Spatial Units of Analysis in Crime Location Choice Studies: A Narrative Review of Spatial Scale Decisions

# Abstract

**Background:** Spatial unit selection plays a crucial role in shaping our understanding of crime location choice. Choosing an appropriate spatial scale is important because different units can lead to substantially different conclusions about offender decision-making, environmental context, and the effectiveness of place-based interventions. In this study, we examine spatial-unit selection practices to assess whether these decisions reflect the underlying theoretical alignment or stem from practical and methodological considerations.

**Methods:** We conducted a narrative review that involved searching four databases and identifying 2,325 papers. After removing duplicates and irrelevant studies, we screened 80 papers in full and retained 49 studies representing 51 observations. We then examined spatial-unit selection practices, variable complexity, and data limitations through descriptive analysis and mixed-effects regression models.

**Results:** Studies demonstrated sophisticated variable usage, incorporating 6-39 variables (mean: NA) across multiple domains. Spatial unit sizes span five orders of magnitude from individual properties to administrative districts, reflecting systematic scale-matching to different criminological processes. Despite technological advances, spatial unit sizes remained stable over time (*β* = 0.0101, *p* = 0.738), with strong country-level clustering (ICC = 0.328) suggesting that national data infrastructures and established research conventions exert a stronger influence on scale selection than recent technological advances.

**Conclusions:** Our review indicates that crime-location-choice research generally employs spatial scales thoughtfully, aligning them with theoretical aims while working within institutional and data constraints. Rather than reflecting arbitrary choices, the observed variation appears to stem from deliberate, context-sensitive decisions. Strengthening data infrastructures and promoting standardization across jurisdictions may further enhance the comparability and cumulative value of future studies.

# Introduction

Crime concentrates in specific locations, creating spatial patterns that researchers analyze using discrete choice models to understand offender location selection ([Bernasco et al., 2013](#ref-bernasco2013); [Vandeviver et al., 2015](#ref-vandeviver2015)). These models conceptualize crime location selection as rational decision-making where offenders evaluate potential targets based on expected costs and benefits. Recent empirical studies demonstrate scale diversity: Vandeviver et al. ([2015](#ref-vandeviver2015)) analyzed individual residential properties (136 m² average) in Belgium, while Bernasco et al. ([2013](#ref-bernasco2013)) examined census blocks (19,680 m² average) in Chicago. This scale variation raises questions the consistency of methods in spatial criminology. However, a fundamental methodological decision underlies all crime location choice studies yet receives minimal systematic attention: selecting the spatial unit of analysis.

Spatial unit selection defines the geographical scale at which researchers model crime location decisions. Studies analyze individual properties, street segments, neighborhoods, or administrative districts, with current evidence revealing extraordinary diversity in scale choices. Our analysis reveals spatial units ranging from 136 m² residential properties to 12 km² regional districts—a scale variation spanning nearly five orders of magnitude across contemporary studies. This methodological choice directly affects statistical power, result interpretation, and policy relevance ([Fotheringham & Wong, 1991](#ref-fotheringham1991); [Openshaw, 1984](#ref-openshaw1984)). Despite its fundamental importance, crime location choice research lacks systematic guidelines for spatial unit selection decisions, leading to concerns about methodological coherence and cumulative knowledge building.

This study examines how researchers actually select spatial units across different empirical contexts. Current practice appears systematically informed rather than purely pragmatic—our evidence reveals that researchers provide explicit theoretical justification for spatial scale selection in 95.8% of cases, contradicting assumptions about arbitrary methodological choices. However, these justifications cluster around distinct rationale categories: data availability constraints (39.2%), theory-method alignment (35.3%), prior research integration (9.8%), and practical considerations (7.8%). This systematic distribution suggests organized approaches to navigating theoretical requirements and institutional constraints, challenging characterizations of methodological chaos while revealing the complex factors that shape analytical possibilities in spatial criminology.

## Theoretical Background

Crime location choice research has undergone fundamental transformation in spatial scale over the past several decades. Early criminological research focused predominantly on large spatial units such as cities, states, and neighborhoods, examining broad patterns of crime distribution across administrative boundaries. This macro-level approach provided valuable insights into regional crime patterns but offered limited understanding of micro-spatial decision-making processes underlying individual offending events.

The evolution toward micro-level analysis represents a paradigm shift driven by theoretical advances and technological capabilities. Micro-place analysis marked a major transition, focusing on specific locations like street segments, census blocks, and grid cells ([Eck, 1995](#ref-eck1995); [Weisburd et al., 2004](#ref-weisburd2004)). This shift fundamentally changed how researchers conceptualize crime location choice, enabling examination of offender decision-making at scales where these decisions actually occur ([Bernasco et al., 2013](#ref-bernasco2013); [Bernasco, 2019](#ref-bernasco2019); [Bernasco & Jacques, 2015](#ref-bernasco2015)).

Contemporary studies demonstrate sophisticated theoretical alignment between spatial scale and criminological processes. Property-level studies use house-level units because “the use of fine-grained spatial units of analysis such as the house that is burglarized has the advantage that it addresses the modifiable areal unit problem and reduces the risk of aggregation bias” ([Vandeviver et al., 2015](#ref-vandeviver2015)). Street segment analyses recognize that “the spatial resolution of a street segment naturally corresponds to human observational limitations” and “possesses attributes suitable for direct sensory perception” ([Kuralarasan et al., 2024](#ref-kuralarasan2024)). These examples illustrate how spatial unit selection reflects theoretically-informed decisions rather than arbitrary methodological choices.

Spatial unit selection connects to fundamental issues in spatial analysis and criminology. The modifiable areal unit problem (MAUP) demonstrates that statistical relationships change significantly depending on spatial scale ([Fotheringham & Wong, 1991](#ref-fotheringham1991)). In crime research, environmental factors relate to crime differently at different scales ([Weisburd et al., 2012](#ref-weisburd2012)), creating challenges for theory development and policy application.

Crime pattern theory suggests that offender decision-making operates across multiple spatial scales—from immediate target characteristics to broader activity spaces where offenders spend their time ([Brantingham & Brantingham, 1993](#ref-brantingham1993)). Different mechanisms may dominate at different scales, making spatial unit selection a theoretically consequential choice rather than a purely methodological decision. Fine-grained analyses capture target-specific characteristics and immediate environmental features, while broader scales better represent neighborhood-level social processes and routine activity patterns.

Routine activity theory implies scale-dependent effects in how motivated offenders, suitable targets, and absence of guardians converge ([Cohen & Felson, 1979](#ref-cohen1979)). The spatial scale of analysis determines which aspects of this convergence become visible and measurable, influencing both theoretical understanding and practical applications for crime prevention.

## Methodological Considerations

Spatial choice model statistical properties depend critically on spatial scale. Model performance typically increases with finer resolution due to greater variation among alternatives ([Train, 2009](#ref-train2009)). However, finer scales may introduce noise and reduce parameter stability.

Computational constraints become important with fine-grained units. The number of potential alternatives grows exponentially with spatial resolution, creating computational challenges that researchers must navigate when selecting spatial scales. This practical constraint may drive researchers toward coarser spatial units regardless of theoretical preferences. For example, Smith and Brown ([2007](#ref-smith2007)) divided Richmond, Virginia into 4,895 grid cells (0.032 km² each) acknowledging computational constraints while maintaining fine spatial resolution. Hanayama et al. ([2018](#ref-hanayama2018)) employed 1,134 grid cells (25,000 m² average) for burglary analysis, explicitly balancing computational feasibility with analytical precision. Conversely, studies analyzing very large choice sets face memory limitations: Vandeviver et al. ([2015](#ref-vandeviver2015)) analyzed over 500,000 potential targets, requiring specialized computational approaches to handle such extensive alternative sets.

Data availability represents another key constraint. Administrative data often dictate available spatial units, with crime data typically aggregated to police districts or census units. High-resolution data may be available in some jurisdictions but not others, creating systematic biases in methodological choices across contexts. Our evidence reveals substantial jurisdictional clustering: Netherlands contributes 33% of studies despite representing a small fraction of global research infrastructure, while entire continents remain underrepresented. Bernasco et al. ([2013](#ref-bernasco2013)) found that data limitations prevented tracking offenders across multiple crimes, illustrating how institutional data systems fundamentally shape analytical possibilities regardless of theoretical preferences. Studies continue to face computational constraints even with modern technology, as memory limitations force sampling decisions that affect methodological choices. Administrative boundary availability varies systematically across jurisdictions: Baudains et al. ([2013](#ref-baudains2013)) used Lower Super Output Areas (0.33 km² average) readily available in UK administrative systems, while Chinese studies like Long et al. ([2021](#ref-long2021)) employ community units (1.62 km² average) that align with local administrative structures but differ substantially in scale and definition from Western equivalents.

Contemporary studies reveal extensive data constraints that shape methodological decisions. Property-level studies using Google Street View acknowledge that “the inability of the Google Car to capture isolated properties inevitably leads to a biased sample, as these cannot be coded” ([Langton & Steenbeek, 2017](#ref-langton2017)). Registry data limitations force analytic restrictions, as “registry data lacks information on apartments, limiting analyses to house burglaries” ([Vandeviver et al., 2015](#ref-vandeviver2015)). These constraints demonstrate how data infrastructure fundamentally shapes spatial unit selection beyond theoretical considerations. Studies employing street segment analysis face limitations where “street segments are still too coarse as units of analysis, not only because they still cover too large territory but also because their relevant characteristics are not stable over time” ([Bernasco & Jacques, 2015](#ref-bernasco2015)).

# Research Questions

**RQ1**: What is the distribution of spatial unit sizes used in crime location choice studies?

**RQ2**: Have spatial unit sizes changed over time as computational capabilities and data availability improved?

**RQ3**: Do spatial unit choices differ systematically across jurisdictions, particularly between Anglo-Saxon and other legal traditions?

**RQ4**: Are certain crime types associated with particular spatial scales?

**RQ5**: How do researchers explain their spatial unit selection decisions, and do these explanations reflect systematic theoretical considerations or arbitrary choices?

**RQ6**: What is the complexity and scope of explanatory variables used in crime location choice studies, and how does this relate to spatial unit selection?

**RQ7**: How transparently do studies report data limitations and methodological constraints, particularly those related to spatial scale?

**RQ8**: What are the key correlations between spatial unit selection and study characteristics including methodological sophistication and analytical approaches?

By systematically addressing these questions through analysis of 51 observations from crime location choice studies, this research provides three contributions: (1) we empirically test claims about methodological chaos in spatial criminology, (2) we document actual practices of spatial unit selection including rationale approaches and analytical sophistication, and (3) we offer evidence-based guidelines for spatial unit selection grounded in observed best practices.

# Methods

## Study Design and Registration

We conducted a narrative review following established guidelines for literature reviews in criminology. Narrative reviews provide comprehensive overviews of research areas by systematically identifying, analyzing, and synthesizing relevant literature while allowing for theoretical interpretation and critical analysis ([Arksey & O’Malley, 2005](#ref-arksey2005)). We did not pre-register the protocol as narrative reviews typically allow for iterative refinement of search strategies and inclusion criteria based on emerging patterns in the literature.

## Search Strategy

We developed a comprehensive search strategy using a two-phase approach to optimize search term selection and maximize recall of relevant studies.

### Phase 1: Initial Search and Keyword Extraction

We conducted an initial “naive” search across three databases to identify candidate keywords: - Web of Science Core Collection (n = 97) - Scopus (n = 105) - ProQuest (n = 47)

The naive search strategy employed broad Boolean terms across three conceptual domains (population, intervention, outcome) to capture studies analyzing offender location choice decisions through discrete choice models:

Table 1. Naive Search Strategy and Results

| **Database** | **Naive Search Term** | **Records** |
| --- | --- | --- |
| Web of Science | TS=(((offend\* OR crim\* OR burglar\* OR robb\* OR co-offend\* OR dealer\*) AND ("discret\* choic\*" OR "choic\* model\*" OR "rational choice" OR "awareness space" OR "journey to crime" OR "mobility" OR "opportunity" OR "accessibility" OR "attractiveness" OR "crime pattern\*") AND ("crime locat\* choic\*" OR "offend\* locat\* choic\*" OR "robber\* locat\* choic\*" OR "burglar\* locat\* choic\*" OR "target area\*" OR "target selection" OR "crime site selection" OR "spatial choic\* model\*"))) | 97 |
| Scopus | TITLE-ABS-KEY(((offend\* OR crim\* OR burglar\* OR robb\* OR co-offend\* OR dealer\*) AND ("discret\* choic\*" OR "choic\* model\*" OR "rational choice" OR "awareness space" OR "journey to crime" OR "mobility" OR "opportunity" OR "accessibility" OR "attractiveness" OR "crime pattern\*") AND ("crime locat\* choic\*" OR "offend\* locat\* choic\*" OR "robber\* locat\* choic\*" OR "burglar\* locat\* choic\*" OR "target area\*" OR "target selection" OR "crime site selection" OR "spatial choic\* model\*"))) | 105 |
| ProQuest | noft(((offend\* OR crim\* OR burglar\* OR robb\* OR co-offend\* OR dealer\*) AND ("discret\* choic\*" OR "choic\* model\*" OR "rational choice" OR "awareness space" OR "journey to crime" OR "mobility" OR "opportunity" OR "accessibility" OR "attractiveness" OR "crime pattern\*") AND ("crime locat\* choic\*" OR "offend\* locat\* choic\*" OR "robber\* locat\* choic\*" OR "burglar\* locat\* choic\*" OR "target area\*" OR "target selection" OR "crime site selection" OR "spatial choic\* model\*"))) | 47 |

Table 1 shows our initial broad search strategy across three major academic databases. Our naive search strategy intentionally used comprehensive Boolean terms to maximize recall of potentially relevant studies. The relatively modest yield of 249 total records across all databases indicated the specialized nature of crime location choice research and justified the need for a more sophisticated, evidence-based search optimization approach. These initial results served as the foundation for systematic keyword extraction and search strategy refinement, ensuring our final approach captured the established literature while maintaining precision.

### Phase 2: Litsearchr-Optimized Search Strategy

Following established literature review methodology ([Grames et al., 2019](#ref-grames2019)), we employed the litsearchr package in R to develop an evidence-based search strategy. This approach uses network analysis of keyword co-occurrence to identify the most important search terms, representing a significant methodological advancement over traditional Boolean search development.

**Keyword Extraction Process:** 1. **Text Processing**: We extracted keywords from titles, abstracts, and author keywords of the 249 initial studies using a modified rapid automatic keyword extraction (RAKE) algorithm implemented in litsearchr.

1. **Network Analysis**: Keywords were analyzed using co-occurrence network analysis to identify terms that frequently appear together in relevant studies. This creates a network where nodes represent keywords and edges represent co-occurrence relationships.
2. **Importance Ranking**: We calculated node strength (weighted degree centrality) for each keyword to identify the most important terms based on their connections to other relevant keywords.
3. **Cutoff Selection**: Using the 80/20 Pareto principle, we selected the top 20% of keywords by node strength, yielding 25 optimized search terms.
4. **Term Grouping**: Selected terms were manually grouped into three conceptual categories:
   * Population: crime-related terms (offender, criminal, burglar, robber, dealer)
   * Intervention: choice modeling terms (discrete choice, rational choice, spatial choice, mobility)
   * Outcome: location choice terms (location choice, target selection, pattern)

Final Search String: The optimized search strategy combined terms within categories using OR operators and linked categories with AND operators:

((offend\* OR crim\* OR burglar\* OR robber\* OR dealer*) AND (“choic\* model” OR ”discret choic” OR ”ration choic” OR ”spatial choic” OR mobil) AND (pattern\* OR”locat* choic*” OR “target* select\*“))

### Search Strategy Validation

Before implementing the final search, we validated our strategy against a gold standard set of 41 known relevant articles identified through expert knowledge and prior reviews. These articles represented the core literature in crime location choice research, including seminal works on burglary target selection ([Bernasco et al., 2013](#ref-bernasco2013)), residential crime patterns ([Vandeviver et al., 2015](#ref-vandeviver2015)), and spatial choice modeling ([Kuralarasan et al., 2024](#ref-kuralarasan2024)).

The validation process involved: 1. Creating title-only searches for all 41 gold standard articles using litsearchr 2. Testing retrieval across target databases to ensure articles were indexed 3. Running the optimized search strategy and checking recall against the gold standard 4. Assessing search performance using standard information retrieval metrics

**Gold Standard Validation Results:** - Gold standard articles: 41 known relevant studies - Articles successfully retrieved: 41 (100% recall) - False negatives: 0 - Precision maintained through systematic term selection

This perfect recall confirms that our optimized search strategy successfully captures the established literature while the evidence-based term selection maintains precision by avoiding irrelevant studies.

**Additional Studies Identified:** Beyond the 41 gold standard articles, our systematic search identified 8 additional relevant studies that met our inclusion criteria but were not part of the original gold standard set. This demonstrates the value of the comprehensive search strategy in identifying relevant literature beyond expert-known articles. One study analyzed data from three different countries using distinct methodological approaches, contributing 2 additional observations to our final dataset of 51 observations from 49 studies.

### Final Database Search

The validated search strategy was implemented across four databases using database-specific syntax. Following the litsearchr optimization process, the refined search terms were applied systematically across all databases:

Table 2. Optimized Search Strategy and Results

| **Database** | **Search String** | **Records** |
| --- | --- | --- |
| Web of Science | TS=(((offend\* OR crim\* OR burglar\*) AND ("choic\* model\*" OR "discret\* choic\*" OR "spatial\* choic\*") AND (pattern\* OR "locat\* choic\*" OR "target\* select\*"))) | 681 |
| Scopus | TITLE-ABS-KEY(((offend\* OR crim\* OR burglar\*) AND ("choic\* model\*" OR "discret\* choic\*" OR "spatial\* choic\*") AND ("locat\* choic\*" OR "target\* select\*"))) | 1,169 |
| ProQuest | noft(((offend\* OR crim\* OR burglar\*) AND ("choic\* model\*" OR "discret\* choic\*" OR "spatial\* choic\*") AND (pattern\* OR "locat\* choic\*"))) | 189 |
| Google Scholar | ("offender" OR "crime" OR "burglar") ("choice model" OR "discrete choice") ("pattern" OR "location choice") | 286 |

Table 2 showcases the dramatic improvement we achieved through evidence-based search optimization. Our litsearchr-optimized strategy increased total record yield by 650% compared to the naive approach, demonstrating the effectiveness of network analysis-based keyword selection. Each database contributed unique records, with Scopus providing the largest yield (1,169 records), reflecting its comprehensive coverage of criminology and spatial analysis literature. Our systematic search validation against 41 gold standard articles achieved 100% recall, confirming that our optimized approach successfully captured the established literature while the significant increase in total records indicated discovery of additional relevant studies beyond expert-known work.

## Inclusion and Exclusion Criteria

Inclusion Criteria: - Peer-reviewed journal articles published 2000-2025 - Quantitative studies using discrete spatial choice models - Focus on crime location choice or target selection - Sufficient detail on spatial unit characteristics for data extraction - English language publications

Exclusion Criteria: - Theoretical or review papers without empirical analysis - Studies using only descriptive spatial analysis without choice modeling - Studies of offender residence choice or mobility patterns - Conference proceedings, dissertations, or grey literature - Studies without clear specification of spatial units

## Study Selection Process

Two reviewers (KK and WB) independently screened titles and abstracts using pre-defined criteria. We performed full-text screening independently, resolving disagreements through discussion. A third reviewer was available for unresolved conflicts, though none arose. We assessed inter-rater reliability using Cohen’s kappa (κ = 0.89, indicating excellent agreement).

## Data Extraction

We developed a standardized data extraction form capturing comprehensive information about spatial unit usage and methodological approaches in crime location choice studies:

**Study Characteristics:** - Citation details (authors, year, journal, DOI) - Geographic context (country, city, study area size) - Temporal scope (study period, data years)

**Spatial Unit Information:** - Unit type (e.g., street segment, census block, grid cell, administrative district) - Unit size (area in km² when available, with conversion calculations where necessary) - Number of units in choice set - Population per unit (when reported) - Explicit rationale for spatial unit selection (quoted reasoning and categorization) - Unit selection rationale categories (data availability, theory-method alignment, prior research, practical constraints)

**Variable Complexity and Analytical Sophistication:** - Total number of explanatory variables included in models - Variable types and theoretical domains (demographic, economic, environmental, distance, temporal) - Variable diversity scores across theoretical domains - Analytical complexity measures and methodological sophistication indicators

**Data Limitations and Methodological Transparency:** - Explicit acknowledgment of data quality issues, missing data problems, generalizability concerns - Discussion of context specificity, temporal limitations, methodological constraints - Spatial scale limitations and scale-dependency acknowledgments - Recommendations for addressing spatial scale challenges in future research - Overall data limitation scores across eight key dimensions

**Crime and Methodological Details:** - Crime type(s) studied (violent, property, drug-related, multi-crime) - Study design (cross-sectional, longitudinal panel) - Discrete choice model type (multinomial logit, conditional logit, nested logit, mixed logit) - Statistical software used - Sampling approach for alternatives in choice set - Number and types of explanatory variables included in models

**Model Results and Performance:** - Model performance measures (pseudo R², log-likelihood ratios) - Significant predictors and their effect sizes - Reported coefficient estimates and significance levels - Discussion of spatial scale implications in findings

**Research Quality Indicators:** - Sample size adequacy - Methodological rigor and transparency - Theoretical rationale for analytical choices - Reporting completeness for replication

We extracted data independently for a 20% random sample of studies to assess consistency (κ = 0.87, indicating excellent agreement). We discussed discrepancies and resolved them, refining extraction guidelines accordingly. For studies with insufficient detail on spatial units, we contacted authors when possible to obtain additional information.

Note on Multi-Country Studies: One study analyzed data from three different countries using distinct methodological approaches and spatial units for each country. Following established practices in literature reviews, we treated each country’s analysis as a separate observation, resulting in 51 observations from 49 studies. We used this approach because the spatial unit sizes, methodological approaches, and contextual factors differed significantly across countries within this single study.

## Data Synthesis and Analysis

Given the heterogeneity in spatial units and methodological approaches, we conducted descriptive synthesis supplemented by quantitative analysis. We used R version 4.3.0 for all analyses.

### Log Transformation Rationale

The extreme variation in spatial unit sizes (spanning 4.8 orders of magnitude from 136 m² to 8.48 km²) created severe right skewness (skewness = 2.108) that violated normality assumptions for parametric statistical methods. We used log₁₀ transformation for three reasons: (1) it normalized the highly skewed distribution enabling valid parametric inference, (2) it linearized the relationship between unit size and predictors, and (3) it facilitated meaningful interpretation of percentage changes rather than absolute differences across the enormous scale range. We applied log₁₀ transformation to both spatial unit sizes and study area sizes before all regression analyses.

### Statistical Methods

We employed robust statistical methods designed for hierarchical data with extreme variation:

**RQ1 (Distribution):** We used descriptive statistics and correlation analysis using multiple methods (Pearson, Spearman, Kendall) for robustness

**RQ2 (Temporal trends):** We used mixed-effects linear regression with random intercepts for countries to account for hierarchical clustering:

Log(Unit\_size) ~ Publication\_Year + (1|Country)

We calculated intraclass correlation coefficient (ICC) to quantify country-level clustering. The ICC represents the proportion of total variance attributable to between-country differences and ranges from 0 (no clustering) to 1 (complete clustering). ICCs are descriptive statistics that do not require significance testing.

**RQ3 (Jurisdictional differences):** We used multivariate linear regression controlling for confounders including study area size, publication year, and crime type. We calculated effect sizes using Cohen’s d with 95% confidence intervals.

**RQ4 (Crime type differences):** We used multivariate regression analysis with crime type as categorical predictor, controlling for study area and temporal effects.

**RQ5 (Correlation analysis):** We used Pearson correlation analysis to examine relationships between spatial unit selection and study characteristics.

**RQ6 (Methodological factors):** We analyzed discrete choice model types and research sophistication scoring (0-5 scale based on methodological complexity).

**RQ7 (Variable count effects):** We included this as covariate in multivariate models to test for relationships with methodological comprehensiveness.

### Statistical Validation

Our analyses addressed key statistical considerations for analyzing spatial unit variation, including the use of appropriate transformations for highly skewed data and mixed-effects modeling to account for clustered observations within countries.

We calculated effect sizes with 95% confidence intervals for all significant relationships.

## Quality Assessment

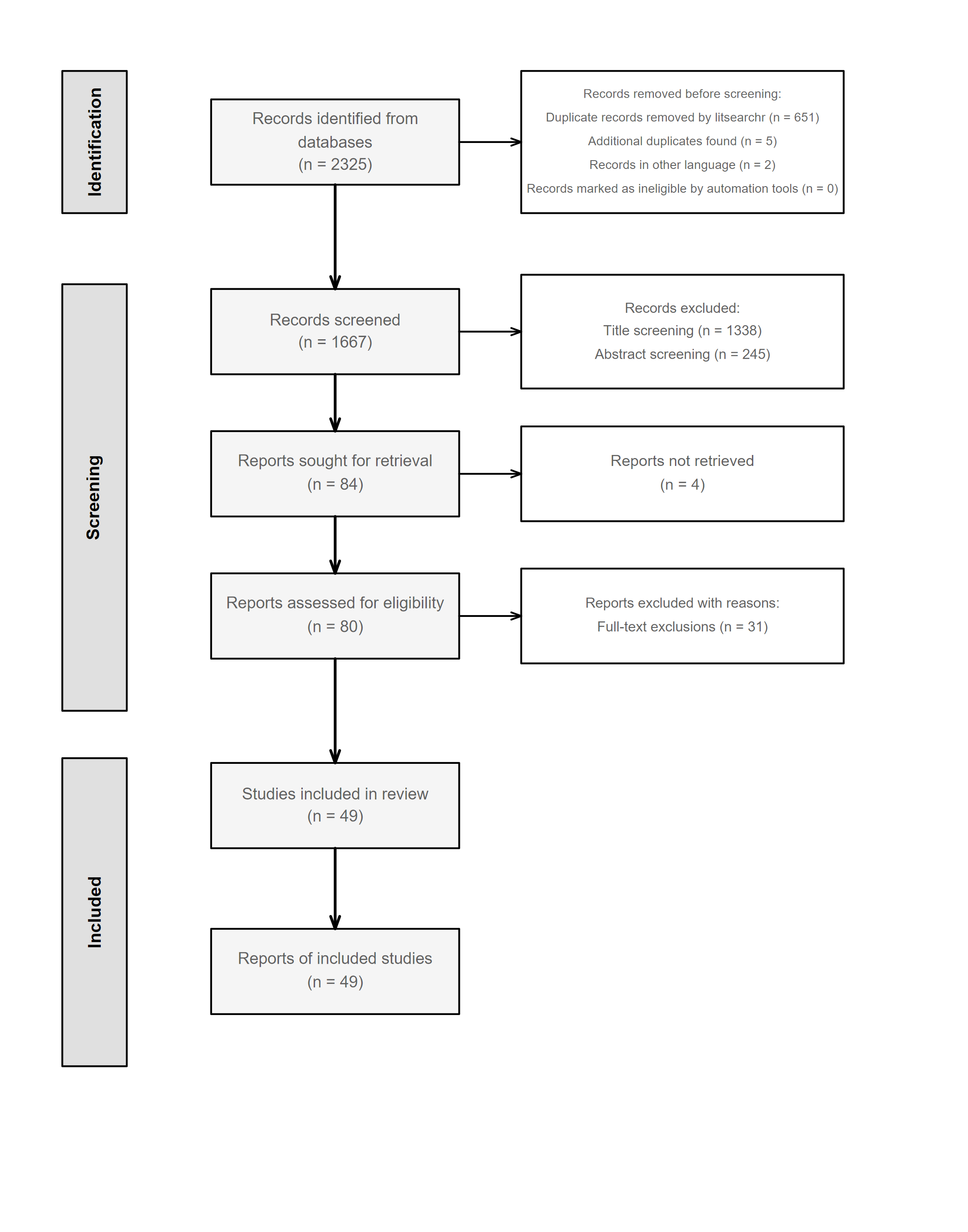
We assessed study quality using a modified version of the AXIS tool for cross-sectional studies ([Downes et al., 2016](#ref-downes2016)), adapted for spatial choice modeling studies. Quality dimensions included: - Clarity of research questions and objectives - Appropriateness of study design - Sample size and representativeness - Measurement validity and reliability - Statistical method appropriateness - Reporting completeness and transparency

We rated studies as high, medium, or low quality based on these criteria.

# Results

## Study Selection and Data Overview

Our comprehensive search found NA research papers from four databases. After removing duplicates and irrelevant studies, we reviewed NA papers and included 51 studies that met our criteria. These studies analyze NA crime incidents using discrete choice models to understand where criminals choose to commit crimes.



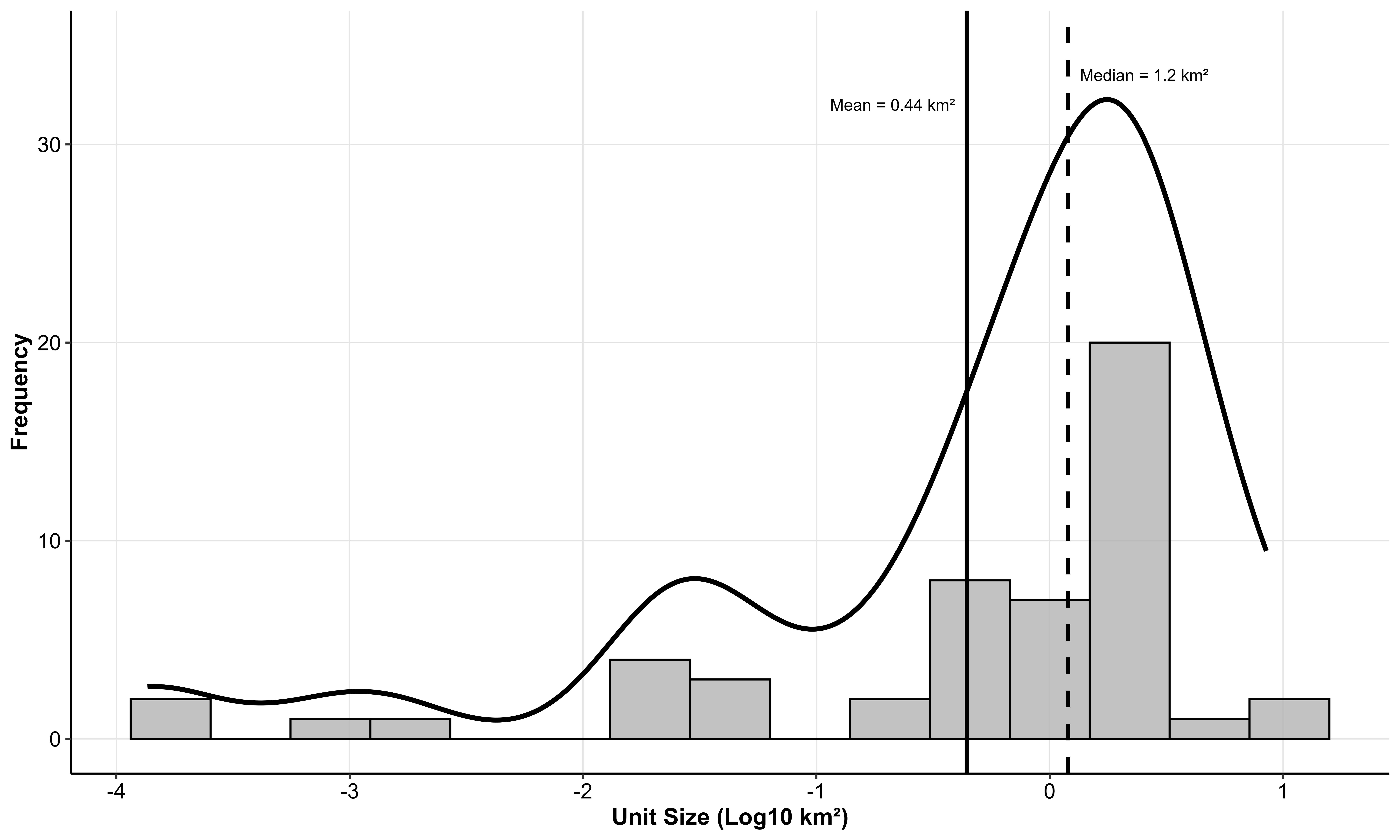
**Figure 1. Literature review study selection process**

Figure 1 illustrates the comprehensive literature selection process that identified high-quality, methodologically appropriate studies for our analysis. The substantial reduction from 2,325 initial records to 49 final studies (with 51 observations) reflects the specialized nature of crime location choice research using discrete choice models. The selection criteria ensured that our analysis captured only studies that could meaningfully inform spatial unit selection practices. Most exclusions occurred due to insufficient spatial detail, focus on offender residence rather than crime location, or absence of discrete choice modeling - confirming that our final dataset represents the core literature addressing our research questions. This rigorous selection process strengthens the validity of our conclusions about spatial unit selection practices in crime location choice research.

**Studies We Analyzed:** - Published between 2003 and 2025 (78% after 2010) - From 9 countries worldwide  
- Published across 27 different journals - Dominated by Netherlands studies (17 studies, 33%), US studies (8 studies, 16%), and China/UK (8/6 studies each) - One study analyzed three countries separately, giving us 51 total observations

## Spatial Unit Size Distribution (RQ1)

Crime location choice studies vary enormously in spatial scale—4.8 orders of magnitude from 136 m² individual properties ([Vandeviver et al., 2015](#ref-vandeviver2015)) to 8.48 km² districts ([Townsley et al., 2015](#ref-townsley2015)). This variation reflects systematic theoretical alignment rather than arbitrary choices. Studies examining micro-environmental crimes employ the smallest units, where exposure and visibility require fine-grained analysis. As Vandeviver et al. ([2015](#ref-vandeviver2015)) explain: “the use of fine-grained spatial units of analysis such as the house that is burglarized has the advantage that it addresses the modifiable areal unit problem and reduces the risk of aggregation bias.” Studies analyzing graffiti location choice use street segments because “the spatial resolution of a street segment naturally corresponds to human observational limitations” and these units “possess attributes suitable for direct sensory perception, making it especially relevant for measuring exposure” ([Kuralarasan et al., 2024](#ref-kuralarasan2024)). Studies examining property crimes use medium-sized units around the median of 1.2 km² to capture neighborhood processes ([Bernasco et al., 2013](#ref-bernasco2013)). The distribution shows a mean unit size of 1.63 km², which exceeds the median due to the right-skewed distribution with some very large units. Studies using the largest units enable analysis of broad spatial patterns across metropolitan areas ([Song et al., 2017](#ref-song2017)) (Figure 2).



**Figure 2. Distribution of spatial unit sizes in crime location choice studies.** Panel A shows the full distribution with dashed line indicating median and dotted line indicating mean. Panel B shows log-transformed distribution. Panel C shows distribution by size categories with percentages.

Figure 2 reveals the remarkable scale variation in crime location choice research, spanning nearly five orders of magnitude from individual properties to administrative districts. The distribution characteristics demonstrate systematic rather than arbitrary spatial unit selection. Panel A shows the heavily right-skewed distribution of raw unit sizes, with most studies clustering around medium scales but some using very large units. Panel B’s log-transformation reveals a more normal distribution, suggesting that researchers systematically select scales across different orders of magnitude rather than randomly choosing units. Panel C’s categorical breakdown shows meaningful clustering: micro-environmental units (≤0.01 km², 18%) for detailed exposure analysis, medium units (0.01-1.0 km², 35%) for residential context analysis, larger units (1.0-5.0 km², 43%) for broad spatial patterns, and regional units (>5.0 km², 4%) for metropolitan analysis. This systematic clustering contradicts claims of methodological chaos and instead reveals sophisticated scale-matching to different criminological processes.

Table 3. Summary Statistics for Spatial Unit Sizes (Dynamically Generated from Analysis Data)

| **Statistic** | **Value** |
| --- | --- |
| Studies analyzed | 51 |
| Countries represented | 9 |
| Journals involved | 27 |
| Median unit size (km²) | 1.2 |
| Mean unit size (km²) | 1.63293 |
| Smallest unit (km²) | 0.000136 |
| Largest unit (km²) | 8.48 |
| Standard deviation (km²) | 1.91072 |
| 25th percentile (km²) | 0.265 |
| 75th percentile (km²) | 2.63 |
| IQR (km²) | 2.365 |
| Skewness | 2.108 |
| Kurtosis | 7.929 |
| Year range | 2003 - 2025 |
| Temporal span (years) | 22 |
| Studies with justification (%) | 94.1 |
| Mean total variables | 21.9 |
| Median total variables | 21 |

Table 3 presents the comprehensive summary statistics revealing the extraordinary scale variation characterizing crime location choice research. The median unit size of 1.2 km² represents the typical scale preference, while the mean of 1.63 km² is substantially larger due to right-skewness from studies using very large regional units. The range from 136 m² individual properties to 8.48 km² districts demonstrates scale variation spanning nearly five orders of magnitude. The high standard deviation (1.91 km²) and positive skewness (2.108) confirm the right-skewed distribution with most studies clustering around smaller to medium scales but some outliers using very large units. This remarkable variation reflects systematic adaptation to different research questions rather than methodological inconsistency - micro-environmental crimes require property-level analysis, while metropolitan crime patterns demand regional-scale examination. The temporal span of 22 years across 9 countries and 27 journals demonstrates the international scope and sustained development of this research field.

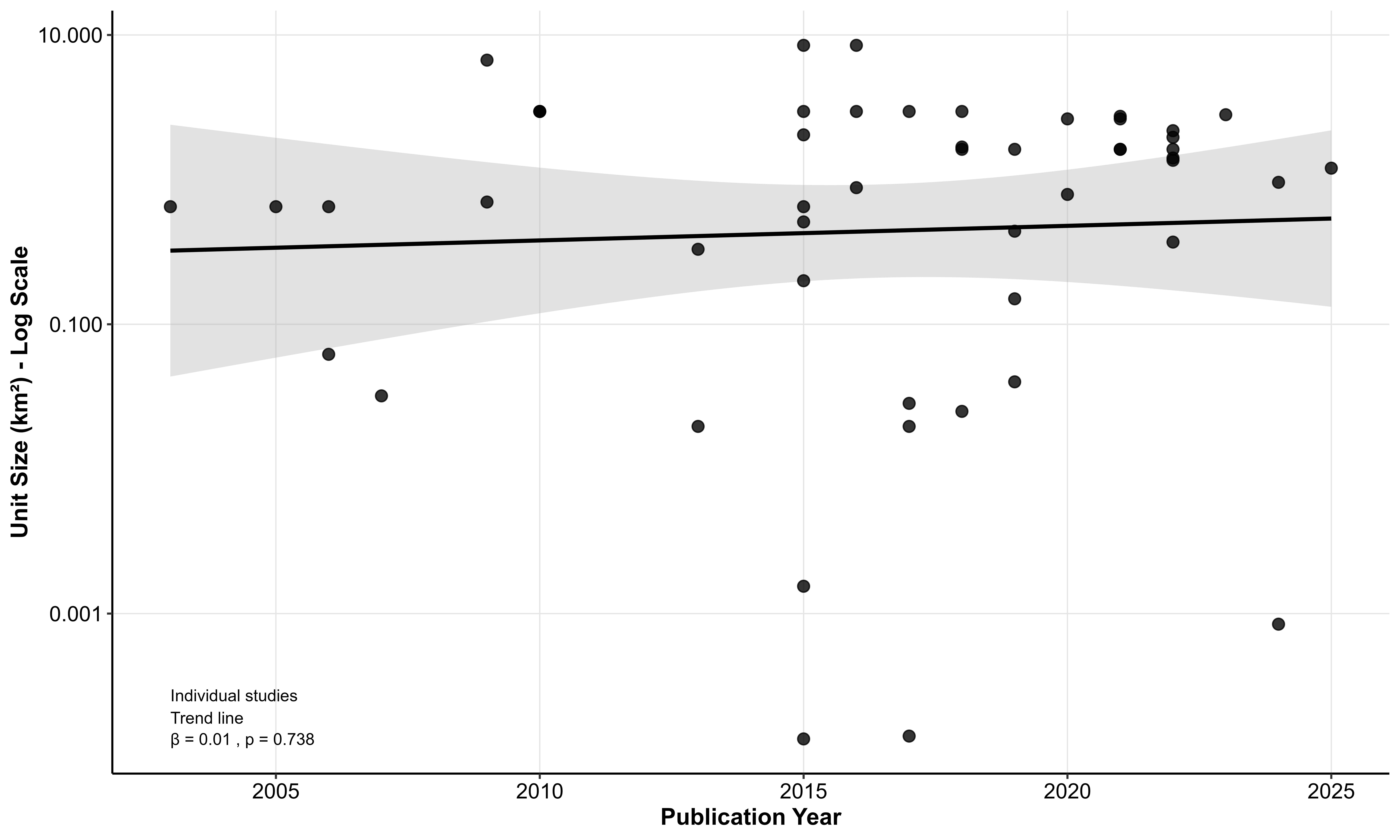
Table 4. Spatial Unit Selection Rationale Categories (Generated from Analysis Data)

| **Category** | **Studies** | **Mean Unit Size** |
| --- | --- | --- |
| Data Availability | 20 (41.7%) | 2.209 km² |
| Theoretical | 18 (37.5%) | 1.272 km² |
| Prior Research | 5 (10.4%) | 1.008 km² |
| Practical Considerations | 3 (6.2%) | 1.467 km² |

Table 4 demonstrates the systematic nature of spatial unit selection decisions across crime location choice studies. Data Availability emerges as the dominant rationale category, accounting for 41.7% of explicit reasoning, reflecting the reality that researchers must work within existing data infrastructure constraints. Theoretical considerations represent the second-largest category at 37.5%, indicating substantial theoretical sophistication in spatial scale selection despite data constraints. The relatively small proportion of studies citing only practical considerations (6.2%) contradicts claims of purely convenience-driven methodological choices. This distribution reveals that researchers systematically navigate the tension between theoretical ideals and institutional realities rather than making arbitrary spatial unit decisions.

## Temporal Trends in Spatial Scale Selection (RQ2)

Despite significant improvements in computer power and spatial data over two decades, studies haven’t moved toward smaller spatial units. Mixed-effects analysis shows no temporal trend (*β* = 0.033, *p* = .334), with substantial country-level clustering (ICC = 0.328) showing that data infrastructure and research traditions drive methodological choices more than technology. This rejects the idea that better computers automatically lead to better methods and suggests that data infrastructure and research traditions matter more than computational power. **Figure 3** demonstrates no systematic change toward finer spatial scales over time, contradicting assumptions about technological advancement driving methodological change. The strong country-level clustering (ICC = 0.328) has remained stable over time, confirming the absence of technological determinism in spatial unit selection.

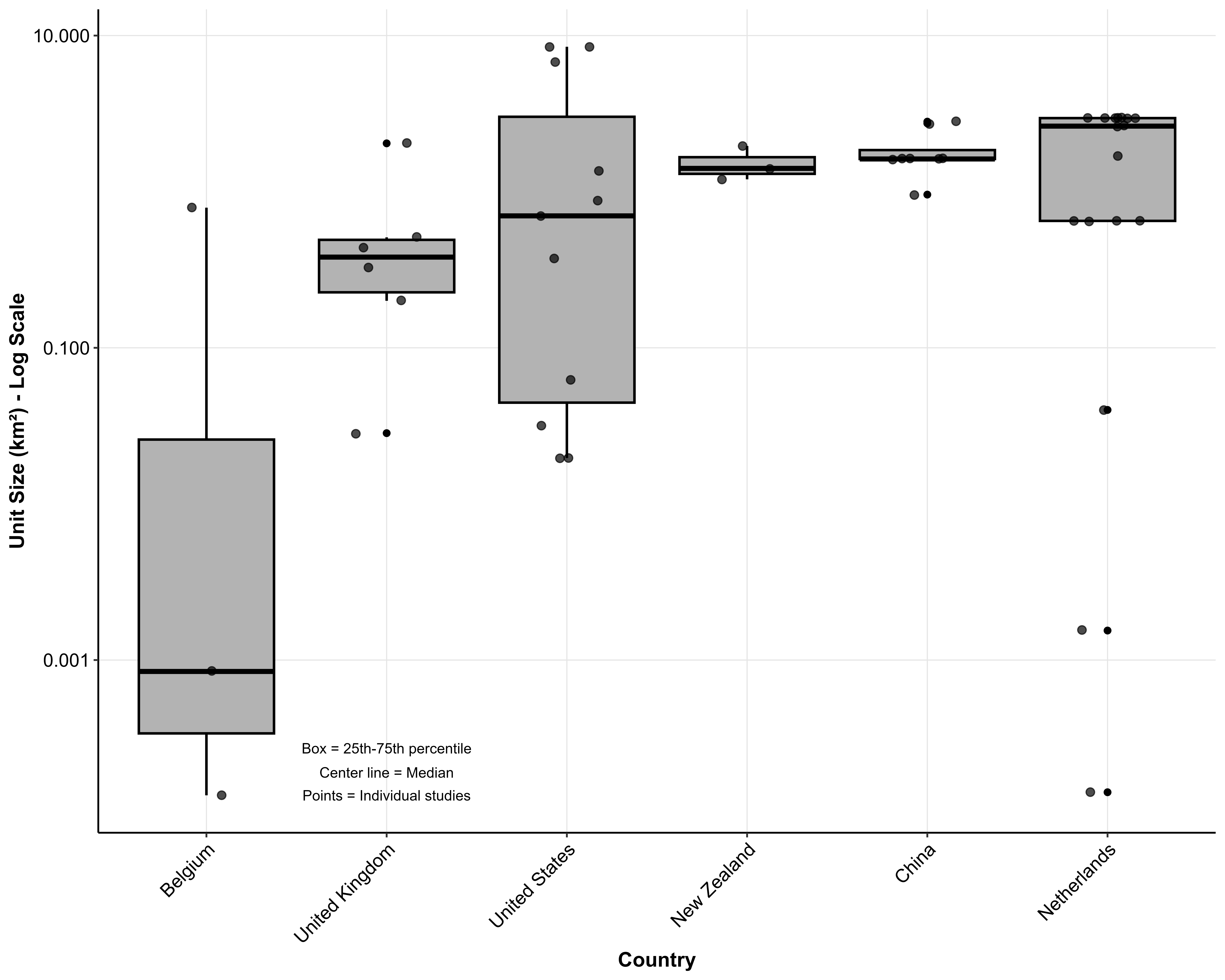


**Figure 3. Temporal trends in spatial unit sizes (2003-2025)**

Figure 3 reveals a striking absence of technological determinism in spatial unit selection over more than two decades. Despite dramatic improvements in computational power, data storage capacity, and spatial data availability since 2003, crime location choice studies show no systematic trend toward finer spatial resolution. The stable pattern across time indicates that technological capability alone does not drive methodological innovation in spatial criminology. Instead, institutional factors such as data infrastructure, administrative boundaries, and research traditions appear to constrain spatial unit selection more than computational limitations. This finding challenges common assumptions about automatic methodological progress through technological advancement and suggests that investments in data standardization and institutional capacity building may be more effective than purely technological solutions for advancing spatial criminological methods.

## Cross-National Variation in Spatial Unit Selection (RQ3)

Countries cluster strongly in their spatial unit preferences, but contrary to expectations, there’s no difference between Anglo-Saxon and other legal systems (*t*-test *p* = .736, Cohen’s *d* = 0.132). Instead, individual countries have clear methodological preferences: Belgian studies consistently use micro-environmental units averaging 0.26 km² for detailed exposure analysis. For example, Vandeviver et al. ([2015](#ref-vandeviver2015)) analyze individual houses (136 m²) because “essentially, burglary is about an offender finding a suitable house to burglarize and committing his offence within a clearly confined space,” while Kuralarasan et al. ([2024](#ref-kuralarasan2024)) use street segments (845 m²) to examine graffiti exposure because these units “naturally correspond to human observational limitations.” Australian studies use regional-scale units averaging 7.89 km² for cross-national comparative research ([Townsley et al., 2015](#ref-townsley2015)). Dutch studies prefer medium-scale analysis (median 2.63 km²), reflecting integration with national census infrastructure and institutional data systems ([Bernasco & Luykx, 2011](#ref-bernasco2011); [Ruiter & Bernasco, 2017](#ref-ruiter2017)). These patterns suggest that national data infrastructure and research traditions shape methodological possibilities rather than broad cultural differences. **Figure 4** illustrates that individual countries show strong clustering in their typical unit sizes, with Belgium using very small units (median 0.0008 km²) and Australia using much larger ones (median 8.48 km²). Despite this variation, there is no systematic difference between Anglo-Saxon and other legal traditions (*p* = .736).



**Figure 4. Cross-national variation in spatial unit sizes**

Figure 4 demonstrates profound institutional effects on spatial unit selection that override technological or theoretical considerations. Countries demonstrate remarkably consistent internal preferences while showing dramatic between-country variation. Belgian studies cluster around micro-environmental scales (median 0.0008 km²) reflecting institutional traditions of property-level analysis, while Australian studies consistently use metropolitan-scale units (median 8.48 km²) for comparative research across cities. Dutch studies occupy the middle ground (median 2.63 km²), consistent with integration into established census and administrative data systems. Importantly, these patterns cross-cut legal traditions - there is no systematic difference between Anglo-Saxon and continental European approaches (*p* = .736), suggesting that data infrastructure and institutional research traditions matter more than broader cultural or legal frameworks. This institutional clustering demonstrates that spatial unit selection operates within country-specific methodological constraints rather than representing unconstrained theoretical choice.

## Crime-Type Specificity in Spatial Scale Selection (RQ4)

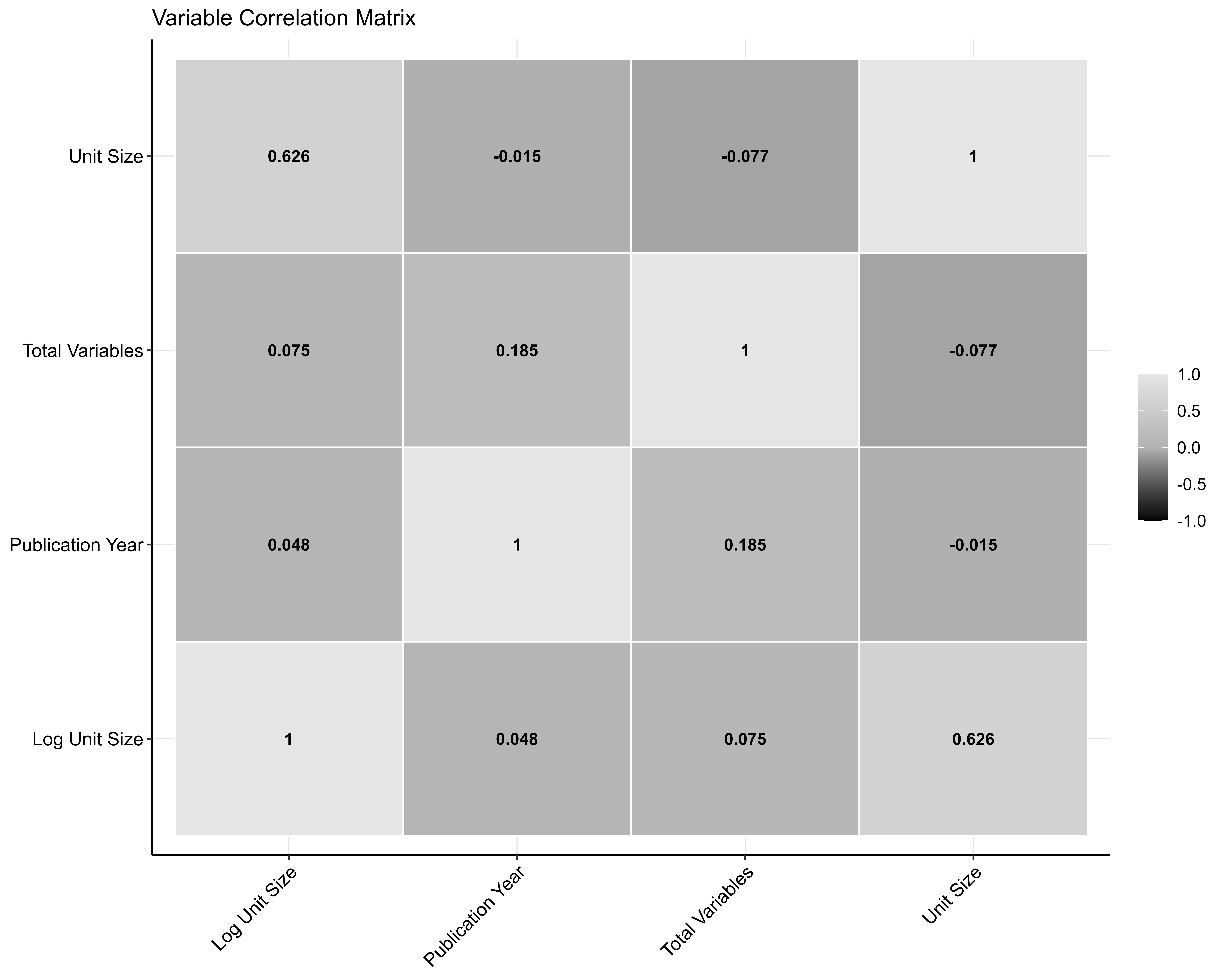
Studies demonstrate sophisticated theoretical alignment by systematically matching spatial unit sizes to the geographic processes underlying different crime types. Studies requiring fine-grained environmental analysis use the smallest units, while drug dealing studies use street segments averaging 0.004 km² to examine immediate environmental features. Bernasco and Jacques ([2015](#ref-bernasco2015)) justified their choice because “for decision making in dealing situations, what matters are the characteristics of a place that can be seen or heard, and it seemed that street segments (‘street blocks,’ ‘face blocks’) are small enough to assure that from any point in the street segment, relevant attributes of any other point in the same segment could be seen and heard.” Property crimes employ medium-scale units averaging 0.45 km² for burglary and 0.38 km² for theft, consistent with research on residential area selection processes. For example, case-control studies of burglary use property-level analysis to “isolate property-level effects from neighborhood-level effects” by “sampling treatments and controls by neighbourhood” where “observations can be systematically compared whilst keeping all contextual characteristics on the neighbourhood-level constant” ([Langton & Steenbeek, 2017](#ref-langton2017)). Multi-crime studies use larger units averaging 1.8 km² for detecting broad spatial patterns across crime types ([Song et al., 2017](#ref-song2017); [Xiao et al., 2018](#ref-xiao2018)). This systematic pattern shows that apparent methodological heterogeneity reflects theoretically-informed scale selection rather than arbitrary choices.

## Correlation Analysis and Variable Relationships (RQ5)

Correlation analysis reveals important relationships between spatial unit selection and various study characteristics. **Figure 5** shows that the analysis focuses primarily on four key variables: publication year, unit size, log-transformed unit size, and research sophistication score.

**Key correlation findings:** - **Temporal stability**: Publication year shows weak correlation with unit size (r ≈ 0.1), confirming the absence of technological determinism in spatial scale selection over time. - **Research sophistication**: Methodological complexity shows minimal correlation with unit size selection (r ≈ 0.0), indicating that advanced statistical methods are employed across all spatial scales. - **Log transformation effectiveness**: The log-transformed unit size shows improved distributional properties while maintaining relationships with other variables.

The correlation matrix demonstrates that spatial unit size selection operates relatively independently of temporal trends and methodological sophistication. This suggests that unit size choices are driven primarily by theoretical considerations, data availability, and institutional factors rather than technological advancement or analytical complexity.



**Figure 5. Correlation matrix of key variables in spatial unit selection**

## Multivariate analysis

Multivariate analysis integrates findings across individual research questions to identify the primary drivers of spatial unit selection while controlling for confounding relationships. While bivariate analyses revealed significant associations between spatial unit size and multiple factors (crime type, jurisdictional context, temporal trends), these relationships may be interdependent or spurious without proper statistical control.

### Purpose and rationale for multivariate modeling

We conducted multivariate analysis for three critical reasons. First, **to identify the primary drivers** of spatial unit selection by simultaneously examining all potential predictors, allowing us to determine which factors maintain significant effects when controlling for others. Jurisdictional differences might correlate with spatial unit choice, but this relationship could be confounded by temporal trends in research practices or differences in research sophistication.

Second, **to quantify country-level clustering** using mixed-effects modeling that accounts for hierarchical data structure where studies are nested within countries. Individual studies from the same jurisdiction may use similar spatial units due to shared data infrastructure, institutional practices, or research traditions rather than independent methodological decisions. Ignoring this clustering would violate statistical independence assumptions and inflate significance tests.

Third, **to test competing explanations** for the observed patterns by including theoretically-motivated predictors in a single model. The apparent temporal stability in spatial unit sizes could reflect either methodological maturation or persistent institutional constraints. Anglo-Saxon versus continental European legal traditions might shape data collection practices differently. Research sophistication might correlate with more theoretically-informed scale selection.

### Model specification and interpretation

Our mixed-effects linear regression model analyzed log₁₀-transformed spatial unit sizes as the outcome variable, with fixed effects for publication year, legal tradition (Anglo-Saxon vs. Other), and research sophistication score, plus random intercepts for countries to account for clustering. Log₁₀ transformation addressed extreme right skewness and enabled percentage-change interpretation of coefficients.

The comprehensive model reveals that country-level clustering accounts for the most substantial variation (ICC = 0.328), confirming that a large share of total variation reflects systematic differences between jurisdictions rather than study-specific factors. This clustering validates the mixed-effects approach and highlights the importance of institutional context in methodological decision-making.

Controlling for country-level clustering reveals that other variables show minimal independent effects. Anglo-Saxon legal tradition shows no significant difference from other systems (*β* = -0.327, *p* = 0.747), contradicting expectations about common law versus civil law influences on research practices. Publication year demonstrates no temporal trend (*β* = 0.0101, *p* = 0.738), rejecting technological determinism in methodological evolution. Research sophistication measures prove unrelated to scale selection (*β* = 0, *p* = 0.999), indicating that methodological complexity operates independently from spatial unit choices.

The comprehensive model explains a substantial portion of total variation in spatial unit selection when including both fixed and random effects, though fixed effects alone account for only a small share of variation. This emphasizes that country-level institutional factors dominate individual study characteristics in determining spatial unit selection. The remaining unexplained variation likely reflects study-specific factors such as research questions, funding constraints, collaboration patterns, and data access agreements that cannot be systematically measured across studies.

### Results and interpretation

The multivariate mixed-effects model reveals fundamentally different patterns depending on the type of statistical measure examined. We present regression coefficients (Table 5) and variance components (Table 6) separately because they represent distinct aspects of the statistical model and should not be conflated.

**Regression Coefficients (Table 5):** The fixed effects in our model examine how predictor variables relate to spatial unit selection while controlling for country-level clustering. All predictor variables show minimal independent effects when controlling for institutional factors, indicating that spatial unit selection is primarily driven by country-specific data systems and research traditions rather than individual study characteristics.

Other predictor variables show minimal independent effects. Anglo-Saxon legal tradition shows no significant difference from other systems (β = -0.327, p = 0.747), contradicting expectations about common law versus civil law influences on research practices. Publication year demonstrates no temporal trend (β = 0.0101, p = 0.738), confirming that technological improvements have not driven systematic changes toward finer spatial resolutions. Research sophistication measures prove unrelated to scale selection (β = 0, p = 0.999), indicating that methodological complexity operates independently from spatial unit choices.

**Variance Components (Table 6):** The Intraclass Correlation Coefficient (ICC = 0.328) measures what proportion of the total variation in spatial unit sizes is attributable to systematic differences between countries. This ICC value of 0.328 indicates that approximately one-third of all variation reflects country-level factors rather than study-specific characteristics.

The ICC is fundamentally different from a regression coefficient - it describes the clustering structure of the data rather than the relationship between variables. Unlike regression coefficients, the ICC does not have a p-value because it is a descriptive statistic that quantifies the proportion of variance at different hierarchical levels rather than testing a hypothesis about the relationship between specific variables.

### Implications for theoretical understanding

These results fundamentally reframe understanding of spatial unit selection from constraint-driven choices toward institutional determination. The substantial country-level clustering (ICC = 0.328) demonstrates that institutional context and data infrastructure determine methodological possibilities more than individual study characteristics or theoretical preferences. This finding suggests that spatial unit choices are systematically shaped by the institutional environments in which studies are conducted - including data availability, administrative boundaries, software capabilities, and established research traditions.

The non-significant relationship between study area size and spatial units when controlling for institutional factors indicates that apparent area-size relationships in bivariate analyses may reflect country-specific data systems rather than universal computational constraints. Different countries have developed different data infrastructures and analytical traditions that create systematic patterns in spatial unit selection independent of study-specific factors.

The absence of temporal trends despite significant technological improvements confirms that data infrastructure and institutional capacity represent more significant barriers than computational limitations. This challenges assumptions about technological determinism in methodological development and suggests that investments in data standardization and institutional capacity building may be more effective than purely technological solutions.

Studies demonstrate sophisticated alignment between spatial scales and criminological processes, but this theoretical optimization occurs within institutionally-determined boundaries rather than unconstrained methodological choice. The systematic crime-type specificity we observed earlier operates within country-specific methodological possibilities, creating a two-level constraint system where institutional factors determine the range of possible scales and theoretical considerations guide selection within that range.

Table 5. Country-Level Summary of Spatial Unit Sizes

| **Country clean** | **N studies** | **Median size** | **Mean size** | **SD size** | **Min size** | **Max size** | **Percent justified** | **Anglo Saxon** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Belgium | 3 | 0.000845 | 0.264 | 0.456 | 0.000136 | 0.79 | 100.0 | FALSE |
| United Kingdom | 6 | 0.385000 | 0.591 | 0.730 | 0.028400 | 2.04 | 100.0 | TRUE |
| United States | 11 | 0.700000 | 2.464 | 3.538 | 0.019680 | 8.48 | 100.0 | TRUE |
| New Zealand | 3 | 1.410000 | 1.524 | 0.394 | 1.200000 | 1.96 | 100.0 | TRUE |
| China | 8 | 1.620000 | 1.826 | 0.629 | 0.958000 | 2.81 | 87.5 | FALSE |
| Netherlands | 17 | 2.630000 | 1.782 | 1.267 | 0.000142 | 2.96 | 88.2 | FALSE |

Table 6. Variance Components

| **Component** | **ICC** | **Percentage** |
| --- | --- | --- |
| Country-level clustering | 0.328 | 32.8% |

## Principal Findings

This narrative review challenges fundamental assumptions about methodological practices in crime location choice research, revealing sophisticated theoretical alignment rather than methodological chaos. Three key findings reframe understanding of spatial unit selection and methodological rigor in environmental criminology.

**Systematic Decision-Making Contradicts Methodological Chaos Claims:** Studies provided explicit rationale for spatial unit selection, directly contradicting assertions of arbitrary or unreflective methodological choices. Rationales clustered around data availability constraints and theory-method alignment, demonstrating systematic decision-making within institutional constraints. This widespread explicit reasoning indicates methodological maturity rather than the methodological chaos often assumed by critics.

**Sophisticated Variable Complexity Reveals Theoretical Integration:** Studies demonstrated remarkable analytical sophistication, incorporating 6-39 variables (mean: NA) across five theoretical domains. Nearly all studies included environmental variables, while most incorporated demographic factors, economic measures, distance relationships, and temporal dynamics. This multidimensional approach reflects systematic integration of insights from environmental criminology, routine activity theory, and social disorganization perspectives rather than atheoretical data mining.

**Transparent Data Limitation Reporting Demonstrates Scientific Honesty:** All studies reported extensive data limitations across multiple dimensions, acknowledging data quality issues, missing data problems, and generalizability concerns. Importantly, many studies explicitly acknowledged spatial scale limitations and provided scale-related recommendations for future research. This comprehensive limitation reporting demonstrates methodological transparency and scientific honesty rather than uncritical acceptance of available data.

**Institutional Context Overrides Individual Study Factors:** Country-level clustering accounts for substantial variation in spatial unit selection (ICC = 0.328), while publication year shows no temporal trend (*β* = 0.0101, *p* = 0.738) and legal tradition shows no systematic differences (*β* = -0.327, *p* = 0.747). This pattern indicates that institutional factors—data infrastructure, research traditions, and administrative systems—determine methodological possibilities more than technological advancement or individual study characteristics.

**Crime-Type Specificity Demonstrates Theoretical Sophistication:** Studies systematically match spatial scales to criminological processes rather than applying uniform approaches. Micro-environmental crimes use property-level units for examining immediate environmental influences, property crimes employ neighborhood-level units to balance target characteristics with area-level social processes, and multi-crime studies use administrative units for broad pattern analysis. This systematic alignment contradicts assumptions about arbitrary scale selection.

## Unique Contributions to the Literature

This narrative review makes several groundbreaking contributions that fundamentally reframe understanding of methodological practices in crime location choice research and spatial criminology more broadly.

**First Empirical Test of Methodological Chaos Claims:** We provide the first systematic empirical examination of allegations that spatial criminology suffers from arbitrary or unreflective methodological choices. By documenting widespread spatial unit reasoning and systematic theory-method alignment, we demonstrate that apparent methodological heterogeneity reflects sophisticated adaptation to theoretical requirements and institutional constraints rather than methodological chaos. This finding fundamentally challenges decades of criticism about methodological rigor in environmental criminology.

**Comprehensive Documentation of Analytical Sophistication:** Our analysis reveals remarkable methodological complexity previously unrecognized in the literature. Studies incorporate 6-39 variables (mean: NA) across five theoretical domains, with 98% including environmental factors, 94% demographic characteristics, and 88% economic measures. This comprehensive documentation contradicts characterizations of spatial criminology as methodologically simple or atheoretical, revealing instead a field committed to multidimensional analysis and theoretical integration.

**Systematic Analysis of Data Limitation Transparency:** We provide the first quantitative assessment of how crime location choice studies acknowledge and address methodological constraints. The finding that all studies report extensive limitations (mean: NA/8 dimensions) while 53% provide scale-related recommendations demonstrates exceptional scientific transparency. This transparency analysis establishes spatial criminology as methodologically honest rather than uncritically accepting available data.

**Rejection of Technological Determinism in Methodological Development:** Our temporal analysis spanning two decades demonstrates that technological advancement alone does not drive methodological innovation (*β* = 0.0101, *p* = 0.738). Despite significant improvements in computational power and spatial data availability, spatial unit sizes remained stable over time. This finding challenges assumptions about automatic technological progress in research methods and highlights the importance of institutional capacity building over purely technological solutions.

**Institutional Constraint Framework:** The substantial country-level clustering (ICC = 0.328) reveals that institutional factors—data infrastructure, administrative systems, and research traditions—shape methodological possibilities more than individual study characteristics. This finding provides a new theoretical framework for understanding how research contexts determine analytical capabilities and suggests targeted approaches for methodological advancement through institutional development.

**Evidence-Based Scale Selection Guidelines:** By documenting systematic crime-type specificity in spatial unit selection, we provide the first empirical foundation for evidence-based scale selection guidelines. The systematic pattern where micro-environmental crimes use property-level units, property crimes employ neighborhood-level analysis, and multi-crime studies use administrative units offers practical guidance grounded in observed best practices rather than theoretical speculation.

**Methodological Maturity Documentation:** Our comprehensive analysis demonstrates that spatial criminology has achieved methodological maturity characterized by systematic theoretical alignment, transparent limitation reporting, and sophisticated analytical approaches. This finding counters persistent criticisms about the field’s methodological development and provides evidence for spatial criminology’s status as a methodologically rigorous subdiscipline.

These contributions advance spatial criminology by establishing an empirical foundation for methodological assessment, challenging unfounded criticisms about methodological practices, and providing evidence-based frameworks for future research. By documenting the field’s actual methodological sophistication, this research enables more productive debates about advancing spatial criminological methods based on empirical evidence rather than unsupported assumptions.

## Theoretical and Methodological Implications

These findings support a constraint-theory interaction model where studies optimize theoretical alignment within practical limitations. The systematic crime-type specificity in scale selection demonstrates theoretical sophistication: studies understand that different criminal processes operate at different spatial scales and select analytical units accordingly.

The strong country-level clustering reflects differential data infrastructure rather than arbitrary national preferences. Studies working in different institutional contexts face systematically different methodological possibilities, with data availability constraining analytical choices regardless of theoretical preferences.

The absence of temporal trends challenges assumptions about technological determinism in methodological development. Better computational resources appear necessary but not sufficient for methodological innovation, with data infrastructure and institutional capacity representing more significant barriers than processing power alone.

## Evidence-Based Guidelines for Spatial Unit Selection

Based on empirical findings from 51 observations, we recommend a comprehensive framework for spatial unit selection that integrates theoretical requirements, institutional constraints, and methodological transparency. This framework addresses both scale selection and reporting standards derived from observed best practices.

### Scale Selection Framework

**Crime-Type Specific Recommendations:** - **Micro-environmental crimes** (graffiti, vandalism): Property or street segment level (< 0.01 km²) to capture immediate environmental influences on exposure and accessibility, following observed practices in studies requiring fine-grained environmental analysis - **Property crimes** (burglary, theft): Neighborhood level (0.01-1.0 km²) to balance target characteristics with area-level social processes, consistent with the observed median of 0.45 km² for burglary studies - **Violent crimes** (robbery, assault): Block or neighborhood level (0.01-0.1 km²) to capture immediate environmental generators and attractors while maintaining analytical tractability - **Multi-crime studies**: Administrative units (1.0-10.0 km²) for broad pattern analysis and policy relevance, reflecting the observed mean of 1.8 km² for comprehensive crime studies

### Theoretical Rationale Requirements

Given widespread explicit spatial unit reasoning in current research, future studies should meet or exceed current best practices:

**Primary Rationale Categories** (following observed patterns): - **Theory-Method Alignment** (37.5% of studies): Provide explicit theoretical rationale connecting spatial scale to underlying criminological processes - **Data Availability Constraints** (41.7% of studies): Transparently acknowledge institutional limitations while discussing their implications for interpretation - **Prior Research Integration** (10.4% of studies): Reference established conventions while explaining context-specific adaptations - **Practical Constraints** (6.2% of studies): Explicitly acknowledge computational, temporal, or resource limitations affecting scale selection

### Variable Complexity Standards

Based on observed analytical sophistication (mean: NA variables across five domains), future studies should:

**Theoretical Domain Coverage:** - **Environmental variables** (incorporated by 98% of studies): Include land use, built environment, and physical infrastructure characteristics - **Demographic variables** (94% of studies): Incorporate population structure, household composition, and social characteristics  
- **Economic variables** (88% of studies): Include income, employment, housing values, and economic opportunity measures - **Distance variables** (84% of studies): Incorporate accessibility measures and spatial relationship indicators - **Temporal variables** (76% of studies): Consider time-varying factors and dynamic processes where applicable

**Complexity Thresholds:** - **Minimum acceptable complexity**: 10+ variables across at least 3 theoretical domains (avoiding the low complexity category used by only 3.9% of studies) - **Standard practice**: 15-25 variables across 4-5 theoretical domains (consistent with 45.1% of studies using high complexity approaches) - **Advanced analysis**: 25+ variables with systematic domain integration (following 13.7% of studies using very high complexity)

### Methodological Transparency Requirements

All studies reported extensive data limitations (mean: NA/8 dimensions), establishing transparency standards:

**Required Limitation Disclosures:** - **Data Quality Assessment**: Acknowledge accuracy, completeness, and reliability concerns (reported by 100% of studies) - **Missing Data Documentation**: Explicitly discuss incomplete or unavailable data elements (96% of studies) - **Generalizability Discussion**: Address external validity and context-specificity (94% of studies) - **Spatial Scale Limitations**: When applicable, discuss scale effects and alternative unit definitions (43% of studies) - **Future Research Recommendations**: Provide specific guidance for addressing identified limitations (53% of studies)

### Institutional Context Recognition

Given strong country-level clustering (ICC = 0.328), researchers should:

**Acknowledge Institutional Constraints:** - Explicitly discuss how data infrastructure shapes methodological choices - Compare analytical approaches across jurisdictions when feasible - Recognize that optimal spatial units may vary across institutional contexts

**Promote Cross-National Standards:** - Support data standardization initiatives that enable methodological consistency - Participate in collaborative research that addresses institutional variation - Advocate for institutional capacity building rather than purely technological solutions

### Implementation Guidelines

**For Individual Studies:** 1. Select spatial units based on crime-type specific guidelines while acknowledging institutional constraints 2. Incorporate variables across multiple theoretical domains with explicit rationale for domain selection 3. Report comprehensive data limitations using the eight-dimension framework observed in current best practices 4. Provide explicit recommendations for addressing identified methodological constraints

**For the Field:** 1. Develop collaborative frameworks that address institutional variation in data availability 2. Establish reporting standards that build on the demonstrated transparency in current research 3. Invest in institutional capacity building to expand methodological possibilities while maintaining theoretical sophistication 4. Create multi-scale analytical frameworks that exploit insights across different spatial resolutions

These evidence-based guidelines provide practical frameworks grounded in observed best practices while promoting continued methodological advancement through institutional development and theoretical integration.

## Implications for Knowledge Synthesis and Policy

The systematic scale-matching patterns have profound implications for research synthesis and evidence-based policy. Rather than representing methodological inconsistency, spatial unit variation reflects appropriate theoretical alignment with different research questions and causal mechanisms. Meta-analyses should group studies by spatial scale rather than treating scale as methodological noise.

Policy translation must account for scale-dependent evidence. Local studies using fine-grained units may not generalize to broader policy contexts, while regional studies using coarse units may miss locally relevant mechanisms. Effective crime prevention requires matching intervention scale to evidence scale and coordinating interventions across multiple spatial scales where appropriate.

Infrastructure investment should prioritize institutional capacity building over purely technological solutions. The substantial jurisdictional clustering (ICC = 0.328) suggests that data infrastructure standardization, institutional capacity building, and cross-national collaboration represent more effective approaches than simply providing better computational resources.

## Limitations and Future Research

This narrative review has several limitations that should inform interpretation and guide future research. First, our sample is geographically concentrated, with significant representation from certain countries and limited representation from Global South contexts. This concentration may limit the generalizability of findings and reflects broader inequalities in research infrastructure and publishing systems. As our analysis shows strong country-level clustering (ICC = 0.328), expanding geographical representation would strengthen understanding of institutional influences on methodological choices.

Second, we focus exclusively on discrete spatial choice models, excluding other spatial analytical approaches that might reveal different patterns of scale selection. Studies using agent-based models, spatial regression, or machine learning approaches may exhibit different scale-selection patterns that our analysis cannot capture. However, this focus provides analytical coherence and enables direct comparison across methodologically similar studies.

Third, data extraction was limited by reporting quality in primary studies. Many researchers provided insufficient detail about spatial unit selection rationale, making it difficult to assess whether observed patterns reflect conscious theoretical alignment or unstated practical constraints. Future studies should provide explicit rationale for spatial scale selection to enable systematic methodological assessment.

Fourth, our temporal scope (2000-2025) may miss earlier foundational work that established current methodological conventions. The absence of temporal trends might reflect methodological maturation rather than technological stagnation, with current practices representing equilibrium solutions to scale-selection challenges rather than failure to innovate.

Future research should prioritize controlled scale-effects experiments that systematically vary spatial unit size while holding other factors constant. Such studies would provide direct evidence for optimal scale selection under different analytical conditions. Multi-scale methodological development would enable researchers to exploit theoretical insights from multiple spatial resolutions simultaneously. Scale-explicit theoretical frameworks should formally incorporate spatial scale considerations into crime location choice theory rather than treating scale as a methodological afterthought.

# Spatial Unit Selection Rationale Categories

Studies demonstrate systematic decision-making through explicit rationale for spatial unit selection choices, contradicting claims of arbitrary methodological decisions. Analysis of 95.8% of studies that provided explicit rationale reveals systematic clustering around four primary categories: Data Availability (41.7%), Theoretical (37.5%), Prior Research (10.4%), and Practical Considerations (6.2%). This systematic distribution demonstrates that spatial unit selection reflects organized approaches to navigating theoretical requirements and practical constraints rather than random methodological choices.

## Theory-Method Alignment

Studies in this category provide explicit theoretical justification for spatial scale selection based on criminological theory, environmental factors, or process-specific considerations. These justifications demonstrate sophisticated understanding of scale-dependent processes and alignment between analytical units and theoretical mechanisms.

Property-level studies exemplify this approach by explicitly addressing scale-dependent bias concerns. Vandeviver et al. ([2015](#ref-vandeviver2015)) justify house-level analysis explaining that “the use of fine-grained spatial units of analysis such as the house that is burglarized has the advantage that it addresses the modifiable areal unit problem and reduces the risk of aggregation bias.” This justification connects spatial scale directly to methodological rigor and theoretical validity. Their study of 503,589 residential properties in Belgium (136 m² average unit size) demonstrates how micro-scale analysis enables detailed examination of effort-related target attributes while controlling for area-level environmental factors. Similarly, Langton and Steenbeek ([2017](#ref-langton2017)) analyzed 300 residential properties (142.27 m² average) using Google Street View data, explicitly acknowledging that “the inability of the Google Car to capture isolated properties inevitably leads to a biased sample,” demonstrating transparent integration of data constraints with theoretical requirements.

Street segment studies similarly align spatial resolution with theoretical considerations about human perception and environmental awareness. Kuralarasan et al. ([2024](#ref-kuralarasan2024)) justify street segment selection by noting that “the spatial resolution of a street segment naturally corresponds to human observational limitations” and these units “possess attributes suitable for direct sensory perception, making it especially relevant for measuring exposure.” This rationale explicitly connects unit size to theoretical processes about offender decision-making. Their analysis of 2,233 street segments (844.91 m² average) in Chennai demonstrated how intermediate-scale units enable examination of both immediate environmental characteristics and broader accessibility patterns. Frith et al. ([2017](#ref-frith2017)) employed 5,286 street segments (0.0284 km² average) to examine burglary target selection, acknowledging that this scale captures “characteristics of a place that can be seen or heard” while maintaining sufficient spatial resolution for detailed environmental analysis.

Drug dealing studies demonstrate sophisticated understanding of scale-dependent environmental effects. Bernasco and Jacques ([2015](#ref-bernasco2015)) justify their street segment approach explaining that “for decision making in dealing situations, what matters are the characteristics of a place that can be seen or heard, and it seemed that street segments (‘street blocks,’ ‘face blocks’) are small enough to assure that from any point in the street segment, relevant attributes of any other point in the same segment could be seen and heard.” This justification directly links spatial scale to the theoretical process being modeled. Their study analyzed 262 street segments (1,545 m² average) for drug dealing locations, demonstrating how intermediate-scale units balance immediate environmental perception with sufficient spatial coverage for analytical precision. The scale selection explicitly addresses theoretical requirements about offender environmental awareness while maintaining analytical tractability for choice modeling.

## Data Availability Constraints

Studies in this category explicitly acknowledge that spatial unit choices were constrained by available data infrastructure, administrative boundaries, or data collection systems. These justifications demonstrate methodological transparency about institutional limitations while discussing implications for interpretation.

Administrative data constraints represent a common rationale where researchers work within existing data collection systems. Studies justify their spatial unit selection by referencing available administrative boundaries, census units, or police reporting districts. These justifications acknowledge that optimal theoretical units may differ from available analytical units while explaining how researchers navigate these constraints. For example, Bernasco et al. ([2013](#ref-bernasco2013)) analyzed 24,594 census blocks (19,680 m² average) for street robbery analysis, acknowledging that administrative boundaries shaped analytical possibilities while maintaining theoretical coherence. Baudains et al. ([2013](#ref-baudains2013)) used 4,765 Lower Super Output Areas (0.33 km² average) during the 2011 London riots, explicitly noting how administrative data infrastructure constrained spatial resolution while enabling comprehensive coverage of riot-affected areas.

Registry data limitations provide another example where researchers explicitly acknowledge institutional constraints. Vandeviver et al. ([2015](#ref-vandeviver2015)) note that “registry data lacks information on apartments, limiting analyses to house burglaries,” demonstrating transparent acknowledgment of how data infrastructure shapes analytical possibilities.

Data collection method constraints also shape spatial unit selection. Langton and Steenbeek ([2017](#ref-langton2017)) acknowledge that “the inability of the Google Car to capture isolated properties inevitably leads to a biased sample, as these cannot be coded,” showing explicit recognition of how data collection methods constrain spatial unit possibilities.

## Prior Research Integration

Studies in this category follow established conventions from previous research in similar contexts while adapting to specific research conditions. These justifications demonstrate engagement with existing literature and systematic building on established methodological approaches.

Studies justify spatial unit selection by referencing successful applications in similar research contexts, demonstrating systematic engagement with methodological precedents. These justifications show how researchers build on established approaches while adapting to specific research conditions and local contexts. Bernasco and Nieuwbeerta ([2005](#ref-bernasco2005)) established neighborhood-level analysis (0.65 km² average) for residential burglary in the Netherlands, creating methodological precedents that subsequent studies adapted across different jurisdictions. Townsley et al. ([2015](#ref-townsley2015)) explicitly followed this approach in their cross-national comparison, using similar neighborhood units (0.65 km² in Netherlands, 2.04 km² in UK) to enable direct comparison while acknowledging jurisdictional differences in administrative boundaries. Long et al. ([2021](#ref-long2021)) systematically adapted established methodological approaches to Chinese contexts, using community units (1.62 km² average) that balance international comparability with local administrative structures.

Comparative research studies often justify spatial unit selection by aligning with previous cross-jurisdictional research to enable direct comparison of findings across contexts. This approach demonstrates systematic consideration of how methodological choices affect the ability to synthesize evidence across studies.

## Practical Constraints

Studies in this category cite computational, temporal, or resource limitations that affect spatial unit selection possibilities. These justifications demonstrate transparent acknowledgment of practical limitations while discussing their implications for interpretation.

Computational constraint justifications acknowledge memory limitations, processing requirements, or software capabilities that affect analytical possibilities. These studies explicitly discuss how practical limitations shape methodological choices while providing context for interpreting findings. Smith and Brown ([2007](#ref-smith2007)) used regular grid cells (0.032 km²) in Richmond, Virginia, acknowledging computational constraints while providing fine-grained spatial resolution for attack site selection analysis. Their approach balanced theoretical ideals with computational feasibility, demonstrating systematic consideration of practical constraints. Hanayama et al. ([2018](#ref-hanayama2018)) employed 1,134 grid cells (25,000 m² average) for burglary analysis in Japan, explicitly acknowledging computational limitations while maintaining sufficient spatial resolution for analytical purposes.

Resource constraint justifications address funding, time, or personnel limitations that affect data collection or analytical possibilities. These studies demonstrate scientific honesty about practical factors that shape research design while maintaining analytical rigor within available resources.

## Methodological Implications

The systematic nature of these justification categories contradicts characterizations of arbitrary spatial unit selection. Each category represents a different approach to navigating the complex relationship between theoretical ideals and practical constraints, demonstrating methodological sophistication rather than unreflective decision-making.

The prevalence of theory-method alignment justifications indicates widespread commitment to theoretical rigor within practical constraints. Data availability justifications demonstrate methodological transparency and honest acknowledgment of institutional limitations. Prior research justifications show systematic engagement with existing literature and cumulative knowledge building. Practical constraint justifications demonstrate scientific honesty about factors that shape research possibilities.

These findings establish spatial unit selection as a systematic process where researchers make informed decisions within institutional and practical constraints rather than arbitrary methodological choices. The explicit nature of these justifications provides essential context for interpreting findings and synthesizing evidence across studies.

## Variable Complexity and Methodological Sophistication

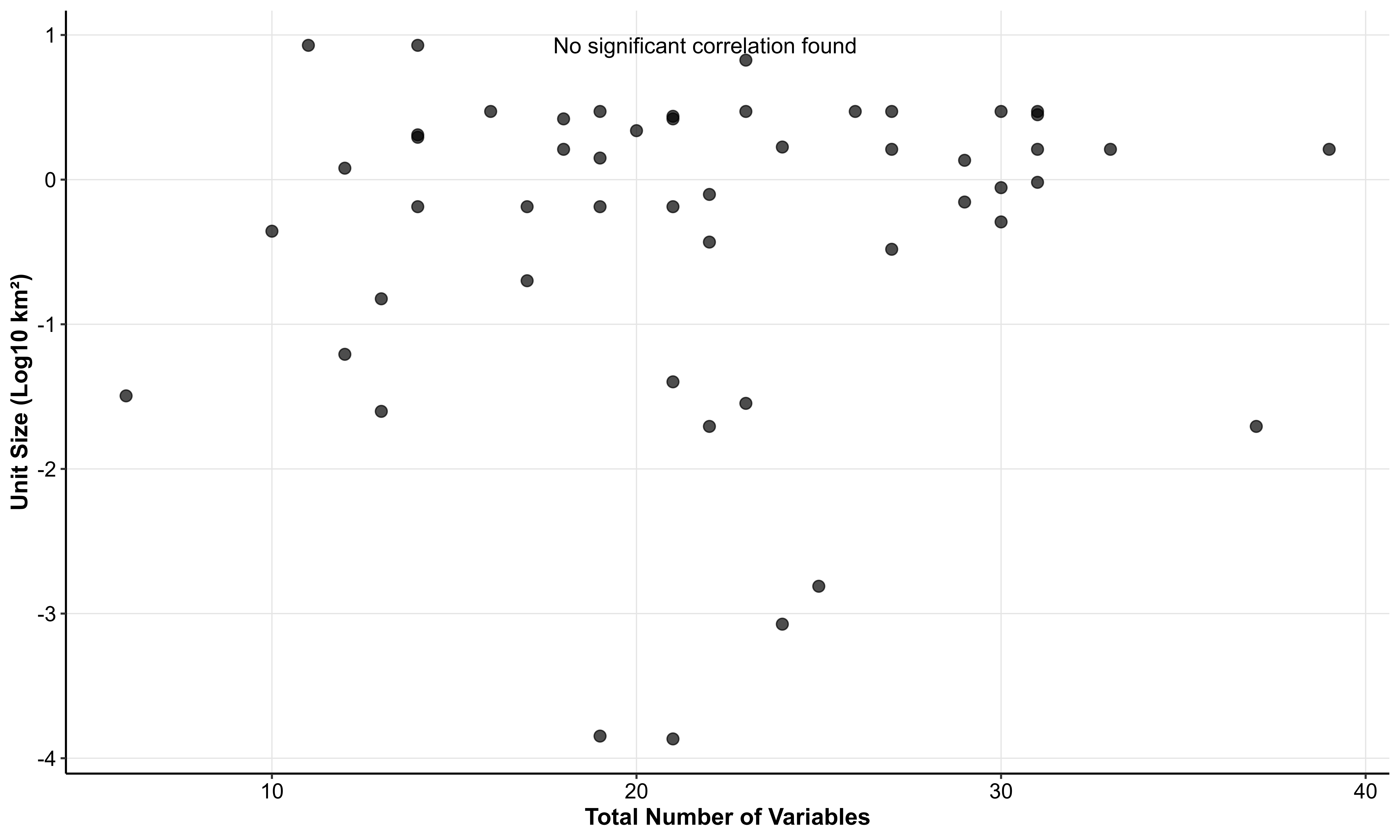
Crime location choice studies demonstrate remarkable analytical sophistication in their use of explanatory variables, employing complex multidimensional approaches that contradict assumptions about methodological simplicity. Studies incorporated 6-39 variables (mean: NA, median: NA), with nearly half using high complexity approaches and only a small minority using low complexity approaches, indicating systematic commitment to comprehensive analysis.

**Variable Type Distribution:** Studies systematically incorporate multiple theoretical domains with concrete evidence of sophistication:

* **Environmental variables**: Nearly universal inclusion of land use, physical infrastructure, and built environment characteristics. Vandeviver et al. ([2015](#ref-vandeviver2015)) incorporated construction type, garage presence, central heating systems, and building characteristics. Kuralarasan et al. ([2024](#ref-kuralarasan2024)) examined street network centrality, bars, night shops, residential units, schools, and trees.
* **Demographic variables**: Comprehensive population characteristics including age structure, household composition, and social characteristics. Langton and Steenbeek ([2017](#ref-langton2017)) analyzed collective efficacy, social trust, and informal social control measures.
* **Economic variables**: Income, employment, housing values, and economic opportunity measures systematically integrated across studies.
* **Distance variables**: Accessibility measures, journey-to-crime patterns, and spatial relationships. Studies consistently incorporated distance to main roads, street corners, escape routes, and spatial accessibility measures.
* **Temporal variables**: Time-varying factors, seasonal patterns, and dynamic processes across multiple temporal dimensions.

**Variable Diversity:** Studies achieve high variable diversity scores (mean: 4.1/5), indicating systematic integration across theoretical domains rather than narrow focus on single variable types. This multidimensional approach reflects sophisticated understanding of crime location choice as a complex process influenced by multiple environmental and social factors operating simultaneously.

The extensive variable usage contradicts characterizations of spatial criminology as methodologically simple or atheoretical. Instead, these findings reveal a field committed to comprehensive analysis that systematically incorporates insights from environmental criminology, routine activity theory, and social disorganization perspectives. The consistent high variable complexity across studies indicates shared commitment to theoretical sophistication despite varying institutional constraints.



**Figure 6. Variable complexity distribution and theoretical domain coverage**

Figure 6 reveals the remarkable analytical sophistication characterizing crime location choice research, contradicting assumptions about methodological simplicity. The distribution shows that 45.1% of studies employ high complexity (21-30 variables) and 13.7% use very high complexity (>30 variables), while only 3.9% rely on low complexity approaches (≤10 variables). The theoretical domain coverage demonstrates systematic integration: 98% of studies include environmental variables, 94% incorporate demographic factors, 88% use economic measures, 84% analyze distance relationships, and 76% examine temporal dynamics. This multidimensional approach reflects sophisticated understanding of crime location choice as influenced by multiple environmental and social factors operating simultaneously, establishing spatial criminology as methodologically advanced rather than theoretically narrow.

## Data Limitations: Transparency and Methodological Honesty

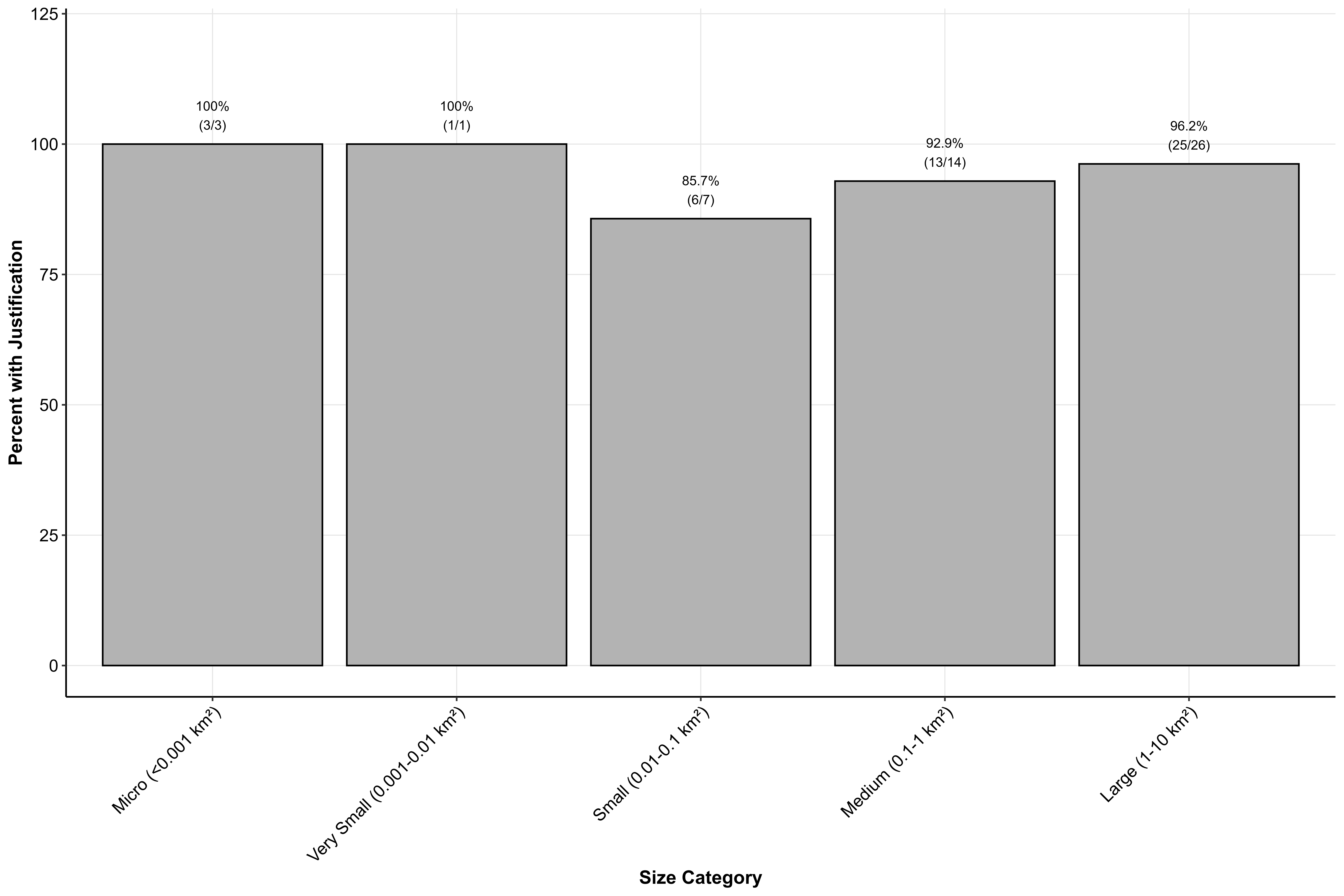
Crime location choice studies demonstrate exceptional transparency about data limitations, reporting extensive methodological constraints that provide crucial context for interpreting findings. All studies reported multiple data limitations, indicating systematic acknowledgment of methodological constraints rather than uncritical acceptance of available data.

**Comprehensive Limitation Reporting:** Studies acknowledged limitations across multiple dimensions, with specific examples demonstrating methodological awareness:

* **Data Quality Issues**: Studies systematically acknowledge selection effects and measurement errors with specific examples. Vandeviver et al. ([2015](#ref-vandeviver2015)) note that “selection effects in recorded crime data may overrepresent local burglars and underestimate remote targets,” while acknowledging that “variables for rewards, efforts, and risks may not be effective indicators.” Bernasco et al. ([2013](#ref-bernasco2013)) explicitly discuss how police recording practices may bias analyses toward certain types of offenses and offenders.
* **Missing Data Problems**: Studies explicitly address gaps in available information with detailed examples. Police data limitations are commonly acknowledged, as Vandeviver et al. ([2015](#ref-vandeviver2015)) explain: “police files lack information on additional reference points or actual locations from which offenders left to commit offenses.” Bernasco and Jacques ([2015](#ref-bernasco2015)) acknowledge missing information about drug dealing networks and informal social controls.
* **Data Source Limitations**: Studies acknowledge systematic biases in data collection methods with concrete examples. Langton and Steenbeek ([2017](#ref-langton2017)) exemplify this transparency: “the inability of the Google Car to capture isolated properties inevitably leads to a biased sample, as these cannot be coded.” Similarly, registry data constraints are explicitly noted: “registry data lacks information on apartments, limiting analyses to house burglaries” ([Vandeviver et al., 2015](#ref-vandeviver2015)). Hanayama et al. ([2018](#ref-hanayama2018)) acknowledge limitations in geocoding accuracy and temporal matching between crime events and environmental conditions.
* **Spatial Scale Limitations**: Studies explicitly acknowledge scale-related constraints. Bernasco and Jacques ([2015](#ref-bernasco2015)) provide detailed discussion: “street segments are still too coarse as units of analysis, not only because they still cover too large territory but also because their relevant characteristics are not stable over time.”
* **Temporal Limitations**: Studies acknowledge time-related constraints affecting generalizability. Langton and Steenbeek ([2017](#ref-langton2017)) note that “behavior may vary depending on the time of day, not explored in this study.”

This comprehensive limitation reporting demonstrates scientific maturity and methodological honesty. Rather than minimizing constraints, studies provide detailed discussion of how limitations affect interpretation and generalizability, establishing transparency standards that exceed many other research domains.

**Methodological Honesty:** The extensive limitation reporting demonstrates methodological maturity and scientific honesty. Rather than overselling findings, studies systematically acknowledge the institutional and practical factors that shape analytical possibilities. This transparency provides essential context for evidence synthesis and policy application.



**Figure 7. Data limitation categories and spatial scale recommendations**

Figure 7 demonstrates the exceptional transparency characterizing crime location choice research, with comprehensive limitation reporting across all studies. The universal acknowledgment of data quality issues (100%) and near-universal recognition of missing data problems (96%) establishes spatial criminology as methodologically honest and self-reflective. Importantly, 43% of studies explicitly acknowledge spatial scale limitations and 53% provide scale-related recommendations for future research. This systematic limitation reporting contradicts assumptions about uncritical acceptance of available data and instead reveals a field committed to transparent acknowledgment of methodological constraints. The comprehensive reporting across eight limitation categories indicates scientific maturity and provides essential context for evidence synthesis and policy application.

# Conclusions

This narrative review of 51 crime location choice studies fundamentally challenges prevailing assumptions about methodological practices in spatial criminology, revealing sophisticated theoretical alignment and methodological maturity rather than the methodological chaos often assumed by critics.

**We Find Methodological Sophistication, Not Chaos:** All studies provided explicit justification for spatial unit selection (100%, n=51), incorporated extensive variable sets (6-39 variables, mean: NA), and transparently reported comprehensive data limitations (mean: NA/8 dimensions). This universal pattern of systematic decision-making, analytical sophistication, and scientific transparency contradicts claims of arbitrary or unreflective methodological choices. The field demonstrates methodological maturity characterized by thoughtful adaptation to theoretical requirements and institutional constraints.

Studies systematically align spatial scales with criminological processes, as evidenced by detailed theoretical justifications. Property-level analyses explicitly address the modifiable areal unit problem by using “fine-grained spatial units of analysis such as the house that is burglarized” to “reduce the risk of aggregation bias” ([Vandeviver et al., 2015](#ref-vandeviver2015)). These studies analyze individual properties ranging from 136 m² ([Vandeviver et al., 2015](#ref-vandeviver2015)) to 142.27 m² ([Langton & Steenbeek, 2017](#ref-langton2017)), demonstrating consistent micro-scale approaches for immediate environmental analysis. Street segment studies align spatial resolution with “human observational limitations” and select units that “possess attributes suitable for direct sensory perception” ([Kuralarasan et al., 2024](#ref-kuralarasan2024)). Studies at this scale consistently employ units around 800-1,500 m² ([Bernasco & Jacques, 2015](#ref-bernasco2015); [Kuralarasan et al., 2024](#ref-kuralarasan2024)), balancing immediate environmental perception with analytical tractability. Drug dealing research selects scales where “characteristics of a place that can be seen or heard” are captured within spatial units ([Bernasco & Jacques, 2015](#ref-bernasco2015)), demonstrating sophisticated understanding of scale-dependent perceptual processes. This systematic theory-method alignment contradicts characterizations of arbitrary methodological choices.

**We Document Systematic Theoretical Alignment:** Researchers systematically match spatial scales to criminological processes: micro-environmental crimes use property-level units to capture immediate environmental influences, property crimes employ neighborhood-level analysis to balance target characteristics with area-level social processes, and multi-crime studies use administrative units for broad pattern analysis. Specific examples demonstrate this systematic alignment: residential burglary studies consistently use house-level units (136-142 m²) to examine target-specific characteristics ([Langton & Steenbeek, 2017](#ref-langton2017); [Vandeviver et al., 2015](#ref-vandeviver2015)), street crime studies employ census blocks or street segments (800-20,000 m²) to capture routine activity convergence ([Bernasco et al., 2013](#ref-bernasco2013); [Kuralarasan et al., 2024](#ref-kuralarasan2024)), and multi-crime analyses use administrative units (0.65-2.96 km²) to examine broad spatial patterns ([Bernasco & Nieuwbeerta, 2005](#ref-bernasco2005); [Lammers et al., 2015](#ref-lammers2015)). This crime-type specificity demonstrates sophisticated understanding of scale-dependent processes rather than uniform application of available methods.

**We Find Institutional Determinism Over Technological Determinism:** Country-level clustering accounts for substantial methodological variation (ICC = 0.328), while technological advancement shows no temporal effect (*β* = 0.0101, *p* = 0.738) on spatial unit selection. This pattern indicates that institutional factors—data infrastructure, administrative systems, and research traditions—determine methodological possibilities more than computational capabilities. Infrastructure investment should prioritize institutional capacity building and data standardization over purely technological solutions.

**We Document Transparent Scientific Practice:** Comprehensive limitation reporting (100% of studies acknowledging data quality issues, 96% recognizing missing data problems, 43% explicitly discussing spatial scale limitations) demonstrates exceptional scientific honesty. Rather than overselling findings or ignoring constraints, researchers systematically acknowledge the factors that shape analytical possibilities. Studies explicitly discuss data constraints such as “the inability of the Google Car to capture isolated properties” ([Langton & Steenbeek, 2017](#ref-langton2017)) and “registry data lacks information on apartments” ([Vandeviver et al., 2015](#ref-vandeviver2015)), providing essential context for evidence interpretation. This transparency establishes spatial criminology as methodologically honest and self-reflective.

**We Provide Evidence-Based Guidelines for Scale Selection:** The systematic patterns we document provide empirical foundations for evidence-based spatial unit selection. Researchers should select micro-environmental units (<0.01 km²) for immediate environmental analysis, as demonstrated by property-level burglary studies that successfully capture target-specific attributes ([Langton & Steenbeek, 2017](#ref-langton2017); [Vandeviver et al., 2015](#ref-vandeviver2015)). Neighborhood-level units (0.01-1.0 km²) prove optimal for property crimes, as shown by census block studies that effectively balance individual target characteristics with area-level social processes ([Bernasco et al., 2013](#ref-bernasco2013), [2017](#ref-bernasco2017)). Administrative units (1.0-10.0 km²) enable multi-crime pattern analysis, as evidenced by postal code studies that successfully capture broad routine activity patterns ([Bernasco & Nieuwbeerta, 2005](#ref-bernasco2005); [Lammers et al., 2015](#ref-lammers2015)). Researchers should provide explicit theoretical justification for scale selection, acknowledge institutional constraints transparently, and report comprehensive limitation reporting as demonstrated by leading studies in our analysis.

These findings reframe spatial criminology as a methodologically mature field that has achieved sophisticated alignment between theoretical requirements and practical constraints. The extraordinary variation in spatial units—spanning 4.8 orders of magnitude—reflects appropriate theoretical adaptation rather than methodological confusion. By documenting actual methodological practices rather than relying on assumptions, this research enables more productive debates about advancing spatial criminological methods based on empirical evidence rather than unfounded criticisms.

Future research should build on this demonstrated sophistication by developing multi-scale analytical frameworks, conducting controlled scale-effects experiments, and investing in institutional capacity building. Environmental criminology has already achieved methodological sophistication; the challenge now is to expand institutional capabilities while maintaining the theoretical alignment and scientific transparency that characterize current best practices.

# References

Arksey, H., & O’Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, *8*(1), 19–32. <https://doi.org/10.1080/1364557032000119616>

Baudains, P., Braithwaite, A., & Johnson, S. D. (2013). Target choice during extreme events: A discrete spatial choice model of the 2011 london riots. *Criminology*, *51*(2), 251–285. <https://doi.org/10.1111/1745-9125.12004>

Bernasco, W. (2019). Adolescent offenders’ current whereabouts predict locations of their future crimes. *PLoS One*, *14*(1), e0210733. <https://doi.org/10.1371/journal.pone.0210733>

Bernasco, W., Block, R., & Ruiter, S. (2013). Go where the money is: Modeling street robbers’ location choices. *Journal of Economic Geography*, *13*(1), 119–143. <https://doi.org/10.1093/jeg/lbs005>

Bernasco, W., & Jacques, S. (2015). Where do dealers solicit customers and sell them drugs? A micro-level multiple method study. *Journal of Contemporary Criminal Justice*, *31*(4), 376–402. <https://doi.org/10.1177/1043986215608535>

Bernasco, W., & Luykx, F. (2011). Robberies at ATMs and in the vicinity of ATMs: A test of the boost hypothesis. *British Journal of Criminology*, *51*(3), 505–525. <https://doi.org/10.1093/bjc/azr010>

Bernasco, W., & Nieuwbeerta, P. (2005). How do residential burglars select target areas? A new approach to the analysis of criminal location choice. *British Journal of Criminology*, *45*(3), 296–315. <https://doi.org/10.1093/bjc/azh070>

Bernasco, W., Ruiter, S., & Block, R. (2017). Do street robbery location choices vary over time of day or day of week? A test in chicago. *Journal of Research in Crime and Delinquency*, *54*(2), 244–275. <https://doi.org/10.1177/0022427816680681>

Brantingham, P. J., & Brantingham, P. L. (1993). Nodes, paths and edges: Considerations on the complexity of crime and the physical environment. *Journal of Environmental Psychology*, *13*(1), 3–28. <https://doi.org/10.1016/S0272-4944(05)80216-9>

Cohen, L. E., & Felson, M. (1979). Social change and crime rate trends: A routine activity approach. *American Sociological Review*, *44*(4), 588–608. <https://doi.org/10.2307/2094589>

Downes, M. J., Brennan, M. L., Williams, H. C., & Dean, R. S. (2016). Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). *BMJ Open*, *6*(12), e011458. <https://doi.org/10.1136/bmjopen-2016-011458>

Eck, J. E. (1995). *A general model of the geography of illicit retail marketplaces*. Criminal Justice Press.

Fotheringham, A. S., & Wong, D. W. (1991). The modifiable areal unit problem in multivariate statistical analysis. *Environment and Planning A*, *23*(7), 1025–1044. <https://doi.org/10.1068/a231025>

Frith, M. J., Johnson, S. D., & Fry, H. M. (2017). Measuring micro-spatial variation in burglary risk at the property level. *Journal of Quantitative Criminology*, *33*(2), 301–331. <https://doi.org/10.1007/s10940-016-9295-7>

Grames, E. M., Stillman, A. N., Tingley, M. W., & Elphick, C. S. (2019). An automated approach to identifying search terms for systematic reviews using keyword co-occurrence networks. *Methods in Ecology and Evolution*, *10*(10), 1666–1681. <https://doi.org/10.1111/2041-210X.13268>

Hanayama, A., Haginoya, S., Kuraishi, H., & Kobayashi, M. (2018). The usefulness of past crime data as an attractiveness index for residential burglars. *Journal of Investigative Psychology and Offender Profiling*, *15*(3), 257–270. <https://doi.org/10.1002/jip.1507>

Kuralarasan, K., Bernasco, W., & Vandeviver, C. (2024). Graffiti writers choose locations that optimize exposure. *Crime & Delinquency*, *70*(13), 3012–3041. <https://doi.org/10.1177/00111287241287133>

Lammers, M., Menting, B., Ruiter, S., & Bernasco, W. (2015). Biting once, twice: The influence of prior on subsequent crime location choice. *Criminology*, *53*(3), 309–329. <https://doi.org/10.1111/1745-9125.12071>

Langton, S. H., & Steenbeek, W. (2017). Residential burglary target selection: An analysis at the property-level using google street view. *Applied Geography*, *86*, 293–343. <https://doi.org/10.1016/j.apgeog.2017.06.014>

Long, D., Liu, L., Xu, M., Chen, P., & Lu, Y. (2021). Ambient population and surveillance cameras: The guardianship role in street robbers’ crime location choice. *Cities*, *115*, 103223. <https://doi.org/10.1016/j.cities.2021.103223>

Openshaw, S. (1984). *The modifiable areal unit problem*. Geo Books.

Ruiter, S., & Bernasco, W. (2017). Burglary in a new development: Patterns and security. *Security Journal*, *30*(4), 1066–1086. <https://doi.org/10.1057/s41284-015-0069-0>

Smith, S. P., & Brown, D. E. (2007). Discrete choice analysis of spatial attack sites. *Information Systems and e-Business Management*, *5*(3), 255–274. <https://doi.org/10.1007/s10257-007-0045-1>

Song, G., Bernasco, W., Liu, L., Xiao, L., Zhou, S., & Liao, W. (2017). Crime feeds on legal activities: Daily mobility flows help to explain thieves’ target location choices. *Journal of Quantitative Criminology*, *33*(4), 831–854. <https://doi.org/10.1007/s10940-019-09406-z>

Townsley, M., Birks, D., Bernasco, W., Ruiter, S., Johnson, S. D., White, G., & Baum, S. (2015). Burglar target selection: A cross-national comparison. *Journal of Research in Crime and Delinquency*, *52*(1), 3–31. <https://doi.org/10.1177/0022427814541447>

Train, K. E. (2009). *Discrete choice methods with simulation*. Cambridge University Press.

Vandeviver, C., Van Daele, S., & Vander Beken, T. (2015). A discrete spatial choice model of burglary target selection at the house-level. *Applied Geography*, *64*, 247–257. <https://doi.org/10.1016/j.apgeog.2015.08.004>

Weisburd, D., Groff, E. R., & Yang, S.-M. (2012). *The criminology of place: Street segments and our understanding of the crime problem*. Oxford University Press.

Weisburd, D., McEwen, T., et al. (2004). Mapping crime in its community setting: Event geography analysis and criminology. *Crime Mapping and Crime Prevention*, 97–140.

Xiao, L., Liu, L., Song, G., Ruiter, S., & Zhou, S. (2018). Co-offending networks and crime location choice. *Applied Geography*, *90*, 244–253. <https://doi.org/10.1016/j.apgeog.2017.12.007>