CRIMINOLOGY

FAMILY MATTERS: EFFECTS OF FAMILY MEMBERS' RESIDENTIAL AREAS ON CRIME LOCATION CHOICE*

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According to crime pattern theory, offenders are likely to select crime locations within their awareness space. Previous studies have shown that offenders often commit crimes within their current and former residential areas and in areas they previously targeted. However, offenders' awareness spaces obviously consist of more locations that potentially influence their crime location choices. This study examines the importance of the residential areas of offenders' family members. Most offenders visit their families at least occasionally and consequently get familiar with the areas in which their families live. It is hypothesized that family members' residential areas are at increased risk of being targeted. Unique data were used to reconstruct residential histories of the parents, siblings, and children of 7,910 offenders who committed 19,420 offenses. The results of discrete spatial choice models showed that residential areas of family members are indeed at increased risk of being targeted. Current familial residential areas had stronger and more consistent effects than had former familial residential areas. Effects were strongest for the residential areas of offenders' children compared with those of their parents and siblings. The residential areas of male and female family members affected the crime location choices of male and female offenders equally.

The importance of family in the etiology of crime is undisputed. However, family may not only influence *whether* people commit crime but also *where* they do. According to crime pattern theory (Brantingham and Brantingham, 1993, 2008), offenders usually commit crimes in areas where the presence of attractive targets overlaps with their awareness space. Because most people visit their family members rather frequently, and because

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places visited frequently are key elements of awareness space, the residential areas of offenders' family members should have an increased risk of being targeted. However, no previous empirical crime location choice studies have focused explicitly on the effects of residential areas of family members of offenders; only the importance of current or former residential areas of the offenders themselves (e.g., Bernasco, 2010) and their previous crime locations have been shown (Bernasco, Johnson, and Ruiter, 2015; Lammers et al., 2015).

This study is the first to examine how the residential areas of their family members affect the crime location choices of offenders. Although these areas have not been emphasized as an activity node in original accounts of crime pattern theory, they are probably part of (many) offenders' awareness spaces if offenders visit their families. However, their importance for crime location choices has not yet been assessed empirically. This study combines police data on 7,910 offenders in the greater The Hague area in the Netherlands and the 19,420 offenses they committed with unique and detailed data to reconstruct the residential histories of their parents, siblings, and children. These data allow us to realize three aims. First, we test the influence of both current and former residential areas of any of the close family members (parents, siblings, or children) of offenders. Second, we assess whether crime location choices are differently affected by the current and former residential areas of parents, siblings, and children. Third, we contribute to existing literature by examining whether the crime location choices of male and female offenders are differentially affected by the residential areas of their male and female family members.

In subsequent sections, crime pattern theory is explained in more detail, followed by arguments to support the expectation that residential areas of family members are part of offenders' awareness spaces and, thus, influence their crime location choices. The possible moderating role of the gender of both the offender and his or her family members is subsequently described. After specifying the hypotheses of this study, the data and methods used are described, and the results are presented. This article concludes with a discussion of the findings and their implications for theory and future research.

CRIME PATTERN THEORY: THEORY AND EMPIRICAL EVIDENCE

According to crime pattern theory, offenders are more likely to target areas within their awareness space because they are familiar with these areas and consequently have some knowledge about the potential risks and rewards involved. All people, including offenders, learn about their environment during their routine activities. Places where a significant amount of time is spent are called "activity nodes." Examples are the home, work location, school, and shopping areas. These nodes and the travel routes between them form an individual's activity space, and an individual's awareness space consists of this activity space and all places within visual range (Brantingham and Brantingham, 1981, 1993, 2008). Because most individuals visit their family members at least occasionally, the residential areas of these family members are also part of their awareness space. Some scholars have indeed mentioned the residential areas of others including family members as being part of an offender's activity space (Alston, 1994; Bernasco, 2010; Rossmo, 2000). Furthermore, in geographic offender profiling, family residences can be indicated as anchor points in addition to the offender's residential area (Rossmo, 2000).

Although people repeatedly visit the same activity nodes over long periods of time, awareness space is essentially dynamic. Activity nodes do change, for instance, when people move to another home. After moving, the new residential area becomes part of the activity space and the former residential area disappears from it. However, because people do not immediately forget about the characteristics of their former residential areas after they have moved, awareness spaces only gradually change over time (Bernasco, 2010; Brantingham and Brantingham, 1981, 2008). When studying crime location choice, it is therefore important to include both current and recent former activity nodes.

Some areas of offenders' awareness spaces have been found to influence their crime location choices. For instance, previous studies have shown that offenders are more likely to commit crime in and near their current (Baudains, Braithwaite, and Johnson, 2013; Bernasco, 2010; Bernasco and Nieuwbeerta, 2005; Johnson and Summers, 2015; Townsley et al., 2015) and former (Bernasco, 2010; Bernasco and Kooistra, 2010; Lammers et al., 2015) residential areas than in otherwise comparable areas. Two recent studies also showed that previous crime locations have an increased risk of being targeted again (Bernasco, Johnson, and Ruiter, 2015; Lammers et al., 2015).

The impact of the residential areas of offenders' family members on their crime location choices has not been examined before. If offenders regularly spend time with their families, the areas where their family members currently live and used to live should be part of their awareness space and, therefore, have an increased probability of being targeted.

KNOWLEDGE OF RESIDENTIAL AREAS OF PARENTS, SIBLINGS, AND CHILDREN

Parents, siblings, and children are close family members, and to most people, they are significant others throughout their lives (Carstensen, 1992; Lye, 1996; Van Volkom, 2006). During childhood and adolescence, most people share the same residence with their parents and siblings, but even after people move out of their parental home, they usually maintain contact with their close family members. The residential areas of these family members may consequently be activity nodes in the awareness space of individuals. The next two sections describe the contact frequency patterns between parents and their children and among siblings with a focus on non-cohabiting family members.

CONTACT BETWEEN PARENTS AND THEIR CHILDREN

Young children generally live with one or both of their parents and consequently have frequent contact with them. In the general population in the Netherlands in 2009, 81.9 percent of children younger than 16 years of age lived with both parents. The rest lived with one parent: 15.6 percent with their mother (plus partner) and 1.6 percent with their father (plus partner; Statistics Netherlands, 2015). These numbers show that minors whose parents do not share the same household (e.g., after a divorce) most often live with their mothers. However, contact between children and their nonresiding father remains in most cases. Approximately 60 percent of the fathers who did not have custody received visits from their children at least weekly, 26 percent less than once per week, and 14 percent never in the first year after the divorce (Kalmijn and de Graaf, 2000). The residential area of the other parent will, thus, generally be part of the child's awareness space and

the residential area of a child will be part of the awareness space of the nonresiding parent.

Most children leave their parental home in late adolescence/early adulthood. In the Netherlands, the average age when moving out is 22.8 years (Stoeldraijer, 2014). Multiple studies have shown that adult children have frequent contact with their parents after leaving the parental home and that this often includes face-to-face contact (for a review, see Lye, 1996). More than half of the nonresiding young adult children reported seeing their parents at least weekly (Bucx et al., 2008). When parents reach old age, most late-life families are characterized by frequent contact patterns between parents and their children (Dykstra and Fokkema, 2011). Contact between parents and adult children in the Netherlands is frequent with more than 80 percent of the dyads having face-to-face contact about monthly or more frequently (Kalmijn and Dykstra, 2006). Most parents and their adult children in the Netherlands visit each other at least once a month (Verbakel and de Graaf, 2004).

CONTACT BETWEEN SIBLINGS

Most adults have at least one sibling. In the Netherlands, more than 90 percent do (Verbakel and de Graaf, 2004). After sharing a history of family experiences while living together in their youth, the relationship often remains intensive when siblings go their separate ways in adulthood, and contact usually lasts a lifetime (Van Volkom, 2006; Verbakel and de Graaf, 2004). Half of adult siblings reported seeing each other at least once a month (White and Riedmann, 1992). Verbakel and de Graaf (2004) showed that most sibling pairs visited each other at least once every 2 months, with 10 percent of the siblings visiting each other at least weekly.

Hence, the contact frequency of individuals with their parents, children, and siblings is rather high, including face-to-face contact and visits, even when they are not sharing the same residence. Therefore, the residential areas of each of these family members are likely known by individuals, at least to some extent, and these can thus be considered part of their awareness spaces.

GENDER DIFFERENCES IN FAMILY CONTACT

Knowledge of familial residential areas may not be equal for men and women because contact frequency differs between male and female family members. Previous studies have shown differences in the relationship and frequency of contact among same-sex, cross-sex, male, and female next of kin. In childhood and adolescence, children were found to spend more time with their mothers than with their fathers (Collins and Russell, 1991). When children had reached adulthood, contact was found to be more frequent between mothers and daughters when compared with mother–son, father–daughter, and father–son pairs (Lye, 1996). In a more recent Dutch study, mothers and adult daughters had the most frequent face-to-face contact, fathers and adult sons the least, and cross-sex pairs scored in between (Kalmijn and Dykstra, 2006). Several studies on sibling relationships in adulthood, one of which measured actual (bidirectional) visiting frequency (Verbakel and de Graaf, 2004), also showed a similar pattern: Sister–sister pairs had the closest relationship and more contact compared with either brother–sister or brother–brother pairs, and there is some indication that brothers are less close than

cross-sex pairs (Cicirelli, 1991; Lee, Mancini, and Maxwell, 1990; Verbakel and de Graaf, 2004).

For both parent–child and sibling relationships, it seems that the presence of women in the dyad increases the closeness between family members. This might be explained by the "kinkeeping" role that is often undertaken by women. Other explanations might be that the social support networks of women are often larger and that women have a more nurturing nature (Akiyama, Elliott, and Antonucci, 1996; Lye, 1996; Van Volkom, 2006).

OFFENDERS AND THEIR FAMILIES

Although the literature on family relations and contact frequency patterns has until now not specifically regarded offenders, similar patterns probably apply to most of this particular group of individuals and their parents, siblings, and/or children. "People who commit crimes spend most of their day in non-criminal activities" (Brantingham and Brantingham, 2008: 79). They likely also engage in activities with their close family members and visit their residential areas. Even in prison, most offenders have at least some contact with their family members (La Vigne et al., 2005). Also, no empirical evidence exists to our knowledge that the contact patterns between male and female family members described earlier would be different for offenders.

Literature that has focused on the influence of familial residential areas on crime location choice is almost nonexistent. To our knowledge, only two examples exist. Rossmo and colleagues (2014) indicated in a case study that residential areas of family members are relevant in predicting where deviant behavior takes place. They studied the spatial distribution of anti-Nazi postcards made by a German couple, Otto and Elise Hampel, during World War II in Nazi-Berlin. At the time, distributing such postcards in Germany was considered a crime. The study showed peaks in the geographic offender profile near the residential areas of the parents, as well as of the siblings, of the Hampels. This finding suggests that the couple was familiar with these areas and decided to distribute the postcards there. Rossmo (2000) also briefly provided an example of a similar case of a bomber in London in the mid-1990s: The offender's family lived in the secondary peak area in the geographic profile. Although both are specific cases, the findings provide support for our reasoning that the residential areas of close family members have an increased probability of being targeted by offenders.

HYPOTHESES

According to crime pattern theory, offenders are likely to commit crime in areas they regularly visit. As contact between close family members is often rather intensive, it is likely that the residential areas of offenders' close family members have an increased risk of being targeted. Therefore, our main hypothesis reads as follows:

> *Hypothesis 1*: Offenders are more likely to commit a crime in an area in which any of their close family members—parents, siblings, or children—currently live or formerly lived when compared with otherwise comparable areas in which no family members ever lived.

Similar to previous findings for offenders' former residential areas, the former residential areas of family members are presumably also at increased risk of being targeted. We expect the knowledge of former residential areas of family members to decrease over time. The new residential area becomes part of the awareness space, and the former residential area is no longer part of the activity space. We therefore propose our *history* hypothesis, which consists of the following two parts:

Hypothesis 2a: Offenders are more likely to commit a crime in an area in which any of their close family members currently live than in otherwise comparable areas in which family members formerly lived.

Hypothesis 2b: Offenders are more likely to commit a crime in an area in which any of their close family members formerly lived than in otherwise comparable areas in which their family members never lived.

We expect that hypotheses 1 and 2 apply to all family members combined as well as for the three family types (parents, siblings, and children) separately.

Based on the literature on gender differences in family contact, we expect visiting frequency between family members to differ between men and women and, likewise, their knowledge of the residential areas of family members. Closer relationships and more frequent contact patterns are expected between female offenders and their mothers/sisters/daughters, followed by male offenders with their mothers/sisters/daughters or female offenders with their fathers/brothers/sons, followed by male offenders with their fathers/brothers/sons. The final hypothesis, which also consists of two parts, therefore reads as follows:

Hypothesis 3a: When both offender and family member(s) are female, the probability that the offender commits a crime in an area in which family members live or have lived is larger than when either the offender or family member(s) is female.

Hypothesis 3b: When either the offender or family member(s) is female, the probability that the offender commits a crime in an area in which family members live or have lived is larger than when both offender and family member(s) are male.

DATA

In this section, the data sources and variables used in this study are described first. Subsequently, the analytical strategy is explained. We used discrete spatial choice models to study crime location choice. In these models, the dependent variable is the choice of one particular area j from a geographical set of alternatives J to commit a crime. To construct the dependent variable, crimes committed between 2006 and 2009 in the greater The Hague area were included in this study. Residential areas of offenders' parents, siblings, and children before and at the time of each offense were used to construct the multiple residential independent study variables. These addresses had to be located in the greater The Hague area, and data were used up until 2009. The set of alternative areas J consists of four-digit postal code areas, of which there are 142 in the study area, with an average population size of around 7,000 and an average area size of 2.96 km^2

Table 1. Offender Characteristics ($N = 7,910$)

Variable	Count	%
Gender		
Male	6,481	81.9
Offenders with Family Members[a]		
Any family member	6,849	86.6
Parents	5,507	69.6
Siblings	5,227	66.1
Children	2,533	32.0

[a] All family members with at least one residential address in the greater The Hague area in the 3 years before or at the time of the offense.

[standard deviation (SD) = 4.38, range = .12 to 24.69, median = 1.47]. Dutch four-digit postal code areas are designed to have minimal travel restrictions for postal delivery services that usually travel by foot or bicycle, and their size is inversely related to the level of urbanization (Bernasco, 2010: 398). The four-digit postal areas are therefore perfectly suited for a crime location choice study because most people will be familiar with these areas when living there or (frequently) visiting the area.

OFFENDERS AND OFFENSES

Data on offenders and their offenses were obtained from the police information system used by the The Hague Police Service. Records with information on offenders and the offenses they had been charged with were used to establish the location and date of the offenses committed. From the electronic system, a random sample was taken of 10,000 offenders with at least one crime incident in 2009.

Of the 10,000 offenders from the original sample, 2,090 individuals were excluded, resulting in a final sample of 7,910 offenders. Exclusion occurred for several reasons: 1) 92 individuals were involved in offenses that did not meet the criteria of a felony; 2) 5 individuals were younger than 12 years old in 2009, and the Dutch criminal law does not allow prosecution of children younger than 12; 3) 308 individuals had no offense committed between 2006 and 2009 at a valid address in the greater The Hague area because offenses were in another region, had an unknown/nonspecific address within the area, or were committed outside the study period 2006–2009; and 4) 1,685 individuals were dropped because they did not have a known residential address within the greater The Hague area at the time they committed the 2006–2009 offenses (hereby excluding crimes committed by people living outside the study area including tourists). Descriptive statistics of the remaining 7,910 offenders are provided in table 1. On average, they were 32.7 years old (SD = 14.3, range = 12–95, median = 29).

All registered offenses of the 7,910 offenders committed in the period 2006–2009 in the greater The Hague area were used to construct the dependent variable. In total, the analyses include 19,420 offenses committed by these offenders. Because previous crime locations were found to influence subsequent crime location choice (Bernasco, Johnson, and Ruiter, 2015; Lammers et al., 2015), the offense histories of these offenders were also reconstructed for the period 2003–2005, with a maximum of 3 years prior to the crime location choices under study. This resulted in 4,262 additional prior offenses. All offense locations were geocoded to 1 of the 142 four-digit postal code areas. For each offense, the

postal code area in which the offense was committed scored 1, and all other remaining postal code areas scored 0. The control variable *previous crime location* (1 = yes; 0 = no) for each 2006–2009 offense and the associated 142 alternative postal code areas was constructed to indicate whether the offender had committed a prior offense in that particular postal code area in the 3 years before this offense.

FAMILY MEMBERS AND RESIDENTIAL HISTORIES

To determine 1) who the family members are of the 7,910 offenders, and 2) the residential histories of the offenders and their family members, population registration data were used. These data are held in a nationwide information system (Dutch acronym BRP) that records information on all Dutch citizens, is continuously updated, and can be extracted by authorized organizations on a daily basis. For each individual, it is registered uniquely and in detail who the parents are and who the children are. By obtaining the information on the children of the registered parents of the offender (with the offender being one of them), the (half-)siblings can be identified. Status changes of citizens, including moving to another residential address, marriage/divorce, birth of a child, and death are registered and updated by municipalities in this system. Historical information (e.g., former addresses) of each person also remains in the system. These registration data are a reliable source for identifying the family members of offenders, as well as for reconstructing residential histories of offenders and their family members. After excluding addresses outside the greater The Hague area, all remaining (former) home addresses inside the study area were geocoded to 1 of the 142 postal code areas.

Family members of each of the 7,910 offenders were eligible for inclusion in the study when they had at least one greater The Hague area address in the 3 years before or at the time of the offense. This resulted in a total number of 9,190 parents, 13,418 siblings, and 5,034 children included in this study. The main reasons for reduced numbers of included family members were the absence of a greater The Hague area address in the study period for a particular family member or because a family member could not be found in the BRP system (e.g., as a result of death before the BRP became operational in 1994, migration, or being from another country).

Three mutually exclusive dummy variables were constructed to indicate for each of the 142 alternative postal code areas whether any family member currently lives or had previously lived there (1 = yes; 0 = no). *Current residential area of any family* indicates postal code areas in which at least one family member of the offender lived at the time of the offense. *Former residential area of any family* indicates postal code areas in which at least one family member had lived before the offense, with a residential end date within the 3 years prior to the offense. *Never residential area of any family* indicates postal code areas in which no family member lived at the time of the offense or in the 3 years prior to the offense. All postal code areas that were simultaneously a former residential area of a family member and a current residential area of another family member were assigned to the *current* familial residential area. To test whether the findings apply equally to the three different types of family members, the three *current*, *former*, and *never residential area* variables were constructed separately for *parents*, *siblings*, and *children* as well.

We also examined gender differences in the probability that residential areas of male or female family members were targeted by male and female offenders. For each postal

code area, it was therefore determined whether any *female* family member (mother, sister, and/or daughter) lived in that area (1 = yes; 0 = no) at the time of the offense or in the 3 years prior to the offense. The same was done to indicate the presence of any *male* family member (father, brother, and/or son). Next to these gender-specific familial residential areas, the gender of the offender is also relevant. We therefore constructed *current/former residential area of any female family member* and *current/former residential area of any male family member* separately for female and male offenders (1 = yes; 0 = no).

Because offenders' residential areas, both current and former, were found to influence crime location choice (Bernasco, 2010), the hypothesized effects of family members' residential areas are likely confounded by the effect of the (former) home location of the offender. For this reason, the current and former residential areas of the offenders were included in the analyses as control variables. We constructed *current*, *former*, and *never residential area of the offender* similar to the family-related residential area variables.[1] In the model that tests for gender differences, current and former residential areas of offenders were combined in a single dummy variable, *current/former residential area of offender*.

Another possible confounder is distance between the home location of the offender and the crime location. Offenders are more likely to commit crime closer to their homes than farther away. This *distance decay* pattern (Brantingham and Brantingham, 1984: 344–6; Rossmo, 1995) has consistently been found in some previous crime location studies (e.g., Bernasco, 2010; Bernasco, Johnson, and Ruiter, 2015; Lammers et al., 2015). We therefore included distance as a control variable to each model in this study. We used the Euclidian distance in kilometers between the centroid of the residential area of the offender at the time of the offense and the centroid of each alternative postal code area. When the distance between the current residential area and the alternative postal code area was zero (when the offense was committed in the current residential area of the offender), we replaced that zero with the average distance between two random points in that postal code area, defined as .49 times the square root of the size of the area in square kilometers (following Ghosh, 1951).

POSTAL CODE AREA CHARACTERISTICS

According to crime pattern theory, crimes are committed in areas where the distribution of criminal opportunities overlaps with the awareness spaces of offenders. Areas with little criminal opportunity are therefore less likely to be targeted. Areas that contain facilities that attract people, such as retail stores, bars, and schools, are expected to generate or attract crime as such areas contain both possible targets and opportunities, as well as potential offenders (Brantingham and Brantingham, 1995, 2008). Areas with lower levels of guardianship are also more opportune to target (Cohen and Felson, 1979). Several

1. Offenders and their family members might have been incarcerated at the time of the study; in which case, the prison could have been registered as their residential address. Because incarceration limits the awareness space of an offender, prison addresses were removed from the residential history of offenders. Incarcerated family can, however, be visited by the offender, similar to a regular familial residential area. Prison addresses of parents, siblings, and children of the offenders were therefore not excluded.

indicators of such crime attractors and generators and of guardianship are included in this study as control variables.

By using census-like statistics from Statistics Netherlands (2014), the population density (the number of residents in each postal code area divided by its surface, obtained from the Ministry of the Interior and Kingdom Relations, 2014), proportion of single-person households, and proportion of residents with a non-Western background were determined for each postal code area for the years 2006–2009. Highly populated areas may generate crime, but there are also more potential guardians in those areas. Proportions of single-person households and residents with a non-Western background provide some information on social cohesion and guardianship in the area, with less guardianship in ethnically diverse areas, as well as in areas with more single-person households.

We used LISA (in Dutch: *Landelijk Informatiesysteem Arbeidsplaatsen*) data on the locations and other characteristics of all businesses and facilities in the study area (for more information, see Steenbeek et al., 2012) to determine the number of retail stores; the number of hotels restaurants bars; the number of schools; the number of culture, health-care, and sports/leisure facilities; and the number of people working in each postal code area in the years 2006–2009. These seven LISA control variables capture relevant crime generators and attractors in each postal code area. All of these control variables were crime-year specific.

METHOD

DISCRETE SPATIAL CHOICE MODELS

The hypotheses were tested by using discrete choice models. These models are used to test why a decision maker chooses a specific single alternative from a distinct number of alternatives given the characteristics of the alternatives and characteristics of the decision maker (Ben-Akiva and Bierlaire, 2003). In crime location choice studies, the decision maker is the offender, the alternatives from which the offender has to choose are distinct spatial entities, and the choice faced by the offender is where to commit a crime. Discrete choice models often follow the random utility maximization (RUM) assumptions and are statistically tested with a conditional logit model (McFadden, 1974, 1978a).

When studying crime location choice, the model implies that a motivated offender evaluates the utility (gain, profits, satisfaction, risks) of each of the possible choice alternatives and selects the alternative with the largest utility. For example, a motivated offender i wants to commit a crime in 1 of 142 mutually exclusive areas. Offender i evaluates the utility of committing a crime in an area j based on several criteria, such as whether the family of the offender lived in the area (RF_{ij}) and the criminal opportunity (CO_j) in the area. Equation (1) describes the utility deduced by the offender i from committing the crime in area j:

$$U_{ij} = \beta_1 RF_{ij} + \beta_2 CO_j + \varepsilon_{ij} \tag{1}$$

The β's denote the weight of the associated criterion for the choice outcome, which are estimated based on the observed data. If the random error term ε_{ij} follows a type I extreme value distribution, a multinomial logit model, also known as a conditional logit model, can be used to estimate the parameters (Ben-Akiva and Bierlaire, 2003).

According to this model, the probability that offender *i* chooses alternative area *j* is given by equation (2):

$$P(Y_i = j) = \frac{e^{\beta_1 RF_{ij} + \beta_2 CO_j}}{\sum_{j=1}^{J} e^{\beta_1 RF_{ij} + \beta_2 CO_j}} \quad (2)$$

The hypothesis that familial residences have an increased risk of being targeted by the offender can be examined by testing whether β_1 is significantly positive. Crime-enhancing opportunity in an area is also expected to have a significantly positive β_2 in this example.

For estimating the conditional logit models, we constructed a large data matrix of almost 2.8 million rows. The matrix contained 142 rows for each of the 19,420 offenses committed (i.e., per offense, one row for each of the 142 alternative postal code areas that could have been chosen in the greater The Hague area). The results of the conditional logit models are presented by using odds ratios (ORs). These indicate the multiplicative effect of a one-unit increase of the independent variable on the odds (the ratio of the probability p and $1 - p$) of choosing a particular target area. ORs between 0 and 1 indicate that the odds decrease (negative effect), and ORs > 1 indicate that the odds increase (positive effect). In the case of binary independent variables as used in this study to indicate whether family members lived in a particular postal code area, an estimated OR of 2 would indicate that the odds of being targeted was two times larger in areas in which family members live (score of 1 on the independent variable) compared with similar areas in which no family members live (score of 0 on the independent variable). Our hypotheses translate into the expectation that all ORs of the study variables should be larger than 1. Differences between ORs were statistically tested by using Wald chi-square tests.

FINDINGS

This section starts with descriptive statistics, which are shown in table 2. Subsequently, the results of the models testing hypothesis 1 (familial residence) and hypothesis 2 (history) are shown, as well as the results for the different family member types. Finally, the results on gender differences are presented (hypothesis 3). The control variables were included in all models. For reasons of parsimony, we present the results of these control variables only in table 4. They have largely similar effects in the other models.

DESCRIPTIVE STATISTICS

Table 2 shows the number of offenses committed in a current or former residential area of any family member, as well as the number of offenses committed in current or former residential areas of parents, siblings, and children separately. Approximately 25 percent of the offenses were committed in an area in which at least one family member currently or formerly lived. When looking at the different family types separately, we observe that a larger absolute number of offenses was committed in residential areas of parents and siblings compared with those of children. Note that there were more parents and siblings than children and, thus, more parental/sibling residential areas that could have been targeted as compared with those of children.

Table 2. Number and Percentage of Offenses Committed by 7,910 Offenders in Current or Former Residential Areas of Any Family Member, Parent(s), Sibling(s), and Child(ren)

Crime Location	# Offenses	% of Total # of Offenses ($N = 19,420$)
Any Family Member		
Current residential area	4,318	22.23
Former residential area	519	2.67
Elsewhere	14,583	75.09
Parent(s)		
Current residential area	2,870	14.78
Former residential area	191	.98
Elsewhere	16,359	84.24
Sibling(s)		
Current residential area	2,616	13.47
Former residential area	467	2.40
Elsewhere	16,337	84.12
Child(ren)		
Current residential area	1,171	6.03
Former residential area	206	1.06
Elsewhere	18,043	92.91

CURRENT/FORMER RESIDENTIAL AREAS OF ANY FAMILY MEMBER

The first model tested whether current and former residential areas of any family member influence crime location choices, while taking into account current and former residential areas of the offender, distance to current residential area of the offender, previous crime locations, and area characteristics. The results are presented in the first part of table 3. They show that current (OR = 1.88) and former (OR = 1.37) residential areas of any family member are more likely to be targeted compared with areas in which no family ever lived (reference category).

FAMILY MEMBERS' RESIDENTIAL HISTORIES

We expected that *current* residential areas of family members are more likely to be targeted by the offender than *former* residential areas and that *former* residential areas of family members are more likely to be targeted than areas in which the offender's family *never* lived. Testing the difference between the two ORs showed that they are statistically significant, with the OR of *current* familial residential areas being larger than the OR of *former* familial residential areas [$\chi^2(1) = 30.8, p < .001$]. Combined with the statistically significant OR for *former* residential areas of any family member, this finding corroborates the history hypothesis (hypothesis 2).

RESIDENTIAL AREAS OF PARENTS, SIBLINGS, AND CHILDREN

The model described earlier was also tested separately for the three different types of family members included in this study. The results of these models are shown in part 2–4 of table 3. For each family member type, the effects of *current residential area* were statistically significant and positive, which is similar to the results of the first model, albeit the ORs were relatively small for parents and siblings.

Table 3. Conditional Logit Models Testing the Effects of Current and Former Residential Areas of Family Members on Crime Location Choice (19,420 Offenses Committed by 7,910 Offenders)

	Any Family Member				Parents			
Residential Area of:	**OR**	***Z***	***B***	**SE**	**OR**	***Z***	***B***	**SE**
Current	1.88***	18.05	.63	.04	1.17***	4.13	.16	.04
Former	1.37***	5.64	.31	.06	.84	−1.81	−.17	.09
Never	1.00		.00		1.00		.00	
	Siblings				**Children**			
Residential Area of:	**OR**	***Z***	***B***	**SE**	**OR**	***Z***	***B***	**SE**
Current	1.21***	5.16	.19	.04	2.72***	21.02	1.00	.05
Former	1.09	1.44	.09	.06	1.45***	3.98	.37	.09
Never	1.00		.00		1.00		.00	

NOTES: OR = odds ratio coefficient and SE = robust standard error of *B* coefficient. Effects of control variables not shown [i.e., current, former and never residential area of offender; distance to current residence of offender; previous crime location; density; proportion non-Western residents; proportion single-person households; number of employees; retail businesses; hotels, restaurants, and bars; schools; health-care facilities; cultural facilities; and sport and leisure facilities].
***$p < .001$ (two-tailed)

Not all *former* residential areas had a statistically significant influence on crime location choice compared with areas in which the family *never* lived. Both the *former* residential areas of *parents* and those of *siblings* appeared not to have a greater probability of being targeted than otherwise comparable areas in which parents and siblings, respectively, had never lived. Only the *former* residential areas of the *children* of offenders were clearly more likely to be targeted. With respect to the history hypothesis, the differences in the ORs were statistically significant, with the OR of the *current* residential area being larger than the OR of the *former* residential areas for *parents* [$\chi^2(1) = 11.8, p < .001$] and for *children* [$\chi^2(1) = 40.5, p < .001$], but not for *siblings* [$\chi^2(1) = 2.41, p = .12$].

When the effects of current and former residential areas of parents, siblings, and children were simultaneously tested,[2] the results were largely similar to those of the separate models. Table 4 shows that the *current* residential area of each family member was more likely to be targeted than otherwise comparable areas where the respective family members had never lived. The same holds for *former* residential areas of *children* and, in this combined model, also for *former* residential areas of *siblings*. Similar to the results from the separate models, the differences in the ORs of *current* and *former* residential areas were statistically different for *parents* and *children*, with the ORs of *current* residential areas being larger than the ORs of *former* residential areas [$\chi^2(1) = 15.8, p < .001$ and $\chi^2(1) = 44.0, p < .001$, respectively], but no such difference was found for *siblings* [$\chi^2(1) = .72, p = .40$]. The odds that the *current* residential areas of *children* were targeted were statistically significantly larger than were those for the *current* residential areas of *parents*

2. There is some overlap in residential areas of the different family member types and the offender (Spearman's rho ranged between .01 and .48 between the current and former residential area variables of the parents, siblings, children, and offenders).

Table 4. Simultaneous Test of the Effects of Current and Former Residential Areas of Parents, Siblings, and Children on Crime Location Choice (19,420 Offenses Committed by 7,910 Offenders)

Crime Location	OR	*Z*	*B*	SE
Residential Area of:				
Parents				
Current	1.27***	4.92	.24	.05
Former	.86	−1.59	−.15	.10
Never	1.00		.00	
Siblings				
Current	1.22***	4.35	.20	.05
Former	1.15*	2.16	.14	.06
Never	1.00		.00	
Children				
Current	3.09***	22.86	1.13	.05
Former	1.62***	5.28	.48	.09
Never	1.00		.00	
Offender				
Current	3.71***	37.01	1.31	.04
Former	2.56***	18.45	.94	.05
Never	1.00		.00	
Distance to Current Residence Offender	.72***	−77.09	−.32	.00
Previous Crime Location	5.94***	67.64	1.78	.03
Density (per 1,000)	.99***	−3.99	−.01	.00
Percentage Non-Western Residents (per 100)	2.03***	15.10	.71	.05
Percentage Single-Person Households (per 100)	2.11***	8.97	.75	.08
Number of Employees (per 1,000)	1.03***	16.26	.03	.00
Retail Businesses (per 10)	1.04***	26.37	.04	.00
Hotels, Restaurants, and Bars (per 10)	1.25***	7.31	.23	.03
Schools (per 10)	1.03	1.66	.03	.02
Health-Care Facilities (per 10)	.98	−2.44	−.02	.01
Cultural Facilities (per 10)	1.01**	2.75	.01	.00
Sport and Leisure Facilities	1.02***	7.96	.02	.00

ABBREVIATIONS: OR = odds ratio coefficient; SE = robust standard error of *B* coefficient.
*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed).

[$\chi^2(1) = 208.6$, $p < .001$] and *siblings* [$\chi^2(1) = 205.3$, $p < .001$]. The same was found for the effect of *former* residential areas of *children*, which was also higher than the effects of *former* residential areas of *parents* [$\chi^2(1) = 23.8$, $p < .001$] and *siblings* [$\chi^2(1) = 9.62$, $p < .01$]. The difference in the effects of *current* residential areas of *parents* and *current* residential areas of *siblings* was not statistically significant [$\chi^2(1) = .26$, $p = .61$], but the effect of *siblings' former* residential areas was higher than the effect of *parents' former* residential areas [$\chi^2(1) = 4.98$, $p < .05$].

GENDER-SPECIFIC EFFECTS

Next, we examined whether the effects of residential areas of female and male family members on crime location choice differed for female and male offenders. The results are presented in table 5. All four ORs that indicated residential areas of female and male family members of both female and male offenders were statistically significant and greater than 1, which indicates that all these areas were more likely to be targeted by the offenders

Table 5. Effects of Current/Former Residential Area of Female and Male Family Member(s) on Crime Location Choices of Female and Male Offenders (2,421 Offenses by 1,429 Female Offenders, and 16,999 Offenses by 6,481 Male Offenders)

Crime Location	OR	*Z*
Female Offender		
Residential area of female family	1.39***	3.63
Residential area of male family	1.22*	2.12
Male Offender		
Residential area of female family	1.34***	7.04
Residential area of male family	1.38***	7.98
Residential Area of Offender	3.56***	39.74

NOTES: OR = odds ratio coefficient and *Z* values with robust standard errors. Effects of control variables other than residential area of offender not shown [i.e., distance to current residence of offender; previous crime location; density; proportion non-Western residents; proportion single-person households; number of employees; retail businesses; hotels, restaurants, and bars; schools; health-care facilities; cultural facilities; and sport and leisure facilities].
*$p < .05$; ***$p < .001$ (two-tailed).

compared with those where no family lived or had lived. Wald chi-square tests, however, showed no statistically significant gender-related differences: *female* versus *male family members'* residences of *female offenders* [$\chi^2(1) = .64$, $p = .42$] and *male offenders* [$\chi^2(1) = .18$, $p = .67$], *female* versus *male offenders* with *female* [$\chi^2(1) = .14$, $p = .71$], and *male* [$\chi^2(1) = 1.62$, $p = .20$] *family members*.

The pseudo-R^2 of all models ranged between .30 and .31, which is considered to represent an excellent fit to the data (McFadden, 1978b: 307). This indicates that the variables in these models provide a strong explanation for where offenders commit their crimes. It should be noted, however, that including the residential areas of family members barely improved the pseudo-R^2, which was already .30 in a model that only contained the variables concerning the residential areas of the offenders themselves, their crime location histories, and the other control variables.

DISCUSSION

Crime pattern theory argues that offenders are likely to select their targets within their awareness space because they are familiar with the area (Brantingham and Brantingham, 1993, 2008). This study started from the premise that people in general, including offenders, frequently have (face-to-face) contact with their close family members and many of them visit each other at least occasionally. This premise implies that the residential areas of family members are part of the awareness space of offenders and, therefore, at increased risk of being targeted. The present study tested this hypothesis. It improved on previous research by studying the influence of the residential areas of family members on crime location choice by using a unique and detailed data set.

Several conclusions can be drawn from our findings. In general, the residential areas of family members were indeed at increased risk of being targeted by an offender. This was particularly true for the current residential areas of family members, which were found to influence crime location choice regardless of the type of family currently living in that

area. The history hypothesis was only partially supported. Only for the residential areas of children were the findings fully in line with the expectation: Their current residential areas were more likely to be targeted than their former residential areas and their former residential areas more than the areas where the children never lived. The difference in the effect of former residential areas of siblings from the effect of areas where they had never lived was only statistically significant when jointly tested with the residential areas of the other family member types; for parents, there were no differences between former residential areas and areas where they had never lived. Moreover, current residential areas of siblings were not more likely to be targeted than their former residential areas. A comparison among the three different family types showed that the effects of residential areas of offenders' children were consistently larger than those of residential areas of parents and siblings. Differences between the effects of residential areas of parents and siblings were less clear. Finally, in contrast to our hypothesis, we found no gender differences. The probability of being targeted was not increased in areas where female family members live(d) compared with areas where male family members live(d). Neither were female offenders more likely than male offenders to target a female or male familial residential area.

Overall, the findings support the idea that familial residential areas are important activity nodes in offenders' awareness spaces. According to crime pattern theory, it is unlikely that offenders choose unknown areas outside their awareness space to commit a crime (Brantingham and Brantingham, 1993, 2008). Our findings stress the importance to move beyond looking at only the most obvious part of offenders' awareness spaces—their own residential areas—as was done in most previous studies on this topic. Areas that are clearly visited less frequently can also influence crime location choices and should therefore be taken into account. This was already theorized for other types of activity nodes (Brantingham and Brantingham, 1993, 2008) and found for former crime locations (Bernasco, Johnson, and Ruiter, 2015; Lammers et al., 2015), but this study's findings suggest that residential areas of offenders' family members are relevant activity nodes too.

Our results indicate that, in particular, the current residential areas of family members affect crime location choice, whereas the hypothesized effects of former residential areas of family members were not found for all three family types. Only the former residential areas of children were consistently found to influence crime location choice. A possible explanation could be that former activity nodes that were visited less frequently disappear faster from offenders' awareness spaces than the nodes they visited more regularly. Moreover, because the residential areas of family members are visited less frequently than other activity nodes such as schools and workplaces, they could have a relatively small effect on crime location choice to begin with. Even though the effects of current familial residential areas were consistently found across the three different family types, they—and those of parents and siblings in particular—were clearly smaller than those of the offender's residential area. Former familial residential areas may thus have lost their initially already smaller effects faster than offenders' former residential areas, which remained influential up to 3 years after having moved in this current study, and in a previous study also when having moved more than 2 years ago (Bernasco, 2010).

The current findings thus showed that, in particular, the residential areas of children were at an increased risk of being targeted by offenders when compared with those of parents and siblings. This is probably because most children of the offenders in our sample were minors. Even when people do not share the same household with their children,

parents tend to have regular contact with their minor-aged children (Kalmijn and de Graaf, 2000). In those cases, there are usually visitation agreements between the parents, and they will often bring their children to the home of their former partners. This increases the number of times a parent visits the residential location of the child. We deem it, therefore, plausible that the residential areas of the parents and siblings of the offenders in this study are visited less frequently than those of the nonresiding children and are, therefore, less likely to be targeted by the offenders than the areas where children live.

We found no support for our gender-specific hypothesis. Although the literature has shown that women generally have stronger familial relationships, no gender differences were found in the effects of familial residential areas on crime location choice. There are several possible explanations for the absence of the expected gender differences. First, our hypothesis was based on research on closeness of familial relationships and visiting frequency between family members in the general population. Although offenders are part of this general population, the population-level findings may apply less to *female* offenders than to *male* offenders (e.g., antisocial behavior is more exceptional among females; Moffitt et al., 2001). Women who offend may have less contact with their family members than women who do not offend. For instance, families of female juvenile delinquents were found to be more dysfunctional than families of male juvenile delinquents (Henggeler, Edwards, and Borduin, 1987). A second explanation might be that female offenders select other areas within their awareness space to commit crime. Although not consistently found across studies and all crime types, Levine and Lee (2013) have found that female offenders committed most types of crime closer to or in their residential area than did male offenders. Female offenders also more often traveled to commercial areas and central retail stores to commit crimes when compared with male offenders (Levine and Lee, 2013). These possible explanations and the robustness of the current findings warrant further scrutiny in future studies by using different data sources as well.

LIMITATIONS

In this final section, we discuss several limitations of this study. First, the study focused only on people who both lived and committed crimes in the greater The Hague area. This is a largely urban area with a population that is not fully representative of the rest of the Netherlands. For instance, The Hague has a relatively large share of people from non-Western ethnic descent, and most of these groups have different family traditions and more frequent contact patterns than do people of native Dutch descent (Kalmijn and Dykstra, 2006). To increase the generalizability of our findings, replications should preferably be conducted in a larger geographical area. The findings may also not apply equally to all offenders as relations between offenders and their families are sometimes difficult or estranged.

Second, awareness spaces were not measured directly in this study but indirectly based on the idea that people at least occasionally visit their family members. From the register data used in this study, we have no way of knowing whether offenders really spent time in the areas where their family members lived. Moreover, offenders may also spend nontrivial amounts of time in other unexamined areas, such as at work, school, shopping malls, sports facilities, public transit, or the homes of friends. In fact, many people probably spend more time at these places than in their family members' homes. Future research should aim to provide a more direct test of the impact of different activity nodes

on crime location choice. To do so, offender-based research is required in which offenders are directly asked about their routine activities (e.g., see Summers, Johnson, and Rengert, 2010). Furthermore, future studies should not limit the awareness space measurements to activity nodes but should also test whether offenders commit crimes along the paths between these nodes.

Third, although we tested a generic model for all crime types, the influence of residential areas of family members may differ for different crime types. Some types of crime are less likely to be committed in residential areas (e.g., shoplifting). Moreover, offenses committed impulsively may be committed in other parts of an offender's awareness space than planned offenses (e.g., bar fight committed when drunk vs. planned burglary). Some offenses may even be directed at family members, such as child abuse; in these cases, the crime is committed in the residential area of the family member as a consequence of the type of crime being committed.

To summarize, this study showed that familial residential areas—measured with extensive and detailed residential history registry data—indeed influence crime location choice. Thus, family clearly matters for crime location choice.

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