environmental criminology (Brantingham & Brantingham, 1981a).

Contemporary environmental criminology is concerned with explaining the spatial distribution of offenders and offences (Bottoms & Wiles, 1997, p. 621). It focuses both on how offences are geographically distributed and the environment in which the offences occur. It seeks to explain where offenders choose to offend and the environmental cues that shape the selection of their crime site in terms of individuals interacting with their environment (Bernasco & Block, 2009; Smith et al., 2009). Studying how offenders select a crime site and the travelling that this includes – the mobility of offenders – is part of environmental criminology.

Multiple theoretical perspectives, such as the rational choice perspective, routine activity theory and crime pattern theory (Eck & Weisburd, 1995, pp. 5-7; Felson & Clarke, 1998, pp. 4-8), add, all in their own distinct ways, to both understanding the crime-place nexus and explaining the way in which offenders select a crime site and the coincidental mobility this entails. Succinctly, the rational choice perspective suggests that offenders balance the costs and benefits of their choices. Offenders choose the alternative for which the benefits outweigh the costs. Routine activity theory (Cohen & Felson, 1979) propagates the view that societal changes affect criminal opportunities and states that crime occurs when a motivated offender converges in time and place with a suitable target in the absence of a capable guardian. Finally, crime pattern theory (Brantingham & Brantingham, 1984) combines insights from the rational choice perspective and the
routine activity theory to explain crime patterns in the environment. It argues that rational offenders will notice suitable targets while performing their daily activities and routines. Crime, then, is the result of the interactions between the offender and his social and physical environment.

Notwithstanding these manifold perspectives’ interest in place, it is the rational choice perspective that offers a basic rationale for understanding how offenders make crime-related decisions and select a crime site (Birks, Townsley & Stewart, 2012, p. 226). It structures thinking about crime target selection and the journey to crime in terms of a balancing act of costs and benefits, and emphasizes the environmental information drawn on in this process. Within this perspective, distance to crime is considered as one of the major costs affecting offenders’ crime and target-related decisions.

The rational choice perspective: balancing costs and benefits

The rational choice perspective (Cornish & Clarke, 2006; 1986b) is one of the dominant frameworks for understanding offender behavior, including offender target selection and the ensuing offender mobility as well as the journey to crime (Elffers, 2004; Lu, 2003, p. 424). It is a heuristic tool for looking at offending behavior and the decisions that underlie and shape this behavior (Cornish & Clarke, 2008, p. 24). The perspective is firmly rooted in microeconomics and offers a lens for understanding how and where individual offenders decide to exploit perceived criminal opportunities and commit their offence. The origins of this perspective can be traced back to the ideas of Cesare Beccaria ([1764] 1963) and Jeremy Bentham ([1789] 1982) but it primarily builds upon the seminal research into rationality and human decision-making undertaken within economics (Becker, 1968). Since the 1980s, this perspective offers criminology a radical new approach to analyzing the offender and his behavior.

From within the rational choice perspective, it is argued that offenders are rational insofar that their behavior is purposive and expresses their intention to benefit themselves (Cornish & Clarke, 1986a; 2006; 2008). The perspective proposes that offenders balance the costs and benefits of their decisions and that when they are confronted with a choice, they will select that particular alternative from a larger set of alternatives that appears to be the best outcome of that balancing act of costs and benefits (Bottoms, 2007, p. 541; Elffers, 2004, p. 184). Offenders aim to maximize their benefits while keeping the anticipated costs to a minimum (Pettiway, 1982; Van Koppen & Jansen, 1998). To do so, they rely on information related to rewards, efforts and risks (Cornish & Clarke, 2006). According to the rational choice perspective, costs and benefits should be interpreted broadly. Costs may include the money required to buy a weapon, the time needed to find an accomplice to carry out an offence or a fence to sell stolen

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1 Throughout this dissertation, the male version of the personal pronoun is intended as a generic he gender-neutral personal pronoun. This is inspired by the observation that the majority of offenders are male.
goods, the risk of getting caught and suffering social exclusion but also the effort, time, money and energy it takes to travel to a target. Benefits can be equally diverse and include a range of financial and psychological rewards such as the money stolen during a burglary, the fun and excitement experienced during a joyride or the particular image that one builds and conveys to his peer group by committing crimes. Some costs and benefits are very high but may also be highly uncertain such as the chance of burglarizing a house and finding a lucrative stash of jewelry or getting arrested by the police and being sentenced to serve time in prison, while other costs and benefits are minimal but almost inevitable to avoid or miss. Possible examples are the time and money required to buy a weapon when carrying out certain personal or property offences or getting a few euros from robbing an elderly person. Not all types of costs and benefits will have an equal impact on an offender’s decisions. The rational choice perspective holds that short-term benefits dominate offender decision-making, while dista and intangible costs and benefits, such as the risk of getting caught and serving a prison sentence or living long enough to see one’s children grow up, are expected to be of minor influence on offenders crime-related decisions (Brantingham, 2013, p. 1; Cornish & Clarke, 2006, p. 20; Felson & Clarke, 1998, pp. 7-8; see also Hakim, Rengert & Shachmurove, 2001, pp. 134-135). Results from a number of quantitative and qualitative studies on burglars provide broad support for the idea of a rational offender that balances costs and benefits with regard to the commission of an offence (e.g., Bennett & Wright, 1984a; Bernasco & Luykx, 2003; Bernasco & Nieuwbeerta, 2005; Cromwell, Olson & Avary, 1991; Nee & Meenaghan, 2006; Nee & Taylor, 1988).

The rational choice perspective also offers a structured approach to offenders’ decision-making leading up to and during a crime event in general and their target selection process in particular. It is proposed that offenders’ decision-making process involves multiple, hierarchical, sequential decisions (Cornish & Clarke, 1986a, pp. 2-6; 2006, p. 23; 2008, pp. 29-36). This is not only true for the initial decision to get involved with crime altogether, but also for the more specific and detailed decision of selecting a particular target to burglarize or rob. The process of offenders’ target selection is described as a spatially structured, hierarchical sequential process that requires offenders to make decisions with regard to multiple levels of spatial aggregation (cf. Cornish & Clarke, 1986a, p. 4).2 For instance, the selectin of a burglary target involves deciding upon a suitable target area such as a municipality or a neighborhood but also choosing a particular house to burglarize. Throughout this process, environmental and situational cues play an important role. These cues provide information on elements such as rewards, efforts and risks, and they may allow offenders to assess the costs and benefits of their decision. Support for a hierarchical, sequential target selection process and the relevance of environmental and situational cues in this process, is found in a number of studies that studied offenders’ target selection process, including burglary (Bennett &

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2 See also Brantingham and Brantingham (1984, pp. 338-340).
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Wright, 1984a; Bernasco & Nieuwbeerta, 2005; Wright, Logie & Decker, 1995) and robbery target selection (Bernasco & Block, 2009; Jacobs, 2010; Wright & Decker, 1997).

Offender mobility and the journey to crime

For a crime to occur, a motivated offender needs to converge in place and time with a suitable target in the absence of a capable guardian (Cohen & Felson, 1979). For the motivated offender, this often requires a certain degree of mobility on his part. The offender needs to leave his home and explore the surrounding environment to come across suitable targets. This is referred to as a journey to crime or, more in general, offender mobility. The journey to crime is the direct spatial link between the offender and his selected target (Elffers, 2004).

An important cautionary note is in order before proceeding with discussing the concept ‘journey to crime’. The notion of a journey to crime suggests an intentional and deliberate action on the part of the offender (Bernasco, 2014; Elffers, 2004). It falsely creates the illusion that offenders make elaborate considerations with regard to this journey and the distance it might cover. However, they are not actively concerned with travelling a particular distance and then committing a crime at whatever location they happen to be once they covered that distance. Instead, offenders are concerned with selecting a suitable crime site or exploiting a particular criminal opportunity that offers certain rewards. Because the offender’s rationale while looking for a target is to make minimal effort, offenders may prefer nearby targets over ones that are further away. The distance of their crime trip mirrors this and will therefore be typically short. Offenders’ target choice reflects this and is not dependent on an initial idea about a certain distance they want to travel prior to committing their offence. In this, offenders are similar to, for example, holidaymakers who are unconcerned with selecting whatever holiday destination that is 2,500 km away from their home but deliberately want to spend a fortnight on a sunny beach in southern Greece or a week skiing on a snowy slope in the Alps. Travelling the 2,500 km that is required to reach this destination is contingent on their holiday destination decision. In other words, the offender’s journey to crime and in particular its distance is a corollary of offenders’ target selection process and the process that leads up to this decision-making (Elffers, 2004). This is not to say, however, that the distance of a crime trip is unimportant for an offender. Distance is in fact one of the most important constraints in an offender’s target selection process but many other choice criteria such as the profits and the risks associated with the offence also come into play and affect an offender’s target-related decision (Bernasco & Nieuwbeerta, 2005, p. 301; Kleemans, 1996, pp. 92-96).

Notwithstanding this important cautionary note, two aspects are important to understand the offender’s journey between his starting point and crime site: the journey’s direction and its distance (Brantingham & Tita, 2008; Eck & Weisburd, 1995, p. 16). The direction refers to where the crime trip is headed. In previous research scholars have not yet reached an agreement on whether offenders are more likely to travel to
opportunity rich areas or to areas poor in criminal opportunities (Rengert, 2004). Some studies suggest that offenders travel to areas with more targets than their home areas (Costanzo, Halperin & Gale, 1986; Phillips, 1980), while other studies concluded that offenders target areas with less opportunities (Wiles & Costello, 2000). The distance typically refers to the Euclidean distance between the starting point and the destination of the crime trip (Van Daele & Bernasco, 2012, p. 135). Journey-to-crime studies usually find that most crime trip distances are short and that the majority of offenders commit offences close to their home.

The offender’s home is typically assumed to be the starting point of the crime trip and the destination where the offender ultimately commits his offence (Bruinsma, 2007, p. 485; Rengert, 2004). However, offenders are similar to non-criminals in that they have multiple reference points from which they may undertake their daily routine activities, including crime (Brantingham & Brantingham, 1981b, p. 239; Rengert, 2004, p. 170). Consider, for example, non-criminal shopping behavior. If an individual needs to do some grocery shopping after work, it is unlikely but not impossible that the individual will first drive home before visiting a grocery store. Instead, the individual is more likely to proceed directly from his or her workplace to the grocery store and continue to home afterwards. Moreover, research confirms that other locations might also act as the starting point of a crime trip, such as a partner’s home or a leisure location (Van Daele, 2009; Wiles & Costello, 2000, p. 40). This casts doubts over the predominant claim that the offender’s home is the starting point of the journey to crime (Bruinsma, 2007, p. 485; Rengert, 2004, p. 170; Rossmo, 2000, p. 91; Stangeland, 1998, p. 70). Nevertheless, there are a number of convincing theoretical and practical reasons to assume that the offender’s home does act as the starting point of a crime trip. First and foremost, the location of the offender’s home is key to his use and understanding of the surrounding environment (Canter & Larkin, 1993; Sarangi & Youngs, 2006) and it imposes an important constraint on the area in which offenders look for suitable targets, primarily because at some point in time offenders will have to return home (Rengert, 2004). Second, journey-to-crime research primarily relies on police recorded crime data to study offender mobility and the journey to crime (Bruinsma, 2007, p. 485). These data rarely include information on additional anchor points. Moreover, address information in police recorded crime data is often limited to the registered, official address.

Distance to crime

The distance between the offender’s home and the selected crime site has been extensively studied in journey-to-crime research. This has given rise to several recurrent findings (Birks et al., 2012, p. 227): offenders generally travel short distances to commit their offences and the likelihood of a particular location being selected as a crime site decreases with the distance from the offenders’ home areas.

Most journeys to crime cover only a short distance (McIver, 1981; Rossmo, 2000, pp. 105-110; Wiles & Costello, 2000). Although offenders are mobile, they generally limit
their travelling to crime as much as possible. In one of the earliest studies on the topic, White (1932) established that crime trips in Indianapolis (US) were predominantly short. The average distance to crime varied between 1.35 km for personal offences and 2.77 km for property offences. Similar results were observed in European settings. Wiles and Costello (2000) studied the travelling habits of offenders in and around Sheffield (UK). Their analysis of police recorded crime data demonstrates that the average travelled distance across all offence types was only 3.11 km. The shortest average travelled distances were observed for personal offences (2.40 km) and the longest average travelled distances for property offences such as shoplifting (4.04 km). Comparable results are observed in a large number of studies, regardless of the applied methodology and across different study regions (including Barker, 2000; Bichler, Christie-Merral & Sechrest, 2011; Capone & Nichols, 1976; Gabor & Gottheil, 1984; Hesseling, 1992a; Laukkanen & Santtila, 2006; Lundrigan & Czarnomski, 2006; Phillips, 1980; Pyle, Hanten, Williams, Pearson & Doyle, 1974; Rhodes & Conly, 1981; Snook, 2004; Turner, 1969).

A related observation is that the majority of offences occur close to where the offenders live and that the number of offences declines sharply as the distance from the offender’s home increases (Rengert, Piquero & Jones, 1999). This is known as the distance-decay effect: as the distance from the offender’s home increases, the likelihood that a particular place is selected as a crime site decreases. It has been repeatedly observed in studies that analyzed the distance to crime (including Bernasco, 2006; 2010a; Capone & Nichols, 1975; 1976; Laukkanen, Santtila, Jern & Sandnabba, 2008; Phillips, 1980; Rattner & Portnov, 2007; Rhodes & Conly, 1981; Santtila, Laukkanen, Zappala & Bosco, 2008), and suggests that offenders are more likely to come across opportunities in their direct environment than in a distant area. This decay pattern is certainly not unique to crime, but is equally observed in other non-criminal forms of human interaction and movement, such as human migration and marital partner selection (Taylor, 1983, pp. 3-6). For instance, the distances between the homes of marital partners clearly exhibit a decay pattern. Marriages between partners from the same, local area occur more frequently than marriages between partners who live more distant from each other. The explanation for the occurrence of this phenomenon is similar to that of the criminal distance-decay pattern: suitable partners from the same home area are more likely to meet each other than partners from distant areas.

Interestingly, not all crime trips are definitely short. According to some studies, longer crime trips might be more common than what this seemingly broad accordance in journey-to-crime research suggests (e.g., Gabor & Gottheil, 1984; Lundrigan & Czarnomski, 2006; Morselli & Royer, 2008; Polisenska, 2008; Rattner & Portnov, 2007; Smith et al., 2009; Van Daele et al., 2012). In fact, some offenders might even be deliberately looking for remote targets (cf. Polisenska, 2008; Van Daele & Vander Beken, 2011b; Van Koppen & Jansen, 1998). Itinerant crime groups or mobile property offenders are an example of this particular type of offending behavior (Van Daele et al., 2012).
Their offending and mobility patterns show that they systematically target residences further away from their (temporary) homes.

Results from a number of studies in multiple localities and contexts indicate that a sizeable number of offenders target faraway offence locations and travel longer distances before committing their crimes. For instance, a quarter of all studied journeys to crime related to sexual offences in New Zealand were longer than 10 km (Lundrigan & Czarnomski, 2006, p. 224). Rattnner and Portnov (2007, p. 682) established a considerable degree of interurban criminal commuting. Their results indicate that approximately half of all property crimes in Tel Aviv (Israel) were committed by offenders living outside the city and who had to travel at least 10 km from their home area to their crime site. Similar results were observed in Ottawa (Canada). Approximately a quarter of all offenders that committed offences in Ottawa were not residing in the city and the communities directly bordering the city or had no fixed address at all (Gabor & Gottheil, 1984, p. 274). Hesseling (1992a, p. 111) observed that 20% off all offenders in the city of Utrecht (the Netherlands) were out-of-towners. Similarly, one in five Dutch commercial robbers committed their robberies more than 20 km from their home (Van Koppen & Jansen, 1998, p. 238) and Smith et al. (2009, p. 233) established that a third of their sampled UK burglars did not look for targets nearby their home area at all. Finally, some of the observed journey-to-crime distances are exceptionally long. For instance, Santtila et al. (2008) studied the journey-to-crime distances of offenders involved in homicides, rapes and commercial robberies in Milan (Italy). Although the average travelled distances were relatively short, a number of extremely long crime trip distances of up to a 1,000 km were observed suggesting that the offender’s home area was in southern Italy (Santtila et al., 2008, p. 350). While less extreme but more commonly observed, Polisenska (2008, p. 56) reports that a sample of interviewed Czech burglars who had offended in different regions and cities in the Czech Republic indicated that they did not offend close to their home at all but deliberately travelled as far as possible. Some burglars reported travelling distances up to 150 km. Trips of similar length have been observed in The Netherlands (Van Koppen & Jansen, 1998, p. 238) and Belgium (Van Daele et al., 2012, p. 297) as well.

**The rational choice perspective applied to offender mobility and the journey to crime**

Applied to offenders’ target selection process and offender mobility, the rational choice perspective allows to understand the previously discussed recurrent findings with regard to offenders’ journey to crime (Bernasco, 2014). The observation that most crimes occur close to where the offenders live and that the majority of crime trips is short illustrates offenders’ inclination to keep anticipated costs to a minimum (Rengert et al., 1999, p. 429). There are no reasons to believe that offenders expend more time and energy than strictly needed to commit their offences and so criminals are hypothesized to be more likely to exploit a nearby criminal opportunity instead of a distant one. They are expected to look for easy, profitable targets close to their home. They will travel as little as
possible for committing their offences keeping the efforts and risks associated with their offences to a minimum. A corollary of this decision-making strategy is that crime trips are short and offences occur primarily in and around the offenders’ home areas.

Although the occurrence of longer crime trips intuitively seems at odds with the rational choice perspective (Rengert et al., 1999, p. 429), the rational choice perspective might nonetheless offer the tools for understanding this particular type of offender mobility by highlighting the expected utility of long crime trips (Felson, 2006, p. 265; Morselli & Royer, 2008, p. 6; Van Koppen & Jansen, 1998, p. 231). Selecting a remote target will result in a longer journey to crime. Travelling further to reach the target increases the costs of committing the offence, since it requires a greater investment in terms of time, money, energy and effort needed to overcome these longer distances. Selecting remote targets is therefore an undesirable target selection strategy, unless the anticipated benefits of successfully completing the offence outweigh the costs of travelling further. After all, the rational choice perspective posits that offenders balance the costs and benefits of their decisions. While distance is a major cost in this balancing process, other costs and benefits such as the extent of the realized financial profits and the risk of detection and apprehension also play a role in this process and affect its outcome. Selecting a remote target may prove appealing to an offender if the anticipated financial profits are large enough or the risk of detection and apprehension is small enough to compensate for the increased travel costs.

A number of studies have indeed established that committing offences further away from home may be more rewarding since higher criminal benefits are associated with longer journeys to crime (e.g., Baldwin & Bottoms, 1976; Gabor & Gottheil, 1984; Morselli & Royer, 2008; Pettiway, 1982; Snook, 2004; Van Koppen & Jansen, 1998). For instance, Morselli and Royer (2008, p. 17) demonstrated the existence of a positive relationship between offenders’ criminal range, or how far they travelled to commit crime, and their reported financial profits: higher profits were associated with greater travelled distances. In Morselli and Royer’s study, criminals travelling to more than one city reported earnings up to 23 times larger than those of offenders who only committed offences in a single city. In a similar vein, Snook (2004, pp. 61-62) found that burglars who undertook longer crime trips obtained greater rewards than burglars operating close to their home. In addition, Van Koppen and Jansen (1998, pp. 244-245) reported that the most distant robberies resulted in the greatest financial rewards.

Furthermore, offenders could expose themselves to a lower risk of detection by travelling further (Capone & Nichols, 1976; Lammers & Bernasco, 2013; McIver, 1981). For example, a study in the Miami-Dade County (US) found that some commercial robbers frequently targeted locations of a particular chain of convenience stores despite that equally attractive locations of an alternative chain were much closer for the robbers (Capone & Nichols, 1976, pp. 210-211). Although the targeted chain required the robbers to travel further, it had a particular type of retail operation that considerably reduced the risk of apprehension for the offenders. Additionally, Lammers and Bernasco (2013)
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analyzed DNA traces in the Netherlands to assess the influence of the geographical range of offenders on their probability of arrest and found that offenders that selected geographically dispersed targets have a reduced risk of arrest. As offenders increased their geographical range to commit offences and selected targets in multiple regions that fall under the jurisdiction of different police forces, their chance of detection and arrest significantly decreased. Although this study analyzed inter-crime distances instead of the more common home-crime distances, the results of the study of Lammers and Bernasco (2013) provide some additional support for the idea that mobile offenders may benefit from a reduced risk of detection. Notwithstanding the fact that multiple crimes committed by the same offender within a small geographic range could be associated with long crime trips (cf. Canter & Larkin, 1993, p. 65), crimes committed by the same offender within a larger geographic range also reflect a degree of mobility on the part of the offender and suggest that an offender may have travelled longer distances to commit at least some of these crimes.

In short, although adopting the rational choice perspective may intuitively have us conclude that offender mobility must be limited and crime trips predominantly short, this same perspective might at the same time offer a framework to grasp why offenders deliberately select remote targets and coincidentally increase their mobility. If offenders balance the costs and benefits of their choices, then selecting remote targets and travelling longer distances may occur when the increased profits offset the increased travel efforts required to reach these remote targets. Higher profits may precisely be what counterbalances the increased travel efforts but lower risk could also help to reduce travel efforts.

Knowledge gaps and research questions

The rational choice perspective offers a potentially powerful framework to help frame offender mobility and advance our understanding of the occurrence of long crime trips. By drawing on this particular perspective, this PhD dissertation attempts to understand variation in journey-to-crime length. More in particular, the occurrence of long crime trips is studied using the principles of the rational choice perspective. The central research question informing this PhD study is:

- To what extent do remote target selection and the ensuing occurrence of long crime trips fit with the principles of the rational choice framework?

This central research question can be broken down into three guiding research questions that are answered throughout this PhD dissertation. The first guiding research question is prompted by the observation that earlier journey-to-crime studies typically focused on a limited geographic range to study offender mobility and mostly ignored non-local offending patterns. Their study designs make identifying longer crime trips difficult and in some cases even these particular crime trips cannot be studied at all.
Conclusions with regard to the journey to crime are stooled on research that has primarily studied offender mobility within a limited geographic range, such as a city (e.g., Hesseling, 1992a; Snook, 2004; White, 1932) or a small town (e.g., Barker, 2000). This inherently limits the maximum observable length of a crime trip in the study area, since it is difficult to identify and study journeys to crime that are longer than the diameter of the city or town in question. Moreover, focusing on a limited geographic range may have an additional downside in the study of offender mobility. It is unclear to what extent non-local travelling patterns can be identified at all in a similar research design, especially if the study area consists of a city. Cities are known to have an attractive opportunity structure for possible offenders (Pyle et al., 1974) and contain numerous crime generators and attractors (Bernasco & Block, 2009; Brantingham & Brantingham, 1995).

In general, cities are therefore attractive to offenders and, in particular, eliminate the need for local urban offenders to travel longer distances before finding an attractive target or suitable criminal opportunity. Conversely, because rural areas may be poor in opportunities local rural offenders may fail to identify criminal opportunities in close proximity to their home and may therefore be incited to increase their distance to crime out of a lack of suitable targets. They may be drawn to a more distant city to capitalize on the many criminal opportunities available there (e.g., Brantingham & Brantingham, 1995, p. 8). Focusing on a limited geographic range not only disallows a possible falsification of the conclusion that offenders generally do not travel far to offend but the previously highlighted assumptions about urban and rural offender mobility cannot be properly tested. In other words, the research designs of these earlier journey-to-crime studies might be biased towards finding local offender mobility and short journey-to-crime distances.

In addition, the majority of journey-to-crime research typically relies on recorded crime data from a single local police force to study offender mobility and criminal travelling patterns (Bruinsma, 2007, p. 485). This makes studying the full extent of non-local travelling patterns difficult because of the operational procedures typical of local police departments. For instance, crime trips starting inside a police department’s jurisdiction but ending outside it – so-called outbound crime trips (cf. Van Daele & Vander Beken, 2011b) – cannot be studied using local police recorded crime data since police departments only register crimes occurring inside their judicial boundaries – the so-called local and inbound crime trips (Wiles & Costello, 2000, p. 14).

Furthermore, some studies that touch upon offender mobility only include local offenders in their analysis (e.g., Bernasco & Nieuwbeerta, 2005, p. 305; Clare, Fernandez & Morgan, 2009, p. 153; Laukkanen et al., 2008, p. 227; Phillips, 1980, pp. 170-172) and ignore non-local travelling patterns altogether (Stangeland, 1998, p. 70). Other studies treat longer crime trips as outliers and deliberately eliminate them from further analysis to avoid ambiguity when interpreting results (e.g., Fritzon, 2001, pp. 48-50; Hesseling, 1992a, p. 104; Laukkanen et al., 2008, p. 227; Lundrigan & Czarnomski, 2006; Townsley & Sidebottom, 2010, p. 905; Turner, 1969, p. 13; Wikström, 1991b, p. 215). In one study the
criminal events and corresponding crime trips of a particular offender are excluded because the offender has travelled distances between 40 and 60 km and such distances are “uncharacteristic of the distances travelled by the other offenders” (Barker, 2000, pp. 62-63 emphasis added). In a similar vein, even though nearly 20% of all included offenders reside outside the city of Utrecht, a detailed study of the offender mobility in Utrecht did not include out-of-towners (Hesseling, 1992b, pp. 98, 106-107).

Evidently, this local approach limits the validity and generalizability of journey-to-crime research results and underestimates journey-to-crime distances. It disallows studying long crime trips and the reasons and motivations that may add to explaining their occurrence. Instead of these studies with a limited geographic framework, a more appropriate strategy to study offender mobility needs to focus on a broader geographic range and rely on data that capture a fuller extent of crime trip distances (Hesseling, 1992a, p. 111; Stangeland, 1998, p. 70). This PhD dissertation therefore studies offender mobility and the journey to crime within a larger geographic range. Longer crime trips are deliberately included in the analysis, even though their inclusion may introduce ambiguity when studying distance to crime and interpreting results. This evident shortcoming in previous research begs the formulation of the first guiding research question which is concerned with establishing and describing the extent of offenders’ mobility and the (average) distance of offenders’ journey to crime:

1. Which distances do offenders typically travel to offend?

Once it has been established how far offenders travel to commit their offences and it has become clear to what extent longer crime trips occur, it is important to understand how the occurrence of longer crime trips can be explained. Offenders’ target selection process and the general environmental attributes that play an important role throughout this process may help to explain crime trip length variability. As previously argued, offenders follow a spatially structured, hierarchical sequential target selection process that involves several decisions with regard to multiple levels of spatial aggregation (Cornish & Clarke, 1986a, pp. 2-6; 2006, p. 23; 2008, pp. 29-36). Prior to selecting their ultimate target, offenders select a larger target area such as a municipality or neighborhood. This initial selection of a larger target area then largely determines the final length of the crime trip and the extent of the travel efforts required to reach the target. Slight variations in trip length and travel efforts may occur at a later stage once a specific target is selected inside the larger target area. Environmental attributes of the larger target area related to rewards, efforts and risks play an important role throughout this process (e.g., Bennett & Wright, 1984a; Bernasco & Luykx, 2003; Nee & Meenaghan, 2006; Nee & Taylor, 1988) and may also help to explain why some crime trips are longer than others.

In a first stage of this PhD research, the distance between the offender’s home and the selected crime site or the crime trip length is treated as the single choice criterion that affects offenders’ target choice. Variability in the importance of this choice criterion, as indicated by varying distances to crime or the occurrence of shorter and longer crime
trips, is explained using a selection of environmental attributes that help characterizing the target areas. The second research question addresses precisely this matter and is concerned with explaining variation in crime trip length using primarily environmental characteristics of the target areas:

2. Can variation in distance to crime be explained using environmental characteristics of target areas?

In a second research stage, the manifestation of longer crime trips is redefined in terms of a corollary outcome of offenders’ target selection process. It is emphasized that many choice criteria including distance but also the profits and the risks associated with the offence and the selection of a particular target may affect the offender’s choice of target (Bernasco & Nieuwbeerta, 2005, p. 301; Kleemans, 1996, pp. 92-96). The final research question acknowledges this and explicitly scrutinizes the rational choice perspective in relation to the occurrence of longer crime trips. This question aims to establish to what extent one of the major costs in this process, the distance from the offender’s home to the crime site, is being compensated and in particular whether this compensation is reflected in offenders’ ultimate choice of target.

3. Does offenders’ target selection process, in particular in the case of remote target selection and the ensuing increase in travel efforts, reflect a balancing act of costs and benefits?

As previously discussed, a number of benefits may compensate the increased costs of selecting a remote target and travelling further. Benefits include such things as increased rewards or a reduced risk of detection and apprehension. First and foremost, selecting remote targets is financially lucrative. Previous studies into the benefits of longer crime trips established a positive relationship between crime trip length and financial profits (e.g., Morselli & Royer, 2008; Van Koppen & Jansen, 1998). However, these studies relied on reported financial profits that were acquired and assessed after successfully completing an offence. Although insightful, detailed profit-related information is rarely available when an offender selects a target and he implicitly decides on increasing the associated travel efforts. Only when a crime has been successfully committed will it become clear to an offender to what extent the increased travel efforts where worthwhile given the realized profits. This prompts the question whether offenders’ decisions to select a particular target and eventually increase the associated travel costs may be informed by profit-related information that is available to the offender at the moment of this decision, such as house-related attributes that could allow the offender to form an opinion on possible financial benefits. In other words, does profit-related information play a role in offenders’ target selection process, in particular in the case of remote target selection and the resulting rise in travel costs?

Furthermore, selecting remote targets and travelling longer distances could prove a successful target selection strategy that helps offenders to avoid detection and escape
arrest (Capone & Nichols, 1976). However likely that seems, the rational choice perspective suggests that offenders are relatively unconcerned about vague and distant risks such as the chance of detection and apprehension. A number of studies has indicated that risk-related information is not of primary importance when offender balance the costs and benefits of their decisions (Brantingham, 2013, p. 1; Cornish & Clarke, 2006, p. 20; Felson & Clarke, 1998, pp. 7-8; see also Hakim et al., 2001, pp. 134-135). In addition, offenders’ reduced detection risk may be rooted in certain organizational aspects of police jurisdiction and the poor exchange of police information (Lammers & Bernasco, 2013, p. 3; Rossmo, 2000, p. 51). Increased mobility will often result in offenders crossing multiple police jurisdiction borders. Law enforcement agencies may not notice certain crime patterns because they fail to cooperate and share important information (Egger, 1990). This raises the question to what extent do offenders influence their reduced risk of apprehension and whether they may be able to distinguish between possible targets based on risk-related information. If this is the case, offenders could be found to prefer targets with certain attributes that signal a reduced exposure to certain risks. This preference, then, could be apparent in their target selection process. Situational information that may allow an offender to anticipate possible risks could play a more important role in this decision-making process than what the rational choice perspective suggests. In other words, does risk-related information affects offenders’ target choice, in particular when more distant targets are selected and the associated travel costs increase?

Methodology

From the onset of this PhD study, the goal has been to study offender mobility within a large geographic area that allows identifying longer crime trips and, if such trips are found, including them in the analysis. This follows directly from the initial observation that earlier journey-to-crime studies predominantly studied offender mobility within a limited geographic range (cf. 0 Knowledge gaps and research questions) and attempts to answer the first guiding research question of this PhD study – i.e., which distances do offenders typically travel to offend? To this end, recorded crime data from various official sources were analyzed throughout this PhD study including data from the Public Prosecutor’s office, crime data recorded by multiple local police forces and crime data from the Belgian Federal Police. Each dataset has its unique characteristics and spans a large geographic area which allows studying offender mobility to a fuller extent. In the analysis of these datasets, a variety of statistical methods is applied ranging from basic descriptive statistics to more advanced statistical models such as the discrete spatial choice model and the closely related conditional logit model. Finally, it is also important to explain how long crime trips are defined in this PhD dissertation. In the following section, each of these points is addressed. First, each dataset and its corresponding study area are discussed. Next, the applied methods are discussed and, finally, the operationalization of ‘long’ crime trips in this PhD study is explained.
Data and study areas

Data collection approval

Prior to collecting and analyzing recorded crime data, requests for approval were filed to the appropriate authorities. These requests were granted and the necessary approvals were obtained. First, the Belgian Commission for the Protection of Privacy issued a general approval for the use of recorded crime data and address information. Second, the Prosecutor General of the Ghent jurisdiction approved the use of crime data recorded in East and West Flanders and allowed to contact the appropriate Public Prosecutor offices and local police forces responsible for recording and processing criminal events. Third, all Public Prosecutor offices in East and West Flanders allowed collecting recorded crime data in their jurisdiction. The approval of the Ghent Public Prosecutor office is particularly relevant since this allowed the collection of recorded crime data for the Greater Ghent area. Finally, 46 out of 48 local police commissioners granted their approval to collect and analyze local police recorded crime data in their jurisdiction.

Public Prosecutor data for the Greater Ghent area

The Public Prosecutor is part of the Belgian judiciary and executive power. In criminal cases, it represents the state and safeguards the public interest. Its task is to prosecute individuals who are suspected of having committed an offence. To realize this goal, the Public Prosecutor service maintains a database that contains information on cleared offences and the identified suspects linked with these particular offences. The database includes both cases that are still in a preliminary phase and have thus not (yet) resulted in a conviction, and cases that have resulted in a conviction.

At the time of the data collection (early 2012), there were 27 local Public Prosecutor services of which seven were located in East and West Flanders. Originally, the plan was to collect data from all seven Public Prosecutor services in East and West Flanders (Belgium) and combine all recorded crime data into a single, large recorded crime database. However, a lack of unique offender and offence identifiers in the Public Prosecutor databases meant that this could not be done without losing too much valuable information. Although the database was being transitioned into a single large database that contains unique offence and offender identifiers at the national level, the majority of offences and offenders were recorded before this transition started and the vast majority of offender and offence identifiers were limited to the individual local Public Prosecutor service’s jurisdiction level.

Instead, recorded crime data was collected from a single Public Prosecutor service: the Ghent office of the Public Prosecutor. All detected cases of serious property crimes

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3 Currently, there are 12 Public Prosecutor services, of which two are located in East and West Flanders respectively.
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committed during the period 2006-2010 and for which at least one suspect has been identified, were extracted from this database. Serious property crimes include robbery, shoplifting, theft in a dwelling, burglary in a dwelling, and burglary in a shop. These offence types were selected because they are so-called high frequency crimes (Costello & Wiles, 2001, p. 28; Herrman, 2013, p. 100) and allow to study a large number of offenders and their crime trips.

A total of 12,332 offender-offence combinations or crime trips were present in the full dataset. For each offence, the dataset contains an anonymous offence identifier and an anonymized offender identifier. The first identifier allows uniquely identifying a particular criminal event within the jurisdiction of the Ghent Public Prosecutor. The second identifier allows uniquely establishing whether a certain offender is involved in multiple criminal events within the study area. The full dataset also provides information on the type and date of the offence, the location of the offence with municipality-level accuracy\(^4\), the number of suspects involved, the official home for each offender with address-level accuracy, and the recording police force.

Before proceeding with the analysis, the original Public Prosecutor data were subjected to a data cleaning procedure and a number of cases were excluded from further analysis. First, the offender address information was aggregated to the corresponding level of aggregation at which the offence address information was available. This was done to make sure that for each offender-offence combination the address information was measured consistently and with similar levels of measurement error (Bernasco, 2006, p. 147; Bernasco & Elffers, 2010, p. 704). Although offender home address information was available with address-level precision, offence address information was only available with municipality-level precision and sometimes inner-city borough-level precision. All address information, including offenders’ home addresses, was therefore aggregated to the lowest level of aggregation that could be reliably established using the available offence address information. If offence address information was available with inner-city borough-level accuracy, the offender address information was also aggregated to the inner-city borough level insofar that this could be reliably extracted from the available offender address information. Otherwise offender and offence address information was aggregated to municipality-level precision. Whenever crime site address information was available with municipality-level accuracy, offender address information was also aggregated to municipality-level precision. This procedure did not result in loss of any cases. Second, a number of additional selection criteria\(^5\) were applied that resulted in the exclusion of 1,854 offender-offence combinations with invalid or missing address information. This reduced the total and final sample size of the Public Prosecutor data to 10,478 offender-offence combinations, corresponding to 7,975 offences committed by 6,574 unique offenders. The Public Prosecutor data are the primary data source that is

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\(^4\) For some offences, the location was available with inner-city borough-level accuracy.

\(^5\) The exact selection criteria are discussed in detail in the first chapter of this dissertation.
used to answer the first research question of this PhD study. This particular dataset is used in the study reported in the first chapter of this dissertation.

The jurisdiction of the Ghent Public Prosecutor’s office is limited to the greater Ghent area (see Figure 1). This area covers approximately 1,277 km² and has a population of around 600,000 inhabitants. It includes a mixture of rural towns, several medium-sized cities and the city of Ghent, one of Belgium’s most populous cities. In total, 27 municipalities fall within the jurisdiction of the Ghent Public Prosecutor’s office and 14 different local police forces operate in the area. It borders the Netherlands in the north and three important motorways run through it. These motorways intersect in and around the city of Ghent. The area contains a number of industrial areas, a medium-sized international seaport, and the second-busiest Belgian railway station.

Figure 1 Map of study areas with names of the municipalities included in the studies

Local police recorded crime data for East and West Flanders

Following the 1998 police reforms in Belgium, 196 local police forces were created in Belgium – later reduced to 194 and soon to be reduced to 193 – of which 48 operate in East and West Flanders. The local police are charged with primary policing tasks which include responding to emergency calls and maintaining law and order in their jurisdiction. As a result, the local police forces register the bulk of offences in Belgium. Among other tasks, the local police are tasked with investigating offences and identifying suspects. To realize this goal, local police forces closely collaborate with the local Public Prosecutor office. Each police force has jurisdiction in one or more municipalities. All
offences occurring within its jurisdiction are registered in initial police reports and stored in a database, the Integrated System for the Local Police (ISLP), which is unique to each local police force but shares its architecture and nomenclature with all other Belgian local police forces. This makes it possible to easily integrate information from different local police databases. The database contains a variety of information on solved and unsolved offences, and possible suspects linked with these offences.

All 48 local police forces operating in East and West Flanders were requested to participate in the PhD study and provide data on aggravated burglaries committed during the period 2006-2011. 46 local police forces allowed the extraction of all initial police reports for detected cases of aggravated burglary with at least one known offender from their databases. The requests were filed in early autumn 2012 and the data were collected during the winter of 2012-2013. Aggravated burglary is a classification used by the police and is assigned to a theft in a dwelling – which, for example, includes houses and apartments but not garden sheds or greenhouses – that is aggravated by certain circumstances, particularly if the offence involved breaking and entering, if the offender entered the dwelling through an unusual entrance (such as scaling a wall), or if the offender used forged keys to enter the dwelling. Aggravated burglary is similar to the previously mentioned burglary in a dwelling that is used by the Public Prosecutor. Once again, the focus was on a particular type of property crime since this type of offences occur frequently and open up the possibility to study a large number of offenders and their journeys to crime.

A total of 2,372 burglaries committed by 2,728 unique burglars were initially extracted from the 46 local police databases. Each local police database contains a unique offence and offender identifier. These identifiers are unique at the national level. They allow to cross reference and identify offenders across multiple local police databases. Additionally, each database provides information on the location of the offence with address-level accuracy, the date of the offence, the number of suspects involved along with their gender, age, nationality and official home address with address-level accuracy at the time of the offence. After data cleaning, 618 burglary cases and 768 unique burglars were excluded from further analysis. Offences that fell outside the adopted time window (2006-2011) or were committed outside the jurisdiction of the participating local police forces and lack of accurate official home address information were excluded.\(^6\) In the end, 2,387 offender-offence combinations or crime trips were retained, corresponding to 1,754 burglaries committed by 1,960 unique offenders. The local police recorded crime data were the primary data source used to answer the second guiding research question of this PhD study – i.e., can variation in distance to crime be explained using environmental characteristics of target areas? – and is used in the study which makes up the second chapter of this dissertation.

\(^6\) These reasons and the according selection criteria are discussed in detail in the second chapter of this dissertation.
The jurisdiction of the participating local police forces largely coincides with the Belgian provinces of East and West Flanders. Combined, both provinces cover approximately 6,151 km², have a population of around 2.6 million inhabitants and contain 129 municipalities. However, since two local police forces did not participate in the PhD study, the actual study area is limited to the 115 municipalities that fall within the jurisdiction of the participating local police forces and thus excludes 14 municipalities in the southwestern part of West Flanders (see Figure 1). The study area is heavily urbanized and densely populated. It contains 28 cities, including Ghent, and 78 rural towns. The study area borders France in the west and the Netherlands in the north. All municipalities in the study area can be reached in less than two hours due to a dense road network and the presence of five motorways in the study area. An extensive and widely used rail and public transportation network links the majority of municipalities. The study area also contains multiple large industrial areas, two medium-sized international seaports, and the second-busiest Belgian railway station.

There is one particular drawback to using local police recorded crime data that should be mentioned. Some criminal phenomena such as burglaries committed by itinerant crime groups or serial burglaries committed across multiple police jurisdictions are not systematically registered in the local police database, because it sometimes remains unknown to the recording local police force whether the burglary is cleared and an offender has been identified. These particular offences are transferred to the decentralized branches of the Federal Judicial Police, which are tasked with investigating complex criminal phenomena, and will be registered in the General Police Database (Dutch: Algemene Nationale Gegevensbank – ANG) instead of the local police database. As a result, local police recorded crime data may underestimate the total amount of offences occurring in a particular geographic area and some criminal cases are categorized as unsolved even though an offender may have been identified. Using Federal Police recorded crime data offers a solution to this particular drawback.

**Federal Police recorded crime data for East Flanders**

In addition to the creation of 196 local police forces, the 1998 police reforms envisaged a Federal Police that provides assistance to the local police forces and is responsible for certain specialized policing tasks. Part of the tasks assigned to the Belgian Federal Police include specialized judicial investigations into certain crimes that have a major disrupting impact on society and the daily lives of many citizens such as organized crime and terrorism but also property crimes. The judicial branch of the Federal Police is responsible for these tasks and consists of a number of decentralized and centralized directorates that each focus on a different criminal phenomenon. The Central Directorate of Crimes Against Goods is of particular interest for the current PhD study since it is responsible for the coordination of police investigations into property crimes, including burglary. The Federal Police are also responsible for the data management and maintenance of the General Police Database. This operational police database combines
all information on offences, offenders and criminal phenomena present in any of the police databases at the local and federal level. The local police crime databases are the primary source of offence and offender-related information, although additional offence and offender information is added to the General Police Database by the decentralized and centralized judicial branches of the Federal Police. The General Police Database is the primary source and reference database for nationwide crime statistics in Belgium (Van Daele & Vander Beken, 2011b, p. 72).

A request was filed to the Federal Police for a research internship at the Central Directorate of Crimes Against Goods. This request was granted and the internship was completed during the period August-October 2013. The result of this internship was a more thorough and practical knowledge of burglary and offender mobility in Belgium in all its facets, including the many implemented crime control policies aimed at combatting these criminal phenomena. Furthermore, the internship offered the opportunity to explore some of the information on property offences present in the General Police Database. The Directorate’s staff extracted and anonymized all aggravated burglary cases committed in East Flanders during the period 2006-2012 for which at least one offender is known. All offender and victim characteristics that could lead to the identification of those involved were removed from the data, and the offence and offender address information was removed after it was geocoded by the Federal Police.

4,308 aggravated burglaries committed by 4,089 unique burglars were initially extracted from the General Police Database. The information contained in the General Police Database is similar to the information present in the local police databases. Offence and offender identifiers make it possible to uniquely identify each offence and offender. The database also contains information on the location of the offence with address-level accuracy, the date and time window of the event, and the number of suspects involved in the offence. With regard to the offenders, the database contains information on the age and gender of the offenders, their nationality, and their official home address with address-level accuracy at the time of the offence. The data were thoroughly cleaned and subjected to a number of very strict selection criteria, after which 650 burglaries committed by an equal number of burglars remained. The crime data recorded by the Federal Police were the primary data source used to provide an answer on the third guiding research question of this PhD study – i.e., does offenders’ target selection process, in particular in the case of remote target selection and the ensuing increase in travel efforts, reflect a balancing act of costs and benefits? – and is used in the study that constitutes the third chapter of this dissertation.

The extracted crime data relate to burglaries committed in the Belgian province of East Flanders (see Figure 1). This northwestern province borders the Netherlands in the north. The province is a heavily urbanized and densely populated region that contains 12 cities, including Ghent, and 53 towns, covers approximately 3,000 km² and has a population of

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7 These criteria are discussed in detail in the third chapter of this dissertation.
around 1.5 million inhabitants. East Flanders has multiple industrial areas and a medium-sized international seaport located in the city of Ghent. The road network is dense and three motorways run through it. The 65 municipalities in the study area are also linked by an extensive public transportation system that primarily consists of bus routes and a train network.

Limitations of recorded crime data

The three recorded crime datasets used in this PhD study are impacted by a number of possible limitations, that are not necessarily unique to the current research (cf. Bruinsma, 2007, p. 485). First, clearance rates and policing practices impact the content of the datasets. In general, clearance rates are low and law enforcement agencies typically clear up about only 20 percent of all offences (Costello & Wiles, 2001, p. 33). In East and West Flanders, however, the clearance rates are lower and hover around 10% of all registered offences (Vandeviver, Van Daele & Vander Beken, 2015). Moreover, only a fraction of those cleared offences will ultimately result in a court conviction. This could introduce important selection effects in the data and might limit the conclusions and external validity of this study.

Second, in light of earlier research results indicating that mobile offenders and those travelling longer distances may more easily escape arrest (cf. Capone & Nichols, 1976; Lammers & Bernasco, 2013; McIver, 1981), recorded crime data could be biased towards local burglars and their particular offending patterns (Bruinsma, 2007, p. 485). Short crime trips might therefore be overrepresented in the data and analysis. The major yet undesirable implication of this bias is that the total amount of offender mobility may be underestimated and that figures presented and discussed throughout this PhD dissertation reflect a lower bound of the total amount of offender mobility and number of long crime trips.

Third, similar to other journey-to-crime studies, the data are necessarily limited to cleared offences and corresponding offenders with correct address information (cf. Townsley et al., 2014, p. 20). Crime trip distances can only be computed between two known address locations and the relationship between offenders’ target choice and environmental attributes can only be investigated when relevant and correct address information is available.

Fourth, the recorded crime datasets predominantly contain suspects instead of convicted offenders which might introduce additional uncertainty. Although the individuals present in the datasets are referred to as offenders throughout this PhD dissertation, strictly speaking each dataset contains individuals who have been identified by the law enforcement agencies and are suspected of having committed the offence. The individuals present in the recorded crime data have not (yet) been convicted by an independent judge for their alleged involvement in the cleared offences – and some suspects will actually never be convicted.
Notwithstanding these limitations, Wiles and Costello (2000, p. 44) triangulated offending data from various sources such as police recorded crime data, offender interviews and DNA databases and concluded that recorded crime data allow researchers to study offender mobility and identify general patterns. Furthermore, data from alternative sources such as interviews and ethnography suffer from similar biases and selection effects that limit the external validity of their conclusions (Townsley et al., 2014, p. 20). For instance, ethnographic studies and offender interviews focus on prolific offenders and offender interviews in particular might be affected by a number of cognitive biases.

Additional environmental datasets and information on burglary clearance rates

The research questions of this PhD dissertation and the nature of the analyses that are conducted to answer these questions, require that the recorded crime data are supplemented with environmental information on the offenders’ targets and the larger target areas. This supplementation makes it possible to quantify the influence of environmental characteristics on offenders’ target selection process and assess how environmental characteristics might inform the offenders’ process of cost and benefit balancing (cf. Bernasco & Luykx, 2003; Bernasco & Nieuwbeerta, 2005; Cromwell et al., 1991; Nee & Meenaghan, 2006).

First, socio-economic background characteristics of each municipality in East and West Flanders for the period 2006-2011 were manually extracted from the be.STAT module accessible on the website of Statistics Belgium (Statistics Belgium, 2013). These variables were included to capture certain features of the municipalities in the study areas. To be consistent and minimize the loss of information due to missing values in the statistical analysis, a single value was imputed for all the environmental characteristics. If the available information spans the entire time window or only part of it, then the average across all available years was used in the analysis (cf. Bernasco & Luykx, 2003, pp. 988-989). Variables available in the Statistics Belgium dataset include average property sales price, population density, presence of a highway, road network density, ethnic heterogeneity rate (i.e., percentage of non-Belgian residents in the municipality), and residential mobility rate (i.e., average of the percentage of residents moving into and out a municipality). These municipality-level variables capture a range of concepts that are believed to affect offenders’ decision to select a particular target area and may play a role in offenders’ effort to minimize the costs of committing their offence as much as possible or compensate increased costs by improved benefits. This particular dataset is used in combination with the local police recorded crime data and helps answering the second guiding research question of this study. The dataset is used in the study reported in the second chapter of this dissertation.

Second, the nature of the analysis conducted to answer the third research question required detailed information on residential houses in East Flanders. Such residential housing data was purchased from the Belgian Land Registry (Belgian Land Registry,
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2013. Strictly speaking, this Registry contains information on land plots. For a land plot corresponding with a single residential unit, the accompanying information can be extracted straightforwardly and unambiguously cross-referenced with a corresponding residential house. For an apartment, however, a single land plot is associated with multiple residential units. This introduces ambiguity when linking certain land plots with residential units since the land plot information cannot be uniquely linked with a residential unit. Therefore, the data are limited to residential houses in East Flanders and do not relate to apartment buildings. In this way, information was obtained on a total of 503,950 residential housing plots. Four plots were removed from the database because they were built with multiple residential houses and the correct residential house associated with the land plot could not be unambiguously identified. Upon inspection of the Registry data, a number of manifest coding errors were additionally identified (e.g., residential properties with 95 floors or properties that had more than a hundred garages listed). All residential housing plots for which it was considered highly likely that a coding error occurred were excluded from further analysis. In particular, information was dropped on residential houses that were listed with more than four floors in addition to the ground floor (N=33) and with more than four garages (N=324). This led to the loss of information for 357 residential properties. In the end, information on 503,589 residential properties in East Flanders remained in the dataset. The Belgian Land Registry data reflect the situation on 1 January 2013 and contain a selection of variables, including the construction type of the residential property, the number of floors in addition to the ground floor, whether there is a rooftop living floor, the number of garages, availability of a central heating and/or air conditioning system, and the built surface area. These house-level variables capture a range of concepts that are believed to affect offenders’ decision to select a particular target and may impact offenders’ anticipation that higher rewards or lower risk could offset increased travel efforts. The Registry data are used in combination with the Federal Police recorded crime data. The analysis and its outcome are reported in detail in chapter three of this dissertation.

Third, an objective measure of risk, the probability of being apprehended by the police (cf. Van Daele & Vander Beken, 2011b, p. 72), is introduced in the analysis discussed in the second chapter of this dissertation as well. The information required to compute this variable was obtained from the Belgian Federal Police and relates to all burglaries committed in East and West Flanders during the period 2009-2011. The variable is computed by dividing the number of burglaries for which at least one offender was identified by the total number of recorded burglaries in a given municipality.

Methods

Descriptive statistics

A number of descriptive statistics were initially computed to provide an answer on the first guiding research question. The descriptive statistics are briefly highlighted in each
reported study and are discussed at length in the study reported in the first chapter of this dissertation. The basic measures of dispersion and central tendency such as the mean, median, minimum and maximum and standard deviation were computed to describe the distance-to-crime distributions and identify the number of long crime trips present in the recorded crime datasets. Descriptive statistics were complemented with plots of the aggregate distance-to-crime distributions that were estimated by a kernel density procedure.

Kernel density estimation is a non-parametric technique to estimate the probability density function of a variable. It can be used to visualize the underlying distribution of random data as a continuous, smoothed line or surface and is a very suitable technique to use when visualizing crime data (Chainey & Ratcliffe, 2005; Chainey, Tompson & Uhlig, 2008, p. 8). The technique estimates a smooth, continuous line that connects all individual data points. The researcher has to specify both a kernel or a weighting function and a bandwidth or smoothing parameter. The bandwidth is the range to which the preferred weighting function will be applied. A variety of weighting functions exist, such as a block kernel and a Gaussian kernel. The former, a block kernel, applies a local average to the selected bandwidth. In other words, the average value of all data points that fall within a certain area is computed and used as the point through which the continuous line should pass. The latter, a Gaussian kernel, is one of the most common weighting functions and applies a Gaussian function to all data points that fall within the bandwidth. This technique is closely related to histograms, which have the disadvantage that the shape of the distribution is affected by the numbers and width of the bins that are used to group the individual data points (Smith et al., 2009, p. 227). Kernel density estimation is susceptible to the choice of bandwidth. This means that, on the one hand, applying a kernel to a range that is too large will result in an over-smoothed line that obscures the underlying data structure. On the other hand, selecting a bandwidth that is too small will result in an under-smoothed line that contains false data artefacts. Throughout this dissertation, a Gaussian smoothing kernel was applied and the bandwidth automatically selected using Silverman’s (1986, p. 48) rule of thumb.

Finally, an important remark should be made with regard to applying kernel density estimation to visualize the aggregate distance-to-crime distributions. A downside to applying kernel density estimation to obtain a probability density function of a censored variable, as is the case with distance to crime (where no distances smaller than zero can occur), is that ‘edge effects’ may occur (Levine, 2005, p. 9). This may introduce artifacts in the kernel density plot and could result in vertical edges being rounded or give the impression of the tails of the distribution slightly extending into non-existent values for the variable (e.g., negative values for distance or values that fall outside the considered range). Substantially, this may erroneously lead to the conclusion that offenders shy away from offending in very close proximity to their homes but prefer travelling a short distance before committing their offences. Previous journey-to-crime studies have interpreted these possible artifacts as evidence of the existence of so-called ‘buffer
zones’ around the offenders’ homes or areas where offenders are less likely to offend because of a perceived increased risk of recognition by their neighbors (e.g., Rossmo, 2000; Turner, 1969).

Figure 2 Comparison of kernel density plot and histogram of aggregate distance-to-crime distribution

An example of an artificially introduced buffer zone in a distance-to-crime distribution can be observed in Figure 2. The upper half of Figure 2 shows the kernel density plot of the aggregate distance-to-crime distribution of 1,853 crime trips shorter than 10 km that have been undertaken in East and West Flanders, while the lower half of Figure 2 shows a histogram of the aggregate distance-to-crime distribution for those same crime trips. The histogram has been plotted using 100 bins each representing increments of 100 meters in the crime trip length. Whereas a buffer zone can be observed in the upper half of Figure 2, the lower half of that same figure actually shows a substantial number of crime trips falling within the first bin that corresponds to crime trips with a length of 0 to 100 meters. In other words, interpretation of the tails of the density plot could erroneously result in concluding that very short crime trip distances do not occur and that a buffer zone around the offenders’ homes possibly exists, even though this is not supported by the raw data. The reader should be aware of this and should not conclude

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This is a subset of the local police recorded crime data used in chapter two of this dissertation.
that the density plots presented in this dissertation unambiguously support the existence of a buffer zone.

In spite of this methodological downside, kernel density estimation was nevertheless applied to plot the aggregate distance-to-crime distributions because of its particular suitability to visualize crime data and ability to make straightforward comparisons between the aggregate distance-to-crime distributions presented in the various chapters of this dissertation. Although the same kernel and size of bandwidth was used for all density plots in this dissertation, using the same number and size of bins to group individual data points in multiple histogram would prove difficult given the changes in the range of crime trip distances that are studied. Furthermore, the introduction of an artificially created buffer zone in the aggregate distance-to-crime distributions is considered to be only a minor disadvantage since this dissertation focusses on longer crime trips and does not pay particular attention to the shortest crime trips.

**Negative binomial regression analysis**

Negative binomial regression analysis was applied to model distance to crime as a function of environmental characteristics. These regression models were used in conjunction with the local police recorded crime data and the environmental data obtained from Statistics Belgium. The outcome of this analysis is discussed in the second chapter of this dissertation. It gives valuable insight how environmental characteristics explain variation in crime trip length and, consequently, contribute to answering the second guiding research question of this PhD dissertation.

Normal linear regression models, such as ordinary least squares regression, are inadequate when modelling non-negative, highly skewed distributions such as journey-to-crime distances. Instead, a number of alternative analytical strategies exist such as transforming the raw distance-to-crime variable by taking its natural logarithm or opting for a type of regression model that allows the observed over-dispersion to be modelled. Although the former solution, a logarithmic transformation, at first sight might seem appealing since it allows the adoption of the normal linear regression framework with which most researchers are familiar, it has the disadvantage that a logarithmic transformation introduces biases of its own and can feed potentially misleading interpretations (Hannon & Knapp, 2003). With regard to distance-to-crime data in which zero distances may occur, a logarithmic transformation confronts the researcher with an additional challenge because the natural logarithm of zero is undefined. Either information from the raw distance-to-crime variable will be lost or a very small number should be added to the zero-values. This could also lead to strange results (Levine, Lord & Park, 2010, p. 19).

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9 The first chapter includes crime trips of over 1,000 km in length, while the third chapter only considers journeys to crime undertaken within East Flanders with a maximum length of approximately 50 km.
A more appropriate strategy, therefore, is to opt for a regression model that explicitly allows non-negative, skewed data, such as the Poisson regression and the closely related negative binomial regression, to be modelled. These models are encompassed within the larger collection of generalized linear models and have some very desirable statistical properties with regard to modeling distance-to-crime data (Hilbe, 2011, p. 30; Levine et al., 2010, p. 24). This particular type of regression models will not predict negative values since their underlying distributions have a minimum of zero and they are intrinsically right skewed, which means they have a long tail on the right of the distribution. The Poisson regression assumes that the variance of the model equals the mean (Hilbe, 2011), but when the data are over-dispersed this will usually result in the variance being larger than the mean (Levine et al., 2010, pp. 27-28). This is the case for the distance-to-crime variable currently under consideration and is discussed in the study reported in the second chapter of this dissertation.

The negative binomial (Poisson-gamma mixture) regression does not have this assumption and allows for more flexibility in modelling the mean and variance. This mixed function model assumes that the mean follows a Poisson distribution and the variance a gamma distribution (Hilbe, 2011) – hence the name Poisson-gamma mixture. Like other generalized linear models, the negative binomial regression model is tested with a link function, in particular the natural logarithm. This makes the interpretation of the results less straightforward than within the more familiar linear regression model, which relies on the identity link. The negative binomial regression is an exponential function that models the log of the expected outcome on the predicted variable as a function of the predictor variables. For a unit change in the predictor variable, distance-to-crime increases exponentially by the respective regression coefficient, controlling for all other predictors in the model. Levine and Lee (2013) have previously discussed and demonstrated the appropriateness of the negative binomial regression to model highly skewed data in general and distance-to-crime data in particular.

Although the journey-to-crime data may be expected to exhibit a hierarchical data structure that potentially introduces dependency in the data, i.e., crime trips undertaken by the same individual are more alike than crime trips undertaken by different individuals (Smith et al., 2009; Townsley & Sidebottom, 2010), no multilevel negative binomial regression models were fitted since the design effect value suggests that nesting does not pose a serious problem and therefore does not need to be taken into account.

The design effect allows to quantify the factor by which the standard errors of an estimator under a particular design, here a multilevel design, would be biased when that design is ignored and a simple random sampling design is instead assumed (Snijders, 2005). A value larger than two suggests that the clustering needs to be taken into account.

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10 Hilbe (2011) provides an in-depth discussion of the negative binomial regression model, including mathematical formulae.
account during estimation (cf. Muthén & Satorra, 1995, p. 304). The design effect is a function of the intra-class correlation and the average cluster size.

For the final selection of local police recorded crime data that are eventually included in the analysis, the design effect equals 1.06. Since the computed value for this measure is smaller than two, this suggests that a standard design would not result in severely biased standard errors nor that nesting needs to be accounted for in the analysis (cf. Muthén & Satorra, 1995, p. 304). Moreover, the data under study violate commonly accepted rule-of-thumbs to have at least 10 to 30 observations per cluster with a minimum of 30 to 100 clusters (Bickel, 2007, pp. 272-273; Hox, 2010, p. 235). Although the local police recorded crime data contain 1960 clusters and thus exceeds the recommended minimum number of clusters, each cluster contains on average 1.22 observations and there is a substantial proportion of singletons with 85.97% of all clusters having only one observation. This may result in low power for the testing of random slope variances (Snijders, 2005) and, since generalized linear modelling is applied, also in poorly performing linearization and estimation methods and biased estimates (Hox, 2010). Although Bayesian estimation methods might offer improvements, these are not as readily available for negative binomial generalized linear multilevel models as they are for other types of multilevel models.

Discrete spatial choice modelling and the conditional logit model

The third research question of this dissertation redefines the occurrence of long crime trips as a corollary outcome of offenders’ target selection process. This research question approaches offenders’ target selection process as a choice problem where offenders, in particular burglars, select a suitable house to burglarize from a larger set of alternative residences (Bernasco & Nieuwbeerta, 2005). Burglar’s target choice is affected by many criteria such as anticipated rewards and possible risks but also by the effort it takes to cover the distance from the home to the preferred crime site. This research question thus indirectly addresses distance to crime and long crime trips and does so by scrutinizing offenders’ target choices and establishing the influence of and interaction between multiple selection criteria that affect the choice of target.

The discrete choice framework and, particularly, the discrete spatial choice approach (Bernasco & Nieuwbeerta, 2005) were used to answer the third research question of this dissertation.11 This framework allows to model a decision-maker’s choice from a finite set of mutually exclusive and collectively exhaustive alternatives (Agresti, 2002; Train, 2009). Whereas regression models are primarily concerned with establishing quantities of choices and establishing ‘how much’ of a choice is enough, discrete choice models focus on qualities of choices and examine ‘which’ choice is chosen. The discrete choice

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11 For a discussion at length of the discrete choice framework, including its mathematical formulae, consult Ben-Akiva and Lerman (1985) and Train (2009). Bernasco and Ruiter (2014) provide a detailed discussion of the discrete spatial choice approach in criminology.
framework is firmly rooted in the micro-economics theory of random utility maximization (Ben-Akiva & Lerman, 1985). This theory suggests that decision-makers are rational in their choice behavior to the extent that they evaluate the relative utility of each alternative and select the alternative that is expected to maximize their perceived utility. Under the assumption of random utility maximization, both the discrete choice approach and its spatial extension can be estimated using a conditional logit model (Bernasco & Nieuwbeerta, 2005; McFadden, 1974).

A classic example of an application of a discrete choice model is an analysis of a commuter’s choice of the mode of transportation to work. Commuters can choose from a number of possible transportation modes to travel to work such as biking, driving, or taking the train. Several factors influence the choice of transportation such as travel time and distance from home to work, monetary costs for fuel and fares, and ride comfort. These factors vary for each alternative mode of transportation and commuters seek to find an optimal balance between these factors. They select the mode of transportation that offers the greatest perceived utility. For some, this may be the car because they value comfort above all. For others, this may be the bike because this guarantees the shortest travel time. Still others may prefer the train because of the low costs and the relative comfort offered by this particular transportation mode. By comparing the chosen alternative with the unselected choices, it is possible to gain insight in the underlying motivations that shape a commuter’s choice of transportation mode. Discrete choice models make it possible to study a variety of choice behavior including the choice of travel modes, travel routes and trip destination (Ben-Akiva & Lerman, 1985), but also consumer behavior such as the choice of which car to buy (Train & Winston, 2007), a firm’s decision to invest in energy-saving measures (DeCanio & Watkins, 1998), a patient’s choice of hospital (Tay, 2003), and recreational behavior such as an angler’s choice of fishing site (Train, 1998).

The majority of applications of these discrete choice models are revealed preference models (Bernasco, 2010a), of which the underlying assumption is that an individual’s behavior reveals his preferred choice. By using information of an individual’s revealed preference and comparing this information with the alternatives that are left unchosen, it is possible to study an individual’s taste and choice behavior. For instance, when a consumer buys pizzas from a particular brand he not only reveals his preference for that brand but also, by extension, his dislike for other brands of pizza. By studying sales figures of pizza brands in a supermarket it is possible to gain insight into consumers’ preferences for particular brands of pizza and the criteria that inform their decisions to buy a given brand such as price, flavor and the pizza’s location in the shop. Similarly, burglars reveal their preference for a particular type of dwelling by burglarizing it. Burglary figures provide insight in these patterns and by comparing the burglarized house with the unchosen residences it is possible to gain insight in the underlying factors that guide an offender to burglarize a particular house such as the size of the residence, its location in the street and its distance from the offender’s home. Revealed preference
models stand in contrast to stated preference models, who directly ask individuals about their choices and preferences using questionnaires or choice experiments (Hensher & Bradley, 1993).

The discrete spatial choice approach is an extension of the general discrete choice framework. In particular, it allows to estimate the effect of environment-specific features on a decision-maker's choice (Bernasco & Nieuwbeerta, 2005) and includes a distance measure between the origin of the decision-maker and the location of the alternative (Townsley et al., 2014). With regard to burglary, this makes it possible to include variables such as area affluence, accessibility and risk as well as house-specific characteristics such as construction type, surface area, and distance between the offender’s home and the alternative. The discrete spatial choice approach has previously been applied in criminological research to study burglary location choice (Bernasco, 2006; 2010a; Bernasco & Nieuwbeerta, 2005; Clare et al., 2009; Townsley et al., 2014), robbery target selection (Bernasco, 2010a; Bernasco & Block, 2009; Bernasco, Block & Ruiter, 2012; Bernasco & Kooistra, 2010), violent offenders’ spatial behavior (Summers, 2012) and the target choices of rioters (Baudains, Braithwaite & Johnson, 2013). It is currently considered to be the customary approach to study offenders’ target selection process since it combines all theoretically important features of the target selection process in a single framework (Townsley et al., 2014): burglars, their selected targets and all houses from which they can choose.

With regard to the estimation of the discrete spatial choice models, two remarks should be made. First, the current application of the discrete spatial choice approach to study burglary target selection adopted the residence as the spatial unit of analysis, which contrast with previous applications that typically use the residential neighborhood as the spatial unit of analysis (Bernasco, 2006; 2010b; Bernasco & Nieuwbeerta, 2005; Clare et al., 2009; Townsley et al., 2014). The current approach adopted throughout this PhD dissertation is unprecedented in criminology and closely aligns the spatial resolution of the analysis with the existing theoretical and empirical understanding of burglary behavior but also significantly burdens the computational process (Bernasco & Ruiter, 2014). In this approach, conditional logit models are estimated using an iterative maximum likelihood process and require the likelihood function to be computed for each decision-maker-by-alternative combination. However, using the entire choice set of more than 500,000 residences in East Flanders would yield more than 327,332,850 decision-maker-by-alternative combinations, making it computationally infeasible for most contemporary desktops.

To counter this setback, a two-step solution was implemented. Because discrete choice models can consistently be estimated on a subset of alternatives provided that the

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12 650 unique burglars are extracted from the Federal Police recorded crime data (cf. 0 Federal Police recorded crime data for East Flanders). Each of these burglars has burglarized one house in East Flanders from a choice set of 503,589 alternative residences (cf. 0 Additional environmental datasets and information on burglary clearance rates).
chosen alternative is included and for each choice at least one alternative from the choice set is randomly sampled as well (McFadden, 1978), a sampling-of-alternatives procedure was implemented using simple random sampling. Furthermore, the resources of the Ghent University High Performance Computing infrastructure were used for the sampling-of-alternatives procedure and estimation of the discrete spatial choice models. Additional details on the sampling-of-alternative procedure and the Ghent University High Performance Computing Environment are provided in the third chapter of this dissertation.

Second, for burglars that committed multiple burglaries, one burglary case was randomly selected from the Federal Police recorded crime data and included in the final analyses. All other burglary cases for that particular burglar were disregarded, primarily to obtain a clear test of the model and also to avoid biased estimators and inaccurate standard errors. Multiple offences per offender are an example of a nested data structure. This introduces statistical dependency in the data and violates a critical assumption of many statistical techniques (Hox, 2010). If such a nested data structure is ignored, this could result in artificially small standard errors and produce spuriously significant results. In the case of discrete spatial choice models, a nested data structure is commonly accounted for by estimating robust standard errors or Huber Sandwich estimators (e.g., Bernasco, 2010b; Bernasco et al., 2012; Bernasco & Kooistra, 2010; Summers, 2012; Townsley et al., 2014). This is however not necessarily an appropriate strategy for maximum likelihood estimated non-linear models such as the conditional logit model since the assumption that the obtained estimators of a miss-specified model – which is implicitly acknowledged by computing robust standard errors – are consistent and unbiased does not hold (Freedman, 2006). Because of the risk of obtaining inconsistent and biased estimators and the fact that it is insensible to correct standard errors of inconsistent parameters, it was decided to decimate nests as much as possible.

**Operationalization of ‘long’ crime trips**

Although the primary focus of this PhD study is on long crime trips, the full spectrum of crime trip distances is nonetheless explored in the analyses to avoid that the current study is biased towards finding long crime trips and concluding that offenders are surprisingly mobile. Nevertheless, a criterion is needed to assess to what extent crime trips are short and long.

Some studies adopt a qualitative criterion to study offender mobility and the possible long crime trips that may occur. Based on the location of the offender’s home these studies typically distinguish between local and non-local offenders: the former are associated with short crime trips whereas the latter undertake long crime trips. Gabor and Gottheil (1984, p. 273), for example, identify in-towners or local offenders – the offenders residing in Ottawa and the communities directly bordering that city – and non-local mobile offenders – the offenders residing outside that area, that have no fixed address, or for whom the police have no address information. Hesseling (1992b, p. 107)
similarly distinguishes between in-towners – offenders residing inside the study area –, and out-of-towners – those residing outside the study area (see also Hesseling, 1992a, pp. 104, 111). The advantage of this criterion is that it closely corresponds to the definition of local and non-local offenders used by the Belgian law enforcement agencies. Belgian police forces only have jurisdiction in a clearly defined area and offenders committing offences inside this area but living outside it are referred to as non-local offenders and vice versa. The drawback to this criterion is that in some cases offenders and their crime trips may respectively be somewhat artificially defined as mobile and long. This is rooted in the high degree of ribbon development that is characteristic for Flanders. Cities and towns often lack clear boundaries and gradually run into each other. Because of this high degree of urban sprawl, neighbors in the same street may actually be living in different municipalities. An offender living on one end of the street but offending on the other end of that street may have crossed a municipal boundary and is strictly speaking a non-local offender, even though that particular crime trip only covers a few hundred meters. Arguably, these crime trips should not be treated as long crime trips.

Adopting a quantitative criterion may alternatively offer a solution. Using a particular cut-off length to distinguish between short and long crime trips may help avoiding the ambiguity introduced by ribbon development in Flanders when studying offender mobility and long crime trips. Earlier studies relied on relatively liberal cut-off lengths to define long crime trips or identify travelling criminals. For instance, Wiles and Costello (2000, p. 10) propose a cut-off of 2 miles (3.22 km) when distinguishing between travelling and non-travelling offenders and Smith et al. (2009, p. 233) relied on the mean trip length across all sampled offenders (3.70 km) to distinguish between offenders who made short and long crime trips. However, these relatively liberal criteria may inflate the amount of offender mobility and number of long crime trips. The current study therefore adopts a similar quantitative albeit more conservative criterion: crime trips that are 10 km and shorter are considered ‘short’, while crime trips over 10 km in length are treated as ‘long’ crime trips.

**Structure of the PhD study**

The structure of the remainder of the PhD dissertation closely follows the guiding research questions identified earlier in this introduction. The second part of this dissertation consists of two published papers and one paper submitted for review to a scientific journal. Each paper addresses one or more of the research questions that were previously formulated. Since each paper stands on its own and cannot simply build on the arguments presented in an earlier publication, there will be a degree of overlap between the papers. This will particularly be the case for some of the central arguments for this PhD study, as they are reiterated in various forms in the three articles. The third part of the dissertation integrates the conclusions of the separate papers. It focuses on the occurrence of long crime trips in general and evaluates to what extent remote target
selection and long crime trips fit within the conceptual framework offered by the rational choice perspective.

Part 2 Chapter 1 - Distance matters: A look at crime trip distances in Flanders

The first paper of the PhD study, ‘Distance Matters: A Look at Crime Trip Distances in Flanders’ (Vandeviver, 2013), outlines the theoretical and empirical arguments that warrant continued research into the journey to crime and long crime trips. Based on a thorough review of the existing journey-to-crime literature, two key weaknesses with regard to earlier journey-to-crime studies are detected: previous research predominantly studied offender mobility within a local geographic range (e.g., Barker, 2000; Hesseling, 1992a), and some studies deliberately excluded non-local offending patterns and longer crime trips from their analysis (Stangeland, 1998, p. 70). Notwithstanding these limitations, there is a growing understanding with regard to the occurrence of longer crime trips – including that increased profits may outweigh the travel efforts associated with undertaking longer crime trips (cf. Morselli & Royer, 2008; Van Koppen & Jansen, 1998) – but there remain many questions to be answered. Furthermore, an analysis of five-year public prosecutor data (N = 10,478 crime trips) from the greater Ghent area adds additional empirical weight to the claim that long crime trips deserve dedicated criminological study. A substantial number of crime trips are found in the public prosecutor data, with approximately 35% (N = 3,716) of all crime trips longer than 10 km. Variation in journey-to-crime length is found for different property offence types: the mean journey-to-crime length across all property offences is 39.41 km, but the shortest average crime trip length is for theft in a dwelling (16.40 km) and the longest average crime trip length is for shoplifting (47.54 km). The implications of the paper’s journey-to-crime length analysis for future research into offender mobility are discussed.

This paper answers the first guiding research question of the PhD study: which distances do offenders typically travel to offend? It establishes and describes the observed pattern when offender mobility is studied in a larger geographic area and when long crime trips are deliberately included in the analysis. Throughout the paper, particular attention is paid to the theoretical and empirical arguments that warrant continued research into the journey to crime and long crime trips, the patterns that are observed when studying offender mobility in a larger geographic area, and the amount of long crime trips present in the data. The paper was published as:

Part 2 Chapter 2 – What makes long crime trips worth undertaking? Balancing costs and benefits in burglars’ journey to crime

The second paper, ‘What Makes Long Crime Trips Worth Undertaking? Balancing Costs and Benefits in Burglars’ Journey to Crime’ (Vandeviver et al., 2015), studies the relation between undertaking long crime trips and the rational choice perspective. It scrutinizes the assumption that profit maximization and effort minimization govern offenders’ decisions related to offending behavior and the journey to crime (Pettiway, 1982; Van Koppen & Jansen, 1998). Although the adoption of the rational choice perspective intuitively leads to the conclusion that offenders prefer targets nearby their home area and that crime trips will be short (Rengert et al., 1999, p. 429), the rational choice perspective may also offer a framework that allows to understand why some offenders increase their travel efforts (Felson, 2006, p. 265; Morselli & Royer, 2008, p. 6; Van Koppen & Jansen, 1998, p. 231). In this particular paper, this framework is adopted and offenders’ cost-benefit balancing process is modelled. Distance is considered as one of the major costs in offenders’ target selection process and is therefore treated as the dependent variable in the analysis. Building upon the idea that offenders rely on environmental cues to assess the possible rewards, efforts and risks of their target preference (Bennett & Wright, 1984a; Bernasco & Nieuwbeerta, 2005; Nee & Taylor, 2000), a choice of general community characteristics such as the area’s average property value, the density of the road network and the clearance rate serve as independent variables. The rationale behind this is that when offenders explicitly select a particular target area, they also make an implicit decision with regard to the distance of their crime trip. If they rely on environmental attributes to help inform their target decision, these attributes may also play a role in offsetting the travel efforts of their undertaking. Local police recorded crime data on residential burglaries from two northwestern provinces in Belgium are combined into a single dataset that allows studying long crime trips. Negative binomial regression analysis is used to analyze the balancing of costs and benefits with regard to these burglary trips (N = 2,387 crime trips). Journey-to-crime distance increased when burglaries were committed in communities containing motorways, dense road networks, and being ethnically heterogeneous. Journey-to-crime distance decreased when densely populated areas and communities with high clearance rates were targeted. In line with the rational choice perspective, the results indicate that travel efforts are compensated by a decrease in other perceived efforts, such as the accessibility of the target area, and a decrease in the detection risk. Furthermore, if the apprehension risk increases, travel efforts decrease as well. In contrast with the hypotheses, however, increased criminal opportunities resulted in decreased travel efforts. Although the rational choice perspective suggests otherwise, no effects of perceived rewards were observed.

This paper addresses the second research question: can variation in distance to crime be explained using environmental characteristics of target areas? It assesses whether offenders that select remote targets balance the costs and benefits of their target choice
and how increased travel efforts are compensated. Particular attention is paid to how offenders are able to make an initial assessment of the costs and benefits of their undertaking, what the role of environmental attributes at the municipality-level is in this process, whether offenders assess possible benefits of selecting a remote crime site beforehand, and whether profit maximization and effort minimization characterize their decisions with regard to their choice of target area and coincidentally the travel efforts. This paper was published as:


Multiple authors contributed to the final version of this paper. All co-authors’ contributions were substantial and of an extent that justifies their inclusion as a co-author. Work was divided amongst the contributing authors as follows, with Christophe Vandeviver being the first author and primary contributor to the paper: Christophe Vandeviver outlined the study and manuscript, performed the literature study, collected the data, analysed the data and drafted the first and final versions of the manuscript; Stijn Van Daele and Tom Vander Beken helped to outline the study and manuscript, provided valuable comments on earlier drafts of the manuscript, and helped with the revision of the final manuscript.

**Part 2 Chapter 3 – Burglary target selection in Flanders: Lower risk compensates travel effort**

The third and final paper, ‘Burglary Target Selection in Flanders: Lower Risk Compensates Travel Effort’ (Vandeviver, Neutens, Geurts, Van Daele & Vander Beken, under review), focuses on how house-level attributes moderate the effect of distance on burglars’ target selection process. The rational choice perspective propagates the view that burglars’ decisions are characterized by profit maximization and effort minimization (Pettiway, 1982; Van Koppen & Jansen, 1998). This is reflected in the target choice of burglars. Offenders rely on a range of residence attributes to select targets by optimizing a combination of perceived rewards, efforts and risk (Bernasco et al., 2012; Cornish & Clarke, 2006). Overcoming the distance from the offender’s home to the crime site is a particularly important effort that offenders typically minimize by selecting targets nearby their home (Bernasco, 2014). However, some offenders do not minimize travel distances and select faraway targets (e.g., Gabor & Gottheil, 1984; Polisenska, 2008; Smith et al., 2009). A number of studies that scrutinized this offending behavior suggest that higher financial profits (Morselli & Royer, 2008; Van Koppen & Jansen, 1998) and a decreased detection risk (Capone & Nichols, 1976) might compensate the increased travel efforts that are incurred by selecting remote targets. However, it is unclear whether and how burglars assess anticipated increased profits and decreased risks. Accurate profit-related information is rarely available at the time an offender chooses a target and a decreased
detection risk might also be a second-order effect of selecting remote targets and crossing multiple police jurisdictions (Lammers & Bernasco, 2013, p. 3; Rossmo, 2000, p. 51). The current study first assesses burglars' general target selection process and then tests the hypothesis that higher perceived rewards, lower efforts and lower anticipated risks compensate travel distance. This study applies the discrete spatial choice framework to analyze data on 650 residential burglaries committed by 650 unique burglars during the period 2006-2012 and the approximately 500,000 residences in the province of East Flanders (Belgium). Unprecedented in discrete spatial choice studies, the residence is adopted as the spatial unit of analysis. The results indicate that in general burglars primarily rely on effort-related house attributes to distinguish between individual targets. Higher perceived rewards were found to actually decrease the odds of a residence being burglarized. Risk-related attributes are unimportant for burglars’ target choice in general. With regard to selecting remote targets, the results show that lower risk compensates travel efforts and that burglars minimize efforts, even when they are already confronted with increased travel efforts. The outcome of the analysis does not provide support for the hypothesis that higher perceived rewards compensate increased travel efforts.

The third research question is addressed in this paper: does offenders’ target selection process, in particular in the case of remote target selection and the ensuing increase in travel efforts, reflect a balancing act of costs and benefits? Throughout the paper, it is assessed whether offenders that select remote targets and undertake longer crime trips are able to assess the rewards, efforts and risks of their undertaking beforehand. In particular, this paper addresses whether offenders rely on perceived rewards, efforts and risks to select a target, and when selecting remote targets whether the effects of perceived rewards, efforts and risk differ. Attention is also paid to how house-level characteristics inform offenders’ decision to select a particular target and whether these attributes may help offenders to form a decision on whether selecting a certain target may compensate the travel efforts. This paper is submitted to a scientific journal and is currently under review:


Multiple authors contributed to this paper. Although some authors contributed to a lesser extent, their contributions were crucial and the nature of their contributions justifies their inclusion as a co-author. Work on this paper was divided as follows, with Christophe Vandeviver being the first author and primary contributor to the paper: Christophe Vandeviver outlined the study and manuscript, performed the literature study, analysed the data and drafted the manuscript; Tijs Neutens collected the data from the Belgian Land Registry, spatially linked the Registry data with the anonymised Federal Police recorded crime data, created a map of the study area, and provided assistance with drafting the manuscript; Dirk Geurts extracted the Federal Police
recorded crime data from the General Police Database, geocoded and anonymised the police recorded crime data; Stijn Van Daele and Tom Vander Beken helped to outline the study and provided valuable comments on earlier drafts of the manuscript.
Chapter 1 – Distance matters: A look at crime trip distances in Flanders

This paper was published as:


Abstract

Most journey-to-crime studies are flawed in two ways: they predominantly rely on local police data; and long trips are deliberately removed from the analysis, although a number of studies hint at the presence of substantially longer crime trips than are commonly reported. Consequently, current journey-to-crime studies limit the scope of their conclusions to local offending, and their empirical design is biased towards studying short trips. This paper demonstrates the need for dedicated criminological research into long crime trips, and provides a preliminary insight into journey-to-crime distances in the greater Ghent area, Belgium. It analyses five-year public prosecutor data on property crimes to assess the length of the journey to crime and the number of long crime trips. The study found a substantial number of long crime trips, with 35% over 10 km. The criminological implications for future journey-to-crime research are discussed.

Introduction

Theories that attempt to explain crime generally seek to address one of two questions (Eck & Weisburd, 1995) – why crime occurs, and where it occurs. Up to the late 1970s, most criminology research explored the former question (Clarke, 1980; Smith et al., 2009). However, interest in the latter question is increasing (Braga & Weisburd, 2010). Although an interest in the crime-place nexus is not new and can be traced back to the early days of contemporary criminology (e.g. Guerry, 1833; Quetelet, 1842), it was not until the advent of the Chicago School of Sociology that a concern with the environment in which crime takes place emerged (Bottoms, 2007). Interest has developed particularly since the early 1980s, within Cohen and Felson’s (1979) routine activity theory and with the development of environmental criminology (Brantingham & Brantingham, 1981a). While the advocates of the Chicago School focused on the distribution of criminals and identifying the communities where they live, environmental criminology focuses on how crimes are distributed and the environment in which crime takes place, or where offenders choose to offend (Bernasco & Block, 2009). Studying how this choice is made...
and the distances criminals travel – the mobility of offenders – is part of environmental criminology and links both strands of environmental criminological research.

This paper explores the mobility of offenders. Its primary concern is the journey an offender makes to commit an offence (the journey to crime), and in particular the distance covered on these trips. A journey to crime can be characterised by both its direction and its distance (Brantingham & Tita, 2008; Eck & Weisburd, 1995). The direction refers to where the trip is headed, and the distance usually refers to the straight-line distance between the two reference points of where they start and their destination. Both reference points require additional clarification since they are key to correctly measuring the distance. The starting point is typically assumed to be the offender’s home, and the destination is the place where the offender ultimately commits the crime; this information is obtained from recorded crime data. The length of a crime trip is therefore usually considered to be the Euclidean straight-line distance between the offender’s residence and the recorded crime site.

Throughout this paper it is argued that there is a knowledge gap in current journey-to-crime research in terms of the validity of previous findings and a potential underestimation of the length of a journey to crime. There are also a number of specific issues regarding the initial understanding of long crime trips. This knowledge gap warrants continued research into the journey to crime in general, and long crime trips in particular. In order to close this gap it is essential to broaden the scope of journey-to-crime research and rethink the dominant research design. This paper addresses this knowledge gap theoretically by reviewing the journey-to-crime literature and illustrating why long crime trips require additional dedicated study in contemporary criminology, and empirically by describing the crime trip pattern observed in a Flemish county court district.

Current debates in journey-to-crime studies

Recurrent findings

A number of previous studies have analysed the mobility of offenders and the length of the journey to crime, and several recurrent findings have emerged. First, although offenders are mobile they generally do not travel far to commit a crime (Chainey & Ratcliffe, 2005; Groff & McEwen, 2006; Mclver, 1981; Rossmo, 2000; Wiles & Costello, 2000). In other words, crime trips are usually short. White (1932, p. 507) was one of the first to examine the distance between the criminal’s home and the site of the crime. He found the journey to crime in Indianapolis was short, and he reported average distances travelled of 1.35 km for personal offences and 2.77 km for property offences. Results from a vast number of other studies broadly corroborate these early findings (Bichler et al., 2011; Capone & Nichols, 1976; Gabor & Gottheil, 1984; Laukkanen & Santtila, 2006; Lundrigan & Czarnomski, 2006; Phillips, 1980; Pyle et al., 1974; Rhodes & Conly, 1981;
Snook, 2004; Wiles & Costello, 2000), with reported average distances travelled varying between 0.64 km (Turner, 1969, pp. 13-14) and 5.20 km (Barker, 2000, p. 62).

Second, offenders rarely travel to areas they are unfamiliar with. Most crimes are committed close to the offender’s home and the number of offences declines almost exponentially as the distance from home increases (Capone & Nichols, 1975; 1976; Hesseling, 1992a; Phillips, 1980; Rengert et al., 1999; Rhodes & Conly, 1981; Rossmo, 2000). This crime trip pattern is similar to those exhibited by non-criminal forms of human movement and can be summarised using a distance-decay function (Brantingham & Brantingham, 1984; Brantingham & Brantingham, 1981b). In other words, the likelihood of a particular location being selected as a crime scene decreases the further away it is from the home of the offender. Yet this does not necessarily imply that offenders mainly prey upon their immediate neighbours: a so-called ‘buffer zone’ exists around a criminal’s home. One of the first to observe this buffer zone was Turner (1969, p. 17), who identified an area close to the offender’s home in which they are less likely to commit crimes because of the perceived increased risk of recognition by neighbours (Rengert, 2004; Rossmo, 2000). Thus, offenders appear to seek a balance between operating in a familiar area, while minimising the risk of being identified by residents in the target area (Brantingham & Brantingham, 1981b).

Design problems

In spite of these recurrent findings, further research on the journey to crime is warranted for several reasons. To begin with, two important reservations about the above findings are rooted in the dominant research design of journey-to-crime studies.

First, conclusions have been drawn principally from studies that focus on a limited geographic range and are biased towards finding predominantly local travelling patterns. Some studies (e.g. Barker, 2000; Phillips, 1980) only include local offenders in their analysis and ignore non-local offenders and the distances they travelled (Stangeland, 1998). Moreover, journey-to-crime studies predominantly use local police data13 (Bruinsma, 2007), making a study of the full spectrum of crime trips impossible. Although non-local offending can be studied to a certain extent, specific longer crime trip cannot be analysed because they are not included in local data. If local police data from a given city are used, only crime trips starting and ending within that city (local offending) and crime trips starting outside but ending inside that city (inbound offending) can be analysed, and outbound offending or crime trips that start in that city but end outside it are ignored (Wiles & Costello, 2000). This is a result of how local police departments operate, since their range of operation is limited to their assigned jurisdiction. It is also a consequence of the way offences are recorded in local police databases – offences that are committed outside the local jurisdiction are not entered in the police database of the city where the offender started his journey; instead, they are registered in the police database.13

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13 For a notable exception, see Smith et al. (2009) and Wiles & Costello (2000).
database of the city where the offence was committed. This argument can best be demonstrated with a simple example. Suppose that a burglar living in the city of Ghent commits a burglary in the city of Antwerp. Although his home, the assumed starting point of this particular crime trip, falls within the jurisdiction of the Ghent Police Department, this burglary will not normally be investigated and recorded by the Ghent Police Department. Instead, the Antwerp Police Department will investigate the crime and enter it in their local crime database. Although the Ghent Police Department may help in identifying the suspect, the burglary and the offender’s address details will not be registered in their database. Therefore, this particular 60 km outbound crime trip could not be studied in journey-to-crime research using data only from the Ghent Police Department. It could, however, be studied in offender mobility research if crime data from the Antwerp Police Department were to be used, when it would be classed as an inbound crime trip.

It is also worth considering to what extent focusing on a limited geographic range allows us to identify non-local travelling patterns. For instance, cities typically contain many crime attractors and generators (Bernasco & Block, 2009; Brantingham & Brantingham, 1995) and have appealing opportunity structures (Pyle et al., 1974). This makes them attractive to offenders, and arguably eliminates the need for urban offenders to travel far, given the abundant opportunities that are close at hand. In contrast, motivated rural offenders may be drawn away from their locality to exploit distant opportunities (cf. Brantingham & Brantingham, 1995, p. 8), whether in an urban area or elsewhere. Myopically focusing on a limited geographic range disallows falsification of these assumptions and might erroneously lead to the conclusion that criminal travelling is predominantly local. However, broadening the scope will bring inter-local movements into the picture. When studying offender mobility and journey-to-crime distances, a more appropriate strategy is therefore to use data that allow the full spectrum of crime trips and broader geographic ranges to be studied (Hesseling, 1992a).

A second important reservation about previous findings is that results from a number of studies that use non-local data and focus on wider geographic ranges hint at the existence of a number of crime trips that are considerably longer than commonly reported (e.g. Capone & Nichols, 1976, p. 209; Gabor & Gottheil, 1984, p. 274; Lundrigan & Czarnomski, 2006, p. 224; Smith et al., 2009, p. 233; Wiles & Costello, 2000, p. 16). Although longer trips are observed, their presence is rarely acknowledged and they are rarely explicitly taken into account in the ensuing analysis (Stangeland, 1998). Long trips are often treated as outliers and intentionally excluded from the analysis in order to avoid ambiguity when interpreting results (e.g. Barker, 2000; Clare et al., 2009; Fritzon, 2001; Hesseling, 1992b; Laukkanen et al., 2008; Lundrigan & Czarnomski, 2006; Townsley & Sidebottom, 2010; Turner, 1969; Wikström, 1991a).

It is evident that a research design that excludes long crime journeys would limit the validity and generalisability of the results and potentially lead to an underestimation of the length of the journey to crime. Arguably, the scope of the design and conclusions
from these studies are therefore biased towards finding local offending and short journeys to crime, and it is impossible to confirm whether these recurrent findings apply to offenders in general, and mobile offenders in particular. There is, therefore, a clear scientific need for an alternative empirical design that does not solely rely on local crime data and that explicitly includes longer crime trips.

**Limited research on long journeys to crime**

Further study into the length of the journey to crime and long crime trips is also warranted by questions surrounding the initial understanding of long journeys to crime.

A limited number of studies have already looked into highly mobile offenders and their long journeys to crime. These studies’ findings suggest that long crime trips are more common than the findings of the bulk of previous journey-to-crime studies indicate. A considerable number of offenders are found to be highly mobile, with figures ranging from a fifth (Hesseling, 1992b, p. 98) to a third of all sampled offenders (Smith et al., 2009, p. 233), and crime trips longer than 200 km have repeatedly been observed (Polisenska, 2008, p. 56; Van Koppen & Jansen, 1998, p. 238). This behaviour seems at odds with the results of other studies and the underlying rational choice framework. This framework suggests that offender mobility in general and the journey to crime in particular are governed by profit maximisation and effort minimisation (Grubesic & Mack, 2008; Pettiway, 1982; Van Koppen & Jansen, 1998). Short crime trips are favoured, first, because travelling further takes more time and money (Brantingham & Brantingham, 1981b; Kleemans, 1996) and might entail a greater risk of getting caught (Lu, 2003, pp. 423-424; Wiles & Costello, 2000), and second, because the principle of least effort (Zipf, 1949) stipulates that individuals will make minimal effort to achieve their goal. Therefore, offenders should, ceteris paribus, select a suitable target as close as possible to their starting point and consequently crime trips should be short.

However, if the expected profits outweigh the efforts associated with travelling further, longer crime trips might be a favourable and reasonable undertaking. For instance, Morselli and Royer (2008) found that longer crime trips were associated with markedly higher criminal earnings. Mobile offenders reported earnings 23 times greater than their non-mobile counterparts (Morselli & Royer, 2008, p. 17). Although their study has some drawbacks, their conclusion seems robust. Similar results have been found for commercial robberies in the Netherlands (Van Koppen & Jansen, 1998) and serial burglars in Canada (Snook, 2004). In the same vein, Capone and Nichols (1976, pp. 210-211) found that the longest robbery trips in Miami-Dade County targeted a particular chain of stores with a specific type of retail operation, resulting in a reduced risk of being apprehended.

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14 Offenders were considered ‘mobile’ when they committed offences in more than one city (Morselli & Royer, 2008, p. 9).

15 For example, the use of ‘offending perimeters’ instead of traditional distance estimates hampers comparisons with previous journey-to-crime studies and may overestimate offender travel.
Other studies have explored the target areas of long crime trips, but their findings remain inconclusive. First, research suggested that long crime trips were directed away from areas low in criminal opportunities and towards opportunity-rich areas (Portnov & Rattner, 2003; Rattner & Portnov, 2007), which is also in line with findings from local journey-to-crime studies (Eck & Weisburd, 1995) and opportunity theory (Felson & Clarke, 1998). However, findings from a Belgian study focusing on outbound offenders challenged these conclusions and found the opposite to be true (Van Daele & Vander Beken, 2011b, p. 73) – when outbound offenders undertook longer crime trips, they did not head to areas with numerous criminal opportunities. Second, there is some debate over whether long crime trips are directed towards areas that are relatively unknown to the criminal, as certain studies suggest (e.g. Polisenska, 2008, pp. 55-56; Van Daele & Vander Beken, 2011a, pp. 131-133), or towards areas that have strong ties with the offender’s home area and therefore are more familiar (e.g. Wiles & Costello, 2000). The latter finding fits in with the established understanding of short crime trips and crime pattern theory (Brantingham & Brantingham, 2008; Brantingham & Brantingham, 1981b).

Finally, it is possible that long crime trips are a type of observational error caused by incorrectly identifying the starting points of crime trips (Bruinsma, 2007, p. 485; Lundrigan & Czarnomski, 2006, p. 225; Rossmo, 2000, p. 91; Wiles & Costello, 2000, p. 35). For practical reasons these insights might lead to crime trip lengths being incorrectly estimated. Consequently, the starting point of long crime trips deserves continued critical attention in future journey-to-crime research.

In summary, results from a limited number of studies indicate that long crime trips might be less exceptional than previously suggested by journey-to-crime studies. This preliminary insight leaves many questions outstanding – more criminological inquiry is needed to broaden our understanding and help resolve some of the current debates.

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16 This is related to the dominant use of police recorded crime data. Although such data contain information on offenders’ addresses, this is often limited to the registered, official address and excludes information on the actual starting point of the crime trip.
Data and method

The goal of this paper is to add additional empirical weight to the claim that the journey to crime and long crime trips deserve additional criminological scrutiny. The paper describes the pattern that was observed when crime data for a broader geographical area was analysed and when long trips were deliberately included in the analysis. In particular, it provides a preliminary insight into the length of the journey to crime in the greater Ghent area and estimates the number of long crime trips.

Data

This paper purposely selected for analysis crime data recorded by the Ghent public prosecutor’s office, instead of local police data. The data include all detected cases of serious property crimes by known offenders for the period 2006 to 2010 inclusive. The full dataset contains a total of 12,332 offender–offence combinations or crime trips. For each criminal event, the database provides information on the anonymised crime reference number, the anonymised offender identifier, the offence type, the date of the offence, the number of suspects involved in the offence, the recording police force, the official address of the offender at the time of the offence, and the city, or in some cases the borough within the city, where the offence was committed. To provide more insight into the detail of the recorded crime data, a mocked-up example of a long crime trip – a burglary committed by two offenders living at different legal addresses – has been provided in Table 1. The address information is of particular interest. Only the registered, legal address is listed in the data. The actual or temporary address at which the offender was residing at the time of the offence, which might be of particular interest in the case of foreign offenders, is not listed in the data.

Table 1 Mocked-up example of a long journey to commit a burglary

<table>
<thead>
<tr>
<th>Crime reference number</th>
<th>Offender identifier</th>
<th>Offence type</th>
<th>Date of offence (1)</th>
<th>Date of offence (2)</th>
<th>Number of suspects</th>
<th>Recording police force</th>
<th>Official address (street)</th>
<th>Official address (city)</th>
<th>Offence location</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE14.L3 .1234-56</td>
<td>1234567</td>
<td>Burglary</td>
<td>01/01/2006</td>
<td>03/01/2006</td>
<td>2</td>
<td>Local Police Meetjesland Centrum</td>
<td>Universiteitsstraat 4</td>
<td>9000 Gent</td>
<td>9900 Eeklo</td>
</tr>
<tr>
<td>GE14.L3 .1234-56</td>
<td>7654321</td>
<td>Burglary</td>
<td>01/01/2006</td>
<td>03/01/2006</td>
<td>2</td>
<td>Local Police Meetjesland Centrum</td>
<td>Sint-Pietersnieuwstraat 25</td>
<td>9000 Gent</td>
<td>9900 Eeklo</td>
</tr>
</tbody>
</table>

The jurisdiction of the Ghent public prosecutor’s office, the study area, includes a mixture of rural towns, several medium-sized cities and one large city. It has 27

17 Robbery, shoplifting, theft in a dwelling, and burglary in a shop and a dwelling.
municipalities, including Ghent, the third\textsuperscript{16} most populous city in Belgium. Fourteen different police forces operate in the region and three significant motorways run through it, with a large intersection near Ghent. The area contains several large industrial zones, a medium-sized international seaport, and the second-busiest Belgian railway station. It covers a total area of 1,277.45 square kilometres and has a population of 615,636.\textsuperscript{19}

The use of the public prosecutor’s data enabled the study of offender mobility to be improved, and enhanced the dominant empirical design of a journey-to-crime study in two ways. First, the study area is not limited to a single city but covers a broader geographical range (cf. Hesseling, 1992a, p. 111). Second, the data cover the full spectrum of crime trips, enabling local, inbound and outbound offending to be studied.\textsuperscript{20}

Nevertheless, the current data source has three noteworthy limitations. First, in common with most journey-to-crime studies, only offences for which at least one offender has been identified are included in the analysis; distances can only be computed for crime trips that can be linked to an offender’s address. This might limit the generalisability of the results of the current paper. Some authors (e.g. Lu, 2003, pp. 423-424; Wiles & Costello, 2000) suggest that mobile offenders might have a higher risk of being caught, resulting in an overestimation of crime trip distances, while others (e.g. Bruinsma, 2007, p. 485; Eck & Weisburd, 1995, p. 16; Lammers & Bernasco, 2013; McIver, 1981, p. 43; Rhodes & Conly, 1981, p. 177) suggest that mobile offenders are less at risk of getting caught, which might result in an underestimation. However, using methodological triangulation Wiles and Costello (2000, p. 44) conclude that recorded crime data allows researchers to identify the general travelling pattern of criminals. Therefore, the use of recorded crime data does not jeopardise the goal of the current paper. Second, and more importantly, the use of the public prosecutor’s data potentially introduces a bias towards over-representing adult offenders. In turn, this could result in crime trip distances being overestimated, since juvenile offenders tend to lack the means to travel further (Bernasco & Block, 2009; Bichler et al., 2011). In Belgium, convicted juvenile offenders are diverted towards an alternative youth sanctioning system. Their offences are processed by the youth section of the public prosecutor and recorded in an alternative system.

\textsuperscript{16} Strictly speaking, Ghent is the second most populous Belgian city. However, the Brussels-Capital Region is commonly regarded as a single entity with over a million inhabitants, even though it consists of 19 separate municipalities.

\textsuperscript{19} This figure excludes approximately 67,000 university and college students that temporarily reside in and around the city of Ghent.

\textsuperscript{20} The data contain movements within (local trips) and between municipalities (local in- and outbound trips) within the study area. There are also a number of trips that are into and out of the study area (regional in- and outbound offending). Registration and processing practices of offences at the public prosecutor’s office, however, limit the presence of regional outbound trips in the data. As a general rule, the location of the crime scene decides which of the 27 Belgian public prosecutor’s offices processes the recorded offence. However, there are exceptions – for example, trips committed outside the study area but detected by a police force operating inside the study area will be processed by the Ghent public prosecutor’s office. Regardless, the full spectrum of crime trips is present at the local level and can potentially be studied. Moreover, regional in- and outbound offending can also be studied to a certain, albeit unknown, degree.
database, which was not accessed for the current paper. Third, the current geographical range might still be too limited to allow for a comprehensive understanding of long crime trips. This is especially true in light of some of the results of previous studies that reported crime trips of over 100 km (e.g. Lundrigan & Czarnomski, 2006, p. 224; Polisenska, 2008; Townsley & Sidebottom, 2010, p. 905). Nationwide data, if available, is therefore preferred. However, failure to obtain approval for the use of nationwide recorded crime data meant this study was not able to address that drawback.

Method

The length of the crime trip is estimated by computing the Euclidean straight-line distance between the Google Maps centroids of the city or borough in which the offender was residing at the time of the offence and the city or borough where the offence was committed. Although other distance measures (e.g. Manhattan distances, shortest travel path distances, quickest travel time) have been used in previous journey-to-crime studies, Kent et al. (2006) found the Euclidean straight-line distance to be the optimal distance measure available. Moreover, Euclidian distances are believed to be best suited to the layout of European areas (Smith et al., 2009). Whenever a crime trip starts and ends within the same city or borough, the Euclidean straight-line distance equals zero. This is commonly resolved by equating the distance of the trip to half the square root of the surface area of the city or borough (Bernasco, 2006, p. 147; Bernasco & Nieuwbeerta, 2005, p. 307; Van Daele et al., 2012, p. 293). This matches the distance between two randomly chosen points within that city or neighbourhood. When computing distances, co-offending was ignored and the distance of the crime trip was computed as if the offence was committed individually. While this approach might not be wholly correct (cf. Bernasco, 2006; Bernasco & Block, 2009), it is a pragmatic solution that overcomes the difficulty of deciding on the correct starting point of the crime trip and computing the exact crime trip distance.

In order to be able to compute the straight-line distances, the offender addresses and offence locations were automatically geocoded on the basis of the municipality or, when available, the borough. Whenever automatic geocoding failed, the addresses were manually geocoded using Google Maps. Even though the exact address-point for the offender’s legal address is available, such detailed information is not available for the offence location. It was decided to aggregate the address-point data for the offender address to the lowest level of aggregation that could be identified using the offender address information provided (either the city or borough) and estimate approximate crime trip distances (city or borough centroid distances). This approach was deemed more consistent, since both the offender address and offence location are measured with the same level of measurement error (cf. Bernasco, 2006, p. 147; Bernasco & Elffers, 2010, p. 704).

Prior to analysis, the full dataset was subject to data cleaning. First, offender–offence combinations for which no home address (8.78%; N=1,083) or an invalid home address
(3.21%; N=396) was listed were omitted from further analysis. Invalid home addresses include correctional facilities, psychiatric institutes, local courthouses and ‘postbus’ addresses (an address provided by local social services departments to allow individuals with no fixed residence to have a mailing address for official correspondence). Second, a limited number of offender–offence combinations (0.79%; N=98) had no offence location listed. These were omitted for obvious reasons. Third, for a very limited number of entries (0.09%; N=11) the home address or offence location could not be identified unambiguously, and these were also dropped. Fourth, a small number of offender–offence combinations (2.60%; N=321) actually fell outside the time window of the study and were not included in the final analysis. In total, 1,854 offender–offence combinations (15.03%) were omitted. The final sample totalled 10,478 crime trips.

Throughout this paper, the primary unit of analysis is the crime trip or the offender–offence combination. This unit of analysis has already proved to be insightful in previous studies (cf. Bernasco & Block, 2009; Hodgson & Costello, 2006; Van Daele et al., 2012). Although this paper aims to gain insight into the number of long crime trips in the greater Ghent area, the full spectrum of crime trip distances is initially explored to overcome the potential critique that the approach adopted is biased towards finding long crime trips. Following this, long crime trips are explored more thoroughly, and a clarification of what is meant by ‘long’ crime trips is therefore desirable to avoid ambiguity. Similar to Wiles and Costello (2000, p. 10), a quantitative criterion is adopted and crime trips are considered ‘long’ when they are at least 10 km in length.

Results

A total of 10,478 crime trips were undertaken between 2006 and 2010 inclusive. These trips correspond to 7,975 different criminal events and were undertaken by 6,574 unique offenders.

The majority of offences were committed by offenders operating alone (78.43%; N=6,252), while one in five (21.57%; N=1,719) were committed by two or more offenders. This is similar to what has been reported in previous research (Andresen & Felson, 2010, p. 73; Hodgson & Costello, 2006, p. 117; Wiles & Costello, 2000, p. 11). Figure 3 shows that shoplifting makes up almost half (45.64%; N=3,640). One in five (20.10%; N=1,603) is a shop burglary, and robbery makes up 12.31% (N=982). Theft and burglary in a dwelling correspond respectively to 11.26% (N=898) and 10.68% (N=852) of all offences.

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21 This information was missing for four offences.
**Figure 3** Number of offences per offence type (N=7,975)

**Table 2** Offenders by country of residence at time of offence

<table>
<thead>
<tr>
<th>Country of residence at time of offence</th>
<th>%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>Armenia</td>
<td>0.03</td>
<td>2</td>
</tr>
<tr>
<td>Austria</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>Belgium</td>
<td>96.87</td>
<td>6,368</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>0.06</td>
<td>4</td>
</tr>
<tr>
<td>Croatia</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>Estonia</td>
<td>0.03</td>
<td>2</td>
</tr>
<tr>
<td>France</td>
<td>1.14</td>
<td>75</td>
</tr>
<tr>
<td>Georgia</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>Germany</td>
<td>0.05</td>
<td>3</td>
</tr>
<tr>
<td>Hungary</td>
<td>0.03</td>
<td>2</td>
</tr>
<tr>
<td>Italy</td>
<td>0.11</td>
<td>7</td>
</tr>
<tr>
<td>Lithuania</td>
<td>0.09</td>
<td>6</td>
</tr>
<tr>
<td>Morocco</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.81</td>
<td>53</td>
</tr>
<tr>
<td>Poland</td>
<td>0.18</td>
<td>12</td>
</tr>
<tr>
<td>Romania</td>
<td>0.27</td>
<td>18</td>
</tr>
<tr>
<td>Serbia</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>Slovakia</td>
<td>0.05</td>
<td>3</td>
</tr>
<tr>
<td>Slovenia</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>Spain</td>
<td>0.09</td>
<td>6</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.02</td>
<td>1</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.06</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.00</td>
<td>6,574</td>
</tr>
</tbody>
</table>
Table 2 shows that the overwhelming majority (96.87%; N=6,368) of offenders were living in Belgium at the time of their offence. A total of 1.14% (N=75) were living in France and 0.81% (N=53) lived in the Netherlands. The remainder of the offenders mainly lived in countries within the European Union.\(^{22}\) A limited number of offenders lived in countries outside the EU.\(^{23}\)

Table 3 presents descriptive results for the pattern of crime trip lengths. For all crime trips, regardless of offence type, the lengths range from 4.68 m to 4,704.87 km. The mean length is 39.41 km, which is considerably longer than is commonly reported in journey-to-crime studies. The median distance travelled for all crime trips is 6.25 km. In combination with the mean length, this signals a positively skewed journey-to-crime distribution. Even though short trips are more common than long trips in the data, these initial results indicate that long trips are present, and they have an effect on the commonly observed mean distance of crime trips.

When crime journeys per crime type are assessed, robbery trip lengths vary between 14.70 m and 2,646.86 km, with a mean length of 31.44 km. For shoplifting, distances travelled range between 14.70 m and 4,704.87 km. The average shoplifting trip length is 47.54 km. The length of the crime journey for theft in a dwelling varies between 4.68 m and a maximum of 2,439.77 km, and averages 16.40 km. For shop burglaries, trip lengths range between 14.70 m and 2,501.44 km, with a mean trip length of 38.09 km. For burglaries in a dwelling, trip lengths vary between 14.70 m and 4,704.87 km, and average 44.98 km. For all offence types the mean trip length is markedly longer than the median trip length, indicating that the distributions are highly positively skewed and that long crime trips are present in the data.

### Table 3 Journey-to-crime distances (km)

<table>
<thead>
<tr>
<th>Offence type</th>
<th>Mean</th>
<th>Median</th>
<th>Min.</th>
<th>Max.</th>
<th>S.D.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>All offences</td>
<td>39.41</td>
<td>6.25</td>
<td>0.00(^{a})</td>
<td>4,704.87</td>
<td>206.29</td>
<td>1,0478</td>
</tr>
<tr>
<td>Robbery</td>
<td>31.44</td>
<td>4.54</td>
<td>0.01(^{b})</td>
<td>2,646.86</td>
<td>170.35</td>
<td>1,492</td>
</tr>
<tr>
<td>Shoplifting</td>
<td>47.54</td>
<td>6.25</td>
<td>0.01(^{b})</td>
<td>4,704.87</td>
<td>245.04</td>
<td>4,285</td>
</tr>
<tr>
<td>Theft dwelling</td>
<td>16.40</td>
<td>6.25</td>
<td>0.00(^{a})</td>
<td>2,439.77</td>
<td>75.79</td>
<td>1,151</td>
</tr>
<tr>
<td>Burglary shop</td>
<td>38.09</td>
<td>6.25</td>
<td>0.01(^{b})</td>
<td>2,501.44</td>
<td>176.06</td>
<td>2,366</td>
</tr>
<tr>
<td>Burglary dwelling</td>
<td>44.98</td>
<td>5.96</td>
<td>0.01(^{b})</td>
<td>2,718.10</td>
<td>233.32</td>
<td>1,184</td>
</tr>
</tbody>
</table>

\(^{a}\) actual length is 4.68 m; \(^{b}\) actual length is 14.70 m

The aggregate distance-to-crime distributions were estimated and plotted using kernel density estimation. When inspecting the top half of Figure 4 the typical distance-decay curve can be discerned, although several small peaks in offence frequency can be

\(^{22}\) Austria, Bulgaria, Czech Republic, Estonia, Germany, Hungary, Italy, Lithuania, Poland, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

\(^{23}\) Albania, Armenia, Croatia, Georgia, Morocco and Serbia.
Distinguished around the 20 km, 60 km and 75 km marker. Moreover, a buffer zone can be observed.\textsuperscript{24} The plot shows that most crime trips are short but there are a number of very long crime trips. The bottom half of Figure 4 shows clear distance decay for the aggregate distance-to-crime distributions for all five crime types.

Table 4 provides more detail on the number of long crime trips. The table shows that 64.53\% (N=6,762) of all crime trips are shorter than 10 km in length. Conversely, 35.47\% (N=3,716) of all crime trips are longer. Interestingly, 4.65\% (N=488) of all crime trips are even longer than 100 km and 87 trips (0.83\%) cover distances of 1,000 km and longer. This finding supports the initial claim that long crime trips are less exceptional than the results of previous journey-to-crime studies suggest.

Table 4 Length of crime trips

<table>
<thead>
<tr>
<th>Length of crime trip</th>
<th>%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 km</td>
<td>64.53</td>
<td>6,762</td>
</tr>
<tr>
<td>10–99.99 km</td>
<td>30.81</td>
<td>3,228</td>
</tr>
<tr>
<td>100–999.99 km</td>
<td>3.83</td>
<td>401</td>
</tr>
<tr>
<td>≥1,000 km</td>
<td>0.83</td>
<td>87</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>10,478</td>
</tr>
</tbody>
</table>

Finally, the aggregate distance-to-crime distribution of long crime trips has also been visualised using kernel density estimation. Figure 5 shows the smoothed distance-to-crime distributions for crime trips that are at least 10 km in length. The upper part of Figure 5 displays the distribution regardless of offence type, and the lower part shows the distributions for each offence type. Although less distinct, Figure 5 suggests that the distance-decay principle helps to describe the pattern of long crime trips. The number of crime trips decline steadily as the distance from the home to the crime site increases. Similar results are observed for the distance-to-crime distributions according to offence type. The most pronounced distance decay pattern can be observed for theft in a dwelling. Although the other offence types also exhibit a distance decay pattern, it is less pronounced.

\textsuperscript{24} In part, this is also a side effect of applying kernel density estimation to obtain a smoothed empirical probability density histogram for a censored variable (as is the case with distance, since no distances smaller than zero can occur).
Figure 4 Kernel density estimation for aggregate distance-to-crime distributions for all trip lengths (Gaussian smoothing kernel, bandwidth selected using Silverman’s (1986, p. 48) rule-of-thumb). The upper part shows the distribution disregarding offence type. The bottom part shows the distribution according to offence type. Note: the distance-decay plot was truncated at 250 km for legibility.
Figure 5 Kernel density estimation for aggregate distance-to-crime distributions for trips at least 10 km in length (Gaussian smoothing kernel, bandwidth selected using Silverman’s (1986, p. 48) rule-of-thumb). The upper part shows the distribution disregarding offence type. The bottom part shows the distribution according to offence type. Reference line added to show 10 km cut-off. Note: the distance-decay plot was truncated at 250 km for legibility.
CHAPTER 1

Discussion

This paper explored an existing knowledge gap in current journey-to-crime research and measured journey-to-crime distances in the greater Ghent area. It has argued that further research into the journey to crime in general and long crime trips in particular is warranted for several reasons. On the one hand, the validity of findings from previous journey-to-crime studies is questionable and long crime trips are often deliberately excluded from further analysis to prevent them from clouding interpretations. On the other hand, a limited number of studies suggest that long crime trips might be more common than the results from studies drawing on local data would suggest. Although this resulted in a preliminary understanding of long crime trips, it is partial and many questions remain to be answered.

Interestingly, analysing recorded crime data from the Ghent public prosecutor’s office established the presence of a considerable number of long crime trips – up to 35% of all crime trips were over 10 km. Although differences in conceptualisation and operationalisation hamper clear-cut comparisons between the results of the current study and those of previous journey-to-crime studies, it seems that similar proportions of long crime trips have been found in previous studies. An Israeli study reports that in Tel Aviv just under half of all property crimes were committed by offenders living at least 10 km from their selected crime site (Rattner & Portnov, 2007, p. 682). Moreover, the results point to the presence of a number of offenders who were typically travelling distances of 10 to 40 km before committing their preferred property crime; a few travelled over 100 km. In the Netherlands, Van Koppen and Janssen (1998, p. 242) found that 39.6% of their sample of commercial robbers travelled at least 6 km, and 21.7% travelled more than 20 km. Interestingly, the longest observed crime trip was 267 km (Van Koppen & Jansen, 1998, p. 238). Although exceptional, trips of a similar length have also been found in the Czech Republic (Polisenska, 2008, p. 54) and in Belgium (Van Daele et al., 2012, p. 297). Gabor and Gottheil (1984, p. 274) were particularly interested in identifying mobile offenders and their involvement in offences in Ottawa. They found that nearly a quarter of all offenders could be classified as mobile, since they were either not residing in Ottawa and communities directly bordering the city or had no fixed address. All in all, their results suggest that approximately one in four crime trips can be considered long. Looking at the mobility of property offenders in Belgium, Van Daele and Vander Beken (2009, p. 50) found that 39% of all property crimes are committed further than 10 km from the offender’s home.

Combined, these results suggest that similar proportions of long crime trips have been found in other studies using different data sources from different countries. Moreover, the results of the current study tie in with those of previous studies and point to the presence of a substantial number of long crime trips, suggesting that considerable travelling is associated with crime. By providing a preliminary insight into the length of the crime trips in the greater Ghent area, this study provides additional empirical
evidence for a burgeoning journey-to-crime research field that advocates the dedicated study of long crime trips. In light of these results, it is striking that other journey-to-crime studies have omitted long crime trips from further analysis, especially since this results in a considerable amount of variation in crime trip lengths being lost. The implication of the current research is that long crime trips cannot be viewed as an unexpected, random result found in unlinked journey-to-crime studies. Long crime trips should no longer be treated as if they are an irritating distraction, disturbing the more commonly observed crime trip patterns and making straightforward interpretations of research results more difficult. Although only small distances are covered in the majority of crime trips, longer trips do occur, much more commonly than most journey-to-crime research would suggest.

However, it remains doubtful whether some of the more extreme crime trip distances – perhaps those over 100 km but certainly those over 1,000 km – reflect the actual distances travelled, since crime trips of these lengths are not reported in other research, with the exception of Santtila, Laukkanen, Zappala and Bosco (2008, p. 350). Further exploration is needed into how to assess the correct starting point of crime trips, since it is likely that offenders living abroad and those associated with extremely long journey-to-crime distances have other, temporary anchor points closer by. A particular problem for this study is the use of the offender’s legal address as the assumed starting point of the crime trip – in addition to the doubts that have already been mentioned regarding the veracity of the claim that the offender’s home address acts as the starting point of the crime trip, there are theoretical and empirical arguments that challenge its validity. At the theoretical level, there is a widely held view within criminology that much travelling associated with crime is not premeditated but rather is a corollary of opportunities that criminals come across during routine daily activities (e.g. going to work or shopping) and temporary migration (e.g. holidays) (Wiles & Costello, 2000). This would imply that these extremely long crime trip distances should be revised down, since part of the currently observed distances is likely to be a journey to family or work rather than a journey made only to commit a crime. At the empirical level, a previous case file analysis has indicated that offenders associated with such extreme journey-to-crime distances begin their crime trips from temporary residences in their preferred country (Van Daele, 2009). If it is the case that criminals do not like to travel far to commit crime, this suggests that the registered residence is not the most appropriate starting point to consider. However, these temporary residences and secondary anchor points are seldom registered by the recording police force and were not present in the data obtained for this study from the public prosecutor’s office.

This paper is only a first step towards a comprehensive study of long crime trips, and many questions remain to be answered by future research. These include the utility of prolonged criminal travelling, and the travel efforts associated with long crime trips. The first question has partly been touched upon by several authors who established that longer crime trips are associated with higher criminal profits (Morselli & Royer, 2008;
Snook, 2004; Van Koppen & Jansen, 1998) or a reduced risk of apprehension (Capone & Nichols, 1976). However, it remains unclear to what extent mobile offenders can anticipate these higher criminal earnings, since longer crime trips seem to be directed towards unknown areas (Polisenska, 2008; Van Daele & Vander Beken, 2011a) low in criminal opportunities (Van Daele & Vander Beken, 2011b). Future research could therefore address this puzzling paradox by simultaneously looking into the opportunity structure of departure and target areas, as well as the profits that are realised, at the crime trip level. A potential conclusion might be that target areas exhibit unattractive opportunity structures in an absolute sense but are appealing choices in relation to the departure area. Similarly, travelling farther and targeting seemingly unattractive areas might be compensated by increased criminal activity during a single crime trip.

However, the current study has an important limitation that could be improved in future research. The paper did not take into account the nested nature of journey-to-crime data, albeit that this does not substantially affect its conclusions. Typically, journey-to-crime data exhibits a hierarchical structure, with multiple crime trips committed by a single offender (Townesley & Sidebottom, 2010, pp. 901-903) and multiple offenders living in the same neighbourhood or city (Bichler, Orosco & Schwartz, 2012, p. 84). This nested structure introduces statistical dependency in the data and violates a critical assumption of many statistical techniques (Hox, 2010). In other words, this implies that the distances travelled by offenders from the same neighbourhood will be more alike than distances travelled by offenders from different neighbourhoods. Similarly, trips undertaken by the same offender will be more alike than trips undertaken by different offenders. If these trends are ignored, standard errors will be incorrectly estimated and results will be spuriously significant. The unit of analysis should also be clearly stated in order to avoid making the ecological fallacy, since several authors (Rengert et al., 1999; Van Koppen & De Keijser, 1997) have demonstrated that distance decay patterns observed at the aggregate level do not necessarily reflect travelling behaviour exhibited by individual offenders. Closely related to the ecological fallacy is the modifiable areal unit problem (MAUP) (Oberwittler & Wikström, 2009; Openshaw, 1984), a non-systematic bias in spatial studies whereby different aggregations give rise to different results. Although it has been demonstrated that the MAUP affects results in spatial analysis and, by extension, could affect results of journey-to-crime studies, Bernasco and Block (2009, p. 105) assert that effects in the context of crime tend to be fairly robust across different levels of aggregation. Moreover, Ratcliffe (2005, p. 105) argues that the MAUP prohibits, in particular, reliable inference. Nevertheless, one should be aware of the MAUP and its potential effects in journey-to-crime studies.

However, this paper’s aim was to provide a preliminary analysis of the length of crime trips in the greater Ghent area. The results were not discussed in terms of statistical significance, nor were any claims made regarding mobility or distance decay at the level of the individual offender. An alternative is to take into account the nested nature of the data by applying multilevel models, and mobility at the individual level can be assessed
by computing individual standardised skewness scores for prolific offenders only (cf. Smith et al., 2009; Townsley & Sidebottom, 2010; Van Daele, 2010). Regardless of this, the analytical approach taken was deemed appropriate to achieve the paper’s aims.

It should be explicitly pointed out that this paper does not assert that established knowledge on the journey to crime is incorrect. Instead, it echoes Smith et al.’s (2009, p. 234) pertinent assertion that the accepted insights on the journey to crime stem from methodologically flawed research. In order to advance our understanding of the journey to crime, these methodological problems need to be addressed and the findings replicated in an appropriate way.

This paper has established a need to continue studying the journey to crime in general and long crime trips in particular. It is evident that the dominant empirical design needs to be rethought to further the understanding of offender mobility and that many questions remain, to be addressed in future research into long crime trips. By gauging the length and number of long crime trips, this study has provided additional empirical evidence that long crime trips occur and are less exceptional than is commonly believed. When crime trips are studied at a regional level the number of long trips is substantial, and the common finding of short crime trip distances therefore needs to be adjusted.
Chapter 2 – What makes long crime trips worth undertaking?
Balancing costs and benefits in burglars’ journey to crime

This paper was published as:


**Abstract**

This study taps into rational choice theory and scrutinizes the assumption that profit maximization and effort minimization govern decisions related to burglary behaviour and the journey to crime. It treats distance as one of the major costs in the burglary target selection process and uses community characteristics to gain insight into how the anticipation of particular benefits favours the incremental costs of long crime trips. 2,387 burglary trips were extracted from police records and analysed using negative binomial regression analysis. The journey-to-crime distance was found to increase when burglaries were committed in communities containing motorways, dense road networks, and being ethnically heterogeneous. The journey-to-crime distance was found to decrease when densely populated areas and communities with high clearance rates are targeted.

**Introduction**

The choices and decisions underlying burglary behaviour and shaping the journey to crime are usually interpreted using the rational choice framework (Elffers, 2004; Lu, 2003, p. 424). This framework propagates the view that these decisions are governed by a process of profit maximization and effort minimization (Pettiway, 1982; Van Koppen & Jansen, 1998) and that burglars select targets using a spatially structured, hierarchical, sequential selection process (Bernasco & Nieuwbeerta, 2005; Brantingham & Brantingham, 1984) – burglars initially select a suitable area and then gradually narrow down their selection until they have identified the house they intend to burgle. Throughout this selection process, burglars balance the costs and benefits of their choice. Costs include aspects such as the time and effort it takes to travel to the area, and the risks associated with criminal movement. Benefits include a range of financial and psychological rewards obtained through successfully completing a burglary. General environmental characteristics play an important role throughout this selection and balancing process (Bennett & Wright, 1984b; Brantingham & Jeffery, 1981). Since burglars rely on general environmental characteristics to select target areas, we can also
expect them to rely on these environmental characteristics when making an initial assessment of costs and benefits.

The majority of journey-to-crime studies conclude that travel associated with crime is limited and mostly local in nature (McIver, 1981; Wiles & Costello, 2000). Given that a balancing of costs and benefits shapes this behaviour and that travelling greater distances typically implies higher costs, this conclusion is understandable. Interestingly, a number of journey-to-crime studies found offender travel to be more widespread and long crime trips more common than typically reported in journey-to-crime studies (e.g. Gabor & Gottheil, 1984; Morselli & Royer, 2008; Polisenska, 2008; Rattner & Portnov, 2007; Van Koppen & Jansen, 1998). These findings spawned research on long crime trips and gave rise to new research questions, such as why offenders undertake longer crime trips, and what makes the incremental costs of long crime trips worthwhile. This paper focuses particularly on elements at the environmental level that favour the incremental costs of long crime trips, and explains how longer crime trips and their increased travel costs can be reconciled with the rational choice framework underlying journey-to-crime studies.

This paper reports on the outcome of a quantitative study carried out in a large, heavily urbanized geographic area that explored the costs and benefits that a burglar considers when deciding upon a burglary target. It treats distance as one of the major costs in the burglary target selection process and uses community characteristics to gain insight into how the anticipation of particular benefits favours the incremental costs of long crime trips. In particular, it applies negative binomial regression to model the cost of distance as a function of environmental characteristics at the community level. The broader goal of this paper is to further the understanding of the decision-making process underlying long crime trips and how such crime trips can be reconciled with the dominant rational choice framework.

The paper is structured as follows. First, previous journey-to-crime research is reviewed in order to identify gaps in the current knowledge of the journey to crime in general and long crime trips in particular. Second, we present our data and method, negative binomial regression analysis. This method is then applied to crime trips associated with residential burglaries recorded and cleared by local police forces in East and West Flanders, Belgium. The paper concludes with a discussion of the main results and their implications for journey-to-crime research and our understanding of long crime trips.

Rational choice and the long journey to crime

Results from quantitative and qualitative studies into burglars and burglary (e.g. Bennett & Wright, 1984a; Bernasco & Luykx, 2003; Nee & Taylor, 1988) have resulted in widespread acceptance that burglary behaviour is based on a rational decision-making process (Cornish & Clarke, 2008, pp. 40-41; Nee & Meenaghan, 2006, p. 935). While this does not mean that burglars explicitly and elaborately balance potential profits and
What Makes Long Crime Trips Worth Undertaking?

Efforts while attempting to satisfy their needs (Canter & Youngs, 2008, p. 14), it does imply that they exert some influence over the choice of location – the offence location is not selected randomly but is instead the consequence of a bounded decision-making strategy. We therefore assume that burglars’ behaviour is characterized by purpose and logic, and consequently that offender mobility and the patterns that underlie it are a worthwhile subject of study (Bernasco & Block, 2009). Burglars’ journey to crime is a corollary of this purposeful and rational behaviour.

Rational choice theory is the preferred framework for interpreting results from journey-to-crime studies (Elffers, 2004; Lu, 2003, p. 424). From within this framework, it is argued that the decisions related to burglary target selection and that shape the journey to crime are governed by effort minimization and profit maximization (Pettiway, 1982; Van Koppen & Jansen, 1998). When the ‘costs’ increase because burglars travel further, the profits are expected to increase too, effectively balancing out the increased costs. Moreover, the principle of least effort (Zipf, 1949) states that, all other things being equal, individuals will make as little effort as possible to achieve their goal. In other words, burglars aim to maximize their expected profits while keeping the anticipated efforts to a minimum by selecting easy and profitable targets close to their home. A corollary of this decision-making strategy is that crime trips tend to be short – a finding consistently observed in journey-to-crime research, regardless of the applied methodology and across different study regions (Bernasco, 2006; Costello & Wiles, 2001; Gabor & Gottheil, 1984; Pyle et al., 1974; Snook, 2004; White, 1932). However, a number of studies have examined offender mobility within a larger geographic region and found that many offenders are highly mobile and are willing to travel considerable distances before committing their offences (e.g. Gabor & Gottheil, 1984; Morselli & Royer, 2008; Rattner & Portnov, 2007; Van Koppen & Jansen, 1998; Wiles & Costello, 2000). For instance, Polisenska (2008, p. 56) interviewed incarcerated burglars from all regions of the Czech Republic who had offended in different regions and cities. The majority indicated that they did not offend close to their home. Instead, they travelled as far as possible away from their home area in order to commit a crime, with some travelling up to 150 km to burgle a house.

Travelling longer distances intuitively seems at odds with the underlying rational choice framework (Rengert et al., 1999, p. 429) since it takes more time and money, and requires more effort to become familiar with distant target areas (Brantingham & Brantingham, 1984). Carrying out burglaries closer to home would seem to be a more sensible option, because the costs tend to be lower. Surprisingly, the rational choice framework is also helpful in highlighting the usefulness of longer crime trips by pointing out that there might be good incentives to undertake them (Felson, 2006, p. 265; Morselli & Royer, 2008, p. 6; Van Koppen & Jansen, 1998, p. 231).

Incentives to travel further can take many forms. Since burglars are primarily driven by monetary gain (Bennett & Wright, 1984a; Maguire & Bennett, 1982; Rengert & Wasilchick, 1985), higher financial profits unsurprisingly appear to be one of the major
incentives. A number of studies have established a positive relationship between the distance travelled and the profits gained from a crime trip (Baldwin & Bottoms, 1976; Gabor & Gottheil, 1984; Pettaway, 1982; Snook, 2004; Van Koppen & Jansen, 1998), suggesting that travelling greater distances is more rewarding. For example, Snook (2004, pp. 61-62), relying on a quantitative design to study the behaviour of a small sample of burglars active in and around a medium-sized Canadian city, found that burglars that undertook longer crime trips obtained greater rewards than those that operated close to their home. Morselli and Royer (2008, p. 17) came to similar conclusions when they interviewed incarcerated Canadian offenders. They found that larger offending perimeters resulted in higher criminals earnings. Mobile criminals (offenders that commit offences in multiple cities) reported earnings up to 23 times greater than non-mobile criminals. Another incentive to travel to areas that are further away could be the absence of nearby profitable targets. Cities typically have an attractive opportunity structure (Pyle et al., 1974, pp. 33-36). While burglars will not necessarily burgle a great number of houses during a single crime trip (Bernasco & Nieuwbeerta, 2005, p. 299), travelling to a nearby city might allow them to select from an abundant and more varied supply of targets (e.g. Rattner & Portnov, 2007).

In addition to the presence of initial incentives to travel further, mobile offenders are expected to compensate for their increased criminal commute. Felson (2006, p. 265) argues that when offenders undertake long crime trips they are likely to stay longer at their selected crime site. Van Daele and Vander Beken (2011b, p. 74) found that committing multiple offences during a single crime trip was a compensation strategy used by burglars operating from the Belgian capital. They found that 28.7% of crime trips that started within a city but ended outside it were part of a series of offences committed within eight hours of each other, while this was only the case for 6.1% of crime trips that started and ended within the same city. Moreover, committing multiple offences over a short period of time exhibited the strongest positive effect on the likelihood of structurally undertaking crime trips that end outside the home city. Other quantitative studies suggest that using an efficient means of transport might be another compensation strategy, since it allows criminals to travel greater distances more quickly (cf. inter alia Bichler et al., 2012; Snook, 2004; Van Koppen & Jansen, 1998). For instance, using highways or travelling along major arterial roads compensates for the additional effort it takes to cover greater distances (Beavon, Brantingham & Brantingham, 1994; Rossmo, 2000, p. 190; Van Daele & Vander Beken, 2011b, p. 74). In the same vein, Snook (2004, p. 62) observed that Canadian burglars with vehicle access travelled further than those that walked or used a bicycle. In turn, burglars using a bicycle travelled further than those that walked. An additional compensation for travelling longer distances could be the attraction of areas they consider to be low risk in terms of detection. Burglars prefer to operate in areas with a reduced chance of detection and arrest (Bernasco & Luykx, 2003; Van Daele & Vander Beken, 2011a, p. 132). Capone and Nichols (1976) found that the longest robbery trips in Miami-Dade County targeted a chain of stores.
with a particular type of retail operation, resulting in a lower risk of being arrested. This preference for low-risk areas may encourage burglars to travel further (Lu, 2003, p. 424), ostensibly raising the costs associated with their offence. However, while the travel costs increase, the chance of detection actually decreases, resulting in an overall decrease in the costs associated with the offence (cf. McIver, 1981, p. 22). In other words, the lower chance of detection compensates for the increased travel costs.

Results from empirical studies suggest that offenders initially experience particular incentives to travel further, and when they do they deploy additional compensation strategies to compensate for the incremental costs of increased travelling. It would be expected that offenders would need to be familiar with a target area in order to understand the potential incentives to travel further to reach it. However, based on results from offender interviews in Belgium and the Czech Republic, it appears that long crime trips are made to previously unknown areas (Polisenska, 2008, pp. 55-56; Van Daele & Vander Beken, 2011a, pp. 131-133). This raises the question of how offenders can assess incentives and their potential advantage in advance.

The process burglars use to select their target may hold the key to this conundrum. Burglars are expected to follow a spatially structured, sequential and hierarchical decision process when selecting targets (Bernasco & Nieuwbeerta, 2005; Brantingham & Brantingham, 1984). This implies that they gradually narrow down their selection of a specific target, beginning with a particular community or neighbourhood they prefer to operate in and gradually increasing their focus until they have selected the particular house to burgle. In other words, before selecting their target, burglars will first select a particular town, then a neighbourhood, and finally a street. Results from a variety of studies that have applied different methodologies, including offender interviewing, discrete spatial choice analysis and experiments, suggest that general environmental characteristics play an important role throughout this target selection process (Bennett & Wright, 1984b; Bernasco & Nieuwbeerta, 2005; Nee, 2003; Nee & Meenaghan, 2006; Nee & Taylor, 1988; Taylor & Nee, 1988). These characteristics help burglars to select a suitable target area before relying on more detailed characteristics when narrowing down their choice to a particular house. Since burglars experience certain incentives that make them travel further and rely on compensation strategies to balance increased travelling costs, the initial moment of selecting a particular target area is likely to be when they assess costs and benefits associated with the area they have chosen. Therefore, rather than focusing on the outcome of this target selection process, i.e. the actual house that is burgled, in our analysis we focus on the initial choice of a specific target area. In particular, we hypothesize that burglars rely on general environmental characteristics to assess costs and benefits, just as they rely on these environmental characteristics to select target areas. In other words, it is expected that burglars will rely on their own general knowledge and the environmental characteristics of the target area in order to assess the potential incentives of undertaking long crime trips and whether the incremental costs of travelling further can be compensated for. If this is indeed the
case, a detailed analysis of the environmental context and journey-to-crime distances will advance our theoretical understanding of long crime trips (Lundrigan & Czarnomski, 2006).

This paper introduces two advances on previous journey-to-crime studies. First, offender mobility and the journey to crime are studied within the context of a large, heavily urbanized geographic area composed of several large cities and multiple smaller towns. This approach helps to identify a broader range of crime trip distances, which is precluded by focusing on smaller geographic areas such as a single city. Moreover, a variety of criminal travelling patterns can be explored, such as the decision to remain in cities or towns to commit offences, to travel from a city to a small town (and vice versa), or to travel from one town to another. Previous journey-to-crime studies have primarily relied on data from small geographic areas, such as a single city or small urban area, to study trip lengths and offender mobility (e.g. Hesseling, 1992b; Phillips, 1980; Rhodes & Conly, 1981; Snook, 2004; White, 1932). Such studies are therefore biased towards finding short crime trips and predominantly local travelling patterns, and omitting long crime trips. A few journey-to-crime studies have focused on larger geographic areas (e.g. Capone & Nichols, 1976; Gabor & Gottheil, 1984; Smith et al., 2009; Wiles & Costello, 2000) and found sizeable numbers of long crime trips in their crime data, but their study areas are often a single large city or metropolitan area. Focusing on a smaller geographical area prevents the identification of longer crime trips and makes it difficult to study a more diverse range of criminal travelling behaviour; therefore, the current analysis focuses on a study area that covers 6,151 square kilometres, contains 115 cities and smaller towns (including the third most populous city of Belgium) and has more than 2.5 million inhabitants.

The second innovation is the focus on how burglars balance their profits and efforts when selecting target areas, and what environmental information plays a key role in this process. It does this by focusing on a major cost in this process, the distance from the home to the crime site, as the outcome of this balancing process, and explores a selection of environmental characteristics that affect burglars’ decision to target nearby or more distant areas. A few studies have examined how offenders compensate for the incremental costs of travelling to more distant targets and found that increased mobility tends to result in higher financial rewards (inter alia Morselli & Royer, 2008; Snook, 2004; Van Koppen & Jansen, 1998). However, these studies relied on reported financial rewards that were acquired after successfully completing an offence. This information is largely uncertain before the offence is successfully completed and can therefore not be the initial driving factor behind a burglar’s decision to travel to a particular area or burgle a certain house. Instead, when considering the initial decision commit a burglary further away from home, the focus should be on those pieces of information that can be reasonably expected to be available to the burglar at the time a decision is made. Coincidentally, an implicit decision on the crime trip distance is made at this point in time as well. A larger target area is selected before the actual house is chosen. In other words,
distance to crime is primarily the result of the initial choice of a target area rather than of the house that is ultimately burgled. Burglars might have an idea of the potential profits that can be realized, but they will rarely have accurate and full information on the profits that will be made. Instead, burglars need to assess information that helps them to evaluate possible financial profits and anticipate future rewards. Environmental cues, such as whether the prospective area is wealthy or how actively the police patrol the street, can be helpful in this process and deserve further attention (Bernasco & Luykx, 2003; Bernasco & Nieuwbeerta, 2005; Nee & Meenaghan, 2006). This current study aims to identify how different environmental characteristics affect burglars’ decision to travel to a particular area. It hopes to provide insight into the underlying thought process of burglars that affects their decision to target certain areas, and as a corollary their decision to travel a greater or shorter distance to a burglary target.

Data and methods

Data sources

Various data sources are combined in the analysis. The primary source for this study is crime data recorded by 46 of the 48 local police forces operating in East and West Flanders, Belgium. East and West Flanders are two north-western provinces covering an area of 6,151 square kilometres and with a population of 2,610,798 in 2011. The study area borders France in the west and the Netherlands in the north. It has a dense road network with several important motorways, making it possible to reach all cities and towns in the area in less than two hours. There is an extensive and widely used rail and public transport network linking the majority of cities and towns. The study area is heavily urbanized with 28 cities, including Ghent, the third most populous city in Belgium, and 87 smaller towns. There are also several large industrial zones and two international seaports. On average, a municipality in the study area has a surface of 45.18 square kilometres (S.D.=27.12; Min.=10.00; Max.=156.18), with a population of 21,184 inhabitants (S.D.=27,400.95; Min.=2,076; Max.=247,486) and 10,943 residential units (S.D.=14,332.79; Min.=786; Max.=110,251).

All initial police reports for cases of aggravated burglary that have been detected and resulted in the identification of at least one offender by one of the 46 local police forces for the period 2006 to 2011 inclusive were extracted from the local police databases. The burglary clearance rates data obtained from the Belgian Federal Police suggest that the local police forces operating in the study area registered a total of 25,613 burglaries (period 2009-2011) and were able to identify at least one offender for 2,813 burglaries. This corresponds to a burglary clearance rate of 10.98% for the entire study area. On

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25 The study only focuses on the 115 municipalities of East and West Flanders that fall within the jurisdiction of any of the 46 participating local police forces.

26 In 2011 the first and second most populous areas in Belgium were the Brussels metropolitan area and the city of Antwerp.
average, 74.24 burglaries per year were recorded in each municipality in the study area (S.D.=174.11; Min.=2.67; Max.=1,805.33) and at least one offender was identified for 8.15 of these registered burglaries (S.D.=18.40; Min.=.00; Max.=185.67). This results in the average clearance rates reported in table 2. For each record, the data provides information on the recording police force, the year the burglary was committed, the address of the burgled house and the number of identified suspects together with their gender, age, nationality and individual home addresses at the time of the burglary.

Prior to analysis, the data were cleaned and a number of cases were excluded from further analysis. In order to be selected, cases had to fall within the adopted time window and be committed inside the jurisdiction of the participating local police forces. Moreover, they had to involve offenders residing in the jurisdiction of any of the participating local police forces at the time of the offence and for which the legal address was available. Finally, all addresses had to be unambiguously geocodable with address level precision. These criteria and the resulting loss of information are depicted in detail in Table 5. A total of 1,754 cleared burglary cases were examined. These cases correspond to 1,960 unique offenders that undertook 2,387 different crime trips.

The recorded crime data were supplemented with publicly available socio-economic background variables at the community level from Statistics Belgium (Statbel) and burglary clearance rates from the Belgian Federal Police. To be consistent and minimize the loss of information due to missing values in the statistical analysis, a single value was used for all the environmental characteristics that were included. When the available information spans the entire time window or only part of it, the average across all available years was computed and used in the analysis (cf. Bernasco & Luykx, 2003, pp. 988-989). When the information predated the time window, the most recently available information was used.

**Table 5 Selection of burglary cases**

<table>
<thead>
<tr>
<th>Selection criterion</th>
<th>Burglaries</th>
<th>Burglars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleared burglaries in recorded crime data</td>
<td>2,372</td>
<td>2,728</td>
</tr>
<tr>
<td>Committed in the period 2006–2011</td>
<td>2,351</td>
<td>2,706</td>
</tr>
<tr>
<td>Committed in the jurisdiction of participating local police forces</td>
<td>2,339</td>
<td>2,696</td>
</tr>
<tr>
<td>Involving offenders residing in the jurisdiction of participating local police forces</td>
<td>1,966</td>
<td>2,224</td>
</tr>
<tr>
<td>For which legal address information was available</td>
<td>1,925</td>
<td>2,178</td>
</tr>
<tr>
<td>Unambiguously geocodable with address level precision</td>
<td>1,754</td>
<td>1,960</td>
</tr>
</tbody>
</table>
Variables and appropriate hypotheses

**Journey-to-crime distance**

The dependent variable is journey-to-crime distance. It is considered a proxy for the costs associated with travelling to a burglary location. Journey-to-crime distances are estimated by computing straight-line distances in metres between the Google Maps coordinates of the official offender’s address (origin) and the offence location (destination). The primary unit of analysis is the individual crime trip.

Although more than one offender was involved in 29.10% of all the burglary cases (N=510), crime trip distances were computed for all offenders individually. Since Bernasco (2006) has shown previously that co-offenders are very similar to individual offenders in their selection of targets, we adopted this pragmatic solution to overcome the complexity of deciding on the correct starting point of the crime trip and computing the more complicated co-offending crime trip distances.

Though this paper focuses on long crime trips, the full spectrum of crime trip distances is included when modelling the regression models. Nevertheless, it is important to provide a definition of long crime trips. Similar to Wiles and Costello (2000, p. 10), long crime trips are quantitatively defined: trips that are at least 10 km in length are classified as ‘long’.

![Distribution of journey-to-crime distances](image)

**Figure 6** Kernel density estimation (see Appendix 2 for details) for aggregate distance-to-crime distribution (with a lower bound of zero)

The 2,387 burglary trips varied considerably in length, with the shortest starting and ending in the same building (min.=0.00) and the longest ending 128.02 km from the offender’s home. The distribution of burglary trips was severely positively skewed, with an average trip length of 8.17 km (S.D.=15.05) and a median trip length of 2.57 km. This results in the aggregate journey-to-crime distribution, which can be observed in Figure 6. While the majority (77.63%; N=1,853) of crime trips were clearly short, 22.37% (N=534)
were found to be longer than 10 km and could be classified as long crime trips. The current sample of burglary trips therefore contains variability in crime trip length and includes a substantial number of long crime trips.

Community characteristics

A variety of community characteristics have been included that attempt to capture incentives and compensation strategies related to the journey to crime and burglary behaviour. Previous studies established that higher monetary gains are an important incentive to increase the travel costs of a burglary, yet it is unclear whether wealthier areas are targeted or not. Therefore, we have included a measure of the wealth of target areas. We expect burglars to choose wealthier areas over poorer areas since the expected profits will be greater in affluent areas. The affluence of areas has been measured using the average sales price in EUR 10,000 for property in the area. We hypothesize that:

1. The higher the target area’s average property value, the greater the likelihood will be that burglars will, ceteris paribus, travel further to carry out a burglary in that area.

Another criterion that can influence burglars’ decisions to increase the costs of their burglary, i.e. to travel further, is the anticipated opportunity structure and number of opportunities present in the target area. We expect burglars to prefer areas with an abundant supply of opportunities to ones that have fewer suitable targets. The attractiveness of an area in terms of the number of opportunities it offers to burglars is measured using population density, in 100 residents per square kilometre in the target community. In particular, we hypothesize that:

2. The higher the population density of the target area, the greater the likelihood that burglars will, ceteris paribus, travel further to carry out a burglary in that area.

Third, the extent to which target areas are accessible is also a factor that could affect burglars’ decisions to target a certain area or not, and thereby increase the costs of their burglary (Beavon et al., 1994). Some targets are easily accessible because they are near a motorway or major arterial road, while others are less accessible because they are located in remote or hard-to-reach areas. The accessibility of areas is measured using the road network density in kilometres of road per square kilometre in the target area and a variable that considers whether a motorway or main road is present in the target area or not. Our hypotheses with respect to the accessibility of target areas are:

3. Burglars are, ceteris paribus, more likely to travel further to carry out a burglary in target areas that are crossed by a motorway or main road.
4. The higher the road network density of the target area, the greater the likelihood that burglars will, ceteris paribus, travel further to carry out a burglary in that area.

The anticipated risk of detection and chance of being arrested are also important criteria that might affect burglars’ decisions to target a particular, more distant area. Areas with an unstable and non-cohesive social structure are thought to be more attractive to burglars, since residents of such areas are believed to be less likely to recognize strangers and less willing to take appropriate measures when confronted with unwanted visitors and behaviour in their area (Bernasco, 2006; Bernasco & Luykx, 2003; Bernasco & Nieuwbeerta, 2005). Ethnic heterogeneity and residential mobility are two socioeconomic characteristics that are closely linked with a lack of social cohesion and collective efficacy in the area (Bursik & Grasmick, 1993; Sampson & Groves, 1989). An ethnically diverse neighbourhood and a high turnover of residents undermine the creation of social relationships between area residents and make it difficult for newcomers to integrate into the existing social structures of the area. The risk of detection and chance of arrest are measured using ethnic heterogeneity, operationalized as the percentage of non-Belgian residents in the target area, and residential mobility, computed by averaging the percentage of residents moving into a community and the percentage moving out (Bernasco, 2006, p. 148). In addition, we use an objective measure of risk (cf. Van Daele & Vander Beken, 2011b, p. 72): the chance of being apprehended by the police. This measure is computed by dividing the number of burglaries for which at least one known offender was identified by the police, by the total number of burglaries known to the police in the target area. In particular, we hypothesize that:

5. The higher the degree of ethnic heterogeneity in the target area, the greater the likelihood that burglars will, ceteris paribus, travel further to carry out a burglary in that area.

6. The higher the degree of residential mobility in the target area, the greater the likelihood that burglars will, ceteris paribus, travel further to carry out a burglary in that area.

7. The higher the chance of arrest in the target area, the less likely it will be that burglars will, ceteris paribus, travel further to carry out a burglary in that area.

Table 6 provides descriptive statistics and the non-linear Spearman correlation matrix for these community-level variables. This table also contains a concise overview of the time span for which these variables were available and the source of the data.27 The information in the correlation matrix signals that some community characteristics are weak to moderately correlated but no community characteristics are strongly correlated.

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27 An additional check revealed that home and target areas were very similar in terms of the community-level variables (see Table 8 in Appendix 1). Moreover, the variables did not differ markedly between city-sized and town-sized municipalities (not reported here).
suggesting that there is no substantial overlap between any of the included community characteristics. The signs for the correlation between the wealth measure in our study (average property sales price) and the security measure (clearance rate) are especially noteworthy. This sign is not as expected. One would expect a higher degree of security in wealthier municipalities, indicated by a positive sign in the correlation matrix. However, the opposite is true and a negative sign is observed: wealthier communities tend to have a lower degree of security.

Table 6 Descriptive statistics and the Spearman correlation matrix for community characteristics (N=115)

<table>
<thead>
<tr>
<th>(1) Property sales price</th>
<th>(2) Population density</th>
<th>(3) Motorway †</th>
<th>(4) Road density</th>
<th>(5) Ethnic heterogeneity</th>
<th>(6) Residential mobility</th>
<th>(7) Clearance rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td>0.18**</td>
<td>0.23*</td>
<td>-0.25**</td>
</tr>
<tr>
<td>(2) Population density</td>
<td></td>
<td>-0.30**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Motorway †</td>
<td>0.18</td>
<td>0.21*</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Road density</td>
<td>-0.23*</td>
<td>0.61**</td>
<td>0.03</td>
<td>0.13</td>
<td>0.22*</td>
<td></td>
</tr>
<tr>
<td>(5) Ethnic heterogeneity</td>
<td>-0.18</td>
<td>0.49**</td>
<td>0.13</td>
<td>0.22*</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>(6) Residential mobility</td>
<td>0.25**</td>
<td>-0.03</td>
<td>-0.04</td>
<td>0.01</td>
<td>0.15</td>
<td>1.00</td>
</tr>
<tr>
<td>(7) Clearance rate</td>
<td>-0.25**</td>
<td>0.33**</td>
<td>0.13</td>
<td>0.12</td>
<td>0.31**</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Mean                      19.62       4.73       0.46       4.52       2.12       4.90       10.85
S.D.                      5.06        3.16       --         1.46       1.53       0.74       5.78
Min.                      12.59       0.53       --         2.35       0.63       3.51       0.00
Max.                      52.78       18.4       --         9.79       9.65       7.78       33.33
Source                    Statbel     Statbel     Statbel   Statbel   Statbel   Statbel   Police

*0=no; 1=yes
*p<0.050   **p<0.010, ***p<0.001 two-sided

Control variables: offender characteristics

Offender characteristics were extracted from the recorded crime data and serve as control variables in the regression models. In our analysis, we controlled for the offender’s age at the time of the offence and their gender. In addition, we computed a variable that measures whether an offender has burglary experience by counting the number of times the same person is mentioned in the recorded crime data for different burglary cases. Moreover, we constructed a variable that measures co-offending by verifying how many different, identified offenders are linked to a single burglary case.

The 1,960 unique burglars in the recorded crime data were on average 29.58 years old (S.D.=13.00). The youngest burglar was 6 years old and the oldest was 84 at the time of his offence. A total of 83.20% of all burglars were male. The vast majority of burglars had no experience of committing burglaries: 98.20% of all burglars appeared only once in the recorded crime data. Some 47.70% of all burglars committed their offence with one or more people.
WHAT MAKES LONG CRIME TRIPS WORTH UNDERTAKING?

Method

In order to estimate the effects of the selected independent variables on journey-to-crime distance, the negative binomial (Poisson-gamma mixture) regression model is employed. The negative binomial regression model is related to the simpler Poisson regression model and allows to explicitly model non-negative, skewed data such as distance-to-crime data (the distance-to-crime distribution can be observed in figure 1). Both models have some very desirable statistical properties when modelling distance-to-crime data (Hilbe, 2011, p. 30; Levine et al., 2010, p. 24): they will not predict negative values since their underlying distributions have a minimum of zero, and they are intrinsically right skewed, i.e. they have a long tail on the right of the distribution. The Poisson regression assumes that the variance of the model equals the mean (Hilbe, 2011), but when the data are over-dispersed this will usually result in the variance being larger than the mean (Levine et al., 2010, pp. 27-28). This is the case for the distance-to-crime variable currently under consideration: the variance is 27,730 times larger than the mean (variance=226,524.16km; mean=8.17km). The negative binomial regression does not have this assumption and allows for more flexibility in modelling the mean and variance. It is a mixed function model that assumes that the mean follows a Poisson distribution and the variance a gamma distribution (Hilbe, 2011), hence the name Poisson-gamma mixture. Like other generalized linear models, the negative binomial regression model is tested with a link function, in particular the natural logarithm. This makes the interpretation of the results less straightforward than within the more familiar linear regression model, which relies on the identity link. The negative binomial regression is an exponential function that models the natural logarithm of the expected outcome on the predicted variable as a function of the predictor variables. For a unit change in the predictor variable, distance-to-crime increases exponentially by the respective regression coefficient, controlling for all other predictors in the model. Levine and Lee (2013) have previously discussed and demonstrated the appropriateness of the negative binomial regression to model highly skewed data in general and distance-to-crime data in particular.

Initially, an intercept-only model (M0) was fitted to serve as a baseline model to compare more advanced models and assess their improvement in relation to an empty model. Next, a model containing only individual characteristics (M1) was fitted, followed by a model including the community characteristics (M2).

Model fit was assessed in several ways. Since all models are nested the likelihood-ratio test can be used (cf. Hilbe, 2011, pp. 67-68). This test compares the log-likelihood of the restricted and full model and is chi-square distributed with the degrees of freedom equal to the difference in the degrees of freedom between the two compared models. In addition, both the Aikaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) were used to assess improvements in model fit (Hilbe, 2011, pp. 68-75). Lower values for both information criteria indicate superior model fit. Finally, the dispersion parameter $\alpha$ gives an indication of the amount of over-dispersion present in the data and
the extent to which a negative binomial model fits the data better than a simpler Poisson model. In the latter case, $\alpha$ would equal zero. This can formally be tested by computing the likelihood-ratio test of $\alpha = 0$. This test compares the log-likelihood of a similar Poisson model and the negative binomial model and is chi-square distributed with the degrees of freedom equal to the difference in the degrees of freedom between the two compared models.

**Results**

To answer our research question, we assessed which environmental characteristics favoured undertaking long crime trips. The results of the negative binomial regression analysis are presented in Table 7.

**Table 7 Estimates and model fit for negative binomial regression models**

<table>
<thead>
<tr>
<th></th>
<th>M0 – intercept-only</th>
<th>M1 – individual</th>
<th>M2 – individual &amp; community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (S.E.)</td>
<td>B (S.E.)</td>
<td>B (S.E.)</td>
</tr>
<tr>
<td>Constant</td>
<td>9.02*** (0.04)</td>
<td>8.82*** (0.12)</td>
<td>8.10*** (0.33)</td>
</tr>
<tr>
<td>Individual characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender: female</td>
<td>--</td>
<td>0.22* (0.11)</td>
<td>0.21 (0.11)</td>
</tr>
<tr>
<td>Age</td>
<td>--</td>
<td>0.01 (0.00)</td>
<td>0.01 (0.00)</td>
</tr>
<tr>
<td>Co-offending: yes</td>
<td>--</td>
<td>-0.04 (0.08)</td>
<td>-0.06 (0.08)</td>
</tr>
<tr>
<td>Burglary experience: yes</td>
<td></td>
<td>0.32 (0.16)</td>
<td>0.25 (0.17)</td>
</tr>
<tr>
<td>Community characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property sales price</td>
<td>--</td>
<td></td>
<td>0.01 (0.01)</td>
</tr>
<tr>
<td>Population density</td>
<td>--</td>
<td></td>
<td>-0.07*** (0.02)</td>
</tr>
<tr>
<td>Motorway: yes</td>
<td>--</td>
<td></td>
<td>0.19* (0.09)</td>
</tr>
<tr>
<td>Road density</td>
<td>--</td>
<td></td>
<td>0.09* (0.04)</td>
</tr>
<tr>
<td>Ethnic heterogeneity</td>
<td>--</td>
<td></td>
<td>0.05* (0.02)</td>
</tr>
<tr>
<td>Residential mobility</td>
<td>--</td>
<td></td>
<td>0.10 (0.05)</td>
</tr>
<tr>
<td>Clearance rate</td>
<td>--</td>
<td></td>
<td>-0.02* (0.01)</td>
</tr>
<tr>
<td>N</td>
<td>2,343</td>
<td>2,343</td>
<td>2,343</td>
</tr>
<tr>
<td>df</td>
<td>2,341</td>
<td>2,337</td>
<td>2,330</td>
</tr>
<tr>
<td>Deviance</td>
<td>3,031.80</td>
<td>3,030.34</td>
<td>3,027.25</td>
</tr>
<tr>
<td>Log-likelihood</td>
<td>-21,910.83</td>
<td>-21,903.60</td>
<td>-21,888.18</td>
</tr>
<tr>
<td>AIC</td>
<td>43,825.66</td>
<td>43,819.20</td>
<td>43,802.36</td>
</tr>
<tr>
<td>BIC</td>
<td>43,837.18</td>
<td>43,853.75</td>
<td>43,877.23</td>
</tr>
<tr>
<td>Dispersion multiplier $\alpha$</td>
<td>3.23*** (0.08)</td>
<td>3.22*** (0.08)</td>
<td>3.19*** (0.08)</td>
</tr>
</tbody>
</table>

*p<0.050 **p<0.010, ***p<0.001 two-sided

The model with individual characteristics (M1) fitted the data significantly better than the intercept-only model (M0). While the outcome of the likelihood ratio test ($\text{LR} = 14.46$; $\Delta \text{df} = 4$; $p = 0.003$) and the smaller AIC-value for model M1 supported this conclusion, the increase in BIC suggested otherwise. With regard to the appropriateness of the negative binomial regression model, the $\alpha$-value of 3.22 suggested considerable over-dispersion and the results for the likelihood-ratio test for $\alpha = 0$ confirm that a negative binomial
model is appropriate (LR=37,058,548.86; Δdf=1; \( p<0.001 \)). All in all, this model is deemed acceptable. Looking at the coefficients for model M1 displayed in Table 7, we found that gender was the only factor that was significantly related to crime trip length. The effect suggests that females were more likely to undertake longer crime trips than males. No other individual characteristics were significantly associated with journey-to-crime distance.

The next model (M2) modified the previous one by combining individual and community characteristics; individual characteristics were treated as control variables only. Including community level characteristics significantly improved the model fit (LR=30.84; Δdf=7; \( p<0.000 \)). Moreover, the AIC exhibited a decrease in size, signalling that a combination of individual and community characteristics are better at explaining variability in crime trip length than individual characteristics alone. The BIC, however, suggested otherwise. Again, the \( \alpha \)-value of 3.19 signalled considerable over-dispersion and the results of the likelihood-ratio test for \( \alpha = 0 \) showed that a negative binomial model is an appropriate choice (LR=36,302,681.26; Δdf=1; \( p<0.001 \)). Focusing on the results for model M2 in Table 7, we find that community characteristics were more important than individual characteristics for understanding crime trip length. None of the offender characteristics were significantly associated with crime trip length. A choice of community characteristics, however, exhibited a significant association with journey-to-crime distance. In particular, the journey-to-crime distance was found to increase when burglaries were committed in communities that are crossed by a motorway or main road, that have a dense road network and that are ethnically heterogeneous. Journey-to-crime distance decreased when burglaries were committed in densely populated areas and in communities that have a high burglary clearance rate. Population density exhibited the strongest relationship with journey-to-crime distance, as indicated by the Wald chi-square value (Wald chi-square=17.671). Although expected to be associated with journey-to-crime distance, property sales price and residential mobility were not significantly related to crime trip length.

Discussion

This study set out to achieve a better understanding of long crime trips. In particular, its aim was to assess the influence of environmental characteristics on the incremental costs of long burglary trips. The rational choice framework was adopted and choices relating to burglary behaviour and the journey to crime were framed in terms of profit maximization and effort minimization. It was theorized that burglars have certain incentives to undertake long crime trips and that they deploy compensation strategies to make up for the incremental travel costs. We did not focus on actual burglary profits, since the exact amount and nature of such profits are unclear when a burglary is planned. Instead, we

\[ \text{Intercept-only Poisson regression model: log-likelihood} = -18,756,985.97 \ (df=2,342); \text{individual variables only Poisson regression model: log-likelihood} = -18,551,178.03 \ (df=2,338); \text{individual and community characteristics Poisson regression model: log-likelihood} = -18,173,228.81 \ (df=2,331). \]
focused on how burglars anticipate these profits and identify incentives to increase their travel costs or hope to compensate for these costs. Since burglars are expected to follow a spatially structured, sequential and hierarchical target selection process in which it has been proven that environmental characteristics play an important role, it was expected that they rely on general environmental characteristics to identify incentives and form compensation strategies.

Overall, crime trip length was found to be primarily a function of the environmental characteristics of the location where the burglary occurred. Individual characteristics were of little importance. Only when community attributes were not taken into account did individual characteristics come into play. Although gender was significantly associated with crime trip length, no other individual characteristics were related to journey-to-crime distance. Moreover, the effect of gender was rendered insignificant once community characteristics were introduced into the model. In particular, the results suggest that longer crime trips were associated with burglaries committed in communities that are crossed by a motorway, contain a dense road network and have a high degree of ethnic heterogeneity. Conversely, shorter crime trips were associated with carrying out burglaries in communities with a high population density and a high burglary clearance rate. In short, burglars seemed to rely primarily on environmental characteristics to assess whether travelling costs could be increased, and whether travelling further could turn out to be more profitable.

Although individual characteristics served as control variables and were not of primary interest for our study, it should be pointed out that the current study’s result do not corroborate results from earlier studies that assessed the influence of individual characteristics on the journey-to-crime distance. Briefly, the findings of our study do not provide additional support for previous research that concluded that adult burglars travel further than younger ones (Gabor & Gottheil, 1984; Nichols, 1980; Phillips, 1980; Snook, 2004), that experienced burglars undertake longer crime trips than inexperienced burglars (Rhodes & Conly, 1981; Van Daele & Vander Beken, 2011b; Van Koppen & Jansen, 1998) and that co-offending results in longer burglary trips (Levine & Lee, 2013, p. 168; Van Daele & Vander Beken, 2011b). Moreover, it challenges previous research (Gabor & Gottheil, 1984, p. 276; Nichols, 1980) by finding that female burglars travelled further than male burglars.

Next, we evaluate our hypotheses regarding environmental characteristics. First, we hypothesized that burglars prefer to operate in wealthier areas and will travel further to do so. However, the effect of property sales prices did not support this hypothesis. When controlling for individual and community characteristics, property sales prices at the community level did not increase or decrease journey-to-crime distance. This should not come as too much of a surprise, since previous studies in the Netherlands and Belgium were also unable to establish such an association (e.g. Bernasco, 2006; Bernasco & Luykx, 2003; Bernasco & Nieuwbeerta, 2005; Van Daele & Vander Beken, 2011b). Although this result demonstrates that the wealth of the target area is clearly not the primary driving
force behind longer crime trips, it does not in itself challenge the commonly held view that burglars are primarily driven by monetary gains since we purposively did not include measures of actual financial profits accrued. This finding suggests, however, that other community attributes are more important when balancing the costs and benefits of a burglary trip. A possible explanation for this result is that burglars expect to make a profit anyway, regardless of their economic appraisal of the target area. Offender interviews and experiments have previously demonstrated that, irrespective of the selected criminogenic environment, burglars scrutinize potential targets closely for signs of relative wealth, such as the size of the house and the presence of expensive items (e.g. Nee & Meenaghan, 2006; Nee & Taylor, 1988; 2000; Wright & Logie, 1988). Thus it seems that burglars do not make an initial assessment of the wealth of a target area, but instead are guided by existing environmental wealth cues relative to a particular place and time once an area has been selected (Nee & Taylor, 2000, p. 48; Rengert & Wasilchick, 1985). Although this supposition could not be validated based on this study, it is likely that adopting a discrete spatial choice approach (e.g. Bernasco & Nieuwbeerta, 2003) in which affluence measures at the community, neighbourhood and house level are included would provide evidence for its existence, or otherwise.

Second, although we expected burglars to prefer to operate in areas with a greater supply of suitable targets and to be more willing to increase the length of their crime trip to reach such areas, the effect of population density suggests otherwise. In contrast to the hypothesis, committing burglaries in densely populated areas is associated with shorter crime trips. In other words, burglars were found to be less likely to undertake longer crime trips when targeting densely populated communities. While this finding conflicts with our initial hypothesis, it is perhaps not surprising. After all, if plenty of opportunities are available close to the offender’s home, why would burglars travel further afield and increase their travel costs? It seems, therefore, that an abundance of criminal opportunities in a target area is not an incentive to undertake long crime trips, when other individual and community characteristics are controlled for.

Third, our hypotheses with regard to the accessibility of target areas have been confirmed. The effects of the presence of a motorway and road density are in line with the initially formulated hypotheses, providing support for the idea that burglars compensate for increased travel costs by targeting easily accessible communities. In particular, we found that burglars were more likely to travel further to burgle in communities crossed by a motorway. Moreover, burglars targeting areas with a dense road network were more likely to travel further as well. These results are in line with those of previous journey-to-crime studies in Belgium and Canada. These studies found that burglars reduced travel time by choosing speedier travel routes when targeting areas that were further away (Beavon et al., 1994; Van Daele & Vander Beken, 2011b). Furthermore, burglars seem to mitigate travel costs by choosing easily accessible targets (Buck, Hakim & Rengert, 1993; Hakim et al., 2001). The rationale behind this choice is
that there are more routes leading away from the target, facilitating an easy escape and reducing the chance of being apprehended.

Finally, the estimated effects for measures of the risk of detection and arrest were mixed. In line with the hypothesis, we found that burglars undertook longer crime trips when carrying out burglaries in areas with a high degree of ethnic heterogeneity, suggesting that burglars expect increased travel costs to be compensated for by targeting areas with a lower risk of detection. Moreover, the burglary clearance rate was negatively associated with the crime trip length, suggesting that a higher chance of arrest in the target area makes burglars less likely to travel further to burgle in that area. Contrary to earlier Belgian research (Van Daele & Vander Beken, 2011b, p. 75), we found that residential burglars appeared to be able to accurately assess actual chances of arrest. Thus, burglars seem to limit travel costs when costs related to detection and arrest have already been increased. In contrast to our hypothesis, however, a community’s residential mobility was not significantly related to journey-to-crime length. Similarly, Bernasco and Luykx (2003) found that burglars from The Hague in the Netherlands preferred to operate in areas with low social cohesion and little collective efficacy. It seems that burglars expect that a lack of social cohesion and collective efficacy results in a reduced risk of apprehension, and they are willing to increase their travel costs in these circumstances.

This study has several potential limitations. First, by drawing on recorded crime data the actual number of long crime trips are underestimated. While recorded crime data is the preferred data source for journey-to-crime studies (Bruinsma, 2007, p. 485), results from a recent Dutch study that used DNA traces to assess the geographical range of unidentified offenders suggest that recorded crime data might not be wholly appropriate to obtain a full understanding of the amount of mobility associated with crime (Lammers & Bernasco, 2013). The results from this study indicate that highly mobile offenders have a reduced risk of arrest and thus a smaller chance of being present in recorded crime data. Therefore, offenders are perhaps even more mobile than has so far been reported. However, the results obtained here and in similar journey-to-crime studies should not be discarded but could be interpreted as an indication of the lower bound of the total amount of highly mobile offenders present. Regardless, it should be noted that the current study’s results clearly suggest that considerable travelling is associated with burglary. Our results indicate that burglars are perhaps more mobile and crime trips are longer than has so far been reported in journey-to-crime studies. Moreover, this finding is not isolated, and ties in with the findings of other studies on the subject (e.g. Gabor & Gottheil, 1984, p. 277; Morselli & Royer, 2008; Rattner & Portnov, 2007; Van Koppen & Jansen, 1998; Wiles & Costello, 2000).

Second, while we assumed that the offender’s home acts as the starting point of the crime trip, there are doubts surrounding the validity of this claim (cf. inter alia Bruinsma, 2007, p. 485; Rossmo, 2000, p. 91). In fact, crime trips could start from a variety of locations, such as a partner’s house or a pub (Wiles & Costello, 2000). Notwithstanding
the ongoing discussion on the starting point, we have left this issue largely untouched in our study for two reasons. First, we support the assertion that the location of an offender’s home determines his use and understanding of the surrounding environment (Canter & Larkin, 1993; Sarangi & Youngs, 2006) and that offenders will have to return home at some point in time (Levine & Lee, 2013, p. 153; Rengert, 2004, p. 169). Second, the police records used in the study do not include sufficient and valid information on secondary anchor points. Although we have information on secondary addresses for a number of offenders, such information is not readily available for the majority of identified offenders. We felt that only including offenders for which such information is available would limit the scope of our analysis too much.

In spite of these limitations, the current study has demonstrated that burglars are very mobile and do not shy away from undertaking long crime trips. Most importantly, this study has shown that crime trip length is primarily a function of environmental characteristics. It provides support for the idea that burglars deploy compensation strategies, e.g. by taking faster routes or by operating in communities with a lower risk of apprehension, when travelling greater distances. While some hypotheses cannot be confirmed, the results support the rational choice framework and suggest that environmental characteristics play an important role in the underlying process of profit maximization and effort minimization. Initially, some of the individual characteristics were significantly associated with crime trip length. Upon introducing the environmental characteristics into the model, however, individual characteristics no longer exhibited a significant relationship with crime trip length, suggesting that burglars, regardless of their individual characteristics, rely on environmental features to assess the benefits and drawbacks associated with increasing or decreasing travel distance. This corroborates one of the central tenets of the rational choice framework (Cornish & Clarke, 1986a, p. 2; 2008, pp. 22, 38): although individual characteristics affect the criminal decision-making process to a certain extent, the characteristics of the crime and the current environment are the major determinants that shape criminal decisions.

Finally, there is scope for future research on two topics touched on in this study. First, the role affluence plays in burglars’ assessment of incentives to undertake longer crime trips remains unclear. Intuitively, one would expect the affluence of the target area to be a major driving force behind increasing the costs of a burglary and travelling longer distances. However, we did not establish a substantial effect of affluence on crime trip length. This could be due to our particular measure of affluence, which was the average property value in the target community. It could also genuinely be the case that burglars do not make an initial assessment of the wealth of the target area since they rely on their experience and expect to make a profit anyway. This requires a different analytical strategy that includes measures of affluence and wealth of the target at different levels of aggregation. Whatever the case, this could be explored in future research by comparing competing measures of affluence or adopting alternative analytical strategies.
that allow affluence to be modelled at different levels of spatial aggregation. This brings us to our final suggestion.

Second, future studies could repeat and expand this study by including additional measures of a host of environmental characteristics and exploring their differential impact at different levels of aggregation. In the current study we included a selection of environmental characteristics at the community level. Our choice was primarily based on theoretical reasons but was to a certain degree also influenced by the availability of data. Data on environmental characteristics measured at the community level are readily available from Statistics Belgium, which is unfortunately not the case for environmental characteristics measured at smaller spatial units of aggregations. Theoretically, our decision to include certain environmental characteristics was guided by the outcome of previous studies. A more data-driven approach could perhaps help to identify other relevant environmental characteristics. Our decision to focus on the community level is rooted in the spatially structured, sequential and hierarchical target selection process of burglars. The initial moment of selecting a particular target area can be expected to be the time when burglars evaluate costs and benefits associated with their choice of target area. However, changes in situation and environment could force burglars continuously to (re-)balance their perceived costs and benefits, making this process less static than is implied in the current study. Moreover, the spatially structured, sequential, and hierarchical burglary target selection process implies that different levels of aggregation come into play at different moments in time. In other words, burglars will balance costs and benefits at different stages and times, during which different environmental characteristics could and probably will be relevant. Nevertheless, our study focused on why offenders decided to increase the costs associated with their burglary and undertake longer crime trips. Arguably, this decision is important initially, when selecting a particular target area, but will be less significant once a burglar arrives in the chosen area and begins to search for a suitable house to burgle. At that point in time other costs, such as the chance of detection and arrest, or benefits such as actual wealth of the target, might be more important factors.
Appendix 1

Table 8 Descriptive statistics for community characteristics of burglars’ home and target areas

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home areas (N=112)</strong></td>
<td></td>
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<tr>
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<tr>
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Appendix 2

Kernel density estimation is a non-parametric technique to estimate the probability density function of a variable. It can be used to visualize the underlying distribution of random data by estimating a continuous, smoothed line or surface that connects all individual data points and is a very suitable technique to use when visualizing crime data (Chainey et al., 2008). In our paper we applied a Gaussian smoothing kernel and automatically selected a bandwidth using Silverman’s (1986, p. 48) rule of thumb.
Chapter 3 – Burglary target selection in Flanders: lower risk compensates travel effort

This paper is submitted for consideration of publication in a peer-reviewed journal and is currently under review:


Abstract

What residence attributes affect burglars’ target choice and why do some burglars target remote residences? The current study builds on rational choice theory to first investigate how burglars select a target by relying on residence attributes to optimize a combination of perceived rewards, efforts and risks, and then tests the hypothesis that higher perceived rewards, lower effort and lower anticipated risk compensate travel effort. This study uses data on 650 residential burglaries committed by 650 unique burglars during the period 2006-2012 and the approximately 500,000 residences in one Belgian province. Discrete spatial choice models are applied to model burglars’ target selection process using the residence as the spatial unit of analysis. Our results indicate that burglars rely on effort-related attributes to distinguish between targets. Higher perceived rewards decrease the odds of a residence being burglarized. Risk-related attributes are unimportant for burglars’ target choice in general. With regard to selecting remote targets, the results show that lower risk compensates travel efforts and that burglars minimize effort, even when they are already confronted with increased travel efforts. No support is found for the hypothesis that higher perceived rewards compensate increased travel efforts.

Introduction

Underlying burglary behavior are a number of choices and decisions that are usually interpreted from within the rational choice framework (Elffers, 2004; Nee & Meenaghan, 2006). This framework suggests that burglars aim to maximize the expected benefits of their actions while keeping the anticipated costs to a minimum (Van Koppen & Jansen, 1998). This is reflected in one of burglars’ most fundamental decisions: their choice of crime site. Research into burglars’ target selection process indicates that a combination of environmental cues related to reward, effort and risk affects offender’s choice of burglary target. One particularly important criterion to select a target is its distance from the offender’s home. A considerable number of studies (including Bernasco, 2006;
Costello & Wiles, 2001; Snook, 2004; White, 1932) suggest that burglars generally select nearby targets since this minimizes their travel costs and exposure to risk. However, other studies found a sizeable number of burglars who deliberately target faraway offence locations (e.g., Gabor & Gottheil, 1984; Morselli & Royer, 2008; Polisenska, 2008; Rattner & Portnov, 2007; Smith et al., 2009; Van Koppen & Jansen, 1998). This brings up the question as to why these burglars are willing to raise the travel costs associated with their target choice and what exactly makes them consider remote targets.

This paper seeks to answer two specific research questions. First, which attributes at the house-level influence burglars’ decision when selecting a target? Second, how do house-level attributes moderate the effect of distance to the burglars’ home on burglars’ target choice? In answering these questions, the present study introduces several advancements over prior work into burglars’ target selection process. First, this is the first discrete spatial choice study that models the target selection process of burglars using the residence as the spatial unit of analysis. A growing body of research has applied the discrete spatial choice approach to study where burglars offend and what makes them prefer one target area over another (Bernasco, 2006; 2010b; Bernasco & Nieuwbeerta, 2003; 2005; Clare et al., 2009; Townsley et al., 2014). Previous studies modeled this process using larger spatial units such as residential neighborhoods (Bernasco, 2006; 2010b; Bernasco & Nieuwbeerta, 2005; Clare et al., 2009; Townsley et al., 2014). These applications are not erroneous as such, since offenders are assumed to initially select a larger area such as a neighborhood before they narrow down their choice (Bernasco, 2010a, p. 117), but they fail to appreciate that burglars ultimately burglarize a house. In other words, the spatial resolution of existing applications of the approach does not align with the theoretical and empirical understanding of burglars’ target selection process. In this study, we consider over 500,000 residences in a Belgian province as alternatives from which burglars can select their burglary target.

Second, the proposed discrete spatial choice models are operationalized in a study area that is larger and more diverse than that of earlier implementations. The study area comprises the entire province of East Flanders (Belgium), a densely urbanized polycentric study area with a population of approximately 1.5 million inhabitants distributed across 12 cities and 53 towns. This study area is much larger in terms of population size, surface area and available alternatives than that of cognate burglary studies, including Bernasco and Nieuwbeerta (2005), Bernasco (2006; 2010b), and Clare et al. (2009) that have primarily relied on crime data from a single city or metropolitan area. No discrete choice studies have yet looked at a single study area that contains multiple cities and towns. Studying burglars’ target selection process within a large-scale area consisting of multiple cities and towns enables observing a larger range of distances to crime sites than when burglaries are studied within a single city or a small study area (Vandeviver, 2013). This allows gaining a better understanding of the drivers behind the selection of remote targets.
Third, the current application of the discrete spatial choice approach focuses on the importance of residence-related attributes for offenders’ choice of crime site. Previous crime location choice studies focused on the importance of environmental attributes at higher levels of spatial aggregations such as neighborhood affluence or area accessibility (e.g., Townsley et al., 2014). By modelling offender’s target choice as a combination of residence-related attributes, this study bridges the gap between previous discrete choice studies that focused on intermediary outcomes of burglars’ location choice process (e.g., Bernasco & Nieuwbeerta, 2005) and a well-established research tradition that relies on offender accounts, ethnography and experiments to understand burglars’ ultimate target choice (e.g., Nee & Taylor, 2000).

Finally, we also pay attention to a specific type of burglary behavior that has hitherto received only scant research attention, that is: burglars selecting targets further away from their residence and undertaking long crime trips. Although burglars generally do not travel far to commit their offences, a considerable number of offenders actually select more distant targets (cf. inter alia Gabor & Gottheil, 1984; Rattner & Portnov, 2007; Van Koppen & Jansen, 1998). Yet it remains unclear why burglars exhibit this behavior and how this behavior fits in with rational choice theory.

This article is structured as follows. The next section starts with a brief discussion of rational choice theory, burglary target selection and offender mobility. The methodology section discusses the discrete spatial choice framework as our preferred method of analysis. In the subsequent section, we present the study area and the data. This is followed by a section that addresses our analytical strategy and hypotheses. The main findings are presented in the results section. We conclude with a discussion of the results in light of the current knowledge base regarding burglars’ target selection process and outline avenues for future work.

Theoretical framework and previous studies

Burglars’ target selection process: balancing reward, effort and risk

Rational choice theory is the preferred framework to understand the many decisions that underlie burglary behavior (Elffers, 2004; Nee & Meenaghan, 2006), including burglars’ target selection process (Bernasco & Nieuwbeerta, 2005). From within this framework it is argued that offenders decision-making process is governed by effort minimization and profit maximization (Pettitway, 1982; Van Koppen & Jansen, 1998). Burglars’ target choice reflects this balancing of costs and benefits. When the costs of their target choice increase, for instance because the target is remotely located, the benefits are expected to increase as well, for instance because the target is lucrative, effectively offsetting the increased costs (Felson, 2006, p. 265). This does not imply that burglars actively and elaborately weigh the advantages and disadvantages of their choice nor that they are fully aware of the decision-making process that informs their choice (Bernasco & Nieuwbeerta, 2005, p. 297; Canter & Youngs, 2008, p. 14).
Consistent with this framework, previous research indicates that burglars weigh the costs and benefits associated with their decisions throughout their target selection process and that their target choice is affected by a range of target specific attributes related to reward, effort and risk. Ethnographic research and offender interviews suggest that burglars are driven by monetary gain and favor wealthier targets over poorer ones (Bennett & Wright, 1984a; Maguire & Bennett, 1982; Rengert & Wasilchick, 1985). Burglars have indicated that they select houses based on certain visible cues that signal target profitability such as the size of the house and its general upkeep (Nee & Taylor, 2000; Wright & Decker, 1994). This allows us to formulate our first hypothesis that higher perceived rewards increase the likelihood that a residence is burglarized.

Given the circumstances, offenders exert as little effort as possible to achieve their goal and in doing so are very similar to other individuals in their daily activities (Zipf, 1949). One way to minimize effort is to select nearby targets instead of remote ones. This is known as the distance-decay effect and is widely reported in journey-to-crime research (Barker, 2000; Bernasco, 2006; Pyle et al., 1974; Turner, 1969; Wiles & Costello, 2000). Another strategy reported in research is to select targets that can easily be broken into because they have multiple points of entry, preferably on the side or back of the building (Maguire & Bennett, 1982), or because the doors and window frames are weathered or made of inferior materials (Cromwell et al., 1991; Shaw & Gifford, 1994; Wright et al., 1995). We state the second hypothesis that lower perceived efforts increase the likelihood that a residence is selected for burglary.

Finally, offenders want to minimize the risk of committing their offence. Burglars have repeatedly expressed their dislike for houses that have an increased chance of detection by neighbors such as terraced houses (Bennett & Wright, 1984a; Cromwell et al., 1991) and prefer residences that offer multiple escape routes in case of detection (Maguire & Bennett, 1982). For instance, the lack of escape routes is cited by offenders as a reason to bypass apartment buildings altogether when looking for burglary targets (Bennett & Wright, 1984a, pp. 65-66). We formulate the third hypothesis that lower perceived risk increases the likelihood that a residence is burglarized.

Mobile offenders and remote targets

Although the rational choice framework suggests that criminals have incentives to minimize their travel distance (Rengert et al., 1999, p. 429) and selecting nearby targets is an important strategy to exert minimal effort (Bernasco et al., 2012; Rengert, 2004; Wiles & Costello, 2000), a substantial proportion of offenders actually select remote targets and travel greater distances to commit their offences (e.g., Gabor & Gottheil, 1984; Morselli & Royer, 2008; Polisenska, 2008; Vandeviver, 2013; Wiles & Costello, 2000). For instance, nearly half of all property crimes in Tel Aviv in the 1980s were committed by offenders living at least 10 km from their offence location (Rattner & Portnov, 2007, p. 682). Likewise, Smith et al. (2009, p. 233) found that a third of their sampled UK burglars did not look for burglary targets nearby their home at all and
approximately 20 percent of Dutch commercial robbers travelled more than 20 km before committing their offence (Van Koppen & Jansen, 1998, p. 238).

In light of the idea that burglars weigh the costs and benefits of their decisions, one would expect that committing offences further away from home offers some benefit that offsets the increased effort it takes to travel to a faraway crime site as well as the risk associated with criminal movement. Indeed, previous studies on offender mobility suggest that committing offences further away from home offers two major advantages to offenders: (1) they obtain greater financial rewards (Morselli & Royer, 2008; Van Koppen & Jansen, 1998), and (2) they have a reduced risk of getting caught and arrested (Capone & Nichols, 1976; Lammers & Bernasco, 2013). It is, however, unclear whether these are anticipated benefits or unintentional advantages of this particular target selection strategy. Studies that have examined the impact of criminal mobility on criminal earnings suggest that offences committed further from home tend to involve greater rewards (e.g., Baldwin & Bottoms, 1976; Gabor & Gottheil, 1984; Snook, 2004). Morselli and Royer (2008, p. 17) established that offenders that committed offences in multiple cities obtained greater financial rewards that were up to 23 times greater than local, non-mobile offenders. Likewise, Van Koppen and Jansen (1998, pp. 244-245) noted that, if successful, the furthest away robberies netted the greatest financial returns. The average loot of robbers that travelled more than 60 km was approximately 16 times that of robbers who committed their offences in the direct vicinity of their home.

While insightful, criminal earnings do not offer a comprehensive explanation why offenders would initially want to select a faraway target. Since burglars are primarily driven by monetary gain (Bennett & Wright, 1984a; Maguire & Bennett, 1982; Rengert & Wasilchick, 1985), they are expected to look for profitable targets regardless of how far the target is located from their home. Perhaps burglars simply stay longer at a crime site and aim to collect a larger loot when they commit their offences further away from home. For instance, Felson (2006, p. 265) argues that offenders will try to compensate increased travel costs by staying longer at the crime site and by committing multiple offences during a single crime trip (see also Van Daele & Vander Beken, 2011b). Furthermore, profit-related information is largely uncertain and often unavailable to the offender when an offence location is selected. Offenders can only evaluate to what extent the financial rewards compensate the increased costs in time, money and energy required to overcome longer distances after the crime site has been selected and the offence successfully completed. Instead, when considering the initial decision to burglarize a remote target, the focus should be on those pieces of information that can be reasonably expected to be available to the offender prior to committing the offence.

The risk of detection and chance of arrest is perhaps the sort of information that offenders could tap into when they select a crime site. Selecting remote targets might reduce the detection and arrest risk (Bruinsma, 2007; Capone & Nichols, 1976; Eck & Weisburd, 1995; Lammers & Bernasco, 2013; McIver, 1981). To assess the influence of the geographical range of offenders on their probability of arrest, Lammers and Bernasco
analyzed DNA traces and found that offenders that selected geographically dispersed targets have a reduced risk of arrest. As offenders increased their geographical range to commit crimes and selected targets in multiple regions, their chance of detection and arrest decreased. In the same vein, Capone and Nichols (1976) found that some robbers in the Miami-Dade County travelled greater distances to target a particular chain of stores that resulted in a lower risk of arrest.

However, it is unclear to what extent a decreased probability of arrest is an anticipated benefit of deliberately selecting remote targets. Previous research suggests it might be an unanticipated advantage of this particular target-selection scheme. In fact, offenders who operate in a large geographical area that encompasses multiple police jurisdictions could be benefitting from a lack of cooperation and poor information exchange between law enforcement agencies (Lammers & Bernasco, 2013, p. 3; Rossmo, 2000, p. 51; Vandeviver, 2013, pp. 231-232). Because law enforcement agencies fail to cooperate and share important information, certain crime patterns are not identified and crimes are left unsolved (Egger, 1990). Offenders could thus unintentionally be avoiding detection and arrest.

In conclusion, it remains unclear to what extent selecting remote targets is a target selection strategy that is in accordance with the rational choice framework that underpins the study of burglary behavior and target selection. This framework proposes that selecting remote targets occurs when certain benefits outweigh the increased travel costs. Previous studies offer only a partial understanding of how certain advantages may compensate increased travel efforts. In particular, it is uncertain whether these advantages can be inferred by the offender at the time he selects a crime site. This paper therefore examines why burglars exhibit this behavior and what environmental factors affect their decision to target a remote house. It tests whether the effects of perceived rewards, efforts and anticipated risks differ for burglars that select targets nearby and farther away from their home. In other words, we investigate whether burglars compensate travel costs by targeting remote residences that are more rewarding, take less effort to reach and gain entrance to and have a lower perceived risk. In addition to the three initial hypotheses with regard to reward, effort and risk, we formulate a fourth hypothesis: the effects of perceived rewards, efforts and anticipated risk should affect the likelihood of a residence being burglarized more pronounced as targets are selected gradually further away from home and in accordance with their respective previously formulated hypotheses.

**Methodology**

**Discrete spatial choice modeling and the conditional logit model**

We use the discrete spatial choice approach to study burglars’ target selection process. This approach applies the discrete choice framework to a spatially referenced choice setting such as burglars selecting a house to burglarize. It expands the general framework
by estimating the effect of environment-specific features on a decision-makers’ choice (Bernasco & Nieuwbeerta, 2005). With regard to burglary, this permits including house-specific attributes such as construction type and surface area, and the distance from the alternative to the offenders residence. This approach identifies the influence of environmental features on burglars’ target choice.

The approach is rooted in the micro-economic theory of random utility maximization (RUM) (McFadden, 1974) and enables studying the choice behavior of decision-makers selecting one alternative from a larger set of exhaustive and mutually exclusive alternatives. RUM theory assumes that individuals are rational in their choice behavior and will select the alternative that is expected to maximize their perceived utility. Under this assumption, the discrete spatial choice approach can be estimated using a conditional logit model (Bernasco & Nieuwbeerta, 2005).

The discrete spatial choice approach has previously been applied in criminology to study burglary location choice (Bernasco, 2006; 2010b; Bernasco & Nieuwbeerta, 2005; Clare et al., 2009; Townsley et al., 2014), robbery target selection (Bernasco, 2010a; Bernasco & Block, 2009; Bernasco et al., 2012; Bernasco & Kooistra, 2010), violent offenders’ spatial behavior (Summers, 2012) and rioters’ target choices (Baudains et al., 2013). It is currently considered the customary approach to study offenders’ target selection processes since it combines all theoretically important features of the target selection process in a single framework (Townsley et al., 2014): burglars, their selected targets, all houses from which they can choose and the criteria that affect their choice.

Previous applications of the discrete spatial choice approach to study burglary target selection have modeled this process using larger spatial units such as residential neighborhoods (Bernasco, 2006; 2010b; Bernasco & Nieuwbeerta, 2005; Clare et al., 2009; Townsley et al., 2014). Although the underlying spatially structured hierarchical target selection process leaves room to study burglars’ target selection process at intermediary outcomes (Bernasco, 2010a, p. 117), these earlier applications fail to acknowledge that burglars ultimately select a house to burglarize. The current application of the discrete spatial choice approach to burglary target selection adopts the residence as the unit of analysis and in doing so closely aligns the spatial resolution of the analysis with the current theoretical and empirical understanding of burglary behavior. Over 500,000 residences in a Belgian province are considered as alternatives from which burglars select burglary targets. Furthermore, because of the design of earlier discrete choice applications residence-related choice criteria were not included in previous models. The current study therefore models offenders’ target choice as a combination of residence attributes. This approach combines the analytical framework of discrete spatial choice with earlier insights from a well-established research tradition that applies offender interviews, ethnography and experiments to understand burglary target selection (e.g., Nee & Taylor, 2000).
Sampling of alternatives

Estimating a conditional logit model involves an iterative maximum likelihood process and requires the likelihood function to be computed for each decision-maker-by-alternative combination (Ben-Akiva & Lerman, 1985). For the current paper, this would be practically infeasible since at least 327,332,850 decision-maker-by-alternative combinations are involved in estimating the models. Moreover, the model requires access to all choice-specific characteristics additionally burdening the computational process.

However, McFadden (1978) demonstrated that these models can consistently be estimated on a subset of alternatives. Sampling of alternatives yields consistent estimates provided that the chosen alternative is included and for each choice at least one alternative from the choice set is randomly sampled as well. With regard to sample size of alternatives, Nerella and Bhat (2004) examined the effect of sample size on parameter estimate bias and suggest a minimum-size of one-eighth of the original size of the choice set. This implies randomly drawing 62,947 alternatives from the full choice set for each chosen alternative. In the end, 40,916,200 decision-maker-by-alternative combinations have been included in the estimation process. Previously, this strategy was successfully applied to study crime location choice processes when confronted with large choice sets (Bernasco, 2010a; Bernasco et al., 2012).

Given the recurring finding of distance decay in burglary behavior, it is intuitively appealing to apply importance sampling throughout the sampling-of-alternatives procedure. However, favoring nearby alternatives over faraway alternatives does not result in a more efficient model estimation procedure (Ben-Akiva & Lerman, 1985, p. 265). The sampling-of-alternatives procedure was therefore performed using simple random sampling.

Even after applying sampling of alternatives, the size of the decision-maker-by-alternatives dataset as well as the size of buffer memory required to store intermediary estimation results exceeds the limits of most contemporary desktops. The Ghent University High Performance Computing infrastructure was therefore used to estimate all models. In particular, we ran R version 3.0.2 with ICTCE 5.5.0 on two linked dual socket Intel Xeon X5675 hexacore nodes with 96GB of physical memory. The sampling of alternatives procedure ran for approximately 24 hours. The entire estimation procedure required an additional 2 hours.

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29 Each of the 650 burglars (cf. infra) can choose one house from a choice set of 503,589 residences (alternatives).
30 650 burglars multiplied by a random subset of 62,948 alternatives.
Study area and data

The study area spans East Flanders, a north-western province in Belgium that borders the Netherlands in the north. It covers nearly 3,000 km² and has a population of approximately 1.5 million (Figure 7). It is a densely urbanized area that includes 12 cities and 53 towns. East Flanders has several large industrial and economic zones as well as a small-sized international seaport. It has a dense road network and is crossed by three highways, making it possible to reach all municipalities by car in less than two hours. Most municipalities in the study area are linked by an extensive and widely used public transport and railway network.

We combined recorded crime data from the Belgian Federal Police with data on residential houses in East Flanders from the Belgian Land Registry to study burglars' target selection process within the study area. These datasets provide us with information on the decision-makers (burglars), their choices (burglarized houses), and their choice set (all other non-burglarized houses in East Flanders).

Figure 7 Map of study area with each municipality color-coded for population density (cities with population of 50,000+ inhabitants are labeled and selected targets are plotted on the map)

Recorded crime data

The Belgian Federal Police extracted all aggravated burglaries committed between 2006 and 2012 in East Flanders for which at least one offender is known from the General Police Database, the main database for nationwide crime statistics in Belgium. 4,308 aggravated burglary cases committed by 4,089 unique burglars were extracted, equivalent to 7,379 burglar-burglary pairs or crime trips. The police database contains information on the burglars, such as their date of birth and gender, and the burglaries, such as the location of the offence and time window of the event.
In order to be included in the current analysis, the burglaries had to match several additional selection criteria that are similar to selection criteria adopted in previous applications of the method to studying offence location choice (e.g., Bernasco et al., 2012; Bernasco & Nieuwbeerta, 2005). These criteria and their impact on the sample size are listed schematically in Table 9. First, only burglaries committed by an offender with a legal address in East Flanders at the time of the offence were retained. This was primarily done for theoretical reasons. While it is plausible that offenders residing inside East Flanders consider only targets in the study area, this is highly unlikely for offenders residing outside the study area. The latter are more likely to select targets from a different choice set. Second, the address information for both the crime site and the offender’s legal residence had to be geocodable unambiguously with address level accuracy. Third, only burglaries involving a single offender were included. All burglaries that involved multiple offenders were excluded from the analysis to avoid the need to study the complex web of interactions between co-offenders. With regard to burglary, co-offending introduces complexity in terms of deciding on the correct starting point of the crime trip and brings additional choice situations into the equation (Bernasco & Nieuwbeerta, 2005, p. 8), such as whether offenders first select a co-offender and then a target or vice versa. Moreover, Bernasco (2006) previously demonstrated that co-offending burglars and burglars operating individually rely on similar environmental characteristics when selecting a burglary target. Fourth, the Belgian Land Registry data did not contain information on apartment buildings. This forced us to exclude all burglaries that took place in an apartment building. In other words, only burglaries committed in residential houses in East Flanders were included in the analysis. Finally, for burglars that committed multiple burglaries, one burglary case was randomly selected and included in the final analyses. This provides a clearer test of the model. All other cases were disregarded.
In total, 650 unique burglars and their burglaries were included in the analysis. Burglars were on average 31.21 years old (standard deviation [S.D.]=12.11). The youngest burglar was 14 years old, the oldest 72 years old. The majority of burglars were male (85.18%; N=546) and had no experience with committing burglaries (53.69%; N=349). Focusing on the Euclidean distance from the offender’s home to their crime site, the so-called journey-to-crime or crime trip distance, we find that burglars travelled on average 6.17 km (S.D.=8.47) before committing their offence. The furthest burglary target was located at 49.65 km from the offender’s home. This more or less corresponds with an offender living at one end of the study area committing a burglary at the other end. To assess the number of remote targets and short and long crime trips, we adopt a quantitative criterion similar to Wiles and Costello (2000, p. 10): targets that are at least 10 km away from the offender’s home are considered ‘remote’ and correspond with ‘long’ crime trips. Although the majority of offenders select targets nearby their home (80.62%; N=524), nearly one out of five burglars were committed at least 10 km from the offender’s home (19.38%; N=126). The distribution of crime trip distances is displayed in Figure 8.

![Density plot of journey-to-crime distances](image)

**Figure 8 Kernel density plot of distance-to-crime**

**Residential housing data**

Information on attributes of residential houses in East Flanders was obtained through the Belgian Land Registry. In this Registry, for a land plot corresponding with a residential house, the accompanying information can be extracted straightforwardly from the database. We obtained information on 503,950 residential housing plots. Four plots were removed from the database because they were built with multiple residential houses and we could not unambiguously identify the correct residential house associated with the land plot. 359 plots were additionally removed because of coding errors in the database. In total, 503,589 residential properties were included in the final choice set.

The Belgian Land Registry data reflects the situation on 1 January 2013 and contains the construction type of a residence, the number of floors in addition to the ground floor,
whether there is a rooftop living floor, whether a residence has a garage, availability of central heating and/or air-conditioning system, and the built surface area. All variables have been included in our analysis. Table 10 provides descriptive statistics for all house-level attributes. In addition to the variables available in the Registry data, we computed the Euclidean distance between all alternatives included in the final choice set and each of the 650 offenders’ home addresses.

Table 10 Descriptive statistics for house-level variables

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<tr>
<td>Ground floor</td>
<td>45.95</td>
<td>231,411</td>
</tr>
<tr>
<td>One or more</td>
<td>54.05</td>
<td>272,178</td>
</tr>
<tr>
<td>Rooftop living floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>39.57</td>
<td>304,312</td>
</tr>
<tr>
<td>Yes</td>
<td>60.43</td>
<td>199,277</td>
</tr>
<tr>
<td>Garage present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>32.88</td>
<td>164,950</td>
</tr>
<tr>
<td>Yes</td>
<td>67.12</td>
<td>336,695</td>
</tr>
<tr>
<td>Central heating/AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>36.77</td>
<td>185,155</td>
</tr>
<tr>
<td>Yes</td>
<td>63.23</td>
<td>318,434</td>
</tr>
</tbody>
</table>

Perceived reward is measured using the built surface area and whether a garage is present (cf. Nee & Taylor, 2000). The central heating and air-conditioning variable is an indicator for perceived rewards as well as the potential effort required to access the residence (Cromwell et al., 1991, p. 27; Wright et al., 1995, p. 49). We treat this variable as a proxy measure for the quality of the construction and assume that homes without central heating are likely older and might be less well maintained. As a result, they are probably easier to access and, coincidentally, may offer smaller rewards. Distance from the offender’s home to the alternative is an indicator for perceived effort (Townsley et al., 2014). The construction type is an indicator for potential effort as well as risk (cf. Bennett & Wright, 1984a; Taylor & Nee, 1988): it is more difficult to gain access to the back of terraced houses and they might have an increased risk of detection in comparison to semi-detached and detached houses. The number of floors and the presence of a rooftop living floor are risk indicators. Residences with multiple floors have fewer escape routes than residences with just a ground floor (Beavon et al., 1994, p. 130; Bennett & Wright, 1984a, p. 65): all windows of a ground floor residence can be used as an exit and burglars might get cornered on the floors above the ground if the residents return home. The same reasoning holds for a rooftop living floor.
Analytical strategy

Main and interaction effects

We estimate two models to gain insight in the decision-making process of burglars selecting targets further away from their home. The first model assumes that all choice criteria are equally important regardless of the distance from the offender’s home to the target. It contains only main effects.

The second model assumes that the importance of certain choice criteria varies with distance from the home to the target. It acknowledges that all choice criteria are not always equal, in particular distance to the alternative, and contains the interaction effects between all environmental factors and the distance from the offender’s address to the alternative. This model describes the choice process of burglars who weigh target-specific cues and distance simultaneously. It allows testing whether certain environmental cues are more important when targets are located further away from the offender’s address.

Hypotheses

Based on the theoretical framework, four hypotheses were outlined. We now link these hypotheses with the available variables. First, higher perceived rewards are hypothesized to increase the likelihood that a residence is burglarized. In particular, we hypothesize that the likelihood that a residence is burglarized increases with its built surface. Moreover, we hypothesize that residences with a garage have a greater likelihood of being burglarized than residences without any garages.

Second, lower perceived effort is hypothesized to increase the likelihood that a residence is targeted. Although the absence of central heating and/or air-conditioning may signal lower rewards, it could also indicate that it is easier to gain entrance to a residence. We therefore hypothesize that residences with central heating have a smaller likelihood of being burglarized than residences without central heating. Terraced houses are hypothesized to have a smaller likelihood of being burglarized than semi-detached and detached houses. Moreover, the likelihood of being burglarized decreases as houses are located further away from the offender’s home.

Third, lower perceived risk is hypothesized to increase the likelihood that a residence is burglarized. We hypothesize that residences with one or more floors and a rooftop living floor have a smaller likelihood of being burglarized than residences with just a ground floor and without a rooftop living floor respectively.

Finally, we expect the hypothesized effects to play out more prominently when burglars select remote targets. The hypothesized effects of perceived rewards, efforts and risk should affect the likelihood of a residence being burglarized more pronounced as targets are selected gradually further away from home. In other words, we hypothesize that
offenders compensate the increased effort induced by burglarizing further away targets by selecting targets that have higher perceived rewards, lower perceived efforts and lower perceived risks.

Results

The estimation results of conditional logit model 1 and 2 are summarized in Table 11. This table presents odds ratios (ORs) and their corresponding Z-scores. A selection of model fit statistics is also provided. The ORs describe the amount the odds of a house being selected increase multiplicatively with a one-unit change in the associated independent variable.

Model 1: all choice criteria are equally important

The first model reports only the main effects and describes the decision-making of burglars under the assumption that all choice criteria are equally important. The model exhibits an acceptable fit to the data as evidenced by the value for McFadden’s pseudo-R² measure (pseudo-R²=0.15). Three residence attributes and the distance to the target are significantly related with the likelihood of target selection.

Houses have a smaller likelihood of being burglarized if they are semi-detached, have a garage and are outfitted with a central heating and/or air-conditioning system. The overall effect of construction type is significant (LR=7.23; Δdf=2; p=0.027) and the partial effect of semi-detached suggests that burglars prefer terraced houses over semi-detached houses. All other things being equal, the odds of a semi-detached house being burglarized is 27 percent smaller than the odds for a terraced house. Similarly, the odds of a house with a garage being burglarized are 19 percent smaller than those of a house without a garage. Moreover, the odds of a house being burglarized are 33 percent smaller if it is outfitted with a central heating or air-conditioning system compared to houses that are not outfitted with similar systems.

The estimated OR of 0.79 for distance is highly significant (Z=-29.18) and implies that, ceteris paribus, the odds of a house being selected decrease by 21 percent for every kilometer it is further away from the offender's home. In other words, remote houses are less likely to be targeted.

Model 2: interaction effects with distance

Model 2 contains the interaction effects between residence attributes and distance from the home to the target. It demonstrates that not all choice criteria are equally important for burglars when selecting targets, especially not when targeting remote residences. Including the interaction effects significantly improved the model fit compared to the model that contains only main effects (LR=21.84; Δdf=9; p=0.009). However, no improvement of the McFadden’s pseudo-R² measure was observed (pseudo-R²=0.15).
The values listed in the lower half of the second column of Table 11 cannot straightforwardly be interpreted as the ORs for the interaction terms. Instead, several graphs that visualize the interaction effects are provided in Appendix 1. These graphs display the ORs of the significant interaction terms for specified values of distance from the offender’s home and their corresponding 95% confidence intervals (cf. Hilbe, 2009, pp. 189-241; 2011, pp. 520-529). They help to identify the general trend of the interaction effect and indicate that offenders dislike burglarizing faraway targets. Certain environmental features, however, moderate the effect of distance on the likelihood of target selection.

Three residence attributes interacted significantly with distance from the offender’s home. As shown in Table 11, the estimated coefficients for the interaction between distance and the number of floors and the presence of a rooftop living floor is significant. Furthermore, the presence of central heating and/or air-conditioning interacted significantly with distance. In contrast, the construction type, the presence of a garage and the built surface did not interact significantly with the distance from the offender’s home.

The interaction effect between the number of floors in the house and distance from the offender’s home is plotted in Figure 9 (Appendix 1) and implies that remote houses with at least one floor have a smaller risk of being targeted by burglars than houses that have only a ground floor. For instance, the odds of a house being targeted that is located at 25 km from the offender’s home and with at least one floor are 68 percent smaller than those of a similarly located house with just a ground floor.

Similarly, the presence of a rooftop living floor interacted significantly with distance from the offender’s home. The effect is visualized in Figure 10 (Appendix 1) and indicates that the likelihood of target selection decreases as houses are located further away from the offender’s home and that this effect is compounded in the presence of a rooftop living floor. For instance, the odds of a house located at 20 km from the offender’s home and with a rooftop living floor being burglarized are 58 percent smaller than those of a similarly located house without a rooftop living floor. In other words, burglars prefer houses without a rooftop living floor relative to houses with a rooftop living floor when burglarizing remote targets.

Finally, the interaction effect of presence of a central heating and/or air-conditioning system and distance from the offender’s home is plotted in Figure 11 (see Appendix 1). The effect suggests that remote houses outfitted with a central heating and/or air-conditioning system are less at risk of being selected for burglary than houses that have no heating and/or air-conditioning system installed. Looking more closely at the estimated ORs, we find that, for instance, residences at 40 km from the offender’s home and outfitted with a heating and/or air-conditioning system have a 78 percent smaller odds of being burglarized than residences at a similar distance but that have no heating.
and/or air-conditioning system installed. In short, when targeting remote residences burglars prefer residences without a central heating and/or air-conditioning system.

Table 11 Conditional logit model results (odds ratio coefficients and z-values)

<table>
<thead>
<tr>
<th></th>
<th>Main effects</th>
<th>Interaction effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M1</td>
<td>M2</td>
</tr>
<tr>
<td>e^β</td>
<td>Z</td>
<td>e^β</td>
</tr>
<tr>
<td>Semi-detached^a</td>
<td>0.73**</td>
<td>0.59**</td>
</tr>
<tr>
<td>Detached^a</td>
<td>0.81</td>
<td>0.97</td>
</tr>
<tr>
<td>1 or more floors^b</td>
<td>0.88</td>
<td>1.25</td>
</tr>
<tr>
<td>Rooftop living floor^c</td>
<td>0.94</td>
<td>1.26</td>
</tr>
<tr>
<td>Garage present^d</td>
<td>0.81*</td>
<td>0.82</td>
</tr>
<tr>
<td>Central heating/AC^e</td>
<td>0.67***</td>
<td>0.83</td>
</tr>
<tr>
<td>Built surface</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Distance to house</td>
<td>0.79***</td>
<td>0.84***</td>
</tr>
<tr>
<td>Semi-detached*distance to house</td>
<td>--</td>
<td>1.03</td>
</tr>
<tr>
<td>Detached*distance to house</td>
<td>--</td>
<td>0.98</td>
</tr>
<tr>
<td>1 or more floors*distance to house</td>
<td>--</td>
<td>0.95**</td>
</tr>
<tr>
<td>Rooftop living floor*distance to house</td>
<td>--</td>
<td>0.95**</td>
</tr>
<tr>
<td>Garage present*distance to house</td>
<td>--</td>
<td>1.00</td>
</tr>
<tr>
<td>Central heating/AC*distance to house</td>
<td>--</td>
<td>0.97*</td>
</tr>
<tr>
<td>Built surface*distance to house</td>
<td>--</td>
<td>1.00</td>
</tr>
</tbody>
</table>

N 40,916,200 40,916,200

Number of events 650 650

Log-likelihood -6,129.63 -6,118.71

Wald chi²-test 982.30*** 979.10***

McFadden pseudo-R² 0.15 0.15

*p<0.050 **p<0.010 ***p<0.001 two-sided
ref.cat.: a terraced; b ground floor; c no rooftop living floor; d no garage; e no central heating/AC

Conclusion and discussion

This study sought to answer which house attributes influence burglars’ decision when selecting a target in general and how these attributes moderate the effect of distance to the burglar’s home in this decision-making process. Rational choice theory asserted that environmental characteristics related to the target allow burglars to select residences by optimizing a combination of perceived rewards, efforts and risks. Burglars were expected
BURGLARY TARGET SELECTION IN FLANDERS

to look for more rewarding and less risky targets when confronted with increased travel efforts induced by selecting remote targets. A discrete spatial choice framework was applied to study burglars’ target selection process in a Belgian province. The key advantage of our study is that this process was modeled for the first time at its ultimate outcome; that is, the house that is eventually burglarized. This allowed us to combine the insights from earlier ethnographic research, offender interviews and experiments with the power of the discrete spatial choice approach.

In general, our results indicate that lower effort leads to an increased likelihood of target selection. Our hypotheses with regard to the effects of higher perceived rewards and lower perceived risks could not be validated. With regard to selecting remote targets, we found evidence that partially confirms our hypothesis: burglars compensate increased travel efforts by reducing the efforts and risks associated with committing their offence. In particular, our findings demonstrate that burglars actively deploy compensation strategies and primarily rely on risk-related attributes to compensate the increased travel efforts. Furthermore, burglars compensated travel efforts by selecting residences that took less effort to gain entrance to when targeting further away targets. In short, our findings indicate that lower risk compensates travel efforts and that burglars aim to make minimal effort, even when they are already confronted with increased travel efforts.

Which residence attributes affect burglars’ target choice?

Initially, we sought to determine which residence attributes affected burglars’ decision to target a house. Our results indicate that burglars primarily distinguish between targets by relying on effort-related attributes. This confirms our second hypothesis that lower perceived efforts increase the likelihood that a residence is burglarized. We could not confirm our first hypothesis related to reward and our third hypothesis related to risk.

First, burglars were expected to look for profitable targets. Although higher perceived rewards were hypothesized to increase the likelihood that a residence is selected for burglary, our results do not confirm this. In contrast with the first hypothesis, we found that the likelihood of a residence being burglarized actually decreased with higher perceived rewards as indicated by the presence of a garage at or nearby the residence. Moreover, when controlling for other residence attributes the size of the residence, another reward-related attribute, did not increase nor decrease the odds of a burglar selecting a residence for a burglary. These results challenge earlier findings from burglar accounts and experiments that demonstrated that offenders discriminate between targets based on reward-related residence attributes such as the size of the house, general upkeep and the type of car parked outside (Bennett & Wright, 1984a; Nee & Meenaghan, 2006; Nee & Taylor, 1988; 2000; Taylor & Nee, 1988; Wright & Logie, 1988). Instead, our results mimic those of Wright et al. (1995, p. 49) that found that affluence-related attributes at the house-level had little impact on burglars’ decision to burglarize a particular house. In fact, our results reflect the suggestion that burglars do not necessarily need to rely on an appraisal of the target’s affluence as they may expect to
make a profit anyway because of the large-scale availability of profitable loot such as smartphones, tablets and jewelry (Townsley et al., 2014, p. 20; Vandeviver et al., 2015, p. 15).

Second, we expected burglars to make minimal effort to achieve their goal and that this would be reflected in their choice of target. Our results confirm the second hypothesis that stated that lower perceived efforts increase the likelihood of a residence being burglarized. Burglars’ appreciation of the effort required to commit an offence was based on the distance to their home address and the effort required to gain entrance to a residence as indicated by the availability of central heating and/or air-conditioning. The likelihood of a residence being burglarized decreased with the distance to the offender’s home. This comes as no surprise, since it has been elaborately reported in previous studies that burglars prefer nearby targets (cf. inter alia Gabor & Gottheil, 1984; Turner, 1969; Wiles & Costello, 2000). Interestingly, burglars favor residences without central heating and/or air-conditioning: residences that have no central heating and/or air-conditioning system had a greater odds of being selected for burglary than residences that had a central heating system installed. Although we do not argue that the presence of a central heating system makes a residence vulnerable for burglary, we reason that the absence of central heating and/or air-conditioning system indicates that less effort is required to gain access to the residence because residences without such systems will typically be older and the doors and windows could be poorly maintained or made of inferior materials. Residences without central heating may also offer smaller rewards. The current results do not stand alone and corroborate those from ethnographic studies that found burglars opt for houses that can be easily broken into because of weathered doors or window frames (Cromwell et al., 1991; Shaw & Gifford, 1994; Wright et al., 1995). However, they challenge those of earlier studies that identified the presence of air-conditioning systems as a cue that might signal an attractive target (Wright et al., 1995, p. 49) and found some burglars to look for residences outfitted with air-conditioning systems because these can be manipulated to gain entrance to the building (Cromwell et al., 1991, p. 27).

Third, lower perceived risk was hypothesized to increase the likelihood of a residence being burglarized. However, no support was found for this hypothesis. Construction type affected burglars’ location choice. Contrary to our hypothesis, however, terraced houses had a greater likelihood of being burglarized than semi-detached houses. Moreover, we were unable to establish whether burglars distinguish between terraced and detached houses. This contrasts with a number of studies that found terraced houses to be less prone to burglary (Bennett & Wright, 1984a; Hakim et al., 2001; Maguire & Bennett, 1982; Wright & Logie, 1988). Our contrasting finding is perhaps rooted in the design of a number of earlier studies that relied on stated preferences to study burglars’ target selection process. Previous studies predominantly relied on offenders’ personal accounts to gain insight in burglars’ motives for selecting a particular residence to burglarize (e.g., Bennett & Wright, 1984a; Cromwell et al., 1991), even though it might not be wholly
appropriate to rely on verbal reports when studying the motivations and intentions that underlie offenders’ decisions and behavior. Cognitive psychological research suggests that individuals rarely have an accurate, conscious understanding of the complex cognitive processes that underlie their choices (Kahneman, 2011, pp. 85-88; Nisbett & Wilson, 1977). They may be unaware of factors that have a major influence on their decisions or recall idiosyncratic events instead of their general reasoning and behavior. Particularly for burglars, they may be unwilling to say what they would do if the situation was real. By adopting a revealed preferences approach (Bernasco, 2010a; Rushton, 1969) and examining the factors that are associated with the behavioral outcomes of decision-making and thought processes, it is possible to gain insight into the underlying choices. In other words, our results indicate that although offenders say they shy away from burglarizing terraced houses, when push comes to shove they are not hindered by their apparent dislike for terraced houses. Furthermore, we could not establish whether other risk-related attributes such as the number of floors and the presence of a rooftop living floor increased or decreased the likelihood of a residence being burglarized. Apparently, when all other residence attributes are controlled for burglars do not scrutinize individual residences for risk-related attributes to appraise the risk of burglarizing a particular house. In other words, burglars have no specific preference for less risky residences.

How do house-level attributes moderate the effect of distance to the burglars’ home on burglars’ target choice?

Our results confirm that offenders generally avoid selecting remote targets. However, a substantial number of burglars actually preferred remote targets over nearby ones. Up to a fifth of all burglars left their home area and travelled at least 10 km before committing their burglary. When selecting remote targets, our findings demonstrate that not all choice criteria are equally important in burglars’ target selection process. Based on rational choice theory, we hypothesized that offenders compensate increased travel efforts by selecting remote targets that offer higher rewards, take less effort and could be less risky. This hypothesis, however, is only partially confirmed. Burglars primarily compensated travel efforts by minimizing the risk associated with their offence. Furthermore, even though burglars increased the efforts by travelling farther they were found to be attracted to targets that required less effort to gain entrance to. No reward-related attributes were associated with selecting remote targets. While targeting remote residences might ultimately prove profitable (cf. inter alia Morselli & Royer, 2008; Van Koppen & Jansen, 1998), burglars’ initial decision to target faraway residences is not informed by their appraisal of an increased target profitability.

Once distance is taken into account, we found that risk-related cues that were initially not associated with burglars’ target choice, such as the number of floors and the presence of a rooftop living floor, affected the likelihood of a residence being selected for burglary. The likelihood of a remote residence being burglarized decreased if it had at least one floor in addition to the ground floor and if a rooftop living floor was present.
We argued that houses with multiple floors subject the burglar to a greater risk of apprehension in case of detection (Beavon et al., 1994, p. 130; Bennett & Wright, 1984a, p. 65) since they have fewer exit routes compared to houses that only have a ground floor. In the former case, burglars can be cornered on the top floors if the residents return. In the latter case, all doors and windows can be used to quickly exit the residence in case of detection without a major chance of severe injury. These findings provide evidence for the idea that a reduced risk of detection is a major advantage of selecting remote targets. While burglars may also benefit from poor information exchange and a lack of cooperation between law enforcement agencies when targeting faraway residences (Lammers & Bernasco, 2013; Rossmo, 2000; Vandeveiver, 2013), our data suggests that this might be more than a lucky coincidence but could also be the result of an actively deployed compensation strategy. Burglars scrutinize targets for risk-lowering attributes and expect to offset increased travel efforts by selecting safer targets. Moreover, certain risk-related residence attributes were initially not associated with burglars’ general target selection process. Only when distance is simultaneously taken into account, does their importance for burglars’ location choice become apparent. Furthermore, although some burglars increase the efforts by targeting remote residences, our results indicate that this might be compensated by targeting residences that require less effort to gain entrance to. Remote residences that were not outfitted with a central heating and/or air-conditioning system had a greater likelihood of being selected for burglary than similarly located residences outfitted with a central heating system. It seems that burglars want to make minimal effort, even when they are travelling farther.

Limitations

This study has several potential limitations. First, findings rely on recorded crime data and may be subject to selection effects. In particular, local burglars may be overrepresented in the recorded crime data (Bruinsma, 2007; Rengert, 2004) resulting in an underestimation of burglar mobility and the number of remote targets being burglarized. While undesirable, especially in light of the current finding that burglars deploy compensation strategies aimed at reducing detection risk when targeting remote residences, its problematic character should not be overstated. Alternative methodologies suffer from similar biases. As highlighted, results from offender interviews may suffer from a number of cognitive biases including availability heuristics and conjunction fallacies (Kahneman, 2011) and ethnographic studies tend to focus on prolific offenders (Townsley et al., 2014). Second, like other offender mobility studies, this study assumed that offenders’ home was the starting point of their crime trip and ignored that other anchor points might be equally important (Bruinsma, 2007, p. 485). However, using the home as the starting point of the crime trip has grounding since the location of the home is of primary importance for an offender’s use and understanding of the surrounding environment (Canter & Larkin, 1993; Sarangi & Youngs, 2006) and at some point in time an offender will have to return home (Rengert, 2004). Finally,
analyses are limited to burglaries committed in houses since Registry data did not include information on apartments. Though an important limitation, offender accounts suggest burglars bypass apartments altogether (Bennett & Wright, 1984a, pp. 65-66) and apartment burglaries constitute only approximately 20% of all burglaries in Belgium.

**Future research**

To conclude, several avenues of future research are outlined. First, like previous crime location choice studies this study did not explicitly acknowledge that offender’s consideration with regard to crime site selection apply to multiple levels of spatial aggregation. Crime site selection is a spatially structured hierarchical decision-making process (Bernasco & Nieuwbeerta, 2005; Brantingham & Brantingham, 1984; Cornish & Clarke, 1986a) that entails that burglars initially distinguish between larger areas such as a municipality or equivalent area before narrowing down their choice and eventually selecting a residence to burglarize. This implies that environmental attributes at multiple levels of spatial aggregation affect burglars’ choice of crime site. Burglars have a choice among all available residences in a given area. Residences are grouped in streets, which in turn are grouped in neighborhoods and municipalities. Residences in the same municipality share unobserved attributes such as the number of active burglars in the area. Residences in the same street share similar unobserved attributes such as the amount of traffic. This introduces dependency between nested choices and burglars’ location choice problems might better be defined by the residence, street, neighborhood and municipality that is selected. Testing such models involves applying a variation of the nested logit model (Ben-Akiva & Lerman, 1985; Train, 2009).

Second and closely related to the first suggestion, the analysis presented here could be extended in depth by including additional residence attributes and more nuanced environmental attributes of various levels of spatial aggregation. For instance, the location of a residence on a street segment and whether it is observable from the surrounding residences is believed to affect burglars’ target choice (Bennett & Wright, 1984a; Cromwell et al., 1991; Taylor & Nee, 1988). Street characteristics could be included as well since attributes such as connectedness and permeability are believed to affect burglary decisions (Beavon et al., 1994; Townsley et al., 2014).

Finally, future applications could study burglars’ cost and benefit balancing process in detail by investigating the presence of interaction effects between attributes of reward, effort and risk. The current study was limited to establishing what environmental attributes moderate the effect of distance on burglars’ crime choice, but other important interaction effects could exist. Investigating these might shed light on how burglars hope to compensate reduced rewards or why certain risky targets are selected.
Acknowledgments

The computational resources (Stevin Supercomputer Infrastructure) and services used in this chapter were provided by the VSC (Flemish Supercomputer Center), funded by Ghent University, the Hercules Foundation and the Flemish Government – department EWI.
Appendix 1: Graphs of interaction effects

Figure 9 Estimated ORs (with 95% confidence intervals) for the interaction effect of number of floors with distance (ref.cat. = just ground floor)
Figure 10 Estimated ORs (with 95% confidence intervals) for the interaction effect of presence of rooftop living floor with distance (ref. = no rooftop living floor)
Figure 11 Estimated ORs (with 95% confidence intervals) for the interaction effect of presence of central heating and/or air-conditioning system with distance (ref. = no central heating and/or air-conditioning).
Conclusion
Conclusion

This PhD dissertation drew upon the rational choice perspective to study a particular type of offending behavior: offenders selecting remote targets and the coincidental long crime trips they undertake to reach these targets. Offenders’ target selection, their mobility and the journey to crime were analyzed in a study area that was much larger and more diverse than the study areas of earlier implementations. Whereas uncharacteristically long crime trips were intentionally omitted in earlier journey-to-crime studies, such crime trips were deliberately included in the analyses reported in this dissertation. This approach made it possible to confirm that, in general, offenders limit their travelling to crime as much as possible and that crime trips are typically short. Not only were journey-to-crime distances found to exhibit a decay pattern, it was also established that offenders are considerably more mobile than what the bulk of earlier journey-to-crime studies would suggest. Some offenders did not even limit their travelling to crime at all and long journeys to crime, which were defined in this dissertation as crime trips that were longer than 10 km, were routinely observed.

Furthermore, this study investigated how differences in journey-to-crime length may arise and whether variation in distance to crime can be explained by using environmental characteristics of target areas. Analyzing the journey-to-crime lengths from a sample of burglars living and offending in two Belgian provinces demonstrated that environmental characteristics of target areas can indeed be used to explain variation in distance to crime. Although offender characteristics, such as the offender’s sex, initially influenced crime trip length, the effect was rendered insignificant upon the introduction into the statistical model of a selection of environmental attributes related to the offenders’ chosen target municipalities. In particular, it was observed that on the one hand longer burglary trips were related with committing burglaries in municipalities that are crossed by a motorway, contain a dense road network and have a high degree of ethnic heterogeneity. On the other hand, this dissertation has shown that shorter crime trips were associated with burglaries committed in municipalities with a high population density and a high burglary clearance rate.

Finally, offenders’ target selection process was scrutinized and it was examined to what extent offenders’ target choices reflect an intention to balance costs and benefits. A discrete spatial choice analysis of the target choices of a selection of burglars living and committing burglaries in the Belgian province of East Flanders showed that a number of residence-related attributes capturing rewards, efforts and risks influence burglars’ decision-making. The general likelihood of a residence being burglarized increased when the efforts to do so diminished, but actually decreased when the possible rewards of the burglary increased. In particular, the analysis found that the likelihood of a residence
being burglarized gradually decreased as it was located further away from the offenders’ home areas. Additionally, houses had a decreased likelihood of being burglarized if they were semi-detached, had a garage and were outfitted with a central heating or air-conditioning system. This analysis also showed that remote residences are regularly favored. Scrutinizing this particular choice revealed that offenders may balance costs and benefits to a certain degree when selecting burglary targets. Furthermore, some possible compensation strategies were indirectly observed: whereas reduced efforts and decreased risks were important when burglarizing remotely located residences, increased rewards were unimportant. Throughout this dissertation it has become clear that, in particular, as residences were located further away from the home areas of the offenders, the likelihood of being burglarized increased for residences that only consisted of a ground floor, that lacked a rooftop living floor, and did not have a central heating or air-conditioning system installed.

Taking the combined results of this dissertation into consideration, it can be concluded that variation in distance to crime and the occurrence of long crime trips can be understood from within the rational choice perspective albeit not uncritically, as some of the central arguments contained within this perspective require evaluation and reconsideration in light of the current dissertation’s results. Although offenders’ inclination to maximize profits could not unequivocally be established and distant risks were found to be of importance for offender decision-making, this study confirmed the importance of environmental information in offenders’ decision-making process and highlighted that target choices can be framed in terms of a balancing act of costs and benefits. This study has furthermore shown that increased travel efforts were primarily compensated by reducing the risks associated with the target choice. Throughout this balancing act, effort minimization was recurrently observed.

The remainder of this concluding chapter reconsiders and combines the results of the previous chapters to provide an answer on the guiding research questions that were formulated in the introduction of this dissertation. This conclusion is structured as follows. First, the guiding research questions are reiterated and answered. Second, the theoretical implications of the current dissertation for journey-to-crime research and the rational choice perspective are discussed. Third, the implications for crime control policy and police practice are highlighted. Fourth, the limitations of this study are discussed. Finally, several avenues for future research are outlined.

Summary of results

Findings with regard to distance to crime patterns

The initial research question of this dissertation aimed to establish the degree of offender mobility in general and, in particular, which distances offenders typically travel to offend. To achieve this goal, this PhD dissertation studied offender mobility and the journey to crime within the context of a large geographic area that allows identifying
longer crime trips and – whenever present – include them in the analysis. This explicit choice for an enlarged geographic area was prompted by the observation that earlier implementations typically studied offender mobility within the confines of a limited geographic range such as a city or small town. Needless to say, this approach makes studying offender mobility in its full extent difficult (Hesseling, 1992a, p. 111; Stangeland, 1998, p. 70). The study areas covered in this dissertation were larger and more diverse than those of earlier studies within the field. Although the study areas varied in size and composition between the three individual studies reported in this dissertation, there was a degree of overlap between each of the considered study areas and all three study areas were composed of several large cities and multiple smaller towns. Each study area also included the third most populous city of Belgium, Ghent. Furthermore, whereas previous applications generally focused on local offenders and their offending patterns (e.g., Phillips, 1980, pp. 170-172) or even deliberately excluded long crime trips from their analyses (e.g., Hesseling, 1992b, pp. 98, 106-107), the current study included non-local offenders and did not omit long crime trips from the analysis. This novel combined approach made it possible to study offender mobility to a fuller extent than previous studies and helped to identify a broader range of crime trip distances.

Two conclusions with regard to the distances offenders typically travel to offend can be drawn from this approach. The first conclusion is that the distance-to-crime patterns observed in the three studies which made up the body of this dissertation underline that offenders limit their travelling to crime as much as possible and that crime trips typically cover only short distances. On average, crime trip lengths of around 6 km to 8 km were observed in East and West Flanders (Vandeviver et al., 2015) and East Flanders respectively (Vandeviver et al., under review). Average crime trip lengths were exceptionally longer in the greater Ghent area, as property offenders active in and around Ghent travelled on average nearly 40 km before committing their offences (Vandeviver, 2013). To be fair, a number of extremely long journey-to-crime distances skew this average and median crime trip distances observed across multiple studies more closely corresponded to the results discussed in this dissertation. Furthermore, this study has shown that the majority of offences were committed in close proximity to where the offenders lived. Distance-decay curves were observed for all considered types of property offences and across all considered study areas.

The second conclusion, and important establishment, is that a substantial proportion of offenders did not mind travelling greater distances to commit their offences and looked for targets much further away from home. Crime trips that covered more than 10 km, so-called ‘long’ crime trips, were repeatedly observed. In fact, these ‘long’ crime trips made up a fifth to a third of all considered journey-to-crime distances suggesting that some offenders did not mind raising the travel costs associated with committing their offences. Interestingly, the analysis in the greater Ghent area allowed identifying a number of extraordinarily long crime trips. Approximately 5% of all crime trips were over 100 km in length and some journeys to crime were even longer than 1,000 km. However, caution is
in order before jumping to the conclusion that some offenders are prepared to travel across half of Europe to commit a property offence in Flanders (e.g., Santtila et al., 2008, p. 350). Instead of indicating excessive mobility on the part of the offender, these extreme distances probably reflect the inappropriateness to solely rely on an offender’s legal address to compute journey-to-crime distances since some of the included property offenders were officially registered as residing in their foreign country of birth at the time of the offence. Furthermore, the study in the greater Ghent area demonstrated that considerable variation in crime trip length exists across property offence types. The longest average trip lengths were found for burglary (44.98 km) and shoplifting (47.54 km). The shortest average journey-to-crime distances were observed for theft in a dwelling (16.40 km). As a reminder, burglary is an aggravated form of theft in a dwelling that requires the offender to damage the dwelling upon entry, gaining entrance through an unusual entry or using forged keys to enter the dwelling.

In summary, studying offender mobility and the journey to crime in a large geographic area confirms the general distance-to-crime patterns observed in earlier research but also allows identifying substantial proportions of long crime trips. The current study indicates that offenders are mobile and that some of them are not necessarily inclined to travel short distances or commit their offences in close proximity to their home areas. These results provide support for the initial suggestion to include long crime trips as much as possible when studying offender mobility since otherwise a substantial amount of variation in crime trip distance may be lost.

**Explaining variation in distance to crime using environmental characteristics of target areas**

Once considerable variation in crime trip length is established, it is important to try to understand the occurrence of longer crime trips and explain how variation in journey-to-crime length may arise. The second research question of this dissertation addressed precisely this point and sought to explain variation in distance to crime using environmental characteristics of target areas.

From within the rational choice perspective it is argued that offenders rely on a spatially structured, hierarchical sequential target selection strategy that involves a number of sequential decisions with regard to multiple levels of spatial aggregation (Cornish & Clarke, 1986a, pp. 2-6; 2006, p. 23; 2008, pp. 29-36). Throughout this target selection process, environmental cues play an important role and inform an offender’s target choice. In other words, when offenders look for a suitable target, they initially select a larger target area such as a municipality and then gradually narrow down their target choice by selecting a neighborhood within this municipality and a street within that neighborhood, before finally deciding on the actual target. This may be a house in the case of a burglary or an individual in the case of a robbery.
Implied in this perspective is that crime trip length is influenced and largely determined by an offender’s choice of target area. The environmental characteristics that are argued to inform this choice also affect the distance to crime. Arguably, an offender’s initial decision to commit an offence in a particular neighborhood has a greater impact on the eventual distance that he must cover in order to offend than, for example, the ensuing choices made with regard to a particular neighborhood, street or house. This dissertation therefore explored whether municipality-level attributes, which influence the offender’s initial choice of target area, help to explain variation in distance to crime.

The results from this dissertation provide support for this line of reasoning and demonstrate that crime trip length is primarily a function of environmental attributes of the target municipality (Vandeviver et al., 2015). Initially, offender characteristics, in particular the offender’s sex, were related to crime trip length and they indicated that longer crime trips were associated with females and shorter crime trips with males. However, following the introduction of a selection of environmental attributes related to the targeted municipalities the effects of these offender characteristics were rendered insignificant. The journey-to-crime distance increased when burglaries were committed in municipalities that were crossed by a motorway, contain a dense road network and had a high degree of ethnic heterogeneity. Conversely, crime trip distances decreased when targeting municipalities with a high population density and a high burglary clearance rate.

These results suggest that offenders may rely on an initial cursory assessment to decide whether offending further away from home could be worthwhile. Offenders sometimes decide against targeting remote areas and travelling further, a decision that does not seem to come about indiscriminately. Shorter crime trips were associated with committing burglaries in municipalities with a high clearance rate, a possible indication that offenders are able to assess their chances of arrest and decide against increasing their travel efforts when there is no guarantee of a reduced chance of arrest. Offenders may come to the decision that the costs of offending in a particular area are already too high given the elevated clearance rates and that it may not prove worthwhile in the end to tip the scales by increasing the travel efforts. However, sometimes offenders do decide in favor of committing burglaries further away from home. Longer crime trips were directed to municipalities that possibly offered a lower chance of detection by area residents – indicated by a high degree of ethnic heterogeneity – and may have offered better odds to escape in case of detection – indicated by a higher road network density. In other words, offenders may realize that in the end increased travel efforts may be offset by the reduced risks to which they expose themselves by committing their offences in those particular municipalities. In addition, environmental attributes at the municipality level may help offenders to identify possible strategies to compensate the travel efforts they have allowed to increase. With regard to this, the analysis in particular established that longer crime trips were associated with committing burglaries in municipalities that are crossed by a highway. This suggests that offenders may expect to
make up for the increased money, energy and effort required to overcome longer distance by targeting municipalities that can be reached quickly and allow offenders to keep their overall travel time in check.

Balancing costs and benefits in offenders’ target selection process

Finally, the third research question explored the above reasoning in detail and scrutinized offenders’ target choices. It built upon the arguments informing the rational choice perspective and emphasized that many choice criteria, including distance, play a role in this process. In particular, this research question aimed to examine whether offenders’ target choices reflect a balancing act of costs and benefits, and to what extent this is apparent in the compensation of one of the major costs in this process, the distance from the home to the target.

The rational choice perspective puts forward that in order to decide on a suitable target offenders weigh the costs and benefits associated with their choices and seek to optimize a combination of perceived rewards, efforts and risks. The governing principles of this process are profit maximization and effort minimization. Environmental attributes related to the target or crime site inform offenders’ decision-making and allow them to discriminate between possible targets. In principle, there are no reasons to believe that an offender would prefer a distant target over a nearby one since this would load the balance with too much costs (Rengert et al., 1999), unless an increase in certain benefits or a reduction in other costs may help to offset the increased travel costs. This was tested using a discrete spatial choice approach.

To begin with, it was established which target-related attributes affect burglars’ target choices in general and to what extent information related to rewards, efforts and risks play a role in this process. Throughout the analysis it became clear that as residences were located further away from the offenders’ home areas, the chance of being burglarized gradually decreased (Vandeviver et al., under review). Conversely, semi-detached residences, houses without a garage, and residences with a central heating or air-conditioning system had a greater chance of being burglarized. In general, lower efforts lead to an increased likelihood of target selection but unexpectedly the chance of burglary increased with decreased rewards. This may indicate that offenders are primarily intent on reducing the efforts associated with committing their offences, supporting the idea of effort minimization. The elevated chance of burglary for residences in proximity to the offenders’ home areas and the increased likelihood of burglary for residences without central heating illustrate offenders’ preference for targets that require fewer efforts to reach and are possibly easier to gain access to.

Surprisingly, offenders seemed relatively unconcerned with maximizing anticipated profits, questioning the importance of profit maximization as a governing principle of offenders’ target selection process. In fact, offenders preferred to burglarize residences that may offer poorer chances of realizing high rewards. This was indicated by the increased likelihood of burglary for houses without a garage.
The following step of the analysis directly addressed offenders’ inclination to balance costs and benefits and focused on how house-level attributes moderate the effect of distance on target choice. The results indicate that as residences were located further away from the home areas of the offenders, the likelihood of being burglarized increased for residences that consisted only of a ground floor, lacked a rooftop living floor, and did not have a central heating or air-conditioning system installed. This suggests that offenders’ target choices reflect a certain degree of balancing costs and benefits, as in this case certain benefits may help to outbalance the higher travel costs. Offenders seek to find an optimal balance between the location of their target in relation to their home and the incremental travel efforts required to reach their preferred target, and decreasing certain ancillary costs and efforts such as the risk of getting caught or the efforts required to reach the target. This was witnessed in the increased likelihood of burglary for remote residences with just a ground floor and lacking a rooftop living floor. It was reasoned that those particular houses may offer offenders better chances to escape in case of detection. In other words, burglarizing those residences may help offenders to reduce the risks of committing their offence and indicates that lower risks may offset increased travel costs. Furthermore, it was observed that offenders may look to compensate increased travel costs by burglarizing residences that were possibly easier gaining access to as indicated by the elevated chance of burglary for remote residences that did not have a central heating or air-conditioning system installed. Those houses are likely older and probably less well maintained than residences with a central heating system installed. This suggests that offenders may be determined to minimize efforts and risks as much as possible, even when they select a distant target and have already increased the travel costs to reach that particular target. However, it seemed that travel costs were not compensated by selecting potentially more rewarding targets. No reward-related information moderated the effect of distance.

**Theoretical implications**

This section focuses on the scientific impact of this research by listing a number of contributions and theoretical implications of this thesis. First, this dissertation sheds light on some of the benefits that are related to selecting remote targets and undertaking long crime trips. Second, the general advances for the existing journey-to-crime literature are highlighted. Finally, a number of implications for the rational choice perspective are listed.

**The benefits of long crime trips**

Previous studies reported that it might be financially lucrative for offenders to increase their offending range and undertake long crime trips (Baldwin & Bottoms, 1976; Gabor & Gottheil, 1984; Morselli & Royer, 2008; Pettiway, 1982; Snook, 2004; Van Koppen & Jansen, 1998). Selecting targets further away from home may also help offenders to avoid arrest (Capone & Nichols, 1976; Lammers & Bernasco, 2013; McIver, 1981).
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However, it remains unclear whether offenders' target choice may be informed by their anticipation of higher profits and lower risks. This PhD study's results suggest that the lure of higher profits does not make offenders increase the travel costs associated with their target choice. A reduced risk of detection and arrest seems to be what offenders primarily rely on to compensate for their increased travel efforts.

Longer journeys to crime have previously been found associated with higher financial rewards, with the longest crime trips typically yielding the greatest financial profits. It is not entirely clear, however, if offenders' target choice and their decision to travel further and thus raising the travel efforts may be guided by their initial expectation to make a substantially higher profit. Previous research relied on reported financial profits to study this relationship (e.g., Morselli & Royer, 2008; Van Koppen & Jansen, 1998), but offenders rarely have access to this kind of detailed information at the time they select a target and make an implicit decision as to whether or not to increase the travel efforts. If their target choice is guided by this expectation, then one could reasonably expect offenders to tap into informational resources that are available at the time this decision is made, such as environmental information that could allow them to anticipate future rewards.

However, the current study did not find support that offender’s target choice, and their implicit decision to possibly increase the travel efforts, is guided by their anticipation of higher financial profits. First, reward-related information at multiple levels of aggregation such as average property sales price at the municipality-level and the size of a residence did not affect offenders’ decision to travel to a particular target (area) and increase the travel costs required to reach that particular target (Vandeviver et al., 2015). In addition, offenders seemed unconcerned with selecting potentially more profitable residences to burglarize. They actually preferred burglarizing residences that may offer smaller financial rewards indicated by the lack of a garage at or nearby the residence (Vandeviver et al., under review). Second, offenders did not compensate their increased travel efforts by selecting potentially more rewarding targets, even though they may have had the opportunity to do so. Instead, offenders relied on risk and effort-related information to compensate travel efforts.

This raises a second point. Offenders selecting distantly located targets have a reduced chance of detection and arrest. While offenders may be aware of this and are willing to travel further to capitalize on this reduced risk (e.g., Capone & Nichols, 1976), the rational choice perspective actually proposes that risk-related information is of little importance in offenders’ decision-making (Brantingham, 2013, p. 1; Cornish & Clarke, 2006, p. 20; Felson & Clarke, 1998, pp. 7-8; see also Hakim et al., 2001, pp. 134-135). Offenders could also be unwittingly benefitting from police forces that fail to cooperate, do not share crucial offending information and as a result miss certain crime patterns (Egger, 1990; Lammers & Bernasco, 2013, p. 3; Rossmo, 2000, p. 51). If offenders draw on risk-related information to inform their target choice and take advantage of a reduced detection risk to compensate increased travel efforts, they may do so by relying on
certain environmental attributes that convey this sort of information when selecting their target (area).

The results from the reported studies suggest that offenders may indeed have a hand in their reduced risk of apprehension. First, the discrete spatial choice analysis suggests that offenders relied on a subjective appraisal of their chance to make a quick escape in case of detection by the homeowners. Once distance and risk-related information was simultaneously taken into account, the analysis demonstrated that offenders seemed to compensate increased travel costs by selecting residences with a single floor and no rooftop living floor (Vandeviver et al., under review). Second, offenders also appeared to be able to pick up on a variety of risk-related information such as the extent to which they may stand out in a municipality and the chance of arrest by the police. On the one hand, crime trip distances increased when offences were committed in ethnically heterogeneous municipalities which may allow offenders to commit their offences unnoticed (Vandeviver et al., 2015). Similarly, longer journeys to crime were associated with committing offences in municipalities that had a denser road network and therefore may offer more escape routes to the offenders. On the other hand, committing offences in municipalities that had a higher probability of arrest by the police was associated with shorter journey-to-crime distances.

In summary, while longer crime trips may ultimately result in higher financial profits, the current results indicate that offenders’ initial decision to travel further was not guided by their anticipation of higher financial profits. Moreover, offenders did not compensate the costs of a longer crime trip by selecting more rewarding targets. Instead, offenders were intent on reducing the risks of committing their offences and seem prepared to suffer higher travel costs to achieve this goal. Mobile offenders’ lower risk of arrest may be due to the result of failing police information exchange but is also partially the result of their particular target selection strategy.

**Scientific contribution to journey-to-crime research**

In addition to its prime results, this dissertation carries two general implications for the existing journey-to-crime literature. First, it was established that most crime trips are short, corroborating the findings from a long-term journey-to-crime research tradition (McIver, 1981; Wiles & Costello, 2000). This dissertation acknowledged that much what is known about the journey to crime is drawn from studies that suffers from important methodological problems and therefore adopted an approach that explicitly allowed to study offender mobility and the distance to crime in a fuller extent. This approach resulted in confirming some of the accepted insights with regard to the journey to crime. By doing so, this dissertation rehabilitates the findings stemming from methodologically flawed research and demonstrates their validity and generalizability. To a certain extent, this dissertation allows future researchers to continue drawing on the existing journey-to-crime research and assures them that what is known about the journey to crime is confirmed in a research setting that allowed falsification of the existing knowledge.
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The implications of the current dissertation’s findings are not just limited to confirming that crime trips are typically short. They also indicate that offenders are much more mobile than one would come to think based on an overview of the current insights with regard to the distance to crime. Considerable travelling was found to be associated with crime. Offenders did not necessarily commit their offences in close proximity to their home areas and regularly travelled more than 10 km. Some offenders were even prepared to travel more than 100 km. Importantly, these results do not stand alone but tie in with those of a number of earlier studies in multiple localities and contexts (e.g., Rattner & Portnov, 2007; Smith et al., 2009; Van Daele & Vander Beken, 2009; Van Koppen & Jansen, 1998). These studies established similar proportions of long crime trips and in combination with the results from the current dissertation they demonstrate that the occurrence of long crime trips is not an isolated research result. Additional empirical weight is added to the claim that long crime trips deserve dedicated study and are all but uncharacteristic. This study emphasizes that long crime trips cannot simply be ignored since this may imply ignoring a substantial number of crime trips and may result in a considerable loss of variation in journey-to-crime distances.

Implications for the rational choice perspective

This dissertation also has a number of implications for the rational choice perspective. Some of the central arguments of this perspective require evaluation and possibly reconsideration in light of the current results. In particular, the current study challenges the importance of profits and the governing principle of profit maximization. Furthermore this study argues that the importance of risk-related information needs to be highlighted even though the rational choice perspective suggests that distant risks are of little importance for offenders’ decision-making. This is however not to say that the rational choice perspective in itself is challenged. This study highlights after all the importance of environmental information and identified that the occurrence of long crime trips may be the result of offenders balancing the costs and benefits of their decisions.

In general, the results of this dissertation fit with the rational choice perspective. They demonstrate the usefulness of this perspective for studying remote target selection and the ensuing occurrence of long crime trips. The rational choice perspective is a helpful framework to understand how offenders may come to decide to select a remote target and travel further, even though there may apparently be plenty of suitable targets nearby. The current results highlight that offenders are keen on minimizing efforts as much as possible but have target selection strategies that ensure increased efforts can be compensated and may ultimately prove worthwhile. The studies presented in this dissertation provide valuable insight into how offenders balance the costs and benefits of their decisions, including their target choice, and offer an explanation as to how offenders may feel compelled to increase their travel efforts when they expect to capitalize on other benefits such as a reduced risk of detection and apprehension. The
results also underline that offenders’ decisions are impacted at multiple stages in the offending process. Although offenders may initially need to assess certain costs and benefits of selecting a particular target area to commit their burglaries and are forced to evaluate to what extent increased travel effort may be profitable, they are able to deploy additional compensation strategies at a later stage in their decision process such as when they select their ultimate burglary target. Three research results of the current PhD dissertation in particular stand out in relation to the adopted rational choice perspective.

As suggested within the rational choice perspective (Cornish & Clarke, 1986a, p. 2; 2008, pp. 22, 38), environmental attributes were found to play an important role in offenders’ decision-making and their effort to balance costs and benefits. Offenders’ personal characteristics had no major influence on their decision to increase or decrease travel efforts. In one of the studies discussed in this dissertation (Vandeviver et al., 2015), personal characteristics initially affected offenders’ decision to increase the travel costs associated with committing their offence. Their effect, however, was rendered insignificant once environmental attributes were introduced in the statistical models. This indicates that offenders, regardless of their individual features, rely on environmental attributes to weigh the costs and benefits of selecting a remote target and undertaking a longer journey to crime. This finding provides support for the rational choice perspective’s claim that offending decisions come about because of offenders’ interaction with the environment and situation (Cornish & Clarke, 1986a; 2008).

Notwithstanding the limited influence of offenders’ individual characteristics on the criminal decision-making process, environmental factors are the major determinants that shape criminal decisions. Contrary to what the rational choice perspective suggests (Brantingham, 2013, p. 1; Cornish & Clarke, 2006, p. 20; Felson & Clarke, 1998, pp. 7-8; see also Hakim et al., 2001, pp. 134-135), reward-related information did not dominate offenders’ decision-making. Higher perceived rewards were not the major driving force behind offenders’ target choice. In fact, offenders seemed to be relatively unconcerned with increasing the profits of their offences and actually preferred targets with certain attributes that may signal reduced rewards (Vandeviver et al., under review). Offenders were also not intent on compensating increased travel efforts by committing their offences in potentially more rewarding municipalities (Vandeviver et al., 2015) or burglarizing residences that could allow them to realize a higher profit (Vandeviver et al., under review). These results may cast doubts on one of the central claims of the rational choice perspective that offenders are primarily concerned with short-term gains, but could also reflect societal changes. Offenders may expect to make a profit anyway (Townsley et al., 2014; Vandeviver et al., under review; Vandeviver et al., 2015, p. 19), regardless of their efforts to select a particularly profitable target area or choosing a wealthy-looking residence. In particular, the widespread availability of so-called CRAVED goods (Clarke, 1999) – hot products that are concealable, removable, available, valuable, enjoyable and disposable such as smart phones, tablets, laptops and much more – in today’s households may explain why
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offenders are not concerned with environmental attributes that signal wealth. Burglarizing any house could result in substantial financial profits. Offenders may realize this and therefore pay little or no attention to reward-related information when balancing the costs and benefits of their decisions.

Although the rational choice perspective holds that remote and intangible costs are of minor influence on offenders’ decision-making process (Brantingham, 2013, p. 1; Cornish & Clarke, 2006, p. 20; Felson & Clarke, 1998, pp. 7-8; see also Hakim et al., 2001, pp. 134-135), risk-related information actually played a prominent role in this process. Offenders were prepared to increase the travel efforts if this allowed them to operate in municipalities with a reduced risk of apprehension or offered reassurances to escape arrest in case of detection both at the municipality and house-level (Vandeviver et al., under review; Vandeviver et al., 2015). Offenders were also hesitant to travel further if this subjected them to a greater risk of arrest (Vandeviver et al., 2015). While the rational choice perspective suggests that distant risk-related information such as the probability of arrest is of little importance to offenders (Felson & Clarke, 1998, pp. 7-8) and previous studies concluded that offenders fail to accurately assess objective risk rates (Van Daele & Vander Beken, 2011b, p. 75), the current results indicate that at least a subjective evaluation of risk-related information may be much more pertinent for offenders and that they tap into it when balancing the costs and benefits of their decisions.

There remain two thoughts to be expressed with regard to the rational choice perspective that follow indirectly from this dissertation. This first is related to the notion that offenders make decisions under less than perfect circumstances and do not necessarily have access to full and perfect information on their many choice alternatives. The rational choice perspective does not argue that offenders plan their offences in detail nor that they explicitly and elaborately weigh the advantages and disadvantages of their decisions (Canter & Youngs, 2008, p. 14; Cornish & Clarke, 2006, p. 20). Instead, it proposes that offenders’ decision-making is satisficing instead of optimizing and that offenders’ decisions reflect this. Offenders’ choices and decisions are not random but precisely the outcome of a boundedly-rational decision-making process. The perspective advocates the image of an offender who considers the possible advantages and disadvantages of his actions, albeit minimally and momentarily (Andresen, 2010, pp. 22-23; Felson & Clarke, 1998, p. 7). It acknowledges that time and information constraints affect offenders’ decision-making and recognizes that collecting information and postponing decisions also induce costs. Furthermore, it accepts that offenders have limited cognitive resources to digest all collected information and that this is reflected in their decision-making. Although it is acknowledged in the theoretical argumentation underpinning the rational choice perspective that offenders try to make the best decisions under uncertain circumstances (e.g., Cornish & Clarke, 2008, pp. 25-26), empirical applications of this perspective rarely recognize decision-makers’ bounded rationality and their tendency to satisfice rather than optimize, possibly because the research implications of accepting this point of view are not entirely clear. While there is
only one best decision given the circumstances (the optimal one), there are many competing satisficing decisions that are all ‘good enough’. However, this view is not easily applied in the current theoretical and statistical models that are available to criminologists. This difficult stance with regard to offender’s bounded rationality is poignantly observed in the many applications of the discrete spatial choice framework to offenders’ spatial decision-making, which all have in common that they tacitly assume that offenders are omniscient with regard to their surrounding environment and have access to near-perfect information on the many criminal opportunities in this environment. Moreover, all decision-makers are assumed to make optimal decisions and share a large set of alternatives from which they select one possible alternative. However, as the scale of the study area or size of the choice set increases and the spatial unit of analysis becomes more fine-grained, as is the case in the third chapter of this dissertation, this implicit assumption becomes difficult to maintain.

A potential way to solve this, may be by drawing on the insights from crime pattern theory (Brantingham & Brantingham, 1984) and recognizing that offenders are limited to selecting targets in areas they are familiar with or have some preexisting knowledge about. This requires that researchers collect information on offenders’ spatial knowledge which may be obtained by measuring it directly, through interviewing offenders (Summers, Johnson & Rengert, 2010), or by estimating such information, through inclusion of the location of past homes or former crime sites in the statistical models (e.g., Bernasco, 2010b). By including measures of offenders’ spatial knowledge, one may be able to recognize that variation in spatial knowledge on criminal opportunities exists between offenders and that multiple offenders do not necessarily share a common choice set of alternatives. This may particularly help to acknowledge that offenders have imperfect information on their surrounding environment and may rely on informed best-guesses to select possible crime sites. Although an offender may seem to fail to select the optimal target, inclusion of his spatial knowledge may help to understand that the selected target was one of multiple possible targets that were good enough given the circumstances or maybe even the optimal target given that particular offender’s limited spatial knowledge.

The second thought concerns the rational choice perspective and its applicability in criminological research. In itself, the rational choice perspective is an abstract framework that is difficult to adopt in empirical research. The essence of this framework boils down to indicating a common-sense relationship between costs and benefits: offenders commit crime when the benefits transcend the costs (Brantingham, 2013). Unfortunately, the perspective does not offer any additional indications with regard to what exactly those costs and benefits may be, how offenders may evaluate and balance these costs and benefits, and which behavioral rules may be important for understanding offending behavior and offender decision-making. In sum, the rational choice perspective does not contain a set of propositions that can be straightforwardly implemented and tested in environmental criminological research. Developing verifiable propositions,
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defining costs and benefits and clarifying the additional behavioral rules that govern offender decision-making are left to the researcher. Although this opens up the possibility for a great deal of flexibility, it may be detrimental to critically testing the claims of this perspective. Definitions and interpretations are rarely comparable across multiple studies, and there is always the possibility to reframe research results using the offenders’ subjective interpretation and evaluation of costs and benefits; one offender’s benefits may be another one’s costs. However, this does not mean that the rational choice perspective should be discarded and cannot be adopted in environmental criminological research. Both this dissertation and previous research (e.g., Elffers, 2004; Hakim et al., 2001) have demonstrated that the rational choice perspective allows to develop models to study offending behavior and offender decision-making. In spite of this, the applicability of the rational choice perspective may be limited because it remains a rather abstract and general framework for understanding offender decision-making. Developing the framework into a verifiable theoretical model with testable propositions requires additional context and supplementary content to clarify the costs and benefits, the choice situations and behavioral rules that govern these situations.

One particular promising avenue to further develop the rational choice perspective into an empirically verifiable behavioral model may be offered by optimal foraging theory (Bernasco, 2009; Brantingham, 2013; Johnson, 2014; Johnson, Summers & Pease, 2009). Optimal foraging theory is a branch of behavioral ecology that seeks to explain how animals meet their dietary needs. Although it focuses on animal behavior, the questions tackled by this theory are similar to the questions addressed in environmental criminology and the behavioral principles developed within optimal foraging theory are analogous to the behavioral principles propagated by the rational choice perspective (Felson, 2006; Johnson, 2014). Optimal foraging theory essentially defines foraging as a process aimed at maximizing the intake of resources, while minimizing acquisition time and exposure to risks. In other words, both foraging behavior and offending behavior are governed by an underlying process of profit maximization and effort minimization. Contained within the theory are also a set of behavioral rules that allow to develop testable hypotheses (for an overview, see Bernasco, 2009; for a clear example, see Brantingham, 2013). These rules allow explaining among other things offenders’ target choices, offenders’ use of space and time, the frequency with which offenders target remote locations, their mobility with a particular emphasis on certain compensation strategies that may be expected to be deployed as the distance to the target increases. In summary, optimal foraging theory offers access to a formal set of testable propositions that help to adopt the formal framework offered by rational choice perspective in empirical research.

Policy implications

In addition to a number of implications for the criminological knowledge on distance to crime and the rational choice perspective, this thesis and its results also have a societal
impact and carry implications for crime control policy. These implications relate to day-
to-day cooperation and information exchange between law enforcement agencies but
also affect the practices and policies that shape police investigations into property
offenders.

The most obvious implication of this dissertation for crime control policy is that its results
underline the importance and relevance for local police forces to look beyond the local
jurisdictional boundaries in order to effectively combat crime. This may be important to
solve offences, identify offending patterns and chart general offender mobility. Previous
research into offender mobility already highlighted that offenders are able to avoid
detection and escape arrest by increasing their criminal range and suggested that
offenders may benefit from locally operating police forces (e.g., Capone & Nichols, 1976;
Lammers & Bernasco, 2013; McIver, 1981). This is confirmed by this study’s observations
that offenders are mobile and that up to a third of all crime trips are longer than 10 km,
implying not only that substantial numbers of offenders regularly cross police
jurisdictional boundaries but also commit offences in multiple police jurisdictions. When
focusing only on the local catchment area, police forces may fail to notice these
offenders and their criminal events may remain unsolved. An effective police response to
these offenders and their offences will require close cooperation and timely information
exchange between neighboring local police forces. A local police force typically has
additional, soft information on the offenders active in its catchment area and will be
aware of certain local offenders that are responsible for a great deal of offences in its
jurisdiction. If a particular offence is recorded, the local police may be quick to identify a
number of usual suspects and the offenders involved may experience that the police is
actively monitoring them. However, other police forces rarely have direct access to this
type of information. They may therefore be unfamiliar with the offending habits of
visiting offenders in their jurisdiction and could lack access to up-to-date information on
their prior offences. Even when they have this type of information readily available, non-
local offenders cannot as straightforwardly be brought in for questioning as can be done
with local offenders. This requires a degree of planning with and cooperation from the
other local police forces involved. As a result, offenders leaving their home areas and
committing offences in neighboring areas may go unnoticed for a while, until the
receiving police force is aware of their presence and becomes familiar with their
offending behavior. However, this can be resolved by sharing police information with
neighboring police forces and closely cooperating with each other to identify possible
suspects. Over time, local police forces may consider bundling their resources by
increasing the scale of their police investigations as well as their support services that
provide information with regard to offending patterns. As this dissertation demonstrated
by studying offender mobility within the context of a large study area, comprehensive
and accurate information on offender mobility requires looking beyond the local
boundaries and taking the offenders from neighboring jurisdictions into consideration.
Second, this dissertation highlights the importance and relevance of environmental information at multiple levels of spatial aggregation for crime control policy and daily police practice. Throughout this dissertation it was demonstrated that environmental attributes allow explaining variation in distance to crime. This was true for characteristics of the target municipalities and was also the case for attributes of the burglarized houses. The latter provided information on the types of residences that stand out in the burglary target selection process. Furthermore, offender characteristics were relatively unimportant to understand why some crime trips are longer than others. While this provides support for the central tenets of the rational choice perspective, this also carries implications for the everyday practice of police investigations. Contrary to offender characteristics, attributes of the targets and target areas are available to the police as soon as a crime is recorded. This potentially provides them with general information on the possible home areas of the offenders. In particular, environmental information may help police forces to distinguish between local and non-local offenders. In this dissertation, target area attributes were used to explain variation in crime trip distances and indirectly the choice of an offender to commit a burglary in a particular municipality. It was found that certain environmental attributes increased crime trip length, while other attributes reduced crime trip length. By extension and adaptation, this type of information could also be used to determine whether offenders in a particular municipality are more likely to be locals or non-locals coming from outside the local jurisdiction, and whether offenders targeting a particular type of residence are likely to be found in its direct proximity or whether they may have travelled a longer distance. When looking for possible suspects, this could help police forces to determine whether identifying suspects in their own jurisdiction should be of priority or whether neighboring police forces should be contacted and police information exchanged. Obviously, this cannot be implemented immediately since it requires that the police analyze their databases across multiple years to establish stable offending patterns and identify trends in home locations of the offenders. Nevertheless, this may offer the potential to bring up clearance rates, allocate scarce investigative resources more effectively and develop information-led crime control policies informed by environmental information. Worth noting is that the environmental information and datasets that were used in this dissertation are already available to police forces in Belgium since they are either publicly accessible (Statistics Belgium, 2013) or are maintained by the government and can be purchased for a small fee (Belgian Land Registry, 2013).

Finally, this dissertation highlights that crime control policies should address offenders’ appraisal of risks. The current results suggest that there may be little potential for reducing rewards in the prevention of burglary since it was established that reward-related information was relatively unimportant in offender decision-making. Instead, crime control policies should be aimed at increasing the risks associated with committing offences. This requires both improving current detection and clearance rates but also addressing offenders’ appraisal of risks. Implementing this strategy will require
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cooperation between law enforcement agencies, members of the public and local
governments. In the first place, law enforcement agencies need to invest in improving
current clearance rates, as clearance rates have been found to negatively affect crime
trip length in East and West Flanders. By extension, this result indicates that offenders
may be hesitant to leave the proximity of their home areas if this subjects them to an
increased risk of detection and arrest. This is beneficial for a local police force, since this
could result in keeping their usual suspects contained within their local jurisdiction.
Police forces have a number of options to bring up clearance rates, including close
cooperation with neighboring police forces, improving information exchange and
implementing data driven police investigations. In the second place, members of the
public carry a responsibility in deterring burglars and reducing the risk of their residence
being targeted for a burglary. This was apparent in the outcome of the discrete spatial
choice analysis which demonstrated that residence-related attributes affect the target
choices of burglars. Since this analysis indicated that risk appraisal was important for
burglars when distinguishing between possible burglary targets as well as information
related to the ease with which they may gain access to the dwelling, this offers
opportunities for citizens to negatively affect burglars’ appraisal of risks and efforts. In
particular, certain attributes in and around the home can be altered such as installing
grilles in front of windows or improving the material of window and door frames. Finally,
local governments could inform individuals about strategies that may deter burglars and
could set up initiatives that encourage citizens to implement precautionary measures.

Limitations

Like any other research, the current study has several potential methodological
limitations, which have already been discussed in the various chapters of this
dissertation. The most important limitations of this study are rooted in its use of police
recorded crime data and relate to the external validity of the results.

First, local offenders may be overrepresented in police recorded crime data (Bruinsma,
2007; Rengert, 2004). Lammers and Bernasco (2013) previously demonstrated that
mobile offenders have a better chance of avoiding arrest and their information is thus
less likely to be found in police files. Furthermore, the current study found that longer
crime trips are associated with burglarizing in areas where offenders stand a better
chance of not being detected and that the selection of remote targets is associated with
house attributes that may help to improve the chances of escape in case of detection
which may compound this effect. However, this limitation must not be problematized. It
largely implies that the current study might underestimate offender mobility and the
number of long crime trips. The current results are still meaningful but are perhaps
better interpreted as a lower bound of the total number of long crime trips and highly
mobile offenders present.
Second, only cleared offences were used in the analyses. As highlighted in chapter two, the police cleared approximately one out of ten burglaries recorded in East and West Flanders (Vandeviver et al., 2015). Although this rate is low it is not very different from the detection and clearance rates in other Western countries (Bernasco & Nieuwbeerta, 2005, p. 305). Unfortunately, the sample sizes were additionally reduced due to supplemental selection criteria introduced at various points in the analysis. The most dramatic example of the impact of this approach was witnessed in the discrete spatial choice analysis. Only 650 burglaries out of the initial 4,308 cleared burglaries in East Flanders were analyzed after implementing the strict inclusion criteria, amounting to approximately 15% of the original sample size. However, this approach is not uncommon for discrete choice studies (e.g., Bernasco & Nieuwbeerta, 2005; Clare et al., 2009) and the strict selection criteria were nevertheless deemed necessary to obtain reliable results and are discussed in detail to guarantee replicability of the results.

Third, offenders were assumed to begin their journeys to crime from their legal address. This may be a particularly strong assumption (cf. inter alia Rossmo, 2000, p. 91), after all offenders could start their crime trip from a variety of locations, but it has theoretical grounding (Canter & Larkin, 1993; Levine & Lee, 2013; Sarangi & Youngs, 2006) and is not uncommon for journey-to-crime and offender mobility research (Bruinsma, 2007, p. 485). It is also a pragmatic solution to the lack of systematically registered information on additional addresses and possible anchor points of the offenders in the recorded crime data.

As a final note, it deserves mentioning that these limitations are not unique to this study but are shared with other studies that use police recorded crime data as well. Furthermore, alternative methodologies such as offender interviews and ethnomethodology may suffer from similar non-probabilistic biases (Townsley et al., 2014, p. 20).

Future research

Although this dissertation advanced the understanding of variation in crime trip length and how this is related to the rational choice perspective, there is scope for future research on several topics touched on in this dissertation. This final section highlights some potential avenues for future research.

First, future research could critically scrutinize crime trip length and the occurrence of long journeys to crime in relation to the starting points extracted from police recorded crime data and other relevant offender anchor points obtained through offender interviewing. In this dissertation, it could not be scrutinized whether long crime trips reflect actual mobility on the part of the offenders or if long crime trips are partially attributable to measurement error in distance to crime introduced by incorrectly identifying the starting point of the journey to crime. It was assumed that crime trips start from the offenders’ legal addresses. Although this assumption has theoretical
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grounding (Canter & Larkin, 1993; Levine & Lee, 2013; Sarangi & Youngs, 2006), crime pattern theory highlights that multiple locations may be relevant for an offender’s use of the environment and could act as the starting point of the offender’s crime trip (Brantingham & Brantingham, 1984). Furthermore, earlier research reports that some extremely mobile offenders begin their crime trips from temporary residences or local pubs (Van Daele, 2009; Wiles & Costello, 2000). While this observation did not immediately result in adjusting crime trip distances downwardly, it did stress that the official address is not always the most appropriate starting point to consider. However, critically examining the starting points of offenders’ journeys to crime and possibly reevaluating crime trip distances requires supplemental address information that is rarely available in the sort of recorded crime datasets used in this study. At least in Belgium, police do not systematically register address data on secondary addresses, anchor points and activity nodes that might have been relevant for the offender during the commission of his offence. Acquiring this information would involve the use of offender interviews, in which paper or electronic maps might be particularly useful to elicit information on an offender’s spatial behavior and his journey to crime (Summers et al., 2010; Vandeviver, 2014).

The second suggestion for further research is to examine variation in the importance of distance as a choice criterion in offenders’ target selection process. Throughout this study, particularly in chapter three, it was assumed that distance influences offenders’ crime site preference similarly. This is not necessarily the case. Recent studies highlight that there exists considerable variation between offenders in the distances travelled and that this variation is distributed unevenly among offenders (Smith et al., 2009; Townsley & Sidebottom, 2010; Van Daele, 2010). Some offenders seem unconcerned with reducing their distance to crime at all and consistently travel greater distances, while others limit their journey-to-crime length and still others intermittently travel short and long crime trips. Future research could examine this in detail and acknowledge that the effect of distance on offenders’ spatial preference is not constant for all offenders. This may require the application of the mixed logit model, which is an extension of the discrete choice model and allows exploring variation in choice criteria between decision-makers (Bernasco, 2010a; Train, 2009), but could also involve testing for the presence of interaction effects between offender characteristics and distance in order to establish to what extent distance is an equally important choice criterion for different types of offenders. Possible hypotheses that could be tested are whether juveniles’ reduced access to motorized vehicles may result in distance being a more important constraint for their target choice than for adult offenders’ target choice or whether distance becomes a less important choice criterion as offenders become more experienced in selecting targets and committing their offences. For example, Bernasco and Nieuwebeerta (2005, pp. 309-310) previously examined whether proximity of the offender’s home neighborhood to a target neighborhood is a more important constraint for juvenile
burglars’ target choice than for adult burglars but could not validate this hypothesis (see also Bernasco, 2010a).

Finally, offenders’ target selection process in general deserves continued study. The introduction of the discrete spatial choice approach in criminology by Bernasco and Nieuwebeerta (2005) offered criminologists the analytical framework to better comprehend criminal location choice and offenders’ spatial decision-making. This has led to an initial understanding of how offenders come to choose a crime site (e.g., Bernasco & Block, 2009; Bernasco & Nieuwebeerta, 2005; Townsley et al., 2014). However, two important aspects of offenders’ spatial decision-making have not yet been examined and could be addressed in future studies. From within the rational choice perspective it is argued that offender’s target choice is a spatially structured, hierarchical sequential process that involves the offender making sequential decisions with regard to multiple levels of spatial aggregation (Cornish & Clarke, 1986a; 2006; 2008). The spatial resolution of offender’s target decisions gradually narrows down throughout this sequential decision-making process. Before deciding on a particular target to burglarize, a burglar has already made several decisions with regard to a suitable neighborhood and municipality in which he intends to commit his burglary. On the one hand, this entails that multiple levels of spatial aggregation play a role in offenders’ decision-making and that environmental attributes at different levels of spatial aggregation affect offenders’ target choices. Since residences are nested within neighborhoods and neighborhoods are nested within municipalities, offenders’ target choices are nested choices. On the other hand, offenders’ decision-making is thought to be sequential. This implies that offenders make decisions with regard to multiple levels of spatial aggregation at different moments in time. Offenders first select a municipality before selecting a neighborhood and finally choosing a particular target. This also implies that offenders do not consider all possible residences in a large area simultaneously when looking for a burglary target but only consider residences present within the confines of their earlier spatial choices. Attributes of a particular residence are only relevant to the offender within the context of a certain neighborhood. For example, consider burglar’s choice of target in East Flanders. If the sequential nature of this decision-making process is acknowledged, this implies that a burglar initially has to choose one of 65 municipalities in which to commit his burglary. Within that chosen municipality, the burglar has to select one neighborhood out of a few dozen alternative neighborhoods and, within that neighborhood, one residence from a handful of alternative residences. However, current applications of the discrete spatial choice approach in criminology assume that all alternatives are simultaneously considered, even though this may have little credibility if this choice is studied within an extremely large study area that contains more than 500,000 alternative residences and spans more than 3,000 km². It is highly unlikely that information is available on all alternatives present in the choice set and if this would be the case, this would surely lead to information overload for the decision-maker. Reframing offender’s target choice as a hierarchical, sequential choice relating to multiple levels of spatial aggregation at
different time points in the decision process may help to overcome this strong assumption and brings offender target selection models more closely in line with the theoretical understanding of offender’s spatial decision-making. Developing such models will not be straightforward and will require the application of a variety of statistical models including extensions of the discrete choice model such as the nested logit model which allows modelling hierarchical spatial choice structures, the mixed logit model which allows for random taste variation between decision-makers or the mixed nested logit model which helps to represent hierarchical choices with random taste variation between decision-makers (see Bernasco, 2010a; Train, 2009) but may also require a better understanding of decision theory and sequential choice theory in criminology.
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This dissertation studies why some offenders select targets further away from home and why some journeys to crime are therefore longer than others. It builds upon the rational choice perspective to reframe the occurrence of long crime trips in terms of a balancing act between costs and benefits.

In contrast to former research, offender mobility and the journey to crime are now studied within multiple, large geographic areas. This approach not only makes it possible to confirm the existing knowledge established in earlier journey-to-crime research but also stresses that long crime trips occur more frequently than previous research suggested. Through the application of multiple methods and the analysis of various data sources, this study demonstrates that environmental attributes at the municipality level help to explain variation in crime trip length and highlights that a reduction in risk exposure may help offenders to compensate for increased travel costs.

Although the current study finds confirmation for some of the central arguments informing the rational choice perspective, the combined results stress that some of these arguments need to be reconsidered. In particular, the hypothesized importance of reward-related information could not be established in this study and risk-related information was found to be of importance for understanding increases in crime trip length. This dissertation discusses the difficult relationship between the rational choice perspective and empirical research and suggests to further develop the rational choice perspective into an empirically verifiable behavioral model.