Journal of Quantitative Criminology
https://doi.org/10.1007/s10940-019-09431-y

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"Location, Location, Location": Effects of Neighborhood and House Attributes on Burglars' Target Selection

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Abstract

Objectives To empirically test whether offenders consider environmental features at multiple spatial scales when selecting a target and examine the simultaneous effect of neighborhood-level and residence-level attributes on residential burglars' choice of residence to burglarize.

Methods We combine data on 679 burglaries by 577 burglars committed between 2005 and 2014 with data on approximately 138,000 residences in 193 residential neighborhoods in Ghent, Belgium. Using a discrete spatial choice approach, we estimate the combined effect of neighborhood-level and residence-level attributes on burglars' target choice in a conditional logit model.

Results Burglars prefer burglarizing residences in neighborhoods with lower residential density. Burglars also favor burglarizing detached residences, residences in single-unit buildings, and renter-occupied residences. Furthermore, burglars are more likely to target residences in neighborhoods that they previously and recently targeted for burglary, and residences nearby their home. We find significant cross-level interactions between neighborhood and residence attributes in burglary target selection.

Conclusions Both area-level and target-level attributes are found to affect burglars' target choices. Our results offer support for theoretical accounts of burglary target selection that characterize it as being informed both by attributes of individual properties and attributes of the environment as well as combinations thereof. This spatial decision-making model implies that environmental information at multiple and increasingly finer scales of spatial resolution informs crime site selection.

Keywords Discrete spatial choice · Location choice · Target choice · Burglary · Rational choice · Conditional logit

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Published online: 11 October 2019

Introduction

"Location, location, location", is a popular advice in real estate. It warns buyers searching for a home against a myopic focus on the qualities of individual properties, emphasizing the importance of the physical and social environment, such as the lifestyles of neighbors and the accessibility of amenities. In sum, the advice underlines that the value of a property is, to a large extent, determined by its surroundings.

Real estate agents and prospective homeowners share their interest in real estate with burglars. But do burglars follow the 'triple location' advice? When burglars decide on which home to target, do they myopically focus on the attributes of an individual residence, or do they also take into account its physical and social environment? In other words, does the choice of a burglary target depend on the target only, on its spatial context, or on both?

How burglars evaluate and select the residences that they target is of theoretical and practical importance. Theoretically, it speaks to the rational choice perspective, in particular to the untested claim that burglars' target selection is informed both by attributes of individual properties and attributes of their environment (Cornish and Clarke 1986). These attributes signal the expected costs and benefits of committing a burglary against this target (Brantingham and Brantingham 1978). Understanding how burglars select targets has practical relevance for burglary prevention. If burglary victimization risk is determined only by characteristics of the property, then burglary prevention is essentially a private responsibility. Conversely, if environmental attributes affect burglary risk, communal efforts and collective investments may be necessary and could prove cost-effective.

The major contribution of our research is that it investigates burglary target choice at the appropriate level of aggregation—burglars burglarize homes rather than complete neighborhoods—while still considering neighborhood-level attributes that affect these choices and taking into account the home locations of the burglars themselves and their limited action radius. With a single exception (Vandeviver et al. 2015a), all studies of burglary that used the crime location choice framework have hitherto implicitly assumed that burglars target areas (neighborhoods, postcodes, output areas, or street segments) rather than individual properties (Ruiter 2017). In reality, however, it is evident that burglars target individual houses or apartments, not neighborhoods, although clearly their choices may be affected by neighborhood attributes. Thus, we advance the burglary location choice literature by taking into account characteristics of both the property and the surrounding neighborhood.

Some prior burglary research has also addressed the potential multilevel structure of burglars' target selection by including home and neighborhood attributes (Bowers et al. 2005; Rountree and Land 1996). However, these studies did not take into account the distance from their homes that burglars would have to travel to and from the targeted properties, although distance is arguably one of the main determinants of where burglars commit burglaries (Ruiter 2017). Ignoring the distances between burglars' homes and their targets may seriously confound the estimated effects of other variables. The finding that burglars prefer to offend in disadvantaged neighborhoods, for example, might reflect that many burglars themselves live in disadvantaged areas and prefer to offend in the proximity of their homes (Bernasco and Nieuwbeerta 2005). In other research traditions, ethnography (Wright et al. 1992), interviews (Bennett and Wright 1984), quasi-experimental (Nee and Taylor 2000; Taylor and Nee 1988), and experimental approaches (van Gelder et al. 2017) have been used to assess which residential characteristics make an attractive burglary target, but this research has largely overlooked that the evaluation of a property might be affected by its wider environment. In the present study, we use both home and neighborhood attributes, and simultaneously condition on the home locations of burglars. By doing so, we combine the strengths of each of these traditions, while avoiding their limitations.

The remainder of this article is structured as follows. The next section reviews prior empirical research on burglars' spatial decision-making. In the subsequent section, we ground our study in extant theory and formulate hypotheses. In the next two sections, we discuss the data and method used in this study. This is followed by a presentation of the results and, finally, a conclusion and discussion.

Prior Research

Methods of Research on Burglars' Spatial Target Selection

The target selection strategies of burglars have been studied with various research methods, including ethnographic offender-based interviews, offender-based experimental (vignette) studies, and large-scale quantitative studies based on police records or victimization surveys.

Findings from interview studies tentatively support the idea that burglars' evaluate multiple levels of spatial resolution when selecting a suitable target. They seem to rely on a combination of general information, simple heuristics, and more complex deliberation. Burglars report that expected resident wealth and other population characteristics guide them in their choice of target area, and that they rely on readily observable residence attributes (e.g., building type) and situational cues (e.g., temporary absence of residents) when selecting individual residences (Maguire and Bennett 1982; Nee and Meenaghan 2006; Nee and Taylor 2000; Wright and Logie 1988).

Results from quantitative studies and from offender-based experiments also suggest that both area and residence attributes affect burglars' choice of target residences. Offender-based experiments have typically focused on residence characteristics while quantitative research based on victimization surveys or police records has included both levels. Studies that apply the discrete spatial choice approach, arguably the preferred framework to address offender spatial decision-making (Ruiter 2017; Townsley et al. 2015), have predominantly investigated the choice of target neighborhood, but not target residence. Three exceptions are studies by Bernasco (2010b) who used small area postal codes (containing 18 residences on average), Frith et al. (2017) who used street segments (containing 16 residences on average), and Vandeviver et al. (2015a) who used individual residences, as we do in this study. Bernasco (2010b) found that burglars' target choices were affected not only by socio-demographic attributes of the postal code area, but also by attributes of adjacent postal code areas. Focusing on the position of street segments in the urban road network, Frith et al. (2017) found that segments with large general accessibility and large offender-specific accessibility were more likely to be selected for burglary. Vandeviver et al. (2015a) applied the discrete spatial choice approach to individual houses but did not investigate effects of neighborhood-level attributes. They established that residential features affect burglars' appraisal of target suitability.

Relevant Attributes of Neighborhoods and Residences

In the aftermath of burglary, the risk of future victimization is elevated for both the initial target as well as nearby potential targets (Johnson et al. 2007; Townsley et al. 2000, 2003). In previous research, it has been argued that it is the involvement of the initial offender that gives rise to repeat and near-repeat victimization patterns (Bernasco 2008; Johnson et al. 2009). As such, repeat offending against the same target or targets nearby the initial target may be an important target selection strategy for burglars. Within the context of discrete spatial choice studies, Bernasco et al. (2015) demonstrated that burglars are more likely to commit a burglary in an area they had targeted before, particularly if the prior burglary was recent. More generally, Lammers et al. (2015) established that prior locations of recent offences strongly influence subsequent choices of target areas.

One finding consistently reported across all discrete spatial choice studies is that burglars tend to target neighborhoods nearby their own home (Ruiter 2017). As to generic attributes independent of the locations of offenders' own homes or those of their prior burglaries, various studies have further confirmed that burglars tend to select neighborhoods that contain more easily accessible targets, and have a greater supply of potential targets available (Bernasco and Nieuwbeerta 2005; Townsley et al. 2015, 2016). In addition, in some studies effects were observed for ethnic heterogeneity boosting the likelihood of an area being targeted for burglary (Bernasco and Nieuwbeerta 2005) and neighborhoods with a higher degree of rental properties having a greater likelihood of being targeted (Clare et al. 2009). Furthermore, burglars tend to select areas containing train stations, with higher real estate values, and higher population turnover rates (Bernasco et al. 2015). In the only study to date that applied the discrete spatial choice framework to study burglars' choice of individual residence to burglarize, Vandeviver et al. (2015a) determined that burglars were more likely to select residences closer to their home, terraced dwellings instead of semi-detached ones, residences without garages, and residences without central heating or air-conditioning systems installed.

However, evidence for the importance of residence-level attributes in burglars' cost–benefit balancing is primarily found through burglar experiments and quantitative studies of observational data. In early offender experiment studies burglars were shown manipulated photographs to isolate the effects of certain residence attributes on their target choice (e.g., Nee and Taylor 2000; Taylor and Nee 1988). More recent quantitative observational studies apply case–control designs to systematically compare attributes of burglarized and non-burglarized residences (e.g., Langton and Steenbeek 2017; Peeters et al. 2017). Taken together, the results from these studies highlight that burglars rely on a combination of residence attributes to gauge aspects of residence wealth, the risk of detection and apprehension, and residence accessibility.

Burglars are expected to maximize their anticipated benefits. A straightforward strategy is to burglarize well-off residences instead of poorer ones, or look for targets in areas that exhibit stereotypical signs of affluence. A strategy that might require more planning or searching could involve selecting the most well-off residences in the more affluent areas. Although financial profits may be one of the major motivations for burglary, previous research produced mixed findings with regard to the importance of wealth-related residence attributes for burglary target choice. Burglary experiments revealed that certain residence attributes such as general upkeep and property size may help burglars to gauge expected payoff and distinguish wealthier target from poorer ones (Taylor and Nee 1988; Wright and Logie 1988). In contrast, area and residence attributes of wealth have not been found to impact offender's area and target choices in quantitative burglary studies (Langton and Steenbeek 2017; Townsley et al. 2015; Vandeviver et al. 2015a), prompting some scholars to suggest that the wide availability of profitable loot in today's households may render scanning the environment for wealth-related cues unnecessary (e.g., Townsley et al. 2015; Vandeviver et al. 2015a).

Several strategies may be helpful to minimize burglary costs. One strategy may be to reduce the risk of detection and apprehension by burglarizing residences when they are unoccupied, i.e., while residents are absent. Absence of residents is a major predictor for burglary victimization (Bennett and Wright 1984; Bernasco 2009; Waller and Okihiro 1978). Offender experiments reveal that situational cues conveying residents' presence such as a car parked on the driveway or lights burning in the house negatively impact offenders target choice (Bennett and Wright 1984; Cromwell et al. 1991; Wright and Logie 1988). Due to the fleeting aspect of resident presence, however, occupancy indicators are rarely included in quantitative observational studies (Langton and Steenbeek 2017; Peeters et al. 2017). Another strategy to reduce the risk of detection and apprehension may be to target residences for which it is more difficult for neighbors or passersby to notice a burglary attempt and intervene. Burglars are more likely to select residences surrounded by trees and hedges that block lines of sights and residences that are somewhat secluded (Bennett and Wright 1984; Langton and Steenbeek 2017; Peeters et al. 2017; Taylor and Nee 1988; Waller and Okihiro 1978; Wright and Logie 1988). Another strategy at the area level to contain the risks associated with burglary may be operating in areas where the risks of detection are low and guardianship levels are reduced, such as ethnic heterogeneous neighborhoods or areas with high residential mobility (Bernasco and Nieuwbeerta 2005). More advanced cost minimization strategy could entail minimizing encounter and detection risks at the residence and area level simultaneously.

Finally, in their effort to minimize costs and reduce the time and effort required to commit the offence, burglars prefer easily accessible residences. Results from offender experiments and observational studies reveal that burglars avoid residences with access-restricting features such as fences and other target hardening devices (Cromwell et al. 1991; Langton and Steenbeek 2017; Logie et al. 1992; Peeters et al. 2017; Waller and Okihiro 1978; Wright et al. 1995). In contrast, burglars prefer residences with multiple entry points such as detached and semi-detached houses (Bennett and Wright 1984; Peeters et al. 2017). Similar considerations in burglary location choice at the area level have been observed in quantitative studies. Burglars are more likely to select residences in areas that have a greater availability of easily accessible targets (Townsley et al. 2015, 2016). More sophisticated target selection schemes could involve prioritizing target accessibility at the residence and area level.

Integration of Area-Level and Residence-Level Choice Criteria in This Study

Despite research evidence highlighting that attributes of multiple spatial levels impact burglars' target choices, few studies have explicitly acknowledged the simultaneous importance of area and residence-level attributes (for an exception, see Bowers et al. 2005). In particular, extant discrete spatial choice studies consider either area-level or residence-level attributes, but not both.

This study integrates neighborhood and residence attributes into a single discrete spatial choice model of burglars' target choice. We explicitly consider the combined importance of neighborhood attributes, target attributes, and their potential interactions. In doing so, we examine the sophistication and complexity of burglary target selection in detail.

Theoretical Framework and Hypotheses

Theoretical Framework

Most research on offenders' spatial decision-making in general, and on burglars' target selection in particular, is grounded in rational choice theory and in crime pattern theory (Ruiter 2017). Rational choice theory is a general micro-economic theory of decision-making. It assumes that decision-makers maximize benefits and minimize costs. Applied to burglary, rational choice theory addresses *how* burglars choose a suitable target. It emphasizes the role of environmental attributes in evaluating costs and benefits, and highlights the goal-driven nature of burglars' spatial decision-making (Bernasco 2010a; Brantingham and Brantingham 1984; Cornish and Clarke 1986; Taylor and Gottfredson 1986).

The main assumption of rational choice theory is that offenders engage in a nominally rational cost–benefit analysis when they commit crimes and when they select crime targets (Cornish and Clarke 2008; Nee and Meenaghan 2006). In the case of residential burglary, burglars are expected to compare potential targets in terms of their expected outcomes, and to select the residence that minimizes anticipated costs while maximizing anticipated benefits. Burglary benefits are mostly material profits such as the total value of the stolen items and ease of access, while burglary costs are predominantly associated with travel efforts and the risk of detection and apprehension. Although the target of a burglary is a residence, rational choice theory articulates that the costs and benefits associated with the choice of a particular target may be impacted by attributes at higher levels of spatial aggregation, in particular at the neighborhood level. According to the rational choice perspective (Cornish and Clarke 1986, p. 4), what makes a target suitable for burglary is a combination of attributes of the residence and of its neighborhood context—a hypothesis that is very much in line with the 'triple location' advice in real estate.

When burglars value the attributes of residences and neighborhoods in order to choose their optimal target, the outcome of their judgement is not just a weighted sum of residence and neighborhood attributes. Instead, as most human evaluations are context-dependent, burglars' appraisal of residences is likely to be context-dependent too. Therefore, it should depend on the attributes of the neighborhood where the residence is located. In theorizing about this context-dependence, and in line with the rational choice postulate, we assume that for offenders to decide that a particular residence is attractive for burglary, not only the residence but also its surrounding neighborhood must meet a certain attractiveness threshold. If the neighborhood falls below the threshold, the residence attributes become irrelevant. It would be a waste of time and energy to consider and compare them. The same holds true the other way around: neighborhood attributes are irrelevant if a residence does not meet the threshold. Therefore, in burglars' target decision-making, residence-neighborhood interactions theoretically imply that the effects of positively valued residence attributes and positively valued neighborhood attributes should strengthen each other.

Crime pattern theory addresses *where* offenders search for suitable targets. It supplements rational choice theory by emphasizing that the spatial knowledge of offenders, like all other humans, is constrained by their awareness space (Brantingham and Brantingham 1981, 1993). This is a mental representation of the locations and routes that someone is familiar with through their engaging in daily routine activities such as attending school, working, or taking time off. For offenders, their awareness spaces may also include locations and routes they know through the commission of previous crimes (Bernasco 2008; Bernasco et al. 2015). As a result, offenders often chose burglary targets near their homes, schools, workplaces, leisure places, and prior crime scenes.

In summary, the combination of both theories provides a comprehensive theoretical framework for burglars' spatial decision-making: rational choice theory describes how a burglar selects a particular target from his or her choice set, while crime pattern theory describes an offender's knowledge of the environment and thus the construction of their choice set. In this paper, we combine elements of both rational choice theory and crime pattern theory to explain residential burglars' target selection, and derive hypotheses on which area and residence attributes affect burglars' target choices.

Research Hypotheses

In this section, we articulate our research hypotheses. For each hypothesis, we briefly discuss the theoretical grounds. First, we formulate our research hypotheses with regard to the role of neighborhood-level attributes in burglars' spatial decision-making. Next, we discuss our research hypotheses with regard to the influence of residence-level attributes on burglars' target selection. Finally, we articulate our research hypotheses with regard to the combined effect of neighborhood and residence attributes.

Hypotheses on Effects of Neighborhood Characteristics

Our first hypothesis relates to the perceived rewards of the burglary. It is difficult for burglars to assess the payoff of a burglary because valuable items are hidden inside properties. Burglars must therefore estimate the prospective value of what they might steal on the basis of cues that are observable from the outside. The affluence of a neighborhood is likely a good proxy for the expected value of what can be stolen from any residence in that particular neighborhood (Bernasco and Nieuwbeerta 2005; Townsley et al. 2015). We therefore hypothesize that:

Hypothesis 1 Burglars prefer burglarizing residences in more affluent neighborhoods over residences in poorer neighborhoods.

Target availability is a second important choice criterion. Burglars will generally prefer neighborhoods with a high target density (a greater number of residences) over neighborhoods with a low target density, because the former situation allows for more and a greater variety of alternative targets than the latter situation (Bernasco and Nieuwbeerta 2005; Townsley et al. 2015, 2016). At the time of the burglary, many residences may be unsuitable for burglary for a number of reasons, for example, because the residents are home. In such situations, the availability of a greater number of alternative residences to burglarize is a benefit over the availability of fewer alternative burglary targets. Consequently, we hypothesize that:

Hypothesis 2 Burglars prefer burglarizing residences in neighborhoods with a higher target density over residences in neighborhoods with a lower target density.

At the cost side of the equation, burglars will likely avoid neighborhoods where they expect that the risk of detection and arrest is elevated, as indicated by high social cohesion and high social control (Vandeviver et al. 2015b). Conversely, in terms of benefits, burglars will prefer neighborhoods with lower levels of guardianship and reduced chances of detection and arrest. Rooted in social cohesion and social disorganization literature (Sampson and Groves 1989), our third hypotheses asserts that neighborhoods with higher levels of ethnic heterogeneity may impede social interactions in the neighborhood (Bernasco and Nieuwbeerta 2005). This may result in reduced levels of guardianship and a decreased chance of detection. We hypothesize that:

Hypothesis 3 Burglars prefer burglarizing residences in neighborhoods with higher ethnic heterogeneity over residences in neighborhoods with lower ethnic heterogeneity.

Similar to ethnic heterogeneity, neighborhoods with higher proportions of rental units are associated with low residential stability which impedes social cohesion and social interaction, and may inhibit guardianship (Clare et al. 2009; Tseloni et al. 2002; Xie and McDowall 2008). Our fourth hypotheses therefore asserts that:

Hypothesis 4 Burglars prefer burglarizing residences in neighborhoods with higher proportions of rental units over residences in neighborhoods with lower proportions of rental units.

Finally, crime pattern theory suggests that offenders select targets in areas they are familiar with because they committed prior crimes in these areas. This proposition motivates the fifth hypothesis. Like legal activities, engaging in illegal activities allows burglars to expand their awareness space and identify suitable targets. In support of this claim, recent research has demonstrated that burglars and other offenders are likely to commit subsequent crimes in neighborhoods where they committed prior crimes (Bernasco et al. 2015; Lammers et al. 2015), in particular if the previous crime was recent and of the same type. To account for this finding, we hypothesize that:

Hypothesis 5 Burglars prefer burglarizing residences in neighborhoods where they previously committed burglaries over residences in neighborhoods where they did never before commit burglaries.

Hypotheses on Effects of Residence Characteristics

Ultimately, a specific residential unit within a particular neighborhood is the actual target of a residential burglary. Assessments of anticipated costs and benefits should therefore also affect target selection at the building and residence level. The extent to which a building is accessible is likely an important consideration when deliberating target choice (Bernasco and Nieuwbeerta 2005; Townsley et al. 2015). Detached and semi-detached buildings are easier to access than terraced buildings and residences in apartment complexes because the former can be accessed both at the street side and backside (Bernasco 2009; Bernasco and Nieuwbeerta 2005; Hakim et al. 2001; Townsley et al. 2016; Weisel 2002). Furthermore, the higher density of occupants in terraced buildings and apartment complexes may also elevate the risk of detection. We therefore hypothesize that:

Hypothesis 6 Burglars prefer burglarizing residences in a detached building or in a semi-detached building over residences in a terraced building or apartment complex.

As already briefly touched upon, burglars seek to reduce their risk of detection and apprehension and therefore must anticipate the level of surveillance and guardianship at the time of the burglary (Bernasco 2009; Ratcliffe 2002). Burglars may rely on several strategies to gauge detection and apprehension risk. A straightforward strategy is to assess the likelihood that someone is present in the target residence at the time of the burglary or, if the residence is part of a multi-unit building, in other residences in the building. More occupants in a residence may increase the likelihood of someone being present at the time of the burglary, resulting in higher natural surveillance and greater risk of detection (Vollaard and van Ours 2011). Similarly, targeting residences in a multi-unit housing complex could be riskier since there is more natural surveillance and neighbors could walk in on the burglary (Hakim et al. 2000; Weisel 2002). Therefore, we hypothesize that:

Hypothesis 7 Burglars prefer burglarizing residences with fewer occupants over residences with more occupants.

Hypothesis 8 Burglars prefer burglarizing single-unit residences over residences in multi-unit buildings.

Because not only the number of potential guardians is relevant but also the likelihood that guardians will actually exercise social control by intervening in the burglary or calling the police, burglars are expected to prefer buildings and residences that signal reduced levels of social control and social cohesion. Similar to the counterpart hypothesis at the neighborhood level (see hypothesis 4), burglars may prefer burglarizing renter-occupied residences rather than owner-occupied residences. Because renters tend to move more often than homeowners, rental status may inhibit guardianship and reduce the risk of detection since it could be more difficult for neighbors to establish whether visitors are legitimate or not (Andresen 2011; Rephann 2009). We hypothesize that:

Hypothesis 9 Burglars prefer burglarizing renter-occupied residences over owner-occupied residences.

Contained within crime pattern theory is also the argument that familiarity with certain places drives target selection and people are most familiar with the areas around their homes. Burglars are therefore expected to have better knowledge about targets near their home than about more distant targets and will therefore prefer to burglarize nearby residences over distant residences. The same hypothesis can be derived from rational choice theory if we assume that travel away from home represents one of the most significant costs that burglars would like to minimize (Vandeviver et al. 2015b). We hypothesize that:

Hypothesis 10 Burglars prefer burglarizing residences closer to their home over residences further away from their home.

Note that whereas all other hypotheses refer to attributes of residences and neighborhoods that are generic (they have the same value for all burglars, e.g., the dwelling type of a residence or the affluence of a neighborhood), hypotheses 5 and 10 address attributes that are idiosyncratic (they have different values for different burglars). In other words, prior burglary (hypothesis 5) is a neighborhood attribute that varies both across burglars and across neighborhoods, and home distance (hypothesis 10) is a residence attribute that varies both across burglars and across residences.

Hypothesis on the Combined Effects of Neighborhood and Residence Characteristics

Finally, to examine rational choice theory's claim that target suitability is ultimately assessed through a combination of attributes at the residence and neighborhood level, we test all possible 25 first-order cross-level interaction effects that are implied by the previously formulated hypotheses (hypotheses 1 through 10). For each neighborhood-level attribute, we examine to which extent it moderates the relationship between residential attributes and the likelihood of burglary target selection. In terms of the burglars' decision-making, this comes down to the question of whether burglars' appraisal of residence attributes depends on attributes of the neighborhood where the residence is located. In thinking about how burglars value the attributes of individual residences differently in some neighborhoods than in others, it seems plausible to assume that for offenders to perceive a particular residence as attractive for burglary, both the targeted residence and the surrounding neighborhood must be sufficiently attractive: each attribute must meet a certain attractiveness threshold. This proposition implies that if the residence itself is unattractive (e.g., because it is well-guarded or difficult to enter) then neighborhood attractiveness is less relevant or even irrelevant for the burglar's decision. Similarly, if the neighborhood is perceived as unattractive (e.g., because it does not signal affluence or have high levels of guardianship) then the attractiveness of the residence is less relevant or even irrelevant. In other words, the value that a burglar assigns to a potential target positively depends on both the residence and its neighborhood being perceived as sufficiently attractive.

Because each of the 5 neighborhood attributes and each of the 5 residence attributes described above are interpreted in terms of target attractiveness (adding to the potential benefits of the robbery or to reducing its potential costs) the proposition implies $5 \times 5 = 25$ interaction effects between neighborhood attributes and residence attributes. To illustrate the logic of this set of combined hypotheses, we provide two examples: an interaction between residence accessibility and neighborhood affluence, and an interaction between residence occupancy and neighborhood proximity.

The proposed interaction between residence accessibility and neighborhood affluence claims that the target value of a residence is not only larger for accessible residences in any neighborhood and that it is larger for any residence located in affluent neighborhoods, but also that residence accessibility increases the target value of a residence more in affluent neighborhoods than it does in disadvantaged neighborhoods. In other words, some neighborhoods are perceived by some burglars to be below the affluence threshold, and residences in these neighborhoods are not considered attractive, irrespective of their accessibility.

The proposed interaction between residence occupancy and neighborhood proximity claims that, in addition to the main effects of residence occupancy and neighborhood proximity, the negative effects of residence occupancy are stronger in nearby neighborhoods than in distant neighborhoods. In other words, some neighborhoods are perceived by some burglars to be above the maximum distance threshold, and residences in these neighborhoods are not considered attractive, irrespective of the occupancy measure.

In sum, we assert that:

Table 1 Selection criteria for burglary cases

No	Selection criterion	Burglaries	Burglars
	Police-recorded burglary in Ghent	18,974	1872
1	Burglary is cleared	1741	1871
2	Burglar resides in Ghent	1114	1132
3	Home address of the burglar is available	1085	1107
4	At most one burglar is included per burglary	1085	876
5	Burglar and burglary address link to a Census address	726	606
6	Burglar's prior offences during past year are available	679	577

Hypothesis 11 The relationships between residential attributes and burglars' preference for burglarizing a residence vary according to neighborhood-level attributes, whereby the effects of positively valued residential attributes strengthen the effects of positively valued neighborhood attributes.

Data

In this analysis, we assess the extent to which neighborhood attributes and residence attributes determine the target selection of burglars. To that aim, we combine police-recorded information on burglars and the residential burglaries they committed between 2005 and 2014 with Census information on residences and neighborhoods in 2011 for Ghent, Belgium. This northwestern Belgian city covers an area of approximately 156 km^2 and had a population of 247,486 residents on 1 January 2011.

Burglaries and Burglars

To be included in the analysis and in line with previous crime location choice studies (Frith et al. 2017; Townsley et al. 2015), we apply six selection criteria to burglaries and burglars: (1) the burglary is cleared; (2) the burglar resides in Ghent; (3) the home address of the burglar is available; (4) at most one burglar is included per burglary; (5) the burglar home address and burglary address link to a Census address; and (6) the burglar's prior offence records during the past year are available. Applying the six criteria leads to the selection of 679 burglaries that involved 577 unique burglars and 633 unique target residences. Similar data selection criteria and sample sizes have been applied in previous crime location choice studies. Details of the selection process are discussed in the following sections and are summarized in Table 1.

The Burglary is Cleared

To assess the role of the offenders' home locations and the locations of any previous burglaries they committed, the analysis must include only cleared burglaries. Between 2005 and 2014, the local police department cleared 1871 residential burglaries committed in Ghent.[1] Clearance implies that at least one offender was identified.

The Burglar Resides in Ghent

Consistent with the existing crime location choice literature (e.g., Bernasco et al. 2016; Frith et al. 2017), we require that at least one of the burglars involved in a burglary must reside in Ghent is. It is motivated by the structure of the burglary location choice model, in which burglaries make up the sample frame, where they are committed is the dependent variable, and where the offenders live is one of the independent variables. In line with the finding that the home-crime distance follows a steep decay function (Townsley and Sidebottom 2010), 93% of all cleared burglaries in Ghent (N = 1114) involved at least one offender that resided in Ghent.

The Home Address of the Burglar is Available

Occasionally, the police register burglars as residents of Ghent without recording their home addresses. Because we require addresses to calculate distances between burglars' homes and their targets, only burglaries with a valid burglar home address, 97% of the remaining burglaries (N = 1085), were included.

At Most One Burglar is Included per Burglary

Burglaries are often committed alone, but can also involve multiple collaborating offenders. In Ghent, 25.33% (N = 441) of all cleared burglaries is committed by at least two offenders. The analysis of multi-actor decisions, including location choices, introduces a number of theoretical and statistical complexities that have been documented elsewhere in more detail (Bernasco 2006; Lammers 2017). To avoid these complexities, we adopted a procedure that has become the standard in the literature (see also Bernasco et al. 2012; Frith et al. 2017): one burglar was randomly selected from each co-offending group and was subsequently analyzed as a single-offender location choice problem. This procedure is supported by the finding that location choices of single and co-offending burglars are similar (Bernasco 2006). Application of this criterion reduces the number of involved burglars (N = 876), but does not change the number of burglaries (N = 1085).

The Burglar Home Address and Burglary Address Link to a Census Address

The burglar home address and the burglary address in the police records need to be linked unambiguously to an address in the Census data (where the attributes of the residence are stored). This was the case for at least 67% of burglaries (N = 726). Reasons for ambiguity include non-uniquely identified burglary addresses and non-existent burglar home addresses. Although we cannot determine the causes of these ambiguities with certainty, in both situations the burglary cases should most likely not have been selected in the first

[1] The clearance rate of 9% is similar to burglary clearance rates reported for most other Western countries (e.g., Bernasco and Nieuwbeerta 2005; Clare et al. 2009; Frith et al. 2017).

place because either the burglary had been registered at multiple addresses, or the offender lived outside the study area and address information was not available.

The Burglar's Prior Offences During the Past Year are Available

Testing whether burglars are more likely to target properties in neighborhoods they targeted during the prior 6 months, required us to define the first half of 2005 as a 6-month 'buffer': burglaries committed in January–June 2005 are only used to identify the offending histories for burglaries committed in July–December 2005. Consequently, we analyzed as cases only the 679 burglaries in the period July 2005 through December 2014 (89%).[2]

Sample Selectivity due to Application of Selection Criteria

Applying these criteria might introduce selectivity in our included sample. However, comparison of the characteristics of the burglarized neighborhoods in the sample of cleared burglaries (N = 1741; see Step 1, Table 1) and those for the sample of burglaries included in the model estimation procedure (N = 679; see Step 6; Table 1) allows us to conclude that selectivity is not a concern in this study. As depicted in Appendix Table 5, the burglarized neighborhoods included in the final sample are similar to those present in the initial sample of burglary data in terms of mean values for all included neighborhood characteristics. Due to lack of personal data on burglars, however, we cannot explore the impact of our selection criteria on the sample of included burglars.

Neighborhood and Residence Data

As argued in the introduction, residences are the primary targets in residential burglaries. Strictly speaking, burglars do not target larger entities like streets or neighborhoods, although clearly the selection of a specific residence might be affected by its spatial environment. The analysis of burglary target choice should thus preferably define 'residence' as its main unit of analysis (Bernasco 2010a; Vandeviver et al. 2015a). Fortunately, our police and Census data have enough spatial resolution to allow us to use individual residences as our main units of analysis. In order to assess the importance of neighborhood attributes relative to residence attributes, we also use information at the neighborhood level. Both residence and neighborhood variables are from the 2011 Belgian Census (FOD Economie Algemene Directie Statistiek—Statistics Belgium 2011).[3]

[2] Because offenders might learn from their accomplices, offending histories were identified before randomly selecting one offender from each co-offending group (Step 4).

[3] A third and intermediate level of aggregation between residences and neighborhoods—street segments—might be a meaningful addition to our models. Unfortunately, we cannot reliably link residences to the street segments along which they are located because address information was removed by Statistics Belgium during the geocoding process, and address coordinates were withheld by Statistics Belgium to comply with privacy regulations and prevent identification of individual addresses in the Census data. Neighborhood data, however, remain unaffected by this procedure because residences are linked to neighborhoods separately using a unique neighborhood identifier.

Table 2 Descriptive statistics of neighborhood (N = 193) and residences (N = 138,321)

Level	Variable	Mean	S.D.
Neighborhood	Median income (€ 1000)	22.05	4.85
	Number of residences (1000/km^2)	1.98	2.38
	Proportion non-Belgians	8.80	10.13
	Proportion rental units	32.76	16.73
		%	N
Residence	Building type		
	Terraced	59.70	82,573
	Semi-detached	11.03	15,263
	Detached	14.34	19,829
	Apartment	14.93	20,656
	Number of residences in building		
	One residence	53.52	74,034
	Two residential units	3.96	5482
	Three or more residential units	42.51	58,805
	Rental unit		
	Yes	39.40	54,496
	No	60.60	83,825
		Mean	S.D.
	Number of occupants	1.74	1.53

Neighborhood Data

The Census subdivides Ghent in geographical entities called 'statistical districts', of which 193 have a residential function. Throughout this paper we refer to these entities as 'neighborhoods'. The neighborhoods in this study are similarly constructed to the areas used in most previous discrete spatial choice studies and are comparable or smaller in size (e.g., Lammers et al. 2015; Menting et al. 2016). On average, the 193 residential neighborhoods have a population of 1287 residents (standard deviation [sd] = 1299), 717 residences (sd = 785) and cover an area of 0.79 (sd = 1.00) square kilometers.

Four neighborhood attributes and a prior burglary variable are included in the analysis. Unless otherwise stated, all variables reflect the situation on 1 January 2011. Neighborhood attributes vary between residences within different neighborhoods, but not between residences located in the same neighborhood. Descriptive statistics of the neighborhood variables are presented in Table 2. We briefly discuss each neighborhood attribute and how it relates to the behavioral rule:

- *Median income*: an affluence measure capturing the median income averaged for 2005–2012 in € 1000.
- *Residential density*: a target availability measure capturing the number of 1000 residences per square kilometer in the neighborhood.

- *Proportion non-Belgian residents*: an operationalization of ethnic heterogeneity capturing guardianship that is measured as the percentage of non-Belgian residents living in the neighborhood.[4]
- *Proportion rental units*: a guardianship metric that is calculated as the percentage of rental units in the neighborhood. The variable is obtained by aggregating the residential rental status (see "Hypotheses on Effects of Residence Characteristics" section) for each neighborhood.
- *Prior burglary in neighborhood*: a variable derived from the burglars prior burglary records, indicating whether the offender or one of his accomplices had committed a prior burglary in the neighborhood within 0-6 months before the current burglary.

Residence Data

The Census identified 138,321 residences in Ghent. For each residence, Statistics Belgium provided a unique identification number and five variables. Two variables apply to the residence itself: number of occupants, and rental status. Two variables apply to the building in which the residence is located: the building construction type, and the number of residences inside the building. Detached residences and residences in terraced housing (town houses) are defined as separate buildings, but apartments (flats) are part of a single building. In addition, Statistics Belgium provided a dataset that included, for each burglary, the distances between the offender's home address and all other addresses in Ghent.[5] Descriptive statistics of the residence variables are presented in Table 2. We briefly discuss each residence attribute and describe how it relates to the behavioral rule.

- *Building construction type*: an accessibility metric indicating if the residence is located in a detached building, a semi-detached building, a terraced building (townhouse), or part of an apartment complex.
- *Number of occupants*: a risk measure counting the number of people registered at that address.
- *Number of residences inside the building*: a risk measure indicating whether the residence is located in a single-unit building, two-unit building or multi-unit housing complex.
- *Rental status*: a guardianship measure indicating if a residence is rented out or not.
- *Distance*: an effort measure capturing the Euclidean distance between the residence and the burglar's home.

[4] Ethnic heterogeneity is an indicator of qualitative variability that is usually measured with the Herfindahl index (sometimes referred to as the Blau index or index of qualitative variation). Here, we use proportion non-Belgian residents for lack of more detailed information on ethnicity in the Census data. However, this is of little concern since ethnic segregation is much less pronounced in Belgium, and more generally Western Europe, than in the USA. Measures of ethnic heterogeneity and proportion non-natives are very strongly correlated and almost equivalent empirically (around .95, see Bernasco and Luykx 2003, p. 989).

[5] To prevent identification of individual residences in the Census data, Statistics Belgium randomly shifted address coordinates up to 25 m along both the x-axis and the y-axis before computing distances.

Method

To study burglars' target choices, we apply the discrete choice framework to burglary location choices, an approach introduced in criminology by Bernasco and Nieuwbeerta (2005). This approach permits including target features (e.g., neighborhood and residence attributes), offender features (e.g., offending histories), and target-offender interactions (e.g., distance from the offender's home to each alternative) in a single model (for a detailed discussion, see Ruiter 2017). Like most previous crime location choice studies, we use the conditional logit model.[6] However, unlike all previous studies, we simultaneously estimate the effect of both neighborhood-level and residence-level attributes on burglar's selection of targets.

Consistent with the microeconomic theory of random utility maximization, the conditional logit model postulates that burglars select, from a set of exhaustive and mutually exclusive residences, a single residence to burglarize. Burglars are assumed to evaluate the utility of each residence in their choice set and select that particular residence that is expected to yield the highest utility. The model has been successfully applied in many crime location choice studies and to a variety of crime types, including burglary (Townsley et al. 2015), robbery (Bernasco et al. 2012), rioting (Baudains et al. 2013), and theft from motor vehicles (Johnson and Summers 2015).

Analytic Strategy

We estimate three main effects models to determine the effects of neighborhood and residence attributes on target choice.[7] The first model includes the four neighborhood attributes, and the prior burglary variable, as well as the distance from each residence to the offender's home. Corresponding with most crime location choice studies, this model describes how neighborhood attributes affect burglars' choice of residence to burglarize. The second model includes the four residence attributes and the distance measure. The third model estimates the combined impact of neighborhood and residence attributes, prior burglary, and distance.

In addition, we estimate 25 cross-level interaction effect models to determine to which extent the relationships between residential attributes and the likelihood of burglary target selection vary according to neighborhood-level attributes. If burglars indeed evaluate the suitability of a property by gauging both property and the neighborhood simultaneously,

[6] We considered using the nested logit model (Ben-Akiva and Lerman 1985) instead of the conditional logit model. The nested logit model is a more flexible discrete choice model that does not assume independence of alternatives within the same group of alternatives. This model is well-suited for the analysis of hierarchically structured choice sets such as the choice of residences nested in neighborhoods but requires considerable computational resources. Even in a high-performance computing environment, estimation of a nested logit model on a choice set as large as our dataset (i.e. 138,321 alternative residence nested in 193 neighborhoods for each of the 679 burglaries) proved to be computationally prohibitive. This forced us to resort to the computationally less demanding but less flexible conditional logit model. If the assumption of independence of residences within the same neighborhood is violated, the conditional logit model will still yield unbiased coefficient estimates, but standard errors may be underestimated. This requires us to be careful and conservative in interpreting significance levels.

[7] We computed generalized variance inflation factors (GVIFs) to assess multicollinearty among the independent variables in the main effects models. GVIFs > 10 suggest severe multicollinearity. No GVIFs > 3.88 were observed, indicating that multicollinearity is of no concern.

Table 3 Model estimates for integrated main effects conditional logit models of burglary target choice in Ghent, Belgium (679 burglaries, 577 burglars, 138,321 residential units)

Variables	Integrated main effects model Exp(B) (SE(B))
Median income (€1000)	.97 (.02)
Residential density	.90*** (.02)
Proportion non-Belgians	.99 (.01)
Proportion rental units	1.00 (.01)
Prior burglary in neighborhood 0–6 months[1]	18.99*** (.16)
Building type: semi-detached	1.14 (.15)
Building type: detached	1.35* (.13)
Building type: part of apartment building	.79 (.15)
Number of occupants	1.01 (.03)
Number of residential units: two residential units	.78 (.19)
Number of residential units: three or more residential units	.58*** (.10)
Rental unit: Yes	2.01*** (.08)
Distance (km)	.45*** (.04)
AIC (df)	23,823.64 (13)
BIC (df)	23,882.41 (13)

*$p<.05$; **$p<.01$; ***$p<.001$

[1]The offender committed a previous burglary in the neighborhood less than 6 months ago (0/1)

the presence of cross-level interactions is implied. For example, burglars might prefer to target detached houses in affluent neighborhoods but not in poorer neighborhoods. Alternatively, Bowers et al. (2005) demonstrated that, relative to affluent areas, detached houses in deprived areas were particularly vulnerable to burglary, a finding they tentatively attributed to the possibility that in deprived areas detached housing may clearly signal relative affluence (indicating higher burglary yield) whereas in affluent areas, detached housing may be less distinctive. However, the current state of theory does not allow specification of specific a priori hypotheses on how property-level and neighborhood-level variables might interact. Therefore, we explored all potential first-order cross-level interactions. Due to its limited size, our sample is underpowered for testing multiple interactions simultaneously. Instead, we tested all 5 (neighborhood) × 5 (residence) potential cross-level interaction effects separately.

The integrated main effects and the interaction effects models are most relevant for our argument. They also most closely correspond with the rational choice perspective's conceptualization of burglary target selection as a dual-level spatial decision-making model. For these reasons as well as parsimony, we only discuss the integrated and interaction models in the next section.

Results

Table 3 displays estimated odds ratios (OR) and standard errors (SE) as well as the Akaike (AIC) and the Bayesian information criterion (BIC) to assess relative model fit for the integrated main effects only model.[8] The ORs indicate how much the odds of a residence being selected increase multiplicatively given a one-unit change in the associated explanatory variable. The AIC and the BIC offer insight in the quality of the models relative to each other, and in doing so make a trade-off by rewarding goodness-of-fit and penalizing model complexity. Smaller values for both information criteria are preferred (Raftery 1995).

Overall Model Fit

First, we assess relative model fit for the main effects only models (see Table 3 and Appendix Table 6). The smallest AIC and BIC values are observed for the integrated main effects model. This suggests that an optimal description of burglars' target choices requires both neighborhood and residence attributes.

Integrated Main Effects Model

We begin by evaluating the role of neighborhood attributes in burglars' target selection process. As shown in Table 3, residential density and prior burglary activity in the same neighborhood are significantly related to the likelihood of a residence being burglarized, while median income, proportion non-Belgians, and proportion rental units are not. First, in contrast to what was hypothesized, burglars preferred residences in neighborhoods with lower residential density. For every additional 1000 residences per square kilometer in a neighborhood, the odds of the residence being burglarized decrease by 10%. Although this finding conflicts with results of previous burglary location choice studies (Bernasco and Nieuwbeerta 2005; Townsley et al. 2015), it might indicate that burglars prefer reducing the risk of detection and apprehension instead of having access to a greater variety of alternatives.

Second, as hypothesized and in line with previous findings elsewhere (Bernasco et al. 2015; Lammers et al. 2015), burglars are more likely to target residences in neighborhoods where they recently committed a previous burglary, possibly because committing the prior burglary helps them to identify potential future targets. The odds of a burglar selecting a residence in a neighborhood where they committed a burglary in the past 6 months are 19 times greater than the odds of selecting a residence in another neighborhood. This is a very strong effect size in the same order of magnitude as those previously reported (Lammers et al. 2015).

Three out of four residential features are significantly associated with burglary target selection. Building construction type, number of residential units, and rental status are significantly related to burglary target selection. In contrast, number of occupants does not

[8] The parameters of the neighborhood only and residential unit only main effects models are similar to those of the integrated main effects model. Moreover, the integrated main effects model exhibits superior model fit in comparison with the neighborhood only and residential unit only main effects models (as indicated by AIC and BIC). Therefore, the parameters of the neighborhood only and residential unit only main effects models are only reported in Appendix Table 4.

significantly impact burglary target selection. However, the observed effects offer only partial confirmation for our hypotheses. First, some of the results with regard to building type corroborate our hypothesis. Overall, the building type of a residence was significantly associated with the likelihood of being selected for burglary (likelihood ratio test statistic = 4.95; Δdf = 3; $p < .050$). However, burglars only seemed to have a preference for detached houses over terraced houses. Detached residences had 35% greater odds of being burglarized than terraced residences. Burglars did not distinguish between terraced houses, semi-detached houses and residences in apartment buildings. Although burglars' preference for detached residences is in line with findings of other studies (Bernasco 2009; Hakim et al. 2001; Peeters et al. 2017), it contradicts the results of a previous burglary location choice study at the residence level, which found that burglars preferred terraced residences (Vandeviver et al. 2015a). However, the conflicting findings may be rooted in the design of the previous study, which considered burglaries committed in a 3000 km^2 rural area in which terraced houses were spatially concentrated in high-burglary urban areas. In this study, we considered burglaries committed in a single, predominantly urban area.

Second, confirming our hypothesis with respect to the number of residential units per building, burglars preferred residences in single-unit buildings over residences in multi-unit housing complexes. Indeed, residences in single-unit buildings have a 42% higher odds of target selection than residences in a building with three or more residential units. Although the number of residential units per building was overall significantly associated with burglary target selection (likelihood ratio test statistic = 13.81; Δdf = 2; $p < .001$), we did not find a significant difference between residences in single-unit buildings and those in two-unit buildings.

Third, confirming our hypothesis, burglars prefer renter-occupied residences. Renter-occupied residence have 101% greater odds of being selected than owner-occupied residences. Although this finding confirms our hypothesis, it is at odds with previous research on residential burglary risk in which it was established that owner-occupied residences are more at risk of burglary (Vollaard and van Ours 2011).

Finally, with respect to distance our results confirm that burglars have a preference for burglarizing residences nearby their home address, a finding that has been demonstrated repeatedly in prior research (Ruiter 2017). It is interpreted as the most salient externalization of offender cost-minimization strategies (Vandeviver et al. 2015b). Here, we found that the odds of a residence being burglarized decrease by 55% for every kilometer a residence is further away from the offender's home.

Cross-Level Interaction Effects

Next, we explored possible cross-level interaction effects between our five neighborhood and five residential attributes. Table 4 summarizes the results of the 25 tests in terms of statistical significance. Complete numerical results are displayed in Appendix Tables 5, 6, 7, 8, 9 and 10, while a graphical presentation of the significant interactions is provided in Appendix Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14. By way of example and to facilitate the interpretation of these figures in the "Appendix", the cross-level interaction between distance and neighborhood median income is displayed in Fig. 1 and interpreted in detail.

The top panel of the figure shows how the effect size of distance (in kilometers) varies across neighborhood median income levels (in € 1000). Over the full range of the income variable, the odds ratio effect of distance is negative and varies between .37 (at median

Table 4 Significance of cross-level interactions between neighborhood attributes and residential attributes in burglary target choice in Ghent, Belgium (679 burglaries, 577 burglars, 138,321 residential units)

Variables	Neighbor-hood: income	Neighborhood: residential density	Neighborhood: proportion non-Belgians	Neighborhood: proportion rental units	Neighborhood: prior burglary in neighborhood[a]
Building type: semi-detached	n.s.	n.s.	n.s.	n.s.	n.s.
Building type: detached	n.s.	n.s.	n.s.	n.s.	n.s.
Building type: part of apartment building	**	n.s.	***	n.s.	n.s.
Number of occupants	**	n.s.	*	***	n.s.
Number of residential units: two residential units	n.s.	n.s.	*	n.s.	n.s.
Number of residential units: three or more residential units	***	n.s.	**	***	n.s.
Rental unit: yes	n.s.	n.s.	n.s.	*	n.s.
distance (km)	***	***	**	***	***

n.s. not significant; *$p<.05$; **$p<.01$; ***$p<.001$

[a]The offender committed a previous burglary in the neighborhood less than 6 months ago (0/1)

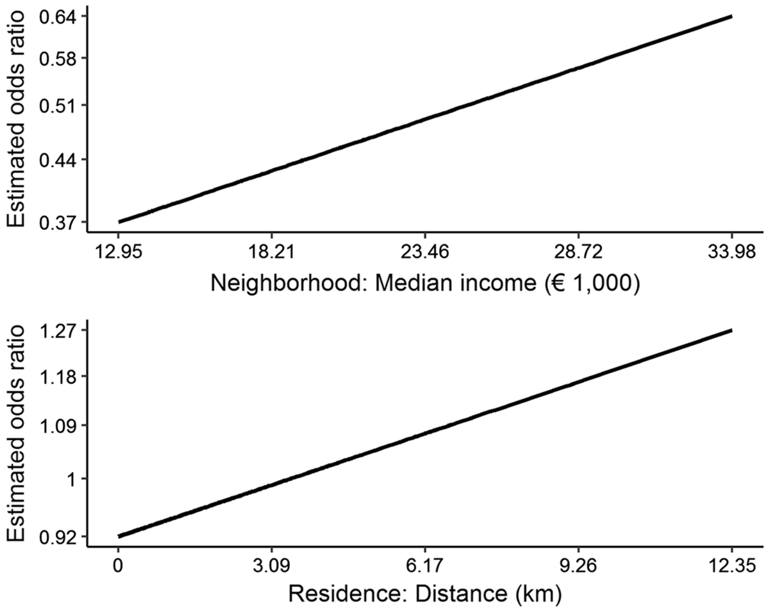

Fig. 1 Estimated odds-ratio of a residence being selected for burglary by neighborhood: median income (in € 1000) and residence: distance from the offender's home (in km). Top: effect of distance across different values of median income. Bottom: effect of median income across different values of distance. Note: Y-axis is on a logarithmic scale

income of approximately € 13,000) and .64 (at median income of approximately € 34,000). This implies that burglars prefer to travel short distances and to burglarize residences close to their own homes, and that this preference is stronger when they compare residences amongst poorer target neighborhoods than when they compare amongst more affluent target neighborhoods. The bottom panel displays the reverse projection of this interaction: it shows how the effect size of neighborhood median income varies across distance. Over the full range of distance, the odds ratio effect of median income varies between a slightly negative .92 (at distance of 0 km) and a positive 1.27 (at distance of approximately 12 km). Up to distances of around 3 km, burglars prefer residences in poorer over more affluent neighborhoods, but their preference reverses beyond 3 km. When comparing residences amongst target neighborhoods beyond 3 km, differences in affluence become an increasingly important decision criterion. In other words, the interaction effect suggests that burglars may seek to compensate their travel efforts by selecting targets in more affluent neighborhoods. Offending nearby home may be indicative of opportunistic target selection strategies, whereas a greater degree of planning may come into play when targeting higher-value targets farther away from home. As shown in Table 4 and in Appendix Table 7, the interaction between both variables is statistically significant.[9]

Out of 25 possible combinations of neighborhood and residence attributes, 14 significantly predict burglary target choice and lead to slightly different and more nuanced appraisals of target suitability (full details in Appendix Tables 7, 8, 9, 10 and 11). First,

[9] For a detailed discussion on how to interpret and present interaction effects in discrete response models, see Hilbe (2011) and Mize (2019).

building construction type and certain neighborhood attributes significantly interact: how burglars evaluate building construction type when assessing target suitability is moderated by (1) neighborhood income, as well as (2) the proportion of non-Belgian residents in the neighborhood, but not by other neighborhood-level attributes. In particular, the model results imply that residences in apartment buildings are progressively less attractive to burglars as neighborhood affluence increases. In poorer neighborhoods, burglars prefer residences in apartment buildings over terraced residences but as neighborhood affluence increases burglars prefer targeting terraced residences over residences in apartment buildings. Conversely, in neighborhoods with greater proportions of non-Belgians the effect of this target accessibility metric is reversed: terraced dwellings are preferred over residences in apartment buildings in predominantly Belgian neighborhoods but as relatively more non-Belgians live in a neighborhood residences in apartment buildings have greater odds of being burglarized than terraced residences.

Second, although number of occupants alone is not a significant predictor of burglary target choice, the interaction effects suggest that its effect may be conditional upon neighborhood context: number of occupants interacted with (3) neighborhood affluence, (4) proportion non-Belgians, and (5) proportion rental units. The directions are different across neighborhood type. Interaction effect (3) suggests that residences with fewer occupants stand out for burglars in poorer neighborhoods whereas burglars prefer residences with more occupants in more affluent neighborhoods suggesting perhaps that burglars are prepared to accept more risks when operating in more affluent neighborhoods. This may be indicative of a degree of sophistication and cost–benefit balancing in target selection: taking additional risks may be justified in light of richer pickings. The reverse is true for neighborhoods with greater proportions of non-Belgians: burglars prefer residences with fewer occupants, and this preference is stronger as the proportion of non-Belgians in the neighborhood increases. Interaction effect (5) similarly implies that burglars prefer residences with fewer occupants, and that this preference is stronger as the proportion of rental units increases. Combined, the effects suggest that burglars do not compensate decreases in the degree of guardianship at the neighborhood level by taking additional risks at the residence level. It seems, that burglars are risk averse both in terms of their selecting residences in neighborhoods which may have weaker guardianship and their selecting residences that may have fewer risks to burglarize combined.

Third, number of residential units interact with (6) neighborhood income, (7) proportion of non-Belgians in the neighborhood, and (8) proportion of rental units. Generally speaking, burglars prefer fewer residential units per building but their preference varies somewhat across neighborhood context. In poorer neighborhoods, burglars have a slight preference for residences in multi-unit complexes over single-unit residences, but their preference reverses in more affluent neighborhoods where single-unit residences are clearly preferred. Although this could suggest that increased affluence at the neighborhood level may not offset additional risks at the residence level, this could also reflect the clustering of single-unit dwellings in more well-off neighborhoods. Interaction effect (7) implies that two-unit residences are preferred over single-unit residences in neighborhoods with smaller proportions of non-Belgians, but the opposite is true for neighborhoods with greater proportions of non-Belgians. Although burglars prefer single-unit residences over residences in multi-unit housing complexes in neighborhoods with fewer proportions of non-Belgians, the opposite effect is briefly observed in neighborhoods with the greatest proportions of non-Belgians. Single-unit residences are preferred in neighborhoods with low to medium proportions of rental units, but residences in multi-unit complexes are preferred in neighborhoods with the greatest proportions of rental units. These interaction effects would suggest that risk minimization, both at the neighborhood and residence level, is a generally prevailing strategy in burglary target selection. Although the lowest levels of neighborhood guardianship may sometimes convince burglars to accept additional risks of detection at the target level.

Fourth, neighborhood context does not generally influence burglars' appraisal of renter-occupied residences, except for (9) the proportion of rental units in a neighborhood. The effect suggests that overall burglars prefer renter-occupied over owner-occupied residences but their preference is less outspoken in neighborhoods with greater proportions of rental units. This would suggest that once a certain guardianship threshold is reached at the neighborhood level, targeting residences that signal reduced guardianship may become less important to burglars.

Finally, interaction effects for distance and all neighborhood attributes are significant: distance interacted with (10) neighborhood income, (11) neighborhood residential density, (12) proportion of non-Belgians in the neighborhood, (13) neighborhood proportion of rental units, and (14) prior burglary activity in the neighborhood. With the exception of the interaction with prior burglary, all interaction effects with distance confirm that burglars prefer to target residences nearby their home and keep travel efforts minimal, regardless of neighborhood context. In other words, keeping travel to a minimum is a dominant target selection strategy for burglars. However, the opposite is observed when considering prior burglary. In fact, considerations with regard to travel efforts may not be in play when selecting targets in neighborhoods where burglars were previously active. The latter effect may further be explained in terms of planned burglary behavior: once suitable targets have previously been identified the costs of travel to those targets may be worth the additional benefits of operating in a familiar area.

Taken together, these interaction effects demonstrate considerable sophistication in burglars' spatial target selection and support the idea that what makes targets attractive to burglars is clearly a combination of the individual target as well as its context. Trade-offs between multiple spatial levels exist and impact target selection decisions. Obviously, the systematic tests of all possible cross-level interaction effects is an exercise to explore which combinations of neighborhood-level and residence-level attributes have explanatory potential and could be candidates for further theorizing and empirical investigation. Consequently, the reported findings on interactions should be regarded as tentative.

Discussion

By stating that the three most important aspects of real estate are "location, location, and location", many real estate advisors warn prospective buyers against a myopic focus on the individual property and urge them to carefully consider the property's surroundings. Based on the analysis of 679 cleared burglaries committed by 577 burglars, our findings demonstrate that residential burglars adhere to this advice as well. Their choice of targets appears to be informed by both house attributes and neighborhood attributes, and the evaluation of house attributes varies in relation to their neighborhood context. Thereby, our findings offer support for the hitherto untested theoretical proposition that burglars' target selection is informed by multiple attributes at multiple spatial scales and possibly also by combinations of those attributes across multiple spatial scales (Bernasco 2009, 2010a; Brantingham and Brantingham 1978; Cornish and Clarke 1986; Taylor and Gottfredson 1986). Even though some of our hypotheses were not supported by the empirical evidence and our investigation of the existence of cross-level interaction effects was explorative, our contribution highlights the multi-level nature of burglars' target selection strategies and thereby extends the theoretical and empirical literature on this topic (e.g., Bernasco 2010a; Townsley et al. 2015; Vandeviver et al. 2015a). Through the interaction effects, it also offers insight into the sophistication and weighing of costs-benefits involved in burglary target selection.

Our results carry implications for theory and research on offender spatial decision-making. In particular, the results of our study are important for how we should think about burglary target selection and, more generally, offender spatial decision-making. First, our analysis offers support for the rational choice perspective's hypothesis that burglars rely on information with regard to environmental features at multiple spatial scales when selecting a suitable target. They show that it is combinations of neighborhood and residence attributes that determine target suitability. Although burglars might sometimes accept trade-offs, ultimately both the neighborhood and the residence must be suitable for burglary. Previously, discrete spatial choice studies either modeled burglars' choice of target area using neighborhood attributes only (Bernasco and Nieuwbeerta 2005; Townsley et al. 2015) or were limited to studying the effect of residence attributes on burglary target choice (Vandeviver et al. 2015a). Our results now extend these studies and indicate that future work on burglary target selection could profit from taking into account environmental features of multiple levels of spatial aggregation.

Second, the adopted model of target selection is not burglary specific. It is a generic model that is applicable to offending in both instrumental and expressive crimes (see Brantingham and Brantingham 1978, 1984). For example, the selection of suitable spots for graffiti writing is influenced by both features of the larger area and the specific spot. Area characteristics such as the presence of particular target audiences and high degrees of graffiti tolerance are major considerations for graffiti writers in their search for a suitable graffiti writing spot (Ferrell and Weide 2010). But individual graffiti spot features, such as surface type, are also very important (Ferrell 1993, p. 73; van Loon 2014). Thus, researchers examining target selection and spatial decision-making in other crime types may want to jointly consider attributes at multiple spatial levels in their analyses as well.

Our study opens up at least two avenues for future research. First, given the well-corroborated finding that burglary risk of a residence is heightened in the wake of a previous burglary (Ellingworth et al. 1995; Farrell and Pease 2001; Polvi et al. 1991), repeated victimization could be reflected in repeated targeting of the same residence by the same offenders. Extant research has only considered whether offenders tend to return to offend in the same neighborhood (Bernasco et al. 2015; Lammers et al. 2015), but future studies could investigate more rigorously whether burglars indeed return to the very same residences they recently targeted, a hypothesis suggested by the findings reported by Bernasco (2008) and by Johnson et al. (2009).

Second, future research could consider short-distance spatial spillover mechanisms in greater detail. Spatial spillover occurs if the attributes of a residence affect the likelihood that nearby residences are being burglarized. For example, a residence surrounded by unattractive residences may be a more suitable target to burglars than a comparable residence surrounded by attractive residences. In particular, this approach could leverage insights from burglary near-repeat victimization research (Johnson et al. 2007; Townsley et al. 2003). For example, burglary victims may improve security measures that actually increase the target attractiveness of neighboring residences because these lack the additional security measures.

In discussing the suggestions for future research, we have also touched upon the implications of our study results for crime prevention practice and crime control policy.

If burglary victims protect themselves and improve household security after having been victimized, offenders who return to the same property may find the place better protected and target a nearby property instead. The promotion of private prevention may thus have the unintended consequence of displacing burglary to nearby targets. Ultimately, this may render preventative action collectively fruitless. At a practical level, this implies that preventative measures implemented in the wake of a burglary should neither be restricted to the recently targeted residence nor should they be taken in isolation of the neighborhood. Instead, they should consider the actual target as well as neighboring residences and the wider community context. Our finding that burglary risk is affected by both residence-level and neighborhood-level attributes underlines this, since it suggests that burglary prevention is optimized by a combination of private and collective efforts. Our findings show that detached residences, rented residences, and properties nearby the homes of burglars have an elevated risk of being targeted, and that the same holds true for low residential-density neighborhoods and neighborhoods recently targeted by burglars. Moreover, the effects of certain neighborhood and residential attributes appear to depend on each other, which could further indicate that individual preventative action may not be successful unless accompanying prevention measures are taken at the neighborhood level to remedy features outside the control of individual homeowners. Admittedly, the current indicators at both levels are too limited to suggest specific preventative actions or develop prevention strategies, in particular because they provide sparse evidence on the underlying mechanisms. Nonetheless, they highlight the dual-level nature of burglary spatial decision-making and stress the importance of residence and neighborhood features in the burglary problem.

It is important to acknowledge that our research is subject to similar limitations as prior crime location choice studies, including that we assume that burglary trips start from the offender's home (Bernasco and Nieuwbeerta 2005; Townsley et al. 2015), that we analyzed co-offending burglaries separately as individual decisions (Bernasco et al. 2015), and that we assume that offenders have full information on all the alternatives and can discriminate between each of the 138,000 residences in the study area. This last assumption, in particular, becomes increasingly unsustainable as spatial units of analysis become more fine-grained and choice sets grow dramatically in size (Ruiter 2017; Vandeviver 2015).

Three additional qualifications, specific to this study, must be made. First, our findings rely solely on detected, reported, and cleared burglaries. In particular, a subset of burglars and burglaries was purposely selected to meet our study's criteria. Admittedly, this may bias our results if cleared burglaries are a non-probabilistic sample from all burglaries. While there is evidence to suggest that burglars who are caught in the act and who have their burglaries witnessed are more likely to be identified by the police (Coupe and Girling 2001; Coupe and Griffiths 1996), the same studies suggest that it is difficult to predict which burglars will be caught in the act or have their burglaries witnessed by bystanders. In addition, comparing identified and unidentified offenders from a DNA-database, Lammers (2014) established that spatial offending patterns for both groups were similar. Therefore, burglary clearance may be subject to sufficient randomness to consider cleared burglaries as a probabilistic sample of all burglaries that allows for tentative generalizations. Additional burglary selection criteria that we imposed may also bias our results. This is an undesirable but inevitable consequence of any approach that considers offender characteristics (e.g., prior offences) and offender-area interactions (e.g., distance between the offender's home and target), including the discrete spatial choice approach. However, alternative methodologies such as ethnography and offender interviews similarly suffer from non-probability biases, focusing strongly on prolific offenders (Townsley et al. 2015) or reporting on idiosyncratic events (Vandeviver et al. 2015a).

Second, Census data are not collected for scientific purposes and consequently do not contain all variables that are potentially relevant predictors for burglary target selection. Certain residential features, such as presence of an alarm, observability, and ease of entry or escape, but also situational cues, such as homeowner presence at the time of the burglary, could not be included in our analyses. In doing so, we may have inadvertently overestimated the effects of the included neighborhood and residence variables on burglary target selection. However, large-scale residence-level data are scarce and the scale of our study made systematically collecting residential features practically infeasible. Moreover, situational cues are important but such time-variable features are also difficult to measure reliably and are therefore excluded altogether from observational studies of burglary target selection (Langton and Steenbeek 2017; Peeters et al. 2017). While the omission of certain residential attributes is undesirable, this does not completely invalidate the results of our study. Our models include environmental features that are mostly stable over time and thus serve to illustrate how time-invariable features of neighborhoods and residences affect burglary target selection.

Third, our neighborhood and residence data were not measured at the same time of the burglary. The burglary data span the period 2005-2014 but the neighborhood and residence data are for 2011 only. As a result, we cannot rule out that some of the neighborhood and residence features have changed since the time of the burglary. However, the majority of neighborhood and residential features included in the Census data are mostly stable over time and will likely not have changed since the burglary.

In conclusion, theoretical accounts of offender spatial decision-making have highlighted that target selection may be affected not only by attributes of potential targets but also by attributes of their spatial context. However, few prior empirical tests have taken this possibility into account. None have investigated the combined impact of multiple levels of spatial aggregation. In this study, we showed that area-level attributes and target-level attributes can be estimated simultaneously. Echoing the “location, location, location” advice in real estate, we established that both area and target attributes affect burglars’ target choices.

Acknowledgements Christophe Vandeviver is a Senior Postdoctoral Fellow Fundamental Research of the Research Foundation—Flanders (FWO). Part of this work was carried out while Christophe Vandeviver was International Research Fellow at the Netherlands Institute for the Study of Crime and Law Enforcement (NSCR). The computational resources (Stevin Supercomputer Infrastructure) and services used in this work were provided by the VSC (Flemish Supercomputer Center), funded by Ghent University, the Research Foundation—Flanders (FWO), and the Flemish Government—department EWI.

Funding Vandeviver’s contribution to this work was supported by the Research Foundation—Flanders (FWO) Postdoctoral Fellowship funding scheme and the Research Foundation—Flanders (FWO) Long Stay Abroad funding scheme [12C0616 N and 12C0619 N to C.V., V430316 N to C.V.].

Appendix

See Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and Tables 5, 6, 7, 8, 9, 10, 11.

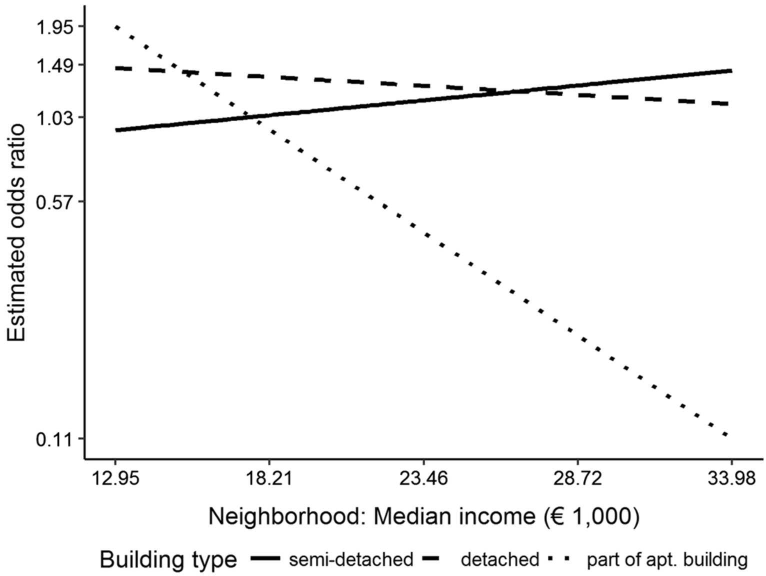

Fig. 2 Estimated odds-ratio of a residence being selected for burglary by neighborhood: median income (in € 1000) and residence: building type (reference category is terraced). Note: Y-axis is on a logarithmic scale

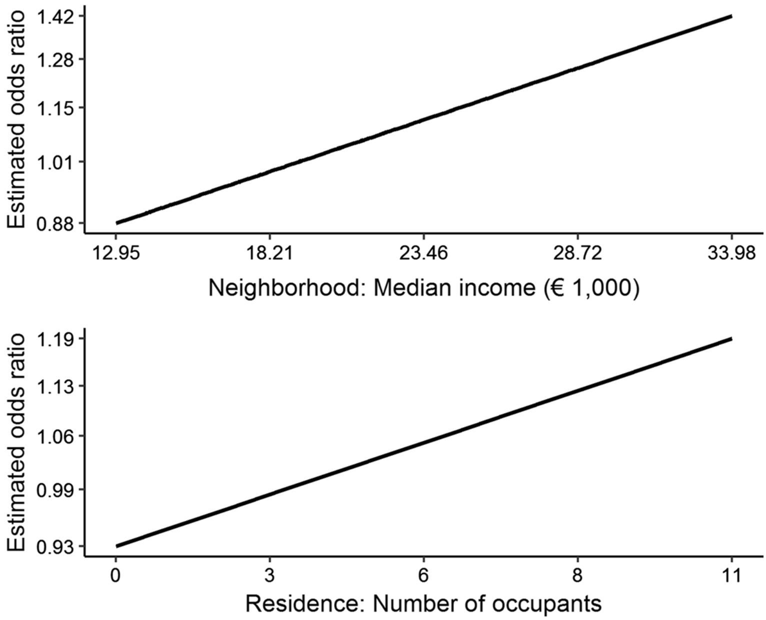

Fig. 3 Estimated odds-ratio of a residence being selected for burglary by neighborhood: median income (in € 1000) and residence: number of occupants. Top: effect of number of occupants across different values of median income. Bottom: effect of median income across different values of number of occupants. Note: Y-axis is on a logarithmic scale

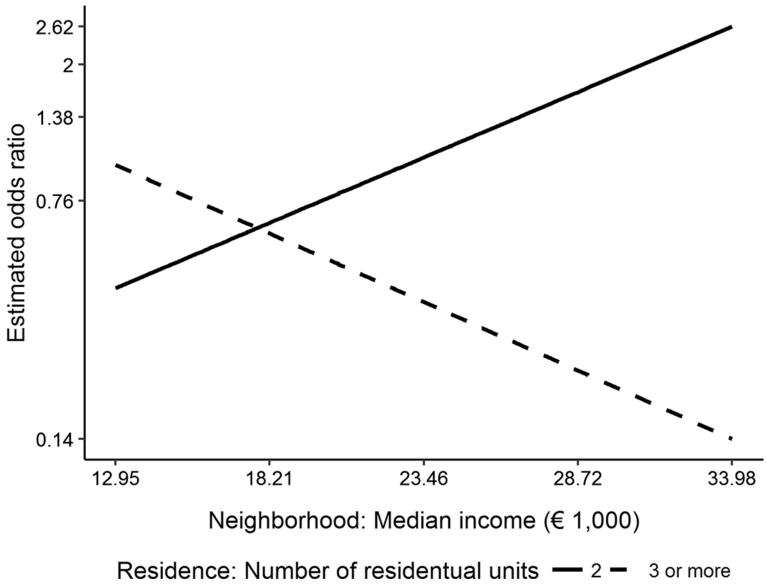

Fig. 4 Estimated odds-ratio of a residence being selected for burglary by neighborhood: median income (in € 1000) and residence: number of residential units (reference category is 1 residential unit). Note: Y-axis is on a logarithmic scale

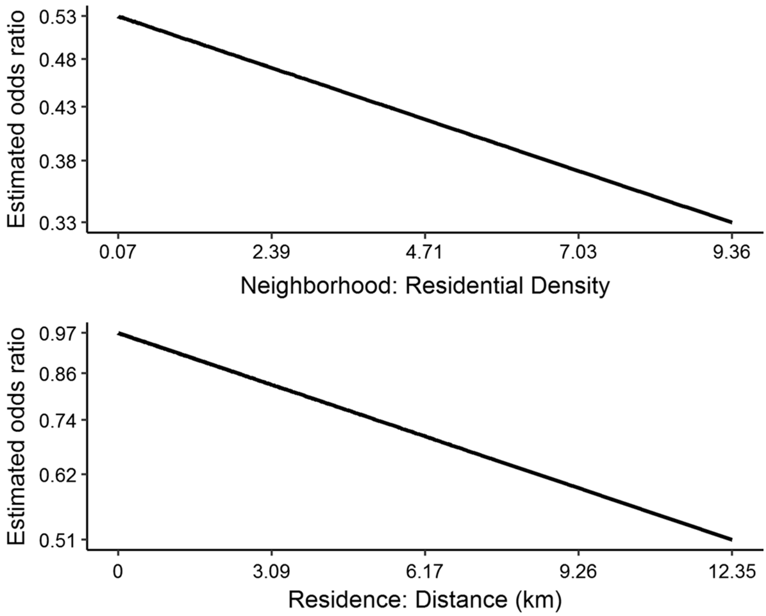

Fig. 5 Estimated odds-ratio of a residence being selected for burglary by neighborhood: residential density and residence: distance from the offender's home (in km). Top: effect of distance across different values of residential density. Bottom: effect of residential density across different values of distance. Note: Y-axis is on a logarithmic scale

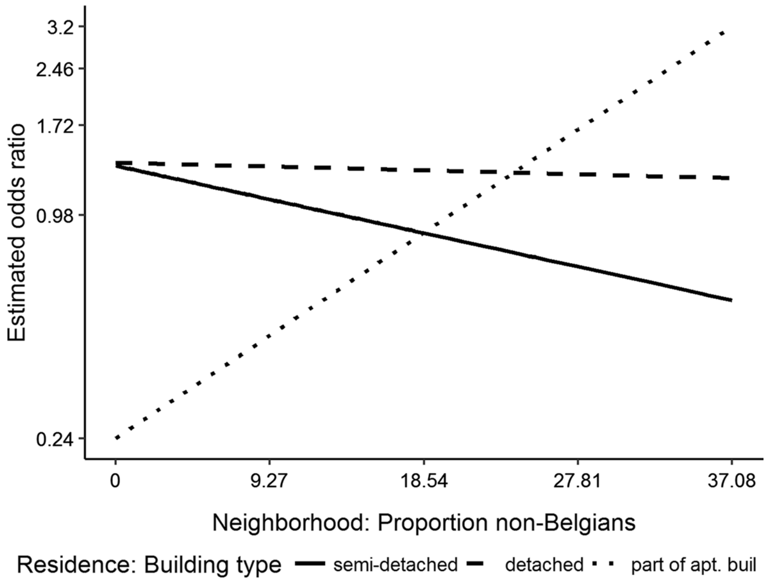

Fig. 6 Estimated odds-ratio of a residence being selected for burglary by neighborhood: proportion non-Belgians and residence: building type (reference category is terraced). Note: Y-axis is on a logarithmic scale

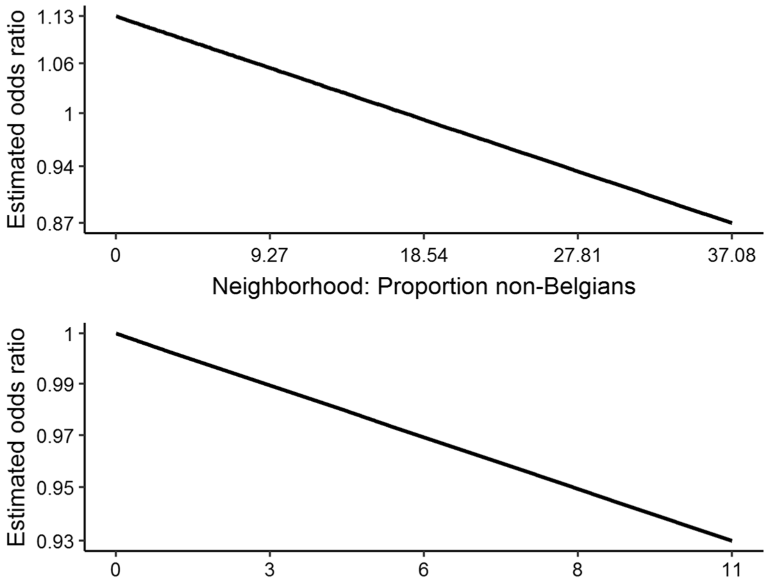

Fig. 7 Estimated odds-ratio of a residence being selected for burglary by neighborhood: proportion non-Belgians and residence: number of occupants. Top: effect of number of occupants across different values of proportion non-Belgians. Bottom: effect of proportion non-Belgians across different values of number of occupants. Note: Y-axis is on a logarithmic scale

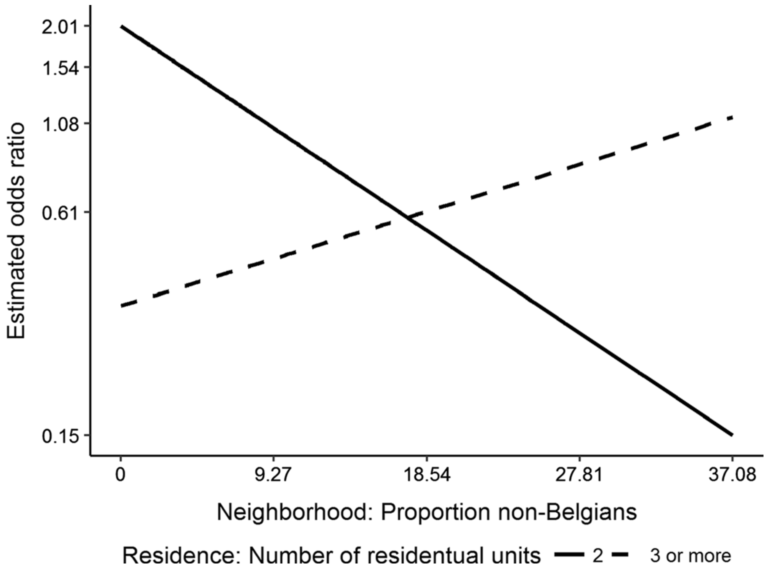

Fig. 8 Estimated odds-ratio of a residence being selected for burglary by neighborhood: proportion non-Belgians and residence: number of residential units (reference category is 1 residential unit). Note: Y-axis is on a logarithmic scale

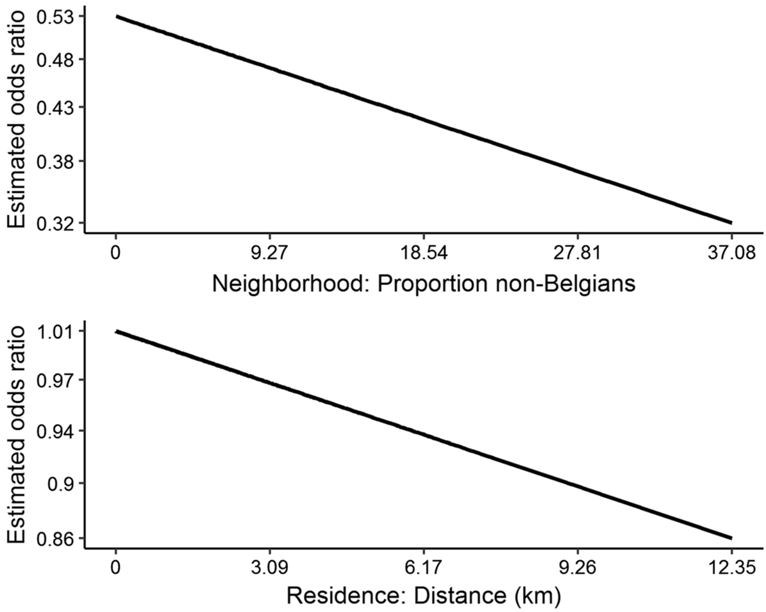

Fig. 9 Estimated odds-ratio of a residence being selected for burglary by neighborhood: proportion non-Belgians and residence: distance from the offender's home (in km). Top: effect of distance across different values of proportion non-Belgians. Bottom: effect of proportion non-Belgians across different values of distance. Note: Y-axis is on a logarithmic scale

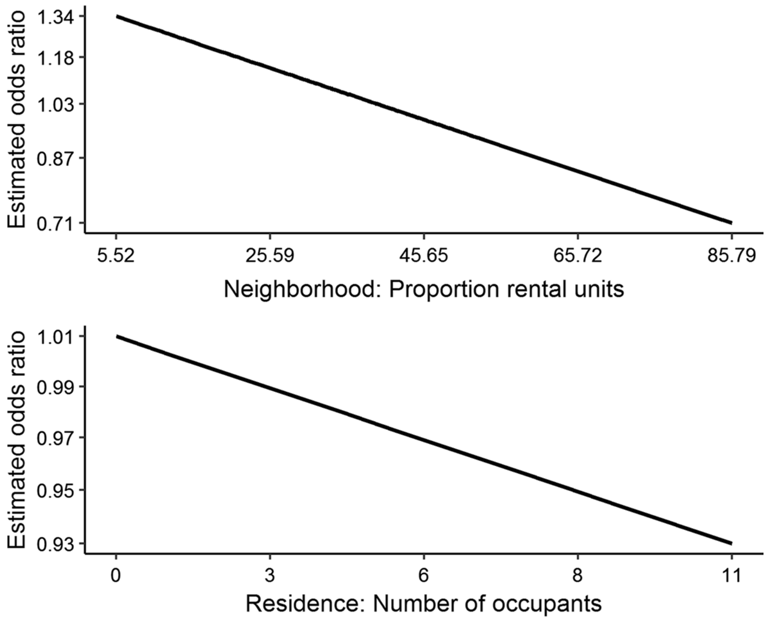

Fig. 10 Estimated odds-ratio of a residence being selected for burglary by neighborhood: proportion rental units and residence: number of occupants. Top: effect of number of occupants across different values of proportion rental units. Bottom: effect of proportion rental units across different values of number of occupants. Note: Y-axis is on a logarithmic scale

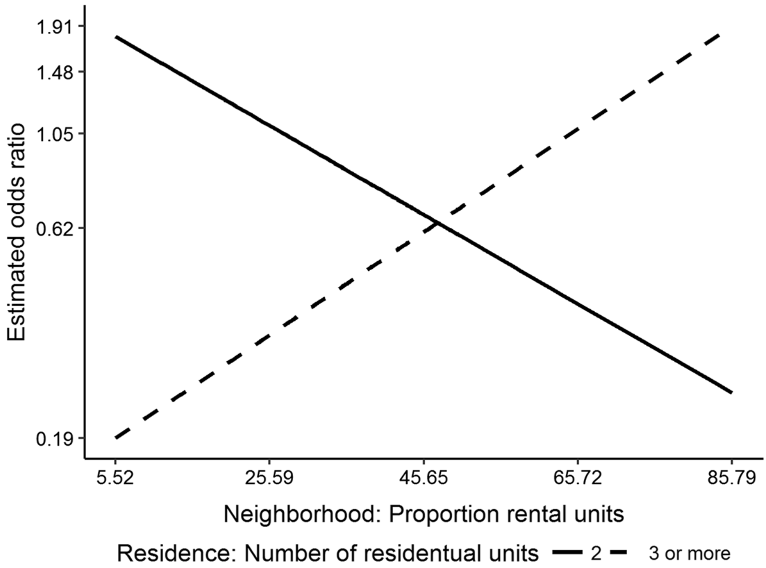

Fig. 11 Estimated odds-ratio of a residence being selected for burglary by neighborhood: proportion rental units and residence: number of residential units (reference category is 1 residential unit). Note: Y-axis is on a logarithmic scale

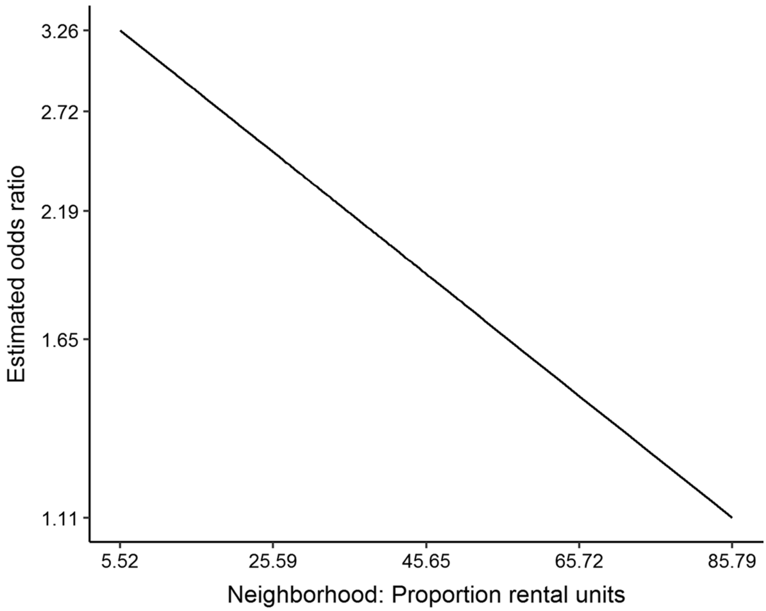

Fig. 12 Estimated odds-ratio of a residence being selected for burglary by neighborhood: proportion rental units and residence: renter-occupied (reference category is no). Note: Y-axis is on a logarithmic scale

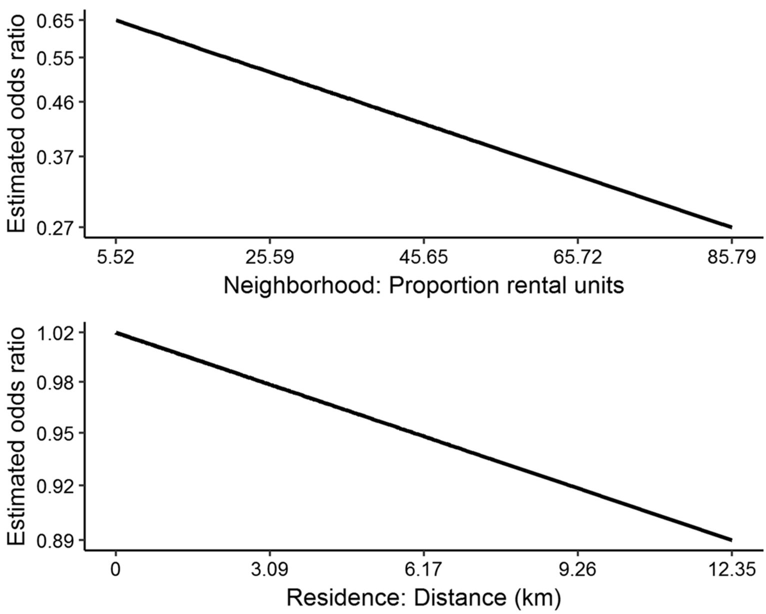

Fig. 13 Estimated odds-ratio of a residence being selected for burglary by neighborhood: proportion rental units and residence: distance from the offender's home (in km). Top: effect of distance across different values of proportion rental units. Bottom: effect of proportion rental units across different values of distance. Note: Y-axis is on a logarithmic scale

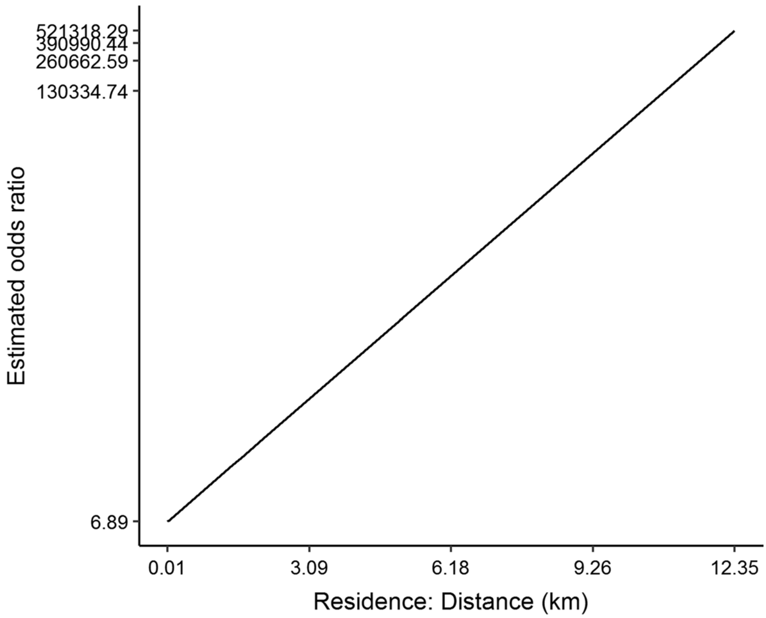

Fig. 14 Estimated odds-ratio of a residence being selected for burglary by neighborhood: prior burglary 0–6 months (reference category is no) and residence: distance from the offender's home (in km). Note: Y-axis is on a logarithmic scale. Quasi-complete separation in the data may render the estimated odds ratios questionable and caution should be taken when interpreting these results

Table 5 Comparison of characteristics of burglarized neighborhoods before and after application of data selection criteria

Variables	Initial sample[1] Mean (SD)	Final sample[2] Mean (SD)
Median income (€ 1000)	19.41 (3.54)	19.18 (3.58)
Number of residences (1000/km^2)	4.35 (2.50)	4.26 (2.44)
Proportion non-Belgians	15.05 (8.71)	14.97 (8.58)
Proportion rental units	42.17 (13.12)	43.25 (14.33)

[1]All cleared burglaries, input for data selection procedure (N = 1741 burglaries, N = 1871 burglars)

[2]After applying all data selection criteria (N = 679 burglaries, N = 577 burglars)

Table 6 Model estimates for neighborhood only and residence only main effects conditional logit models of burglary target choice in Ghent, Belgium (679 burglaries, 577 burglars, 138,321 residential units)

Variables	Neighborhood only model		Residence only model	
	Exp(B)	SE(B)	Exp(B)	SE(B)
Median income (€ 1000)	.95*	.02	–	–
Residential density	.86***	.02	–	–
Proportion non-Belgians	.99	.01	–	–
Proportion rental units	1.00	.00	–	–
Prior burglary in neighborhood 0–6 months[1]	19.61***	.16	–	–
Building type: semi-detached	–	–	1.49**	.14
Building type: detached	–	–	1.87***	.12
Building type: part of apartment building	–	–	.77	.15
Number of occupants	–	–	1.02	.03
Number of residential units: two residential units	–	–	.74	.19
Number of residential units: three or more residential units	–	–	.53***	.10
Rental unit: yes	–	–	2.05***	.08
Distance (km)	.45***	.04	.44***	.04
Proportion rental units * rental unit: yes	–	–	–	–
AIC (df)	23,917.64 (6)		24,028.80 (8)	
BIC (df)	23,944.77 (6)		24,064.96 (8)	

*$p < .05$; **$p < .01$; ***$p < .001$

[1]The offender committed a previous burglary in the neighborhood less than 6 months ago (0/1)

Table 7 Model estimates for cross-level interaction effect conditional logit models of burglary target choice in Ghent, Belgium (679 burglaries, 577 burglars, 138,321 residential units)

Variables	Cross-level interaction effect models (neighborhood: income)				
	(1)	(2)	(3)	(4)	(5)
	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))
Median income (€ 1000)	.98*** (.02)	.93** (.02)	1.00 (.02)	.95* (.02)	.92** (.03)
Building type: semi-detached	.72 (.80)	[a]	[a]	[a]	[a]
Building type: detached	1.69 (.52)	[a]	[a]	[a]	[a]
Building type: part of apartment building	11.61** (.85)	[a]	[a]	[a]	[a]
Number of occupants	[a]	.66** (.14)	[a]	[a]	[a]
Number of residential units: two residential units	[a]	[a]	.13 (1.20)	[a]	[a]
Number of residential units: three or more residential units	[a]	[a]	3.25* (.50)	[a]	[a]
Rental unit: yes	[a]	[a]	[a]	.91 (.45)	[a]
Distance (km)	[a]	[a]	[a]	[a]	.27*** (.16)
Median income (€ 1000) * Building type: Semi-detached	1.02 (.04)	[a]	[a]	[a]	[a]
Median income (€ 1000) * Building type: Detached	.99 (.03)	[a]	[a]	[a]	[a]
Median income (€ 1000) * Building type: Part of apartment building	.87** (.04)	[a]	[a]	[a]	[a]
Median income (€ 1000) * Number of occupants	[a]	1.02** (.01)	[a]	[a]	[a]
Median income (€ 1000) * Number of residential units: Two residential units	[a]	[a]	1.09 (.06)	[a]	[a]
Median income (€ 1000) * Number of residential units: Three or more residential units	[a]	[a]	.91*** (.03)	[a]	[a]
Median income (€ 1000) * Rental unit: Yes	[a]	[a]	[a]	1.04 (.02)	[a]
Median income (€ 1000) * distance (km)	[a]	[a]	[a]	[a]	1.02*** (.01)
AIC (df)	23,818.57 (16)	23,815.55 (14)	23,810.47 (15)	23,822.43 (14)	23,815.02 (14)
BIC (df)	23,890.90 (16)	23,878.84 (14)	23,878.28 (15)	23,885.72 (14)	23,878.31 (14)

(1) Neighborhood: income * residence: building type; (2) neighborhood: income * residence: number of occupants; (3) neighborhood: income * residence: number of residential units; (4) neighborhood: income * residence: rental status; (5) neighborhood: income * residence: distance (km). For clarity and brevity, only the interaction effects and associated main effects are printed

*$p<.05$; **$p<.01$; ***$p<.001$

[a]Omitted for brevity

Table 8 Model estimates for cross-level interaction effect conditional logit models of burglary target choice in Ghent, Belgium (679 burglaries, 577 burglars, 138,321 residential units)

Variables	Cross-level interaction effect models (neighborhood: residential density)				
	(1)	(2)	(3)	(4)	(5)
	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))
Residential density	.90*** (.02)	.92** (.03)	.88*** (.02)	.91*** (.03)	.97*** (.03)
Building type: semi-detached	1.71* (.26)	[a]	[a]	[a]	[a]
Building type: detached	1.19 (.24)	[a]	[a]	[a]	[a]
Building type: part of apartment building	.80 (.32)	[a]	[a]	[a]	[a]
Number of occupants	[a]	1.07 (.05)	[a]	[a]	[a]
Number of residential units: two residential units	[a]	[a]	1.36 (.39)	[a]	[a]
Number of residential units: three or more residential units	[a]	[a]	.45*** (.21)	[a]	[a]
Rental unit: yes	[a]	[a]	[a]	2.19*** (.17)	[a]
Distance (km)	[a]	[a]	[a]	[a]	.54*** (.06)
Residential density * building type: semi-detached	.84 (.09)	[a]	[a]	[a]	[a]
Residential density * building type: detached	1.05 (.24)	[a]	[a]	[a]	[a]
Residential density * Building type: Part of apartment building	1.00 (.32)	[a]	[a]	[a]	[a]
Residential density * number of occupants	[a]	.99 (.01)	[a]	[a]	[a]
Residential density * number of residential units: two residential units	[a]	[a]	.88 (.09)	[a]	[a]
Residential density * number of residential units: three or more residential units	[a]	[a]	1.06 (.04)	[a]	[a]
Residential density * rental unit: yes	[a]	[a]	[a]	.98 (.03)	[a]
Residential density * distance (km)	[a]	[a]	[a]	[a]	
AIC (df)	23,824.72 (16)	23,824.16 (14)	23,822.44 (15)	23,825.30 (14)	23,812.77 (14)
BIC (df)	23,897.05 (16)	23,887.45 (14)	23,890.25 (15)	23,888.59 (14)	23,876.06 (14)

(1) Neighborhood: residential density * residence: building type; (2) neighborhood: residential density * residence: number of occupants; (3) neighborhood: residential density * residence: number of residential units; (4) neighborhood: residential density * residence: rental status; (5) neighborhood: residential density * residence: distance (km). For clarity and brevity, only the interaction effects and associated main effects are printed

*$p < .05$; **$p < .01$; ***$p < .001$

[a]Omitted for brevity

Table 9 Model estimates for cross-level interaction effect conditional logit models of burglary target choice in Ghent, Belgium (679 burglaries, 577 burglars, 138,321 residential units)

Variables	Cross-level interaction effect models (neighborhood: proportion non-Belgians)				
	(1)	(2)	(3)	(4)	(5)
	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))
Proportion non-Belgians	.98* (.02)	.96 (.01)	.98* (.09)	.99 (.01)	1.01 (.01)
Building type: semi-detached	1.34 (.24)	[a]	[a]	[a]	[a]
Building type: detached	1.36 (.22)	[a]	[a]	[a]	[a]
Building type: part of apartment building	.24*** (.31)	[a]	[a]	[a]	[a]
Number of occupants	[a]	1.13* (.06)	[a]	[a]	[a]
Number of residential units: two residential units	[a]	[a]	2.01 (.39)	[a]	[a]
Number of residential units: three or more residential units	[a]	[a]	.34*** (.20)	[a]	[a]
Rental unit: yes	[a]	[a]	[a]	1.82*** (.17)	[a]
Distance (km)	[a]	[a]	[a]	[a]	.53*** (.06)
Proportion non-Belgians * building type: semi-detached	1.00 (.02)	[a]	[a]	[a]	[a]
Proportion non-Belgians * building type: detached	1.07 (.02)	[a]	[a]	[a]	[a]
Proportion non-Belgians * building type: part of apartment building	.98*** (.01)	[a]	[a]	[a]	[a]
Proportion non-Belgians * Number of occupants	[a]	.99* (.01)	[a]	[a]	[a]
Proportion non-Belgians * number of residential units: Two residential units	[a]	[a]	.93* (.03)	[a]	[a]
Proportion non-Belgians * number of residential units: three or more residential units	[a]	[a]	1.03** (.01)	[a]	[a]
Proportion non-Belgians * rental unit: yes	[a]	[a]	[a]	1.00 (.01)	[a]
Proportion non-Belgians * distance (km)	[a]	[a]	[a]	[a]	.99** (.01)
AIC (df)	23,805.32 (16)	23,819.99 (14)	23,808.43 (15)	23,825.16 (14)	23,814.99 (14)
BIC (df)	23,877.65 (16)	23,883.27 (14)	23,876.24 (15)	23,888.45 (14)	23,878.28 (14)

(1) Neighborhood: proportion non-Belgians * residence: building type; (2) neighborhood: proportion non-Belgians * residence: number of occupants; (3) neighborhood: proportion non-Belgians * residence: number of residential units; (4) neighborhood: proportion non-Belgians * residence: rental status; (5) neighborhood: proportion non-Belgians * Residence: distance (km). For clarity and brevity, only the interaction effects and associated main effects are printed

*$p < .05$; **$p < .01$; ***$p < .001$

[a]Omitted for brevity

Table 10 Model estimates for cross-level interaction effect conditional logit models of burglary target choice in Ghent, Belgium (679 burglaries, 577 burglars, 138,321 residential units)

Variables	Cross-level interaction effect models (neighborhood: proportion rental units)				
	(1)	(2)	(3)	(4)	(5)
	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))
Proportion rental units	1.00 (.01)	1.01* (.01)	.98** (.01)	1.01 (.01)	1.02** (.01)
Building type: semi-detached	1.75 (.36)	[a]	[a]	[a]	[a]
Building type: detached	1.07 (.39)	[a]	[a]	[a]	[a]
Building type: part of apartment building	.56 (.60)	[a]	[a]	[a]	[a]
Number of occupants	[a]	1.40*** (.09)	[a]	[a]	[a]
Number of residential units: two residential units	[a]	[a]	2.06 (.86)	[a]	[a]
Number of residential units: three or more residential units	[a]	[a]	.17*** (.33)	[a]	[a]
Rental unit: yes	[a]	[a]	[a]	3.51*** (.28)	[a]
Distance (km)	[a]	[a]	[a]	[a]	.69*** (.09)
Proportion rental units * building type: semi-detached	.99 (.01)	[a]	[a]	[a]	[a]
Proportion rental units * building type: detached	1.00 (.01)	[a]	[a]	[a]	[a]
Proportion rental units * building type: part of apartment building	1.01 (.01)	[a]	[a]	[a]	[a]
Proportion rental units * number of occupants	[a]	.99*** (.01)	[a]	[a]	[a]
Proportion rental units * number of residential units: two residential units	[a]	[a]	.98 (.02)	[a]	[a]
Proportion rental units * Number of residential units: three or more residential units	[a]	[a]	1.03*** (.01)	[a]	[a]
Proportion rental units * Rental unit: yes	[a]	[a]	[a]	.99* (.01)	[a]
Proportion rental units * distance (km)	[a]	[a]	[a]	[a]	.99*** (.01)
AIC (df)	23,826.13 (16)	23,811.61 (14)	23,808.05 (15)	23,821.40 (14)	23,800.57 (14)
BIC (df)	23,898.46 (16)	23,874.90 (14)	23,875.86 (15)	23,884.69 (14)	23,863.86 (14)

(1) Neighborhood: proportion rental units * residence: building type; (2) neighborhood: proportion rental units * residence: number of occupants; (3) neighborhood: proportion rental units * residence: number of residential units; (4) neighborhood: proportion rental units * residence: rental status; (5) neighborhood: proportion rental units * residence: distance (km). For clarity and brevity, only the interaction effects and associated main effects are printed

*$p < .05$; **$p < .01$; ***$p < .001$

[a]Omitted for brevity

Table 11 Model estimates for cross-level interaction effect conditional logit models of burglary target choice in Ghent, Belgium (679 burglaries, 577 burglars, 138,321 residential units)

Variables	Cross-level interaction effect models (neighborhood: prior burglary in neighborhood)				
	(1)	(2)	(3)	(4)	(5)
	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))
Prior burglary in neighborhood 0–6 months[1]	21.17*** (.19)	.97*** (.24)	21.07*** (.20)	22.20*** (.23)	6.83*** (.22)
Building type: semi-detached	1.22 (.15)	a	a	a	a
Building type: detached	1.36* (.13)	a	a	a	a
Building type: part of apartment building	.79 (.15)	a	a	a	a
Number of occupants	a	1.01 (.03)	a	a	a
Number of residential units: two residential units	a	a	.78 (.20)	a	a
Number of residential units: three or more residential units	a	a	.59*** (.11)	a	a
Rental unit: yes	a	a	a	2.05*** (.09)	a
Distance (km)	a	a	a	a	.42*** (.04)
Prior burglary in neighborhood 0–6 months[1] * building type: Semi-detached	.33 (.74)	a	a	a	a
Prior burglary in neighborhood 0–6 months[1] * building type: detached	.83 (.42)	a	a	a	a
Prior burglary in neighborhood 0–6 months[1] * Building type: part of apartment building	1.04 (.55)	a	a	a	a
Prior burglary in neighborhood 0–6 months[1] * number of occupants	a	1.00 (.10)	a	a	a
Prior burglary in neighborhood 0–6 months[1] * number of residential units: two residential units	a	a	1.09 (.76)	a	a
Prior burglary in neighborhood 0–6 months[1] * number of residential units: three or more residential units	a	a	.76 (32)	a	a
Prior burglary in neighborhood 0–6 months[1] * rental unit: Yes	a	a	a	.75 (.31)	a
Prior burglary in neighborhood 0–6 months[1] * distance (km)	a	a	a	a	2.49*** (.08)
AIC (df)	23,826.48 (16)	23,825.64 (14)	23,826.87 (15)	23,824.80 (14)	23,754.14 (14)

Table 11 (continued)

Variables	Cross-level interaction effect models (neighborhood: prior burglary in neighborhood)				
	(1)	(2)	(3)	(4)	(5)
	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))	Exp(B) (SE(B))
BIC (df)	23,898.81 (16)	23,888.93 (14)	23,894.68 (15)	23,888.09 (14)	23,817.43 (14)

(1) Neighborhood: proportion rental units * residence: building type; (2) neighborhood: proportion rental units * residence: number of occupants; (3) neighborhood: proportion rental units * residence: number of residential units; (4) neighborhood: proportion rental units * residence: rental status; (5) neighborhood: proportion rental units * residence: distance (km). For clarity and brevity, only the interaction effects and associated main effects are printed

*$p<.05$; **$p<.01$; ***$p<.001$

[1]The offender committed a previous burglary in the neighborhood less than 6 months ago (0/1)

[a]Omitted for brevity

References

Andresen MA (2011) Estimating the probability of local crime clusters: the impact of immediate spatial neighbors. Journal of Criminal Justice 39(5):394–404

Baudains P, Braithwaite A, Johnson SD (2013) Target choice during extreme events: a discrete spatial choice model of the 2011 London Riots. Criminology 51(2):251–285

Ben-Akiva ME, Lerman SR (1985) Discrete choice analysis: theory and application to travel demand. MIT Press, Cambridge

Bennett T, Wright R (1984) Burglars on burglary. Gower, Aldershot

Bernasco W (2006) Co-offending and the choice of target areas in burglary. J Investig Psychol Offender Profiling 3(3):139–155

Bernasco W (2008) Them again? Same-offender involvement in repeat and near repeat burglaries. Eur J Criminol 5(4):411–431

Bernasco W (2009) Burglary. In: Tonry M (ed) The Oxford handbook on crime and public policy. Oxford University Press, Oxford, pp 165–190

Bernasco W (2010a) Modeling micro-level crime location choice: application of the discrete choice framework to crime at places. J Quant Criminol 26(1):113–138

Bernasco W (2010b) A sentimental journey to crime: effects of residential history on crime location choice. Criminology 48(2):389–416

Bernasco W, Luykx F (2003) Effects of attractiveness, opportunity and accesibility to burglars on residential burglary rates of urban neighborhoods. Criminology 41(3):981–1002

Bernasco W, Nieuwbeerta P (2005) How do residential burglars select target areas? A new approach to the analysis of criminal location choice. Br J Criminol 45(3):296–315

Bernasco W, Block R, Ruiter S (2012) Go where the money is: modeling street robbers' location choices. J Econ Geogr 13(1):119–143

Bernasco W, Johnson SD, Ruiter S (2015) Learning where to offend: effects of past on future burglary locations. Appl Geogr 60:120–129

Bernasco W, Ruiter S, Block R (2016) Do street robbery location choices vary over time of day or day of week? A test in Chicago. J Res Crime Delinq 54:244–275

Bowers KJ, Johnson SD, Pease K (2005) Victimisation and re-victimisation risk, housing type and area: a study of interactions. Crime Prev Commun Saf 7(1):7–17

Brantingham PJ, Brantingham PL (1978) A theoretical model of crime site selection. In: Krohn MD, Akers RL (eds) Crime, law and sanctions: theoretical perspectives. Sage, Beverly Hills, pp 105–118

Brantingham PL, Brantingham PJ (1981) Notes on the geometry of crime. In: Brantingham PJ, Brantingham PL (eds) Environmental criminology. Sage Publications, Beverly Hills, pp 27–55

Brantingham PJ, Brantingham PL (1984) Patterns in crime. Macmillan, New York

Brantingham PL, Brantingham PJ (1993) Nodes, paths and edges: considerations on the complexity of crime and the physical environment. J Environ Psychol 13(1):3–28

Clare J, Fernandez J, Morgan F (2009) Formal evaluation of the impact of barriers and connectors on residential burglars' macro-level offending location choices. Aust N Z J Criminol 42(2):132–158

Cornish DB, Clarke RV (1986) Introduction. In: Cornish DB, Clarke RV (eds) The reasoning criminal: rational choice perspectives on offending. Springer, New York, pp 1–16

Cornish DB, Clarke RV (2008) The rational choice perspective. In: Wortley R, Mazerolle L (eds) Environmental criminology and crime analysis. Willan Publishing, Cullompton, pp 21–47

Coupe RT, Girling AJ (2001) Modelling police success in catching burglars in the act. Omega 29(1):19–27

Coupe T, Griffiths M (1996) Solving residential burglary. In: Webb B (ed) Crime detection and prevention series. Home Office, London, pp 3–23

Cromwell P, Olson J, Avary DAW (1991) Breaking and entering: an etnographic analysis of burglary. SAGE Publications Ltd, Newbury Park

Ellingworth D, Farrell G, Pease K (1995) A victim is a victim is a victim? Chronic victimization in four sweeps of the British crime survey. Br J Criminol 35(3):360–365

Farrell G, Pease K (2001) Repeat victimization, vol 12. Criminal Justice Press, Monsey

Ferrell J (1993) Crime of style: urban graffiti and the politics of criminality. Northeastern University Press, Boston

Ferrell J, Weide RD (2010) Spot theory. City 14(1–2):48–62

FOD Economie Algemene Directie Statistiek—Statistics Belgium (2011) Census 2011 Belgium

Frith MJ, Johnson SD, Fry HM (2017) Role of the street network in burglars' spatial decision-making. Criminology 55(2):344–376

Hakim S, Rengert G, Shachmurove Y (2000) Knowing your odds: home burglary and the odds ratio. (Working paper #00-14). Center for Analytic Research in Economics and the Social Sciences, University of Pennsylvania, Philadelphia

Hakim S, Rengert GF, Shachmurove Y (2001) Target search of burglars: a revised economic model. Pap Reg Sci 80(2):121–137

Hilbe JM (2011) Negative binomial regression, 2nd edn. Cambridge University Press, Cambridge

Johnson SD, Summers L (2015) Testing ecological theories of offender spatial decision making using a discrete choice model. Crime Delinq 61(3):454–480

Johnson SD, Bernasco W, Bowers KJ, Elffers H, Ratcliffe JH, Rengert G, Townsley M (2007) Space-time patterns of risk: a cross national assessment of residential burglary victimization. J Quant Criminol 23(3):201–219

Johnson SD, Summers L, Pease K (2009) Offender as forager? A direct test of the boost account of victimization. J Quant Criminol 25(2):181–200

Lammers M (2014) Are arrested and non-arrested serial offenders different? A test of spatial offending patterns using DNA found at crime scenes. J Res Crime Delinq 51(2):143–167

Lammers M (2017) Co-offenders' crime location choice: do co-offending groups commit crimes in their shared awareness space? Br J Criminol 58:1193–1211

Lammers M, Menting B, Ruiter S, Bernasco W (2015) Biting once, twice: the influence of past on current crime location choices. Criminology 53(3):309–329

Langton SH, Steenbeek W (2017) Residential burglary target selection: an analysis at the property-level using Google Street View. Appl Geogr 86:292–299

Logie R, Wright R, Decker S (1992) Recognition memory performance and residential burglary. Appl Cognit Psychol 6(2):109–123

Maguire M, Bennett T (1982) Burglary in a dwelling: the offence, the offender and the victim. Heinemann, London

Menting B, Lammers M, Ruiter S, Bernasco W (2016) Family matters: effects of family members' residential areas on crime location choice. Criminology 54(3):413–433

Mize TD (2019) Best practices for estimating, interpreting, and presenting nonlinear interaction effects. Sociological Science 6(4):81–117

Nee C, Meenaghan A (2006) Expert decision making in burglars. Br J Criminol 46(5):935–949

Nee C, Taylor M (2000) Examining burglars' target selection: interview, experiment or ethnomethodology? Psychol Crime Law 6(1):45–59

Peeters MP, Van Daele S, Vander Beken T (2017) Adding to the mix: a multilevel analysis of residential burglary. Secur J 31:389–409

Polvi N, Looman T, Humphries C, Pease KEN (1991) The time course of repeat burglary victimization. Br J Criminol 31(4):411–414

Raftery AE (1995) Bayesian model selection in social research. Sociol Methodol 25(1995):111–163

Ratcliffe JH (2002) Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. J Quant Criminol 18(1):23–43

Rephann TJ (2009) Rental housing and crime: the role of property ownership and management. Ann Reg Sci 43(2):435–451

Rountree PW, Land KC (1996) Burglary victimization, perceptions of crime risk, and routine activities: a multilevel analysis across Seattle neighborhoods and census tracts. J Res Crime Delinq 33(2):147–180

Ruiter S (2017) Crime location choice: state of the art and avenues for future research. In: Bernasco W, Van Gelder J-L, Elffers H (eds) The Oxford handbook of offender decision making. Oxford University Press, Oxford, pp 398–420

Sampson RJ, Groves WB (1989) Community structure and crime: testing social-disorganization theory. Am J Sociol 94(4):774–802

Taylor RB, Gottfredson S (1986) Environmental design, crime, and prevention: an examination of community dynamics. Crime Justice 8:387–416

Taylor M, Nee C (1988) The role of cues in simulated residential burglary: a preliminary investigation. Br J Criminol 28(3):396–401

Townsley M, Sidebottom A (2010) All offenders are equal, but some are more equal than others: variation in journeys to crime between offenders. Criminology 48(3):897–917

Townsley M, Homel R, Chaseling J (2000) Repeat burglary victimisation: spatial and temporal patterns. Aust N Z J Criminol 33(1):37–63

Townsley M, Homel R, Chaseling J (2003) Infectious burglaries: a test of the near repeat hypothesis. Br J Criminol 43(3):615–633

Townsley M, Birks D, Bernasco W, Ruiter S, Johnson SD, White G, Baum S (2015) Burglar target selection: a cross-national comparison. J Res Crime Delinq 52(1):3–31

Townsley M, Birks D, Ruiter S, Bernasco W, White G (2016) Target selection models with preference variation between offenders. J Quant Criminol 32(2):283–304
Tseloni A, Osborn DR, Trickett A, Pease K (2002) Modelling property crime using the british crime survey. What have we learnt? Br J Criminol 42(1):109–128
van Gelder J-L, Nee C, Otte M, Demetriou A, van Sintemaartensdijk I, van Prooijen J-W (2017) Virtual burglary: exploring the potential of virtual reality to study burglary in action. J Res Crime Delinq 54(1):29–62
van Loon J (2014) "Just writing your name?" An analysis of the spatial behaviour of graffiti writers in Amsterdam. Belgeo [Online], 3. http://journals.openedition.org/belgeo/13062
Vandeviver C (2015) Understanding variation in distance to crime from within the rational choice perspective (PhD), Ghent University. Faculty of Law, Ghent, Belgium
Vandeviver C, Neutens T, Van Daele S, Geurts D, Vander Beken T (2015a) A discrete spatial choice model of burglary target selection at the house-level. Appl Geogr 64:24–34
Vandeviver C, Van Daele S, Vander Beken T (2015b) What makes long crime trips worth undertaking? Balancing costs and benefits in burglars' journey to crime. Br J Criminol 55(2):399–420
Vollaard B, van Ours JC (2011) Does regulation of built-in security reduce crime? Evidence from a natural experiment. Econ J 121(552):485–504
Waller I, Okihiro N (1978) Burglary: the victim and the public. University of Toronto Press, Toronto
Weisel DL (2002) Burglary of single-family houses. U.S. Department of Justice, Office of Community Oriented Policing Services, Washington, DC
Wright R, Logie RH (1988) How young house burglars choose targets. Howard J Crim Justice 27(2):92–104
Wright R, Decker SH, Redfern AK, Smith DL (1992) A snowball's chance in hell: doing fieldwork with active residential burglars. J Res Crime Delinq 29(2):148–161
Wright R, Logie RH, Decker SH (1995) Criminal expertise and offender decision making: an experimental study of the target selection process in residential burglary. J Res Crime Delinq 32(1):39–53
Xie M, McDowall D (2008) The effects of residential turnover on household victimization. Criminology 46(3):539–575