Graffiti Writers Choose Locations that Optimize Exposure

Kuralarasan, K[1], Wim Bernasco[2,3], Christophe Vandeviver[1],

Author affiliations:

[1] Department of Criminology, Criminal Law and Social Law, Ghent University, Ghent, Belgium
[2] Department of Human Geography, Planning and International Development Studies, University of Amsterdam, Amsterdam, The Netherlands
[3] Netherlands Institute for the Study of Crime and Law Enforcement (NSCR), Amsterdam, The Netherlands

Author for correspondence: Christophe Vandeviver
Email: Christophe.Vandeviver@UGent.be

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Abstract

We investigate the spatial decision-making of graffiti writers when selecting target locations, examining how street segment characteristics influence exposure. Extending the rational choice perspective to expressive offending, we collected data through Systematic Social Observation in Ghent's city center in November 2017, covering 12,655 graffiti instances across 2,233 street segments. The SSO involved counting graffiti items and public facilities likely to attract crowds, and measuring street network centrality. Conditional logit models assessed the impact of these characteristics on graffiti location choices. Results show that street network centrality and the presence of bars, night shops, residential units, and schools significantly increased graffiti writers' preferences. Our findings suggest that graffiti writers aim to maximize exposure, highlighting the rational choice perspective's relevance for expressive offending.

Introduction

Graffiti is a common sight in cities worldwide, with its distinct act of writing or drawing on walls and other surfaces in public spaces or public view. Graffiti exhibits diverse forms that reflect unique artistic intentions and choices in urban space (Halsey & Young, 2002). While graffiti is widespread, its distribution appears neither random nor uniform in urban landscapes, varying considerably across different areas (Haworth et al., 2013; McAuliffe, 2013; Tokuda et al., 2021). Our study aims to uncover the factors behind these variations by exploring graffiti writers' location choices and their underlying motivations. Factors like fame, visibility, and recognition are believed to shape their choices (Ferrell & Weide, 2010; McDonald, 2001; Van Loon, 2014). We term this motivation as 'exposure', indicating graffiti writers' desire for their art to be seen and recognized by a broad audience.

Graffiti occupies a dual role, being perceived both as a crime and as an art form. Kelling & Wilson (1982) point out that visible signs of disorder, such as graffiti, could contribute to public fear and avoidance behavior. In contrast, Ferrell & Weide (2010) describe graffiti as a form of aesthetic resistance against the homogenizing effects of corporate culture and legal control. While acknowledging that graffiti has been studied and can be studied from divergent perspectives, our study focuses solely on understanding the spatial behavior of graffiti writers. By empirically examining their location choices, we aim to contribute to the broader understanding of graffiti as a spatial practice rather than engage in debate over its status as art or crime.

Discussing what motivates graffiti writing leads us to an inherent paradox often referred to as "anonymous fame" (Walker & Schuurman, 2015): Graffiti writers seek recognition and exposure while maintaining their anonymity. This paradox can be resolved by the understanding that graffiti writers, though unknown, still achieve recognition for their style, aesthetic, prolificacy, and innovative placement in high-risk spots (Bloch, 2018; Dar, 2013; Ferrell, 1996; Kindynis, 2018). The graffiti writer's identity might be known to certain members within their subculture but remains anonymous yet recognizable to others and the general public (Dar, 2013; Ferrell & Weide, 2010). This approach guarantees them personal fame and recognition within their community, aligning with their goal of increased, anonymous exposure to the general public without the risk of apprehension.

There is a notable difference in the motivation, style, and placement of gang-related and non-gang-related graffiti. According to Bloch (2020b), gang graffiti often includes antagonistic symbols, such as cross-outs and call-outs, indicative of inter-gang conflicts. In contrast, non-gang graffiti tends to share wall space and incorporates a diverse mix of colors and styles. These qualitative differences between gang and non-gang graffiti are subjective and cannot

be definitively categorized based on socially constructed standards of taste. Based on our conversations with the graffiti prevention team and organizations working with graffiti writers in April 2023, we found that gang-related graffiti activities do not exist in Ghent and were stopped over a decade ago. Therefore, we assume that the graffiti observed in our study consists of non-gang-related graffiti or graffiti created by individuals.

In this study, we examine graffiti writers' location choices through the lens of the rational choice perspective (RCP) (Cornish & Clarke, 1986) and spot theory (Ferrell & Weide, 2010). RCP suggests that individuals make decisions by weighing the costs and benefits to maximize their utility. In the context of graffiti writing, this means selecting locations that maximize exposure while managing potential risks. Spot theory, developed by Ferrell and Weide (2010), complements RCP by highlighting that graffiti writers select locations based on visibility, audience, risk, and the cultural significance of the spot.

We employ a discrete spatial choice model, specifically the conditional logit model, which is one of the methods used under discrete choice models (Bernasco, 2023). Discrete choice models are used to predict an individual's choice among a set of alternatives, and the conditional logit model, introduced by McFadden (1973), is particularly useful when the choice depends on the attributes of the alternatives (see method section for detail). In our case, it helps us to analyze the factors influencing the locations of 12,655 graffiti items collected from 2,233 street segments. This method models the decision-making process specific to graffiti writers, focusing on their preference for maximizing the exposure of their graffiti to others. The RCP helps to formalize the predictions of spot theory, adding assumptions about units of analysis (street segments) and what makes them have exposure (the presence of many people). Our research aims to deepen the understanding of spatial decision-making in graffiti writing and contribute to the literature on location choice.

The remainder of this article is structured as follows. First, we review the empirical research on crime location choice and discuss prior work exploring how graffiti writers decide where to create graffiti. Within this context, we use the rational choice perspective as a foundation for our hypotheses. Next, we elaborate on our data collection methods, explain our systematic social observation, provide inter-rater reliability scores, and our statistical method. We then present our results, followed by a discussion of the research findings, a consideration of the limitations inherent to our study, an identification of avenues for future research, and a conclusion.

Crime location choice

The fact that crime clusters in specific areas indicates that offenders strategically choose their crime locations (Sherman et al., 1989; Weisburd, 2015). The rational choice perspective (Cornish & Clarke, 1976) suggests that offenders inform their spatial decision-making by weighing the expected benefits against potential risks and costs of their potential crime location choice, selecting the location that is perceived to have the greatest benefits relative to the potential risks and costs. A body of quantitative and qualitative research supports this assessment. For example, research on residential burglary demonstrates how offenders evaluate risks and rewards in choosing locations (Bennett & Wright, 1984; Langton & Steenbeek, 2017; Vandeviver et al., 2015). Similar patterns are found in street robbery research (Bernasco et al., 2013; Wright & Decker, 1997), highlighting the significance of location attributes in criminal spatial decision-making.

Consistency across various crime types reveals a common pattern where offenders, regardless of the specific type of crime, engage in a basic risk-reward analysis based on spatial and environmental factors. This includes evaluating factors like neighborhood affluence (Bernasco & Luykx, 2003), proximity to previous crime sites (Xiao et al., 2018), escape routes (Nee & Taylor, 2000), and the distance from the offender's home (Bernasco, 2010).

These considerations suggest that selecting a crime location is a purposeful and calculated decision influenced by various features of the available potential crime locations. This description does not imply that crime location choice is always or necessarily a fully conscious and error-free process.

To date, most crime location studies focus on profit-driven offenses such as burglary or robbery. In this regard, graffiti presents a unique case as it differs in at least three keyways from the offenses studied in extant crime location choice studies. First, the lack of financial gains in graffiti changes the risk-reward balance. Instead, exposure is a prime motivation for graffiti location choice (McAuliffe, 2012). Second, graffiti reporting by bystanders is lower than for other offenses (Megler et al., 2014), implying a reduced risk of apprehension. Third, penalties for graffiti are lenient and often limited to fines or clean-up duties (Ferrell, 1995; Iveson, 2010). This could reduce the deterrent effectiveness of such penalties. These distinct characteristics of graffiti necessitate examining writers' location choices, contributing to crime location choice literature and providing insights that could be useful for graffiti management.

Graffiti writers' location choices

Prior crime location choice studies have identified facilities that potentially attract more people to a location (Bernasco & Jacques, 2015; Block & Davis, 1996; P. L. Brantingham & Brantingham, 1995) as a predictor of crime. This is based on the assumption that offenders are motivated to choose locations with many facilities, which increases the number of potential targets and the opportunity for crime. In the case of graffiti, exposure is a key motivation when selecting a graffiti location (McAuliffe, 2012). Locations providing high visibility and human traffic, such as busy intersections and transit hubs, are preferred, allowing graffiti writers to maximize their exposure (Campos, 2013; Ferrell & Weide, 2010;

McDonald, 2001; Van Loon, 2014). Given this, locations with crowd-attracting facilities can be particularly appealing due to increased exposure potential.

Research on graffiti patterns using GIS-based methods has revealed various influencing factors related to urban zones and demographic attributes. It was found that in San Francisco, graffiti patterns are influenced by commercial and residential zones (Megler et al., 2014), density of young male populations, and parks (Megler et al., 2011). Walker and Schuurman (2015) found that graffiti in Vancouver correlates with violence hotspots. In Sydney, Haworth et al. (2013) observed that frequent graffiti removal leads to spatial displacement rather than reduction. Though the style and motivation for individual and gang graffiti are different (Bloch, 2020b), Smith et al. (2012) discovered that gang territories, shaped by physical barriers and interactions, influence graffiti patterns in Los Angeles. Tokuda et al. (2021) identified a positive correlation between graffiti and location accessibility.

While these findings highlight how various factors influence graffiti placement, these studies utilize graffiti removal (Haworth et al., 2013; Megler et al., 2011, 2014; Walker & Schuurman, 2015b), gang violence (Smith et al., 2012) and GSV (Tokuda et al., 2021) data for their analysis. However, these methods have inherent biases and limitations. For instance, graffiti removal data and citizen-reported data may reflect the perceptions and biases of the reporting individuals rather than an unbiased sample of graffiti locations. These sources may fail to capture graffiti's true extent and patterns as they depend on public reports and city maintenance priorities.

In contrast, Bloch (2020a) challenges the stereotype that graffiti is mainly found in high-crime, economically disadvantaged areas. His findings using in-person observation demonstrate that graffiti often clusters in areas with lower crime, and the highest-density clusters of graffiti were in affluent neighborhoods with higher-than-average home values and

median household incomes. These contrasting results underscore the necessity of using in-person observation to gain a better understanding of the graffiti subculture.

By employing in-person systematic social observation (SSO) in our study, we aim to capture a more comprehensive and less unbiased understanding of graffiti patterns and avoid limitations and biases associated with GSV and citizen-reported data. This approach allows for a more detailed and accurate analysis of graffiti writers' location choices and the factors influencing these choices.

While exposure and other factors impact the location choices of graffiti writers, it is important to recognize that risk also plays a role in their decision-making. Though crowd-attracting and accessible locations provide exposure, they also increase the risk of being reported or apprehended (Tokuda et al., 2021). However, graffiti writers often paint during the nighttime (Campos, 2013; Ferrell & Weide, 2010; Van Loon, 2014) to reduce the likelihood of detection and apprehension. Other risk factors, such as rapid removal (Haworth et al., 2013), apprehension or fines (Campos, 2013), and physical injuries (Ferrell & Weide, 2010), are also considered by graffiti writers and may influence their location choices. Moreover, undertaking risky actions such as painting on very high walls or in hard-to-reach locations, on moving trains, or in zones with a high chance of apprehension is highly regarded in the graffiti subculture (Dar, 2013; Ferrell & Weide, 2010; Van Loon, 2014). This illustrates the interconnectedness of risk and exposure.

In this study, we primarily focus on the aspect of exposure. Although there is potential for legal repercussions, indicating a need for risk consideration, our focus is on how the desire for exposure and recognition influences the choices of graffiti locations due to the limitations of our data. In defense of this approach, we emphasize that the factors determining risk for graffiti writers are often situational and apply mainly during the act of graffiti writing, such as

lighting conditions and the presence of surveillance. However, the exposure of graffiti often has a much longer timeframe, as it can remain visible at a spot for weeks, months, or even years before being removed or overwritten. Furthermore, it is notable that the cultural context of graffiti shows significant differences between countries, such as the U.S., where it is often linked to gang activities and territorial claims (Cresswell, 1992; Iveson, 2007), and Europe, where it is typically not gang-related (Campos, 2013; Van Loon, 2014). This study aims to improve understanding of graffiti location choices from a European perspective, recognizing these cultural differences.

Rational choice perspective and spot theory in graffiti writing

We use the rational choice perspective (RCP) and spot theory as our theoretical framework to investigate the decision-making processes guiding graffiti writers' location choices. RCP suggests that an offender evaluates the potential benefits and costs associated with various actions before making a decision (Cornish & Clarke, 1976). In the context of graffiti writing, RCP is instrumental in understanding the factors involved in location choice. Graffiti writers engage in maximizing the exposure of their art to achieve recognition and fame within and beyond the graffiti community. Applying RCP helps us to understand that graffiti writers are rational in their choices insofar that they might seek spots that maximize exposure and influence.

In addition to RCP, Ferrell and Weide (2010) provide a grounded theoretical framework for graffiti location choices, known as "spot theory," based on qualitative insights and personal experiences. Spot theory suggests that graffiti writers select locations based on visibility, audience, risk, and the cultural significance of the spot within the graffiti subculture. They argue that "*above all, graffiti writers seek recognition, and in order to get the recognition they crave, they need people to see their graffiti*" (p. 51). Therefore, every instance of graffiti writing involves a conscious decision considering visibility, location, and associated risks.

This decision-making process can be spontaneous, occurring just as the graffiti is being created, or it can be meticulously planned in advance. Regardless of the approach, this decision underscores the relationship between graffiti and its urban environment (Ferrell & Weide, 2010). Thus, high-visibility locations are particularly valued as they maximize exposure and status. Ferrell and Weide note that "greater status is earned by those writers who can paint their graffiti in bold, dangerous, and publicly visible spots" (p. 51).

Existing studies strongly support this approach, indicating that graffiti writers prefer locations with high exposure, human traffic and accessibility, allowing them to maximize their exposure and influence (Campos, 2013; McDonald, 2001; Tokuda et al., 2021). The deliberate choice is also evident as graffiti writers often operate at nighttime to overcome the risk of apprehension or being seen (Campos, 2013; Ferrell & Weide, 2010; Van Loon, 2014) while aiming for maximum exposure. These factors suggest that graffiti writers may make rational decisions to maximize their exposure. Therefore, applying RCP specifically to the aspect of exposure as argued in spot theory provides a framework for understanding these choices. Considering this theoretical background, we propose the following hypothesis:

***Hypothesis**: Graffiti writers prefer locations with high exposure.*

Our study makes three significant contributions to the literature. First, it extends the scope of location choice research on offending, which has predominantly focused on property offenses (Bernasco & Block, 2009; Bernasco & Nieuwbeerta, 2005; Langton & Steenbeek, 2017; Vandeviver & Bernasco, 2020) to include expressive offenses in general, and graffiti writing in particular. Crime location choice studies apply the Random Utility Maximization (RUM) theory and assume offenders make rational decisions to maximize utility. For example, a burglar might choose an affluent neighborhood to maximize financial rewards. Ferrell and Weide (2010) state that graffiti writing involves "each act of writing graffiti involves a

deliberate decision weighing visibility, location and risk" (p.51), which is similar to the risk-reward analysis in crime location choice, making it appropriate to study the location choice of graffiti writers from the perspective of crime location choice theory. Unlike acquisitive crimes that are motivated by financial gain, graffiti writers seek fame and exposure. We hypothesize that graffiti writers are more likely to choose street segments with higher foot traffic to increase their chances of exposure. While the motivation differs, the strategic selection of locations that maximize perceived rewards is a commonality.

Second, by utilizing a systematic in-person social observation (SSO) method, we assess the prevalence of illegal graffiti and the characteristics of street segments. This method enhances the validity and reliability of our data compared to earlier studies that relied on citizen reports, graffiti removal databases (Megler et al., 2014), or systematic observations via Google StreetView images (Tokuda et al., 2021).

Finally, most studies on graffiti have been ethnographic (Ferrell, 1996; Halsey & Young, 2002) and often rely on non-probabilistic sampling. Ethnographic interviews with graffiti writers (Bloch, 2018; Campos, 2013; Kramer, 2010; McDonald, 2001; Van Loon, 2014) (Bloch, 2018, Campos, 2013; Kramer, 2010; McDonald, 2001; Van Loon, 2014), and participant observation where the writers are interviewed –at the locations where they produce graffiti (Bloch, 2019) reveal that graffiti writers often seek recognition and fame and that they prioritize locations that offer high exposure. While these studies are informative for hypothesis development regarding graffiti writers' location choices, they largely depend on writers' self-reported preferences from interviews. The reliability of graffiti writers' self-reported motivations is uncertain due to humans' limited ability to introspectively access their decision-making processes (Nisbett & Wilson, 1977). Therefore, it is essential to corroborate these stated preferences with revealed preferences observations of actual behavior. While

ethnographic studies have provided valuable insights into graffiti writers' location preferences, quantitative analysis remains limited. A few studies have utilized diverse methods to examine graffiti's spatial patterns, including a network-based approach (Tokuda et al., 2021), GIS-based methods (Haworth et al., 2013; Megler et al., 2014; Walker & Schuurman, 2015a), and an ecological model (Smith et al., 2012). Although these studies have contributed to our understanding of the spatial distribution of graffiti, an analysis of graffiti writers' location choices and the factors influencing these choices remains unexplored. Our study aims to quantitative exploration of graffiti writers' observed location choices to test whether graffiti writers prefer locations with high exposure.

Data and methods[1]

Study area

In our study, we analyze graffiti instances in Ghent, Belgium. To ensure practicality in the scope of our observations while still focusing on areas with a high incidence of graffiti, we restricted our study area to the city center of Ghent. This decision, informed by previous research (Haworth et al., 2013), aimed to ensure a more unbiased representation of graffiti activity and provided an equitable operating environment for all active graffiti writers. We ensured that nearly all publicly accessible or visible locations in the Ghent city center were included in our observations.

Data collection method

The data were collected by a team of 212 observers in November 2017 using systematic social observation (SSO). These observers were undergraduate-level students from Ghent University who had received training for a month. The training covered the use of the SSO method and the coding of the observational form (see Appendix 1) into CSV files. Each student was assigned a set of street segments for observation based on how much time they

could dedicate to the task. Subsequently, students systematically walked through their designated street segments, recording their observations using a standardized form.

Our choice of SSO was informed by its capacity to provide a more accurate and comprehensive understanding of graffiti patterns, as supported by Bloch's (2020a) findings. SSO is a widely accepted method for measuring disorder in the community (Sampson & Raudenbush, 2004). It has proven to be a reliable method for assessing the physical attributes of locations (Sas et al., 2022). Further, graffiti removal data may not represent all graffiti because it only includes instances deemed nuisances or threats by citizens who have the time and skills to report them to the authorities (Megler et al., 2014). Additionally, relying on big data sources such as Google Street View (GSV) or citizen-reported graffiti data might not capture the specific locations preferred by graffiti writers (Bloch, 2020a). Therefore, employing SSO is necessary for producing a thorough understanding of graffiti patterns and the factors influencing them that are not represented in the removal or other recorded data.

In addition to counting and recording graffiti, our observers recorded the presence of facilities likely to attract higher footfall and increase exposure potential, such as bars, shops, night shops, nightclubs, restaurants, general stores, hotels or hostels, offices, public parking lots, bus or tram stops, schools, and residential units. Simultaneously, our observers identified elements likely to deter graffiti writers, such as surveillance cameras and police stations. They also recorded other street segment characteristics, such as the number of broken windows and the degree of waste and trees along the street (see Appendix 1).

Table 1 presents the descriptive statistics of the variables considered in our study. Each row corresponds to a specific variable, displaying minimum, mean, median, maximum, and standard deviation. For example, 98.93 percent of the segments had no nightclubs, and in

28.08 percent of the segments, no graffiti was observed. This table provides an overview of the data's dispersion, central tendency, and non-occurrence frequency for each variable.

Unit of analysis

We adopted street segments as our spatial unit of analysis, aligning with recent research advocating the use of street segments or similarly sized spatial units for analyzing crime and disorder (Groff et al., 2010; Weisburd et al., 2004). The spatial resolution of a street segment naturally corresponds to human observational limitations. It possesses attributes suitable for direct sensory perception, making it especially relevant for measuring exposure. From nearly any vantage point within a street segment, one can see, hear, or even smell activities occurring elsewhere in that segment. This unique characteristic is not shared by larger spatial units.

The observation focused only on the street segments of Ghent city center. We only observed the number of graffiti instances on each street segment, not on the specific objects where it was written. Our final dataset includes information from 2,233 street segments from the original 2,392. A total of 159 segments were not observed for various reasons and were excluded from the analysis (see Appendix 2 for map). We chose to represent street segments using polygons rather than the more common “line” representations. “Line” representations fail to adequately capture the complexities of older European city urban spaces, particularly when it comes to accurately portraying intersections and bridges that span canals and rivers. Therefore, our classification of street segments includes bridges, intersections, and regular street segments (see Appendix 3 for map). These categories have different structural characteristics that directly affect urban traffic flows in general and may indirectly influence social dynamics. Bridges often connect different parts of a city or different types of areas. Intersections, where multiple streets converge, are bustling spaces with high pedestrian and vehicle traffic. They function as transition points between different street segments or

different types of areas. Regular street segments are the third category, representing typical street segments without special structural features such as bridges and intersections. The study area does not have transit lines other than the trams and buses on the streets, and we haven't observed graffiti along railway tracks or on trains. Appendix 3 provides a map of the street segments in the city center of Ghent, distinguishing these three types of segments.

Inter-rater reliability

To ensure the reliability of our data, we randomly selected 10% of the street segments for dual observation. We evaluated the consistency between these observations using Krippendorff's alpha coefficient (Kα) (Krippendorff, 2004), a versatile statistic suitable for various research designs and capable of analyzing nominal, ordinal, and interval variables. This approach was particularly well-suited to our study, considering the large number of segments that needed evaluation and the variation in workloads among observers.

Table 1 also presents the Kα values with upper and lower confidence intervals. As outlined by Krippendorff (2004), Kα values above 0.80 indicate high reliability, while values above 0.60 are acceptable. However, values below 0.60 suggest inadequate inter-rater reliability and the potential for inaccurate conclusions. Consequently, variables with a Kα value under 0.60 were excluded (see Appendix 4) from our study to preserve the power of statistical tests, except for "Schools," which falls only marginally below the .60 threshold (Kα = .570).

Table 1: Descriptive statistics and Krippendorff's alpha (Kα) coefficients (N = 2233 street segments)

Variables	Min	Mean	Median	Max	SD	0%	Kα	Kα 95% CI Low	Kα 95% CI Up
Number of graffiti	0	5.67	2	152	11.1	28.08	0.754	0.614	0.872
Night clubs	0	0.03	0	12	0.4	98.93	0.718	0.314	0.96
Night shops	0	0.03	0	3	0.17	97.67	0.757	0.319	1
Bars	0	0.17	0	10	0.58	88.22	0.764	0.623	0.876
Schools	0	0.14	0	10	0.48	88.36	0.574	0.325	0.787
Restaurants	0	0.25	0	16	0.86	86.25	0.797	0.646	0.914
Shops	0	0.8	0	24	2.23	73.49	0.604	0.028	0.942
Trees	0	8.47	5	99	11.45	18.09	0.844	0.754	0.916
Residential units	0	2.51	0	70	5.48	55.98	0.752	0.570	0.896
Area (10m2)	0.2	8.44	5.13	189.11	11.05	0			
Bridge	0	0.02	0	1	0.14	97.9			
Intersection	0	0.33	0	1	0.47	66.86			
Street segments	0	0.65	1	1	0.48	35.24			

Note: For Kα – The number of observers was 84, and the number of street segments was 231. All segments were independently coded by two different observers

Street network centrality

Apart from measuring the crowd-attracting facilities on a street segment, we also introduced a measure to indicate the volume of traffic that a street segment might host (and thus to how many people graffiti is potentially exposed) due to its position in the street network of the city center of Ghent. This measure is called "betweenness," a network centrality metric. Betweenness centrality quantifies the number of times a street segment is part of the shortest paths between two locations in a network. It serves as a proxy for the level of traffic a street segment is likely to experience (Birks & Davies, 2017).

Past studies, including those conducted by Davies and Johnson (2015), have successfully used this metric to estimate traffic volume and the potential for surveillance provided by the presence of passers-by. By employing betweenness, we not only align our research with

previous research but we also present a straightforward alternative measure for evaluating the potential accessibility of a location. This measure can be easily calculated from a digitized city map, thereby avoiding the need for additional expensive data collection efforts associated with SSO. Consequently, betweenness[2] can be applied in any study area with a digitized street map.

Statistical model

In line with the rational choice perspective and consistent with the extant location choice literature on offending (see Ruiter, 2017), we used the discrete choice model to examine our hypotheses by estimating the location preferences of graffiti writers. Specifically, we applied the conditional logit model, which is part of the discrete choice model family and is derived from the Random Utility Maximization (RUM) theory (Bernasco, 2023). RUM theory states that when actors are faced with a choice from a set of alternatives, they will choose the alternative that maximizes their expected utility. Utility, in this context, is the overall level of satisfaction obtained by weighing the costs and benefits associated with all available alternatives (McFadden, 1973)[3].

In the conditional logit model[4], the probability that an actor chooses a particular alternative is estimated as a function of the attributes of that alternative relative to those of all other alternatives. These estimates are usually presented as odds ratios, which indicate the effect of a one-unit increase in an alternative's attribute on the odds of an actor choosing that alternative. For example, in the context of graffiti writers choosing a street segment for graffiti painting, an odds ratio of 2 for the attribute "school present" would imply that the odds of graffiti writers choosing a street segment with a school are twice as high as the odds of them choosing a street segment without a school. For more detailed information on the application of this approach in crime location choice studies (see Bernasco, 2023).

Results

We estimated two separate conditional logit models, as detailed in Table 2. Both models included controls for the surface area and the type of street segment (intersection, bridge, or regular segment). Model 1 included betweenness network centrality as a generic measure of exposure, while Model 2 went further by including specific separate factors hypothesized to measure exposure or deterrence. The distinction between the predictor variables in both models is that those in Model 1 can be established solely based on a digital street network map, while those in Model 2 require additional measurements obtained from systematic social observation. If both models generated similar predictions, Model 1 might be preferred for its parsimony and cost-effectiveness as it relies solely on readily available digital map data. However, Model 2 exhibited the lowest Akaike Information Criterion (AIC) value (28,169.993), indicating its superior effectiveness in predicting graffiti writers' street segment choices.

Table 2: Conditional logit model for graffiti in street segments

	Model 1			**Model 2**		
	Odds	**95% CI**		**Odds**	**95% CI**	
	Ratio	**lower**	**upper**	**Ratio**	**lower**	**upper**
Area (10m2)	1.010***	1.009	1.011	1.007***	1.006	1.008
Segment type						
Bridge (reference)	1	1	1	1	1	1
Intersection	0.499***	0.454	0.547	0.455***	0.414	0.500
Street segment	0.614***	0.560	0.673	0.556***	0.506	0.611
Betweenness	1.145***	1.128	1.162	1.161***	1.144	1.179
Bars				1.065***	1.038	1.093
Night shops				1.302***	1.205	1.407
Night clubs				1.084***	1.056	1.112
Restaurants				1.058***	1.041	1.076
Shops				1.034***	1.027	1.041
Schools				1.235***	1.208	1.262
Residences (10 units)				1.034***	1.019	1.050
Trees along the street				0.990***	0.986	0.993
AIC	28910.877			28169.993		

*** $p < 0.01$

We base our interpretation of the results in Model 2 on the odds ratio, representing the effects that predictor variables have on the odds of a street segment being chosen by graffiti writers. The findings show that for every additional bar in a segment, the odds of it being chosen by graffiti writers increase by 6.5% (OR = 1.065, $p < 0.01$). Similarly, adding another night shop in a segment increases the selection odds by 30.2% (OR = 1.302, $p < 0.01$). Findings also indicate that the presence of each additional nightclub, restaurant, and school in a segment increases the odds of selection by 8.4% (OR = 1.084, $p < 0.01$), 5.8% (OR = 1.058, $p < 0.01$), and, 23.5% (OR = 1.235, $p < 0.01$), respectively. Moreover, an increase of 10 residential units in a segment escalates its odds of being chosen by 3.4% (OR = 1.034 $p < 0.01$). The presence of one additional tree along the street slightly decreases the odds by 1% (OR = 0.990, $p < 0.01$).

Regarding the standardized measure of street network centrality, a rise of 1 standard deviation of betweenness increases the odds of selection by 16.1% (OR = 1.161, $p < 0.01$), emphasizing graffiti writers' preference for street segments that connect other streets, even after accounting for other street segment attributes.

As to the controls, street segment surface size has a positive effect: a $10m^2$ size increase is associated with a 0.7% (OR = 1.007, $p < 0.01$) increase in the odds of being selected. The three types of street segments also display differences, with intersections and regular street segments both being less preferred than bridges, decreasing the selection odds by 524.4% (OR = 0.455, $p < 0.01$) and 44.4% (OR = 0.556, $p < 0.01$), respectively.

Discussion

In this study, we investigated the factors that influence the location choice of graffiti writers, using the rational choice perspective (RCP) and spot theory as a theoretical framework and

the discrete spatial choice model as a technique to assess graffiti writers' preferences for specific street segment characteristics. RCP posits that offenders weigh the potential benefits and risks of their actions to maximize their utility. Applying graffiti writing means selecting locations that maximize exposure while managing the potential risk. Spot theory further complements this by suggesting that graffiti writers select locations based on visibility, audience, risk, and the cultural significance of the spot.

Our research aimed to uncover the factors that motivate graffiti writers to choose certain places, with a particular focus on the role of exposure. The findings suggest that graffiti writers prefer vibrant and busy areas with exposure potential, often characterized by the presence of establishments like bars and restaurants that could attract a large number of visitors. These preferences highlight the importance of exposure and align with utility maximization drawn from the rational choice perspective and the emphasis on visibility from spot theory.

The findings support our hypothesis that graffiti writers prefer locations with increased potential for exposure. This tendency is evident from the positive association with the presence of bars (OR = 1.065, $p < 0.01$), night shops (OR = 1.302, $p < 0.01$), night clubs (OR = 1.084, $p < 0.01$), restaurants (OR = 1.058, $p < 0.01$), shops (OR = 1.034, $p < 0.01$), and residential units (OR = 1.034, $p < 0.01$). This preference mirrors earlier qualitative studies (McDonald, 2001; Van Loon, 2014) highlighting graffiti writers' preference for vibrant hubs. This might maximize the exposure and recognition of their work, which are believed to be key values in the graffiti subculture (Halsey & Young, 2002). These urban spaces, replete with social activities and public presence, offer graffiti writers the desired exposure and audience engagement essential for their cultural expression and subcultural recognition.

Furthermore, this trend is indicative of a broader socio-cultural function of graffiti. As noted in studies by Walker & Schuurman (2015) and Megler et al. (2011), graffiti is not merely an act of vandalism but a complex social phenomenon that interacts with urban spaces. The choice of locations with high pedestrian traffic and public exposure suggests that graffiti is a form of communication through which writers interact with and respond to their urban environment. This interaction can be observed in the way graffiti often converges around areas symbolic of urban culture and lifestyle, such as bars, nightclubs, and commercial hubs.

Our findings show that instances of graffiti increase with the number of residential units. Street segments with more residential units could offer greater exposure to graffiti, aligning with the writers' motivation for visibility and recognition. The presence of schools also emerged as a significant factor in increasing the likelihood of graffiti occurrence. This aligns with the trend of graffiti culture being associated with youth involvement (Halsey & Young, 2002; Lasley, 1995; Van Loon, 2014). Our data indicate that street segments with schools on are preferred for graffiti writing. This suggests that graffiti writers may not only be motivated by exposure, but may also seek to connect with peer groups within their subculture. In this regard, schools represent fertile grounds for graffiti due to their high exposure and the opportunities they present for connecting with peer groups within the graffiti subculture and potential activity nodes for active graffiti writers.

Graffiti writers are likely to select targets within their "awareness space" (P. J. Brantingham & Brantingham, 2017). In particular, students may find their schools to be spaces they frequently encounter and are familiar with. This familiarity could enable them to get to these locations easily and help them assess graffiti opportunities. By selecting such familiar locations, writers get to see their work regularly and ensure their graffiti is seen and recognized by their friends and peers. This may highlight their motivation to achieve maximum exposure and recognition within their immediate social group.

Further, the presence of trees in a street segment slightly decreases the likelihood of that segment being chosen for graffiti. Each additional tree along the street reduces the odds. This finding confirms prior work suggesting that a higher number of trees in a location correlates with fewer instances of graffiti (Ksongin, 2020). This could be due to two possible reasons. First, in certain contexts, such as Amsterdam and Melbourne, studies have found that graffiti writers tend to respect greener, aesthetically pleasing areas, possibly reflecting a code of ethics within the graffiti subculture (Halsey and Young, 2006; Van Loon, 2014). For example, Van Loon (2014) identified a tendency among graffiti writers in Amsterdam to respect spaces perceived as valuable or integral to community identity, such as privately owned objects, monuments, cemeteries, and religious objects, pointing to a deeper engagement with the urban environment beyond mere artistic expression. However, it is important to note that this behavior may not be observed universally, as graffiti writers in other regions might not follow the same patterns. Second, reduced visibility due to tree foliage may be a key factor in making location less appealing for graffiti writers because it reduces the exposure of their work (Mansfield, 2022).

Our analysis not only identified preferred graffiti locations but also sheds light on the positions of these locations in the urban street network. A significant finding in our study is the positive correlation between graffiti location choices and street network centrality. Specifically, the positive relation between a street segment's betweenness and its selection for graffiti highlights graffiti writers' choice of central, well-connected locations. Such areas offer exposure and accessibility, aligning with the writers' goal of maximizing exposure for their art (Van Loon, 2014).

Moreover, the functional type of street segment played a role in graffiti location choice. Compared to bridges, intersections and regular street segments were less preferred by graffiti writers. This could be attributed to several factors that make bridges particularly appealing

for graffiti. Bridges offer high exposure due to their size and prominence in urban landscapes. They are often central structures in a city, catching the attention of a large audience.

Additionally, bridges could provide a larger, uninterrupted canvas than regular street segments and intersections, allowing for more elaborate and sizable works. Moreover, the locations and structural designs of many bridges provide a certain level of privacy and reduced risk of detection for graffiti writers during the act. This aspect, combined with the potential for high exposure, makes them a choice for graffiti artists who seek to balance the impact of their work with the practicalities of execution. Furthermore, Ferrell and Weide (2010) note that graffiti writers have two intended audiences: other graffiti writers and the general public. They explain that graffiti writers seek recognition within their community, often choosing secluded spots known primarily to other graffiti writers, such as urban landscapes like river washes, areas beneath bridges and freeways, along abandoned train tracks, in abandoned buildings, and down tunnels. This dual motivation helps explain why bridges are particularly appealing; they offer high visibility and prominence, making them attractive locations for graffiti writers aiming to balance the impact of their work within both the subculture and the general public.

In contrast, regular street segments and intersections do not typically offer the same level of exposure and uninterrupted space as bridges. These areas are often actively monitored and cleaned, increasing the likelihood of graffiti removal. As such, graffiti writers may perceive these locations as less desirable due to their work's increased risk and reduced longevity. The distinction in location preferences among graffiti writers underscores their strategic decision-making process. They opt for places that not only provide a canvas for expression but also align with their goals of exposure, impact, and, to some extent, the preservation of their work.

In summary, the findings of this study support our hypothesis that graffiti writers prefer locations with high exposure. This preference aligns well with the theoretical framework of the rational choice perspective and spot theory. Within the study context, graffiti writers make strategic choices to place their art in areas where it will increase the likelihood of exposure and thus visibility and ultimately impact.

Limitations

While our study offers insights into the spatial preferences of graffiti writers, it has some limitations. First, our observations and conclusions are derived from a specific urban context. Since the nature of graffiti and public perceptions towards it can vary in different urban environments, the behaviors of graffiti writers may differ as well. Thus, consideration should be taken when generalizing these findings to broader or different contexts.

Second, we have not observed graffiti along railway tracks or on trains and in locations that were accessible and known only to graffiti writers. This exclusion limits our understanding of graffiti in these specific areas, which might exhibit different patterns and motivations.

Third, while our study primarily examines the roles of exposure in guiding graffiti placement, we acknowledge that these factors may not encompass the full spectrum of motivations for graffiti writers. Although we quantify variables tied to exposure, our research does not capture the comprehensive array of factors or the complete utility framework that graffiti writers might consider. Thus, readers should be aware that other unquantified motivations and situationally dependent determinants, such as competition for space (Austin, 2016), rapid removal (Haworth et al., 2013), variability in penalties (Ferrell, 1995; Iveson, 2010), and tolerance towards graffiti (Megler et al., 2014), might be at play. However, our data does not allow for such exploration.

Finally, in our effort to maintain the consistency of our research, we found it necessary to exclude certain variables from our analysis due to their failure to meet the required inter-rater reliability threshold ($K\alpha < 0.60$). While this exclusion boosts the reliability of our study, it simultaneously restricts the breadth of variables considered in the model.

Future research

Future research could delve into other aspects of graffiti location choice and could include cross-cultural studies to understand how preferences vary by context and are influenced by cultural and societal factors. Qualitative research methods, like interviews and in-situ observations, could provide deeper insights into writers' motivations. The relationship between urban planning, law enforcement strategies, graffiti removal, and graffiti location choices could also be investigated.

In the digital age, where social media offers exposure, studying how this influences graffiti writers compared to traditional methods could reveal shifts in their motivations. Additionally, exploring tolerance and its correlation with graffiti incidents can provide insights into social acceptance and its influence on location choice. Further research could consider different graffiti types, examining how style and content influence location choices. Competitive dynamics among writers and their quest for space and recognition could also be studied.

Conclusion

In conclusion, we contribute to the existing literature on crime location choice by investigating the spatial distribution of the expressive offense of graffiti writing. Using an in-person systematic social observation (SSO) method enhances the validity and reliability of our findings by capturing a comprehensive view of graffiti incidents in the city center than hitherto considered in studies addressing spatial patterns of graffiti writing. Employing undergraduate students for observational data collection, a method also utilized in a few other

studies (Bloch, 2020a; Dmello & Kras, 2021), we contribute to their academic development by providing opportunities to apply classroom learning in the field. Dmello & Kras (2021) reveal that involving students in research empowers them to challenge traditional modes of knowledge production and equips them with practical skills and experiences that extend beyond the classroom.

By exploring graffiti writers' location choices, this study contributes to the understanding of the spatial decision-making of graffiti, particularly concerning graffiti management and policy development. Our findings highlight a preference by graffiti writers for locations with high exposure, such as locations with more crowd-attracting facilities. This underlines the importance of considering these locations in urban planning and graffiti management strategies. For example, when providing graffiti writers with legal graffiti opportunities, it is important that such opportunities engage with the need of graffiti writers to expose their work to large audiences. Urban planners and policymakers should also consider high-exposure locations in urban planning and graffiti management strategies.

In recognizing the insights offered by our study, it is important to highlight some of the theoretical implications. While graffiti might be perceived as less problematic than other crime types, its analysis provides a valuable lens for understanding criminogenic spatial decision-making in urban spaces. This research not only supports the application of rational choice perspective to expressive offenses like graffiti but also advances our comprehension of how individuals interact with and respond to their urban environments.

Footnotes

1. Data and scripts utilized for this analysis are available on https://github.com/KKural/SSO_graffiti.

2. We applied a 1000-meter buffer outside the study area while calculating betweenness to avoid the edge effect.

3. When all alternatives are available to all decision-makers (e.g. when in principle, all street segments can be used for graffiti by each graffiti writer, which we assume is the case in our analysis) and when their values do not vary across decision makers, the conditional logit model is mathematically equivalent to a Poisson model estimated on aggregated data (Guimarães, 2003; Schmidheiny & Brülhart, 2011). We used the Poisson model implementation because it is computationally easier to estimate. Because the results are equal to those of a conditional logit implementation, our interpretation of the model estimates follows random utility maximization theory.

4. We computed generalized variance inflation factors (GVIFs) to assess multicollinearity among the independent variables in the models. GVIFs > 10 suggest severe multicollinearity. No GVIFs > 1.53 were observed, indicating that multicollinearity is of no concern.

References

Austin, J. A. (2016). From the city walls to ‘Clean Trains’ Graffiti in New York City, 1969-1990. In J. I. Ross (Ed.), *Routledge handbook of graffiti and street art* (pp. 223–233). Routledge.

Bennett, T., & Wright, R. (1984). *Burglars on burglary: Prevention and the offender*. Gower.

Bernasco, W. (2010). A Sentimental Journey To Crime: Effects of Residential History on Crime Location Choice. *Criminology*, *48*(2), 389–416. https://doi.org/10.1111/j.1745-9125.2010.00190.x

Bernasco, W. (2023). Discrete Spatial Choice Models. In E. R. Groff & C. P. Haberman (Eds.), *Understanding crime and place: A methods handbook* (pp. 275–286). Temple University Press.

Bernasco, W., & Block, R. (2009). Where offenders choose to attack: A discrete choice model of robberies in Chicago. *American Society of Criminology*, *47*, 1–38. https://doi.org/10.1111/j.1745-9125.2009.00140.x.

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), 376–408. https://doi.org/10.1177/1043986215608535

Bernasco, W., & Luykx, F. (2003). Effects Of Attractiveness, Opportunity And Accessibility To Burglars On Residential Burglary Rates Of Urban Neighborhoods. *Criminology*, *41*(3), 981–1002. https://doi.org/10.1111/j.1745-9125.2003.tb01011.x

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

Birks, D., & Davies, T. (2017). Street Network Structure and Crime Risk: An Agent-Based Investigation of the Encounter and Enclosure Hypotheses: Street Network Structure and Crime Risk. *Criminology*, *55*(4), 900–937. https://doi.org/10.1111/1745-9125.12163

Bloch, S. (2018). Place-Based Elicitation: Interviewing Graffiti Writers at the Scene of the Crime. *JOURNAL OF CONTEMPORARY ETHNOGRAPHY*, *47*(2), 171–198. https://doi.org/10.1177/0891241616639640

Bloch, S. (2019). Painting Insurgent Artscapes. In T. Banerjee & A. Loukaitou-Sideris (Eds.), *The New Companion to Urban Design* (pp. 649–660). Routledge, Taylor and Francis Group.

Bloch, S. (2020a). An On-the-Ground Challenge to Uses of Spatial Big Data in Assessing Neighborhood Character. *Geographical Review*, *110*(1–2), 210–223. https://doi.org/10.1111/gere.12357

Bloch, S. (2020b). Broken Windows Ideology and the (Mis)Reading of Graffiti. *CRITICAL CRIMINOLOGY*, *28*(4), 703–720. https://doi.org/10.1007/s10612-019-09444-w

Block, R., & Davis, S. (1996). The environs of rapid transit stations: A focus for street crime or just another risky place? In R. V. Clarke (Ed.), *Preventing Mass Transit Crime*. Criminal Justice Press.

Brantingham, P. J., & Brantingham, P. L. (2017). The geometry of crime and crime pattern theory. In R. Wortley & M. Townsley (Eds.), *Environmental Criminology and Crime Analysis* (Second Edition). Routledge.

Brantingham, P. L., & Brantingham, P. J. (1995). Crime Generators and Crime Attractor. *European Journal on Criminal Policy and Research*. https://www.researchgate.net/publication/321478569

Campos, R. (2013). Graffiti writer as superhero. *European Journal of Cultural Studies*, *16*(2), 155–170. https://doi.org/10.1177/1367549412467177

Cornish, D. B., & Clarke, R. V. (1976). Introduction. In R. V. Clarke & D. B. Cornish (Eds.), *The Reasoning Criminal: Rational Choice Perspectives on Offending* (1st ed., pp. 1–16). Springer. https://doi.org/10.4324/9781315134482

Cornish, D. B., & Clarke, R. V. (1986). *The Reasoning Criminal: Rational Choice Perspectives on Offending*. Springer.

Cresswell, T. (1992). The Crucial 'Where' of Graffiti: A Geographical Analysis of Reactions to Graffiti in New York. *Environment and Planning D: Society and Space*, *10*(3), 329–344. https://doi.org/10.1068/d100329

Dar, Aneliese. K. (2013). *Identifying with the graffiti subculture: The impact of entering and exiting the graffiti subculture on the social identities of graffiti writers* [The University of North Carolina at Greensboro (UNCG)]. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjt1ZGQq8__AhXYgv0HHTDiAzgQFnoECAwQAQ&url=https%3A%2F%2Fcore.ac.uk%2Fdownload%2Fpdf%2F345078925.pdf&usg=AOvVaw05YzeOWL8yCUxuYLkTQG-l&opi=89978449

Davies, T., & Johnson, S. D. (2015). Examining the Relationship Between Road Structure and Burglary Risk Via Quantitative Network Analysis. *Journal of Quantitative Criminology*, *31*(3), 481–507. https://doi.org/10.1007/s10940-014-9235-4

Dmello, J. R., & Kras, K. R. (2021). Photovoice as a Research Technique for Student Learning and Empowerment: A Case Study from a South Texas Border Town.

Journal of Criminal Justice Education, *32*(4), 513–536. https://doi.org/10.1080/10511253.2021.1921231

Ferrell, J. (1995). Urban Graffiti: Crime, Control, and Resistance. *Youth & Society*, *27*(1), 73–92. https://doi.org/10.1177/0044118X95027001005

Ferrell, J. (1996). *Crimes of style: Urban graffiti and the politics of criminality*. Northeastern University Press.

Ferrell, J., & Weide, R. D. (2010). Spot theory. *City*, *14*(1–2), 48–62. https://doi.org/10.1080/13604810903525157

Groff, E. R., Weisburd, D., & Yang. (2010). Is it Important to Examine Crime Trends at a Local 'Micro' Level?: A Longitudinal Analysis of Street to Street Variability in Crime Trajectories. *Journal of Quantitative Criminology*, *26*(1), 7–32. https://doi.org/10.1007/s10940-009-9081-y

Halsey, M., & Young, A. (2002). The Meanings of Graffiti and Municipal Administration. *Australian & New Zealand Journal of Criminology*, *35*(2), 165–186. https://doi.org/10.1375/acri.35.2.165

Halsey, M., & Young, A. (2006). Our desires are ungovernable': Writing graffiti in urban space. *Theoretical Criminology*, *10*(3), 275–306. https://doi.org/10.1177/1362480606065908

Haworth, B., Bruce, E., & Iveson, K. (2013). Spatio-temporal analysis of graffiti occurrence in an inner-city urban environment. *Applied Geography*, *38*, 53–63. https://doi.org/10.1016/j.apgeog.2012.10.002

Iveson, K. (2007). *Publics and the city*. Blackwell Pub.

Iveson, K. (2010). The wars on graffiti and the new military urbanism. *City*, *14*(1–2), 115–134. https://doi.org/10.1080/13604810903545783

Kelling, G. L., & Wilson, J. Q. (1982). Broken windows. *Atlantic Monthly*, *249*(3), 29–38.

Kindynis, T. (2018). Bomb Alert: Graffiti Writing and Urban Space in London. *The British Journal of Criminology*, *58*(3), 511–528. https://doi.org/10.1093/bjc/azx040

Kramer, R. (2010). Painting with permission: Legal graffiti in New York City. *ETHNOGRAPHY*, *11*(2), 235–253. https://doi.org/10.1177/1466138109339122

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology* (2nd ed). Sage.

Ksongin. (2020, August 18). *Planting a tree to stop graffiti* [Maveryx Community]. https://community.alteryx.com/t5/Data-Science/Planting-a-Tree-to-Stop-Graffiti/ba-p/556166

Langton, S. H., & Steenbeek, W. (2017). Residential burglary target selection: An analysis at the property-level using Google Street View. *Applied Geography*, *86*, 292–299. https://doi.org/10.1016/j.apgeog.2017.06.014

Lasley, J. R. (1995). New writing on the wall: Exploring the middle-class graffiti writing subculture. *Deviant Behavior*, *16*(2), 151–167. https://doi.org/10.1080/01639625.1995.9967994

Mansfield, I. (2022, July 13). *Network Rail planting trees to reduce graffiti* [IanVisits]. https://www.ianvisits.co.uk/articles/network-rail-planting-trees-to-reduce-graffiti-55984/

McAuliffe, C. (2012). Graffiti or Street Art? Negotiating the Moral Geographies of the Creative City. *Journal of Urban Affairs*, *34*(2), 189–206. https://doi.org/10.1111/j.1467-9906.2012.00610.x

McAuliffe, C. (2013). Legal Walls and Professional Paths: The Mobilities of Graffiti Writers in Sydney. *Urban Studies*, *50*(3), 518–537. https://doi.org/10.1177/0042098012468894

McDonald, N. (2001). *The graffiti subculture: Youth, masculinity and identity in London and New York*. Palgrave Macmillan.

McFadden, Daniel. L. (1973). Conditional Logit Analysis of Qualitative Choice Behavior'. In P. Zarembka (Ed.), *Frontiers in Econometrics* (pp. 105-142-105–142). Academic Press. https://doi.org/10.1108/eb028592

Megler, V., Banis, D., & Chang, H. (2014). Spatial analysis of graffiti in San Francisco. *Applied Geography*, *54*, 63–73. https://doi.org/10.1016/j.apgeog.2014.06.031

Megler, V., Snodgrass, J., & Blackmore, D. (2011). *Patterns of Spatial Distribution for Reported Graffiti in San Francisco*.

Nee, C., & Taylor, M. (2000). Examining burglars' target selection: Interview, experiment or ethnomethodology? *Psychology, Crime & Law*, *6*(1), 45–59. https://doi.org/10.1080/10683160008410831

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, *84*(3), 231–259. https://doi.org/10.1037/0033-295X.84.3.231

Ruiter, S. (2017). Crime location choice: State of the art and avenues for future research. In W. Bernasco, J.-L. van Gelder, & H. Elffers (Eds.), *The Oxford Handbook of Offender Decision Making* (1–June 2018, pp. 398–420). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199338801.013.20

Sampson, R. J., & Raudenbush, S. W. (2004). Seeing Disorder: Neighborhood Stigma and the Social Construction of "Broken Windows". *Social Psychology Quarterly*, *67*(4), 319–342. https://doi.org/10.1177/019027250406700401

Sas, M., Snaphaan, T., Pauwels, L. J. R., Ponnet, K., & Hardyns, W. (2022). Using Systematic Social Observations to Measure Crime Prevention through Environmental Design and Disorder: In-situ Observations, Photographs, and Google Street View

Imagery. *Field Methods*, 1525822X2210747. https://doi.org/10.1177/1525822X221074768

Sherman, L. W., Gartin, P. R., & Buerger, M. E. (1989). Hot Spots of Predatory Crime: Routine Activities and the Criminology of Place. *Criminology*. https://doi.org/10.1111/j.1745-9125.1989.tb00862.x

Smith, L. M., Bertozzi, A. L., Brantingham, Jeffrey. P., Tita, G. E., & Valasik, M. (2012). Adaptation of an ecological territorial model to street gang spatial patterns in Los Angeles. *Discrete & Continuous Dynamical Systems - A*, *32*(9), 3223–3244. https://doi.org/10.3934/dcds.2012.32.3223

Tokuda, E. K., De Arruda, H. F., Comin, C. H., Cesar, R. M., Silva, C. T., & Da F. Costa, L. (2021). Spatial distribution of graffiti types: A complex network approach. *The European Physical Journal B*, *94*(9), 192. https://doi.org/10.1140/epjb/s10051-021-00202-y

Vandeviver, C., & Bernasco, W. (2020). 'Location, Location, Location': Effects of Neighborhood and House Attributes on Burglars' Target Selection. *Journal of Quantitative Criminology*, *36*(4), 779–821. https://doi.org/10.1007/s10940-019-09431-y

Vandeviver, C., Vandaele, S., & Vander Beken, T. (2015). What makes long crime trips worth undertaking Balancing costs and benefits in burglars journey to crime. *British Journal of Criminology*, *55*(2), 399–420. https://doi.org/10.1093/bjc/azu078

Van Loon, J. (2014). "Just writing your name?" An analysis of the spatial behaviour of graffiti writers in Amsterdam. *Belgeo*, *3*. https://doi.org/10.4000/belgeo.13062

Walker, B. B., & Schuurman, N. (2015a). The Pen or the Sword: A Situated Spatial Analysis of Graffiti and Violent Injury in Vancouver, British Columbia. *The Professional Geographer*, *67*(4), 608–619. https://doi.org/10.1080/00330124.2014.970843

Walker, B. B., & Schuurman, N. (2015b). The Pen or the Sword: A Situated Spatial Analysis of Graffiti and Violent Injury in Vancouver, British Columbia. *The Professional Geographer*, *67*(4), 608–619. https://doi.org/10.1080/00330124.2014.970843

Weisburd, D. (2015). The Law Of Crime Concentration And The Criminology Of Place. *Criminology*, *53*(2), 133–157. https://doi.org/10.1111/1745-9125.12070

Weisburd, D., Bushway, S., Lum, C., & Yang, S.-M. (2004). Trajectories of Crime At Places: A Longitudinal Study of Street Segments in The City of Seattle. *Criminology*, *42*(2), 283–322. https://doi.org/10.1111/j.1745-9125.2004.tb00521.x

Wright, R., & Decker, S. H. (1997). *Armed robbers in action: Stickups and street culture*. Northeastern University Press.

Xiao, L., Liu, L., Song, G., Ruiter, S., & Zhou, S. (2018). Journey-to-Crime Distances of Residential Burglars in China Disentangled: Origin and Destination Effects. *ISPRS International Journal of Geo-Information*, *7*(8), 325. https://doi.org/10.3390/ijgi7080325

Appendix 1 - Observation form

A.1. Observer name: _____

A.2. Date of observation (DD-MM): _____

A.3. Observation starting time (HH:MM): _____

A.4. Street name: ____

A.5. Street segment: _____

B. Number of graffiti observed

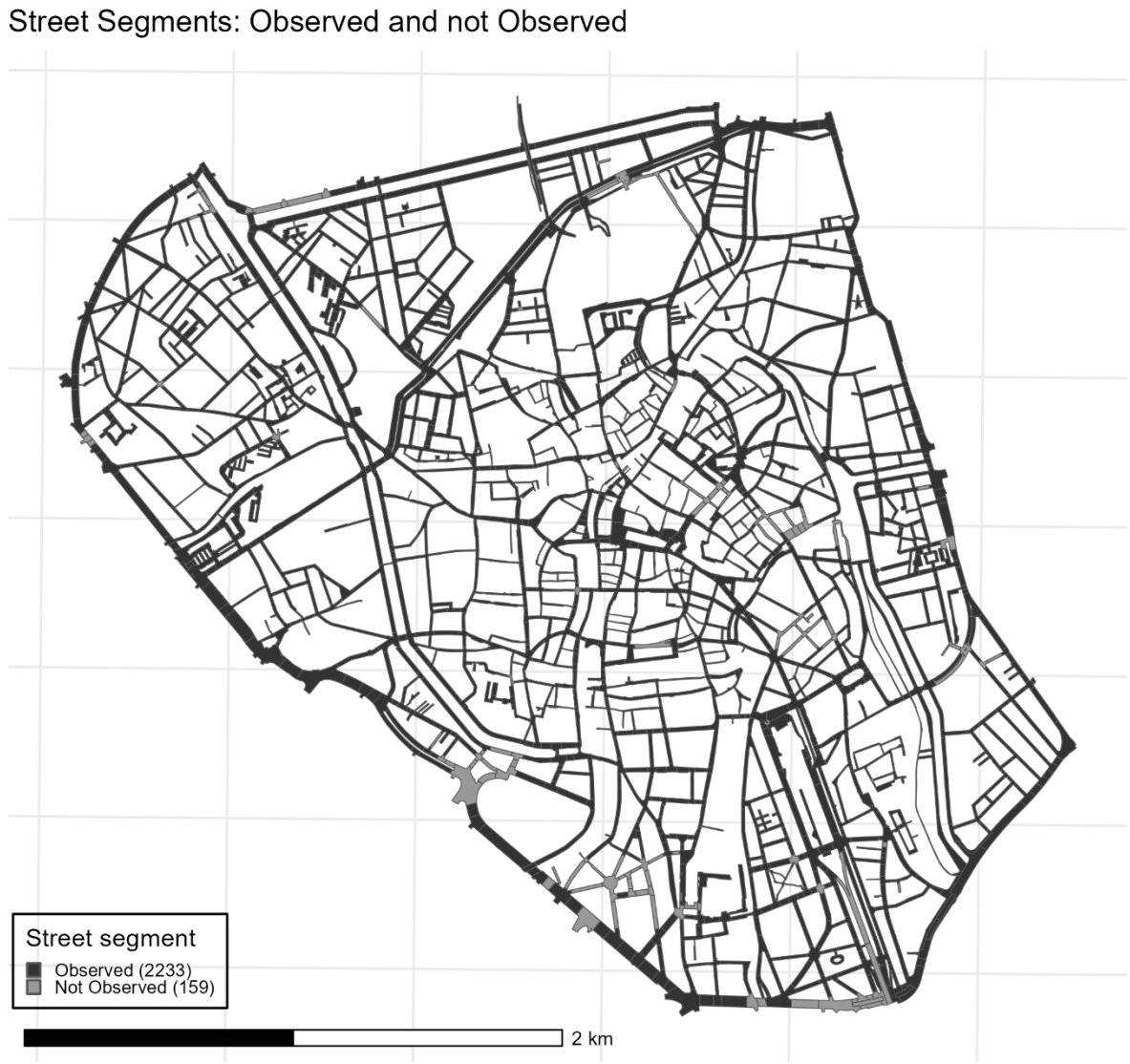
Hash marking	Number

C. Number of facilities present

1: Bars		11: Schools	
2: Shops Selling Liquor		12: Residences	
3: Night shops		13: Surveillance cameras	
4: Nightclubs		14: Trees along the street	
5: Restaurants		15: Public seating	
6: Shops		16: Plants/flower beds	
7: Hotels/hostels		17. Public toilets	
8: Offices		18. Police stations	
9: Public Parking Lots			
10: Bus or tram stops			

D. Comments:

Appendix 2:Street Segment: Observed and not Observed



Appendix 3: Classification of Street Segments