Greenspace and Crime: an Analysis of Greenspace Types, Neighboring Composition and the Temporal Dimensions of Crime

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Abstract

Objectives: There is a growing interest in the relationship between greenspace and crime, yet how particular greenspace types encourage or inhibit the timing and types of greenspace crime remains largely unexplored. Drawing upon recent advances in environmental criminology, we introduce an integrated suite of methods to examine the spatial, temporal and neighborhood dynamics of greenspace crime.

Methods: We collate administrative, census, and crime incident data and employ cluster analysis, circular statistics, and negative binomial regression to examine violent, public nuisance, property, and drug crimes within 4,265 greenspaces across Brisbane, Australia.

Results: We find that greenspace amenities, neighborhood social composition, and the presence of proximate crime generators influence the frequency and timing of greenspace crime.

Conclusions: Our analyses reveal that particular types of greenspaces are more crime prone than others. We argue that this is largely due to the presence of amenities within greenspaces allied with the socio-demographic context of surrounding neighborhoods. We conclude that understanding how these factors influence the behaviors of potential offenders, victims, and guardians is necessary to better understand the spatial distribution of greenspace crime and provide an evidence base for crime prevention initiatives.

Keywords: crime; parks; greenspace; amenity; circular statistics; routine activity theory

Introduction

Greenspaces refer to a range of different public spaces including parks, gardens, greened thoroughfares, sporting fields and ovals. They are an important urban design feature as they provide unique health benefits for local residents that include filtering and sequestering airborne and waterborne toxins (Yang et al. 2005), counter the urban heat island effect (Bowler et al. 2010; Feyisa, Dons, and Meilby 2014; Kong et al. 2014; Li et al. 2012), and assist in the development of immunity responses against allergens (Hanski et al. 2012). Further, greenspaces offer social benefits for local residents by strengthening place attachment (Hur, Nasar, and Chun 2010; Kim and Kaplan 2004; McCunn and Gifford 2014) and social cohesion (Mason 2010).

While the health and social benefits of greenspace are well supported, emerging research indicates that greenspace can also generate crime. Scholars suggest that a greenspace can function as a "social hole", which disrupts community processes necessary for preventing crime (Hipp et al. 2014). However, as greenspaces are morphologically distinct, their ability to generate crime is arguably also distinct. Greenspace types that include hidden areas can create opportunities for consensual crimes such as drug use (Felson and Boba 2010; Hope 1982; Knutsson 1997). Further, greenspace types that attract legitimate greenspace users with playgrounds or sporting features can also create opportunities for predatory crimes such as panhandling or pick pocketing, and more violent predatory offences such as robbery, assault, or rape (Ceccato 2014; Ellickson 1996; Groff and McCord 2012). Last, greenspace can provide opportunities for young people to engage in public nuisance away from adult handlers and guardians (Dinkes, Cataldi, and Lin-Kelly 2007; Felson and Boba 2010; Snyder and Sickmund 2006).

Since greenspaces can be both places of legitimate public recreation as well as places of crime, legitimate users may avoid these areas if problems arise. This avoidance has consequences for individuals, communities, and motivated offenders. Individuals avoiding greenspaces for safety also forgo the previously described associated health and social benefits (Hanski et al. 2012; McCunn and Gifford 2014). In areas where many residents avoid greenspaces, social networks may diminish, which can have a negative influence on positive social processes (Bairner and Shirlow 2003; Habermas 1991; Jorgensen, Ellis, and Ruddell. 2013; Palmer et al. 2005). Last, motivated offenders may become more

inclined to offend when there are fewer residents to intervene. In time these greenspaces develop into gang “set spaces” that further increase crime throughout the surrounding areas (Stodolska, Acevedo, and Shinew 2009; Tita, Cohen, and Engberg 2005).

Despite an emerging interest in crime within greenspace (herein referred to as “greenspace crime”), significant gaps in our understanding of this association remain. First, as Groff and McCord (2012) argue, the literature on greenspace crime is mostly theoretical, and the few empirical studies tend to examine case studies rather than citywide variation in greenspace crime (for exceptions see Anderson and West 2006; Crewe 2001; McCord and Houser 2015). Second, no study compares crime across greenspace types despite the functional and morphological variety of greenspaces. According to crime pattern theory and routine activity theory, greenspaces are “behavior settings” and particular greenspace amenities can be conducive to particular types of crime (Brantingham and Brantingham 1995; Felson and Boba 2010). Thus, the micro-place features ultimately determine *when* and *where* opportunities for crime exist (Clarke 2012). Further, the temporal dynamics of greenspace crime between greenspace types are not well understood. Routine activity theory argues that the lifestyle routines of offenders, victims, and guardians determine *whether*, *where*, and *when* offending occurs (see Felson and Boba 2010; Haberman and Ratcliffe 2015), but the extent to which greenspace crime corresponds to daily or weekly lifestyle routines is unclear. Last, there is insufficient scholarship to reject that greenspace crime may be simply a function of nearby social context and crime generators. Certainly, we know that crime spatially concentrates within poorer neighborhoods (Hirschfield, Bowers, and Brown 1995; Lockwood 2007; Storr 2004), but we also know that poorer neighborhoods generally feature fewer greenspaces with limited amenity variety (Astell-Burt et al. 2014; Crawford et al. 2008; Macintyre, Macdonald, and Ellaway 2008; Timperio et al. 2007). Thus, prior studies could be observing the neighborhood externalities of greenspace crime.

This study addresses these four gaps by spatially integrating crime incident data, census, land use, and local council asset registers into a single dataset. We conduct a cluster analysis to classify greenspaces into a set of mutually exclusive types, and then compare the concentrations of violent, drug, property damage, theft, or public nuisance crimes across each type. Next, we employ circular statistics to compare the temporal dynamics of crime across the greenspace types, and then by crime type. Here we examine whether the greenspace type is associated with *particular timings and types of*

greenspace crime. The final component of our analysis computes a set of negative binomial regression models to establish the extent to which the adjacent social context and presence of proximal crime generators help to explain variations in greenspace crime.

Background

Greenspace as a Behavior Setting

The emergence of environmental criminology marked an important transition from the traditional focus on “whodunit” towards one that examined “wheredunit”. Just as epidemiology labored to protect public health by identifying disease hot spots, environmental criminology labored to protect public safety by identifying crime hotspots (see Sherman, Gartin, and Buerger 1989). For example, Sherman, Gartin, and Buerger (1989) revealed the non-random occurrence of crime across a city with 50 percent of crimes occurring within 3 percent of places. Sherman (1995) offers three hypotheses to explain why crime clusters within places: (1) the *patron* hypothesis that offenders tend to congregate at particular places; (2) the *management* hypothesis that place managers determine who is present and how they behave; and (3) the *behavior settings* hypothesis that places have particular informal rules, configurations of people and objects, and lifestyle roles that influence behavior. Their research finds the greatest support for the behavior settings hypothesis as there is a greater clustering of crime within places than within people (Sherman, Gartin, and Buerger 1989).

According to the theory of behavior settings, places exhibit “standing waves of behavior” that are shaped by both social customs and physical design (Barker 1968). In theory, once these standing waves of behavior coalesce with the lifestyle routines of place visitors, certain behaviors may pass the threshold of public acceptability. For example, bars as behavior settings have extended trading hours and onsite alcohol consumption that lower behavioral inhibitions, and thus shape onsite standing waves of behavior. Simultaneously, the majority of the workforce commence their recreational weekend each Friday afternoon thus they share a lifestyle routine. Combining these two factors may explain why Friday evenings are associated with behavioral excesses that often culminate in violent assaults (Grubesic et al. 2013). However, blaming individual level alcohol consumption for behavioral extremes is overly reductionist given that restaurants are also behavioral settings that share extended trading hours and

onsite alcohol consumption yet lack the same association with violence. Perhaps the distinction is the social customs of restaurants curtail excessive alcohol consumption.

Similarly, routine activity theory includes lifestyle routines but references social encounters rather than places as the focus (Cohen and Felson 1979). From this theoretical perspective, when lifestyle routines determine chance encounters between motivated offenders and suitable targets, offenders will be more likely to act when guardians are absent to minimize risk (Felson and Boba 2010). Lifestyle routines are often cyclic by revolving around diurnal cycles, weekly work schedules, and yearly seasonal changes. As Ratcliffe (2010:15) notes, “As the relevant actors—victims, offenders, guardians, and place managers—adjust their relative densities over time and around specific places, the opportunities for crime shift and coagulate”.

Greenspace Crime

In criminology, scholarship has seriously engaged with the association between particular behavior settings and crime. Schools, shopping centers and licensed venues and their link to crime feature strongly in this literature (Brantingham and Brantingham 1993; Felson and Boba 2010; Nelson, Bromley and Thomas 2001; Snyder and Sickmund 2006). More recently, studies have considered greenspaces as unique settings that may lead to particular types of crime (Crewe 2001; Groff and McCord 2012; McCord and Houser 2015). For the most part research has focused on the link between the presence of greenspace and individuals’ perceived fear of victimization (McCord and Houser 2015) rather than the link between greenspace and actual crime events. From this literature, we know that greenspace is associated with fear of crime (Jorgensen, Ellis, and Ruddell 2013; Kuo and Sullivan 2001; Nasar and Fisher 1993; Sreetheran and Van Den Bosch 2014). Yet greenspace can also enhance feelings of safety and lead to higher levels of place attachment (Arnberger and Eder 2012; Bonaiuto et al. 1999; Fried 1982; Hur, Nasar, and Chun 2010; Lee and Shen 2013). For example, greenspaces generally contain more vegetation than other public settings, which Nasar and Fisher (1993) argue generate fear by potentially concealing predatory offenders that are prospecting for isolated victims; as well as impeding escapes from victimization. In contrast, Kuo and Sullivan’s (2001) findings suggest that vegetation reduces fear, perceived incivilities, and perceived aggression. They attribute these

reductions to vegetation's ability to alleviate mental fatigue, and thus the "psychological precursor to violence" (Kuo and Sullivan 2001: 346).

Jorgensen, Ellis, and Ruddell (2013) argue these contradictory findings are attributable to the omission of physical and social cues—such as hedges that could potentially conceal offenders and uninhabited areas that may ultimately influence research findings. To control for social cues, they provided participants with a series of photos capturing different greenspace micro-settings, and required participants to rate the level of fear evoked from each photo. Interestingly, their findings suggest that both sexes are sensitive to similar environmental cues in the photographs but only female participants are sensitive to the social cues, for example the individuals featured in the greenspace image. While their experiment provides interesting findings, others argue that the relationship between social cues and fear of crime is more complex (Hunter and Baumer 1982). Hunter and Baumer found that unless the person is familiar with someone they encounter or feel connected to the neighborhood, then "each additional person represents another potential offender" (1982, p.127). As such, the experiment may be both heightening and abstracting fear given that the social cues are out of neighborhood context and the people unfamiliar.

These studies are useful in the development of fear of crime reduction strategies to 'design out fear', yet they do not provide an understanding of why greenspace crime might be higher in some places and not others. Few studies of greenspace crime examine greenspaces as crime generators across a city's landscape and fewer still consider the features of greenspaces that might explain why crime concentrates in some greenspaces and not others. Indeed, we are only aware of three studies that examine the greenspace–crime association at the macro level - i.e. across a metropolitan area. Using calls to police in Boston, Crewe (2001) find that crime reports increase with proximity to the Boston South-west Corridor parkland. Groff and McCord (2012) examine greenspace crime specifically within "neighborhood parks" throughout Philadelphia, and find that violent, property, and disorder crime incidents cluster within and around this greenspace type, and that particular greenspace amenities reduce these associations e.g. sporting facilities and lighting within the greenspace, and public transport stops by the perimeter. The authors suggest that sporting amenities may formalize place guardianship by accommodating sporting clubs – e.g. club members and coaches – while amenities such as lighting and public transport stops may extend periods of legitimate visitation thus extending periods of place

guardianship. In a third study, McCord and Houser (2015) examine crime within the “park environs”—the streets adjacent to greenspace—in Philadelphia and Louisville. Their results reveal that violent, property, and disorder crime clusters in the areas surrounding greenspace and that this clustering occurs for the majority of greenspaces in the two cities. Further, the presence of greenspace lighting and the provision of park benches, drinking fountains, and parking lots reduced crime within the park environs (McCord and Houser 2015). This provides evidence that particular greenspace amenities may promote guardianship in both greenspaces and their adjoining streets.

By considering greenspace amenities, the latter two studies lend support for Jacob’s (1961) influential ‘eyes on the street’ theory. This thesis suggests a) that amenity users provide “natural surveillance” within their field of view; and b) “multiuse” settings can attract visitors across multiple periods therefore extending the period of natural surveillance (Jacobs 1961). For example, a greenspace with a playground and a sporting field may attract parents accompanying toddlers in the early afternoon and sporting teams in the late afternoon, thus providing an extended period of natural surveillance through multiple users. In contrast, amenity poor greenspaces may lack the appeal to attract capable guardians but sufficient tree cover to “camouflage” particular criminal activities (Felson and Boba 2010:31). Thus, greenspace amenities can be crime limiting or crime generating depending upon the public behaviors they promote (Brantingham and Brantingham 1995; Groff and McCord 2012).

Greenspace crime case studies shed further light on this. For example, Rhodes and colleagues (2007) find that injecting drug users choose places that afford concealment from interruption, identification, and shaming from friends, family, and colleagues when injecting. Interestingly, reducing hedge heights reduces places of concealment and subsequently reduces drug use within greenspaces (Knutsson 1997). Installing new amenities that increase the “awareness space” of place guardians also reduces drug use (Knutsson 1997; also see Brantingham and Brantingham 1993).

The Temporal and Neighborhood Contexts of Greenspace Crime

Behavior setting theory and routine activity theory highlight the importance of time in understanding the dynamics of crime (Felson and Boba 2010; Haberman and Ratcliffe 2015). By observing the timing of crime, researchers attempt to capture lifestyle *routine activities*—both diurnal and weekly—that account for the temporary movements of individuals between the places where they

may become victimized, protect as guardians, or seize the opportunity to offend (see Felson and Boba 2010). These routines are important for generating site-specific social norms (Barker 1968) that constrain particular behaviors within specific periods of the day or week. An example of this is the consumption of alcohol to specific periods of the day (Ratcliffe 2006).

Ratcliffe (2001) argues that offenders choose particular times of the day to offend. Looking specifically at burglary, he finds that offenders will engage in burglary when they expect to encounter fewer capable guardians. In other words, potential offenders are aware of lifestyle routines and choose when they offend accordingly. Thus, burglars generally target homes during business hours and workplaces during non-business hours. This is consistent with routine activity theory that states that offenders are more likely to offend where there are fewer capable guardians. Brunsdon and Corcoran (2006) also find that temporary population shifts can leave opportunities for property damage and public disorder offences, given that these crimes cluster within the inner city between the hours of 11pm and 4am. This is the same general period that the inner city workforce is more likely to be located elsewhere, and thus absent as place guardians. Similarly, Hermann's (2013) study reveals that when the intended target is a person rather than place, crime will occur within "hot streets"—or points of intersection between offender and victim, and where guardians are momentarily absent. We are unaware of any studies that examine the temporal patterning of greenspace crime, but it is plausible that greenspaces have multiple offending patterns, with each dependent upon whether the intended target is person or property.

In addition to the timing of greenspace crime, we argue that social and physical context surrounding greenspaces will also influence crime. When crime generators are adjacent to other behavior settings, the opportunity for crime is heightened. For example, Groff and Lockwood (2014) observed higher levels of property damage and disorder crime around licensed venues. Similarly, Pridemore and Grubesic (2011) observed higher levels of violent crime around licensed venues. Parker (1993) argues that licensed venues combine two contextual conditions that may influence violence. The first contextual condition is that licensed venues serve alcohol, which can disinhibit individuals that usually refrain from using violence to settle disputes. The second condition is that licensed venues can attract people that enjoy watching violence, and thus actively goad the intoxicated to settle their disputes with violence. Collins (2008) argues that such settings can provide a "moral holiday" for such people

from their usual moral constraints, since they just need to claim they were intoxicated to absolve their amoral behaviors. Since people leaving licensed venues do not leave their intoxication at the door, it may explain the higher levels of violence towards people and property surrounding these licensed venues. Roncek and Lobosco (1983) also observed higher levels of property damage, violence, and burglary near high schools. Felson and Boba (2010) argue that high school attendance spatially concentrates adolescents who have relatively poor inhibitions, and their school day routine provides them with a routine window of opportunity to offend while they return from school and their parents are still within the workplace. Conversely, Groff and McCord (2012) found that greenspaces adjacent to schools had fewer disorder crimes. It is therefore plausible that the proximity of licensed venues and high schools may influence crime in neighboring greenspaces.

In summary, Groff and McCord (2012) argue that while the greenspace crime literature is theoretically rich, it remains evidence poor. This provides opportunities to examine whether greenspace types are distinct behavior settings that influence the types and timings of crime, and whether greenspace crime is, at least in part, a function of the immediate surrounding social and physical context. These opportunities lead us to the following four research questions:

RQ 1: Is greenspace type associated with greenspace crime?

RQ 2: Is greenspace type associated with the timing of greenspace crime?

RQ3: Is the neighborhood social composition associated with greenspace crime?

RQ4: Is the presence of neighborhood crime generators associated with greenspace crime?

Data and Methods

The Research Site

We examine greenspace crime in the Brisbane Statistical Division (BSD). The BSD is located in the south east of the state of Queensland, Australia. Five local councils comprise this region. Collectively these councils provide and maintain 4,265 greenspaces across the region. Greenspace comprises 3% of the BSD and contains 2% of the BSD total crime. Further, a small proportion of these greenspaces account for all observed greenspace crime: violent crime concentrates in 9% of all

greenspace, theft within 17%, drug within 6%, public nuisance within 7%, and property damage within 15% of greenspaces (Figure 1). The Risky Facilities theory points towards the complex and dynamic interactions among offenders, victims, and place guardians to explain this unequal distribution of crime between seemingly homogenous settings (Eck, Clarke, and Guerette 2007). We suggest that the variability of greenspace amenities and spatial context surrounding greenspaces can explain this unequal distribution of greenspace crime.

[Insert Figure 1]

Data Sources, Spatial Integration, and Preparation

We combine five datasets to capture greenspace amenities, crime, and neighborhood context. The combined asset registers from all five local councils provide the park amenities for all BSD greenspace. We procure all information on public transport stops (including bus, train and ferry stops) located within or immediately adjacent to greenspaces from the Translink website (Translink 2015). Combined, these data provide a complete account of greenspace amenities associated greenspace crime, which we employ for classifying greenspace into general types.

Our crime data comes from the Queensland Police Service (QPS 2015). The QPS administer an Application Programming Interface (API) for the public to extract crime data. Using this interface, we extracted the timing and location of all available crime incidents from 1/1/2007 until 12/31/2011 across the BSD. These data provided information on crime types and the timing of crime for all incidents occurring within and adjacent to greenspaces.

The joined Digital Cadaster DataBase (DCDB; Department of Natural Resources and Mines 2011) and the Queensland Valuations And Sales dataset (QVAS; Australian Business Research 2012) provided information at the level of the land parcel. Collectively these data sources provide the spatial boundaries and their associated land use for each land parcel in the BSD. We use these data to identify greenspace. As noted previously, greenspace operationalizations generally comprise public parks, gardens, greened walkways, and nature reserves, sporting fields and ovals. Given that the QVAS database describes one hundred different land use types, we restrict our selection to land use types characterized by “natural ecology” and “public access” (see Burgess, Harrison, and Limb 1988; Comber,

Brunsdon, and Green 2008; Coolen and Meesters 2012; Dinnie, Brown, and Morris 2013; Feyisa, Dons, and Meilby 2014; Lachowycz and Jones 2013). Within QVAS, these particular land use are labelled “sports clubs/facilities”, “sports ground, racecourse, airfield”, and "parks and gardens". Further, we exclude all national and state nature reserves from our selection given that: (1) nature reserve placement is generally unintentional, with the urban form built to accommodate and preserve them; (2) local councils rarely administer nature reserves thus they are less likely to be spatially distributed according minimum policy standards; and (3) visitors generally seek nature reserves to encounter novelty rather than the familiarity sought from neighborhood greenspace. For these reasons we consider national and state parks conceptually distinct from urban greenspaces (Maat and De Vries 2006; Kemperman, Borgers, and Timmermans 2002).

As we argue that crime generators near greenspaces, in particular licensed venues and schools, may influence crime within greenspaces, we use an online registry of Queensland liquor licenses to locate BSD venues that dispense alcohol (Office of Liquor and Gaming Regulation 2015) and the 2012 StreetPro dataset to locate all BSD high schools (Pitney Bowes Insight 2015). Multiple studies suggest that alcohol dispensing venues lower adult inhibitions (Knutsson 1997; Stelzig 2012) and schools spatially concentrate unsupervised and relatively uninhibited adolescents (Felson and Boba 2010; Roncek and Lobosco 1983), which can increase crime with nearby places that include greenspace.

Last, to capture the social composition of neighborhoods surrounding the greenspaces, we employ census data collected and distributed by the 2011 Australian Bureau of Statistics (ABS 2011). We operationalize the surrounding neighborhood context as all Statistical Area Level 1 (SA1) units that are contiguous to each greenspace. In Australia, the SA1 is the smallest available spatial unit provided by the ABS for demographic composition. Each SA1 unit has an average of 162 households and 402 residents, thus it is roughly the equivalent of a US census block group or a UK output area. In our analyses, we spatially overlay the resultant 4,265 greenspace land parcels, 49,180 greenspace amenities, 4,093 SA1 units and 1,219,377 crime incidents to examine the association between greenspace types and crime. We also calculate the Moran’s I of SA1 crime counts to test for the presence of spatial autocorrelation and find that violent ($I = 0.3648$; $p < 0.001$), theft ($I = 0.2198$; $p < 0.001$), drug ($I = 0.4138$; $p < 0.001$), public nuisance ($I = 0.2866$; $p < 0.001$), and property damage (I

=0.3739; $p < 0.001$) crime is positively spatial autocorrelated (across the study area), which suggests that offending is geographically concentrated in particular locales of the BSD.

Greenspace Types

Drawing on the literature (Gehl 2010; Groff and McCord 2012; Henriksen and Tjora 2014), we classify the 25,952 greenspace assets registered across the 4,265 greenspaces in our study site into one of nine theoretically relevant greenspace amenity types (see Appendix I). We then associate these greenspace amenities types with nearby public transport stops, greenspace size and greenspace roundness with a cluster analysis that employs Gower's dissimilarity matrix (1985) and Ward's linkage method (1963) to simultaneously compare the binary and continuous greenspace characteristics. Further, we compare the Calinski and Harabasz' pseudo-f (1974) and Duda and Hart's (1973) pseudo-t index scores of all cluster sets generated with fewer than ten clusters (see Appendix II), and examine the amenities that characterize the clusters (see Table 1) before concluding that the four cluster set provides a qualitatively robust greenspace typology within the BSD context. We also label the clusters "Amenity Rich", "Sit or Play", "Transport", and "Amenity Poor" to reflect these qualitative distinctions, and employ discriminant analysis to evaluate the reliability of our cluster analysis regarding misclassification ($p<0.05$).

[Insert Table 1]

Units of Analysis

We employ two units of analysis throughout this study. Our chi-square and circular t-tests employ greenspace type as the unit of analysis for examining (1) the association between greenspace type and crime type, (2) the daily, and (3) weekly timing of greenspace crime. Since daily and weekly timing has a circular distribution, we recode crime timing as angular units where 0 degrees (functionally equivalent to 360 degrees) is midnight in a daily distribution, and midnight on Sunday in a weekly distribution. Our negative binomial regression analyses employ greenspace as the unit of analysis for examining the social and physical context of greenspace crime.

Dependent Variables

While the QPS crime incident data distinguishes multiple crime types, we examine specifically violent, theft, drug, public nuisance, and property damage since each of these crime types has a theoretical association with greenspaces. Our *violent* crime includes the QPS homicide, assault, and robbery crime incidents; *theft* includes both theft and the handling of stolen goods; *public nuisance* includes good order offences and illegal alcohol consumption; *drug crimes* include consumption and dealing; and *property damage* includes unlawful entry and arson.

Explanatory Variables

When examining the social and physical context of greenspace crime, we employ several explanatory variables coded as follows:

Greenspace Type is coded as a categorical variable where the "amenity poor" greenspace type serves as the reference category. We expect this category to stand apart from other greenspace types by lacking the amenities necessary for attracting place guardians (Groff and McCord 2012).

Crime Timing is coded as the proportion of greenspace crime occurring between 5pm and 5am to examine the nighttime association (see Felson and Poulsen 2003). To observe the weekend association with greenspace crime we use the proportion of greenspace crime occurring between 6pm on Friday and 6am on Monday (see Uittenbogaard and Ceccato 2012). We employ these variables in our negative binomial regression analyses, which we describe below.

Neighborhood Crime rate is the per capita rate of crime incidents within the surrounding neighborhoods of a greenspace (e.g. the SA1s contiguous to the greenspace, which represents our neighborhood context as previously discussed). Since we detected the presence of positive spatial autocorrelation at the SA1 within the BSD, there is the need to account for the geographic concentration of crime in our analytic approach by observing the neighborhood crime rate.

Neighborhood Social Composition includes several variables that are associated with crime in the broader literature, namely: population density, the proportion of adolescents, residential instability, ethnic diversity and income inequality (see Boggess and Hipp 2010; Friedson and Sharkey 2015; Hipp, Tita, and Boggess 2009; Mason et al. 2009; Sampson, Raudenbush and Earls 1997). All these

neighborhood measures are aggregated and coded from the 2011 ABS census data as follows: (1) *population density* divides the neighborhood population by the area of neighborhood (hectares); (2) *adolescents* is the percentage of adolescents (aged fifteen to twenty) within the total population; and (3) *residential instability* is the percentage of residents that lived at their current address for less than five years. Further, (4) ranked *ethnic diversity* employs the Blau's Diversity Index (1977; also, Sampson 1984) using the country of birth as the distinguishing characteristic, and partitions these index scores into deciles to interpret findings. Last, (5) ranked *economic disadvantage* employs principle component factor analysis to calculate an index score from median household income; adult resident proportion unemployed; household proportion living under the poverty line (< $800 that is half the national median), and household proportion headed by a single mother, which is again partitioned into deciles for interpreting findings.

Neighborhood Crime Generators again employs all SA1 contiguous to the greenspace as the neighborhood context, and counts all neighborhood land parcels identified as either (1) *high schools* or (2) *licensed venues* to observe two types of greenspace crime generators.

Analytic Approach

There are three stages to our analytical approach. First, we employ a chi-square analysis to determine whether there is an association between greenspace type and crime type. Second, we employ circular t-tests to determine if crime timing varies significantly between greenspace types or crime types (see, Mardia 1972; Wheeler and Watson 1964), and provide circular plots to visually observe the daily and weekly temporal dynamics of greenspace crime (see, Brunsdon and Corcoran 2006). Last, we compute a negative binomial regression model for each crime type to examine the association between neighborhood context and greenspace crime, and calculate the Moran's *I* of using the residuals and the inverse distance between every greenspace to determine whether the externalities of our models are spatially autocorrelated.

Results

Our first research questions asked whether there is an association between greenspace type and crime type thus our chi-square analysis employs the greenspace type as the unit of analysis. Our results suggest that there is an association ($p<0.001$) with *public nuisance crime* occurring

disproportionately within the “sit or play” and “transport” greenspace types, and property damage crime disproportionately within the “amenity rich” and “amenity poor” greenspace types (Table 2).

[Insert Table 2]

Our second research question asked whether the timing of greenspace crime varies by greenspace type. To compare timings of crime, greenspace type was again the unit of analysis, and we started by employing tests to detect whether each distribution was significantly distinct from a uniform distribution, and followed by testing whether these distributions significantly differed by greenspace type. All daily and weekly timings of crime were significantly different from a uniform distribution (Appendix III). Except for violent crime, the daily timing of crime significantly varied by greenspace type ($p < 0.001$). Likewise, except for property damage crime, the weekly timing of crime significantly varied by greenspace type ($p < 0.01$). We plotted distributions in separate matrices (Figures 2 and 3 respectively) to visualize when this variability occurred. For example, daily around 1pm there was a drug crime increase within the “transport” greenspace type (Figure 2, C3). This is in contrast to a decrease within the “sit or play” greenspace at this same time (Figure 2, B3). This finding suggests that these greenspace types are distinct behavior settings for drug crime. In contrast, the greatest increase in property damage crime was around midnight in all greenspace types, but particularly the “amenity rich” and “sit or play” greenspace types (Figure 2, A5 and B5). This indicates that these greenspace types are similar behavior settings for property damage incidents. Similarly, drug crime increases across the weekend within both the “sit or play” and “transport” greenspace types (Figure 3, B3 and C3) but not within the “amenity rich” greenspace type (Figure 3, A3). We argue this demonstrates that “sit or play” and “transport” greenspace types are similar behavior settings for drug crime on the weekend, yet they are dissimilar behavior settings compared to “amenity rich” greenspace during the same period. These findings provide evidence that greenspace types are distinct behavior settings that influence the timings and types of offending behaviors, and are thus likely to influence the social norms that influence the reporting of offending (Barker 1968; Sherman, Gartin, and Buerger 1989).

Using the same analytic approach, we next compared greenspace crime timing by crime type. Our circular t-test results suggested type of crime significantly varied throughout day and week within all greenspace types ($p < 0.001$). For example, violent crime generally increased around 3pm and

around 9pm within all greenspace types, while property damage crime generally increased later in the evening around midnight (Figure 2). This crime type variation throughout the day and week provides evidence for routine activities theory, which posits that offending occurs during the spatial and temporal intersection of offender and target away from guardians (Felson and Boba 2010). For example, aggressors prospecting for low risk targets may encounter children without adult supervision travelling home from school around 3pm or people alone after dark around 9pm, while vandals prospecting for low risk targets may encounter unguarded greenspace amenities around midnight.

[Insert Figure 2]

[Insert Figure 3]

Our third and final research questions asked whether neighborhood social composition and crime generators are associated with greenspace crime. In these analyses greenspace is our unit of analysis. As our previous analyses demonstrated a relationship between crime timing and greenspace crime, we control for the proportion of crimes that occur at night and the proportion of crimes that occur during the weekend in our analyses. With the “amenity poor” greenspace type as the reference category, we found that the “amenity rich” greenspaces type that accommodates the broadest range of visitor activities was associated with a 349% increase in violent crime (IRR = 4.493; $p < 0.001$; see Appendix IV), 113% increase in theft (IRR = 2.127; $p < 0.001$), 331% increase in drug crime (IRR = 4.309; $p < 0.001$), 347% increase in public nuisance crime (IRR = 4.472; $p < 0.001$), and 328% increase in property damage crime (IRR = 4.280; $p < 0.001$). The “sit or play” greenspace type that accommodates fewer visitor activities was also associated with increased crime but to a lesser degree. For example, this greenspace type was associated with a 92% increase in drug crime (IRR = 1.916; $p < 0.05$), 123% increase in public nuisance crime (IRR = 2.277; $p < 0.05$), and 82% increase in property damage crime (IRR = 1.820; $p < 0.01$). Last, the “transport” greenspace type that lacks amenities other than a public transport stop was once more associated with increased crime. For example, this greenspace type was associated with a 210% increase in violent crime (IRR = 3.096; $p < 0.001$), 129% increase in theft (IRR = 2.294; $p < 0.001$), 160% increase in drug crime (IRR = 2.600; $p < 0.05$), 920% increase in public nuisance crime (IRR = 10.197; $p < 0.001$), and 109% increase in property damage (IRR = 2.092; $p < 0.001$). The timing of crime also influences levels of crime in greenspaces. For example, nighttime was

associated with 3% increase in violent crime (IRR = 1.028; $p < 0.001$), 4% increase in theft (IRR = 1.039; $p < 0.001$), 4% increase in drug crime (IRR = 1.036; $p < 0.001$), 3% increase in public nuisance crime (IRR = 1.030; $p < 0.001$), and 3% increase in property damage crime (IRR = 1.029; $p < 0.001$). Likewise, the weekend was associated with 3% increase in violent crime (IRR = 1.027; $p < 0.001$), 4% increase in theft (IRR = 1.045; $p < 0.001$), 4% increase in drug crime (IRR = 1.038; $p < 0.001$), 4% increase in public nuisance crime (IRR = 1.043; $p < 0.001$), and 3% increase in property damage crime (IRR = 1.027; $p < 0.001$). These findings also suggest that greenspace types are distinct behavior settings.

[Insert Table 3]

Next, we examined the social context of greenspace. Neighborhood theft (IRR = 1.000; $p < 0.01$), drug (IRR = 1.000; $p < 0.001$), and property damage crime (IRR = 1.002; $p < 0.001$) were each associated with greenspace crime but with small effect sizes. Interestingly, each 1% increase in neighborhood adolescents was associated with an 11% reduction in greenspace public nuisance crime (IRR = 0.892; $p < 0.001$). Further, a decile increase in ranked diversity was associated with a 10% reduction in property theft (IRR = 0.901; $p < 0.01$). In contrast, a decile increase in ranked disadvantage was associated with a 26% increase in violence (IRR = 1.262; $p < 0.001$), 12% increase in theft (IRR = 1.121; $p < 0.001$), 13% increase in public nuisance (IRR = 1.133; $p < 0.011$), and 29% increase in property damage (IRR = 1.188; $p < 0.001$). Possible explanations of why disadvantaged neighborhoods have more crime in public places include that they can struggle to attract and maintain the community institutions that often reduce crime (Peterson, Krivo, and Harris 2000), their residents more frequently belong to offending subcultures (Lockwood 2007), and that residents often have greater reliance on public facilities which increases their exposure to victimization (Graif, Gladfelter, and Matthews 2014).

Last, we examined the nearby crime generators. The presence of each school was associated with a 62% increase in violence (IRR = 1.622; $p < 0.001$), 32% increase in theft (IRR = 1.317; $p < 0.001$), 85% increase in public nuisance (IRR = 1.847; $p < 0.01$), and 32% increase in property damage (IRR = 1.316; $p < 0.01$). The presence of each licensed venue was associated with a 1% increase in violent (IRR = 1.014; $p < 0.05$) and property damage crime (IRR = 1.011; $p < 0.01$). While multiple studies suggest that schools (Brantingham and Brantingham 1993; Felson and Boba 2010; Nelson, Bromley and Thomas 2001; Snyder and Sickmund 2006) and licensed venues (Groff and Lockwood 2014;

Grubesic et al. 2013) generate neighborhood crime, our findings specifically examine how they may be offsite crime generators for greenspace crime. Our findings indicate that these specific crime generators spatially concentrate adolescents and intoxicated persons into greenspaces, yet our data do not allow us to determine if members of these groups are victim or offender (Felson and Boba 2010). We concluded by calculating the Moran's I of the model residuals. We found no evidence of spatial autocorrelation for greenspace violent ($I = 0.027$; $p < 0.001$), theft ($I = 0.020$; $p < 0.001$), drug ($I = 0.023$; $p < 0.001$), public nuisance ($I = 0.019$; $p < 0.001$), or property damage crime ($I = 0.021$; $p < 0.001$). The results suggest that the indicators allied with our analytic framework adequately accounted for the spatial processes related to the distribution of greenspace crime.

Discussion and Conclusion

In this paper, we examined the association between greenspace type, crime timing, crime type, and neighborhood context. We find that greenspaces are heterogeneous settings, and this heterogeneity influences both the type and the timings of greenspace crime. Further, our results support several broader theoretical frameworks. For example, Barker's behavior settings theory proposes that amenities and social norms within a setting influence visitor behavior (1968). At least in the Brisbane context, greenspace types represent qualitatively distinct behavior settings, which in turn influence *whether* and *when* greenspace crime occurs. In line with routine activities theory (Felson and Boba 2010), we find that work- and school-day lifestyle routines also influence greenspace crime. In further support of environmental criminology, we also find that the neighboring area is particularly consequential for greenspace crime.

Our results contribute to the extant literature in two important ways. First, we demonstrate that that greenspaces are heterogeneous and greenspace types influence both the timing and the frequency of crime. From our analyses, greenspace types represent distinct behavior settings that are capable of influencing offender and guardian behaviors. Moreover, all greenspace crime was strongly linked to the presence of greenspace amenities. This suggests that amenities attract both offenders and guardians alike, and as a consequence, greenspaces become contested spaces. Second, few studies of greenspace crime have considered the influence of surrounding neighborhoods on greenspace crime (see Groff and McCord 2012 or McCord and Houser 2015 for exceptions). We find that greenspace crime is strongly associated by the neighborhood setting and the routine activity patterns of key

organizations. Equally importantly, the presence of schools in surrounding areas is also associated with higher crime for four of the five crime types we examined. In our sample, crime generally concentrates after 3pm when school children are likely to be least supervised by adults with workday lifestyle routines, and again during the night when most potential guardians with general lifestyle routines are asleep. By demonstrating the spatial externalities of greenspace crime and the link between greenspace crime and routine activities, we are able to explain why similar greenspace types might experience different levels of crime.

Given that greenspace type and location have important implications for greenspace crime, we highlight three important policy implications. First, the 'park-standards' approach that is widely adopted by local councils to ensure that all residents live within a maximum range of a greenspace, and that there is a minimum amount of greenspace per resident (Byrne, Sipe, and Searle 2010) generally excludes specifications concerning the types of greenspace that are required. As we found that greenspace type influences greenspace crime, we conclude that there is generally no regulatory mechanism to determine which urban community receives a relatively safe greenspace type and which receives a relatively criminogenic greenspace type. Further, we find that the "high amenity" greenspace type is associated with more crime, thus retrofitting criminogenic greenspaces with further amenities appears to be an ineffective crime reduction strategy unless the amenities increase guardianship and reporting behaviors. Second, we have demonstrated a limitation of deeming particular greenspace types as 'criminogenic' since we discovered that the strength of these associations varied throughout the day and week. For this reason, we urge planners to consider the daily and weekly lifestyle roles that their greenspace designs will fulfill since this may determine when they are criminogenic. Last, greenspace crime appears sensitive to neighborhood crime rates, neighborhood social composition, and other neighborhood crime generators. This suggests that standardizing greenspace provision across socially distinct neighborhoods is unlikely to produce uniform crime outcomes. For example, our findings suggest that residents of disadvantaged neighborhoods are more likely to encounter violence, thieves, public nuisances, and damaged public property by local councils increasing greenspace provision. Further, positioning greenspace near high schools and licensed venues may create low-risk spaces for motivated offenders to encounter potential victims away from guardians as both go about their daily and weekly lifestyle time-space routines (Brantingham and Brantingham 1993). A more tailored approach is

therefore needed when designing safe neighborhood greenspaces that is sensitive to both the physical and social characteristics of the neighborhood.

While this study advances the greenspace crime literature, there are limitations. We could not directly attribute the greenspace crime reporting to neighborhood residents, which limits how we interpret neighborhood social processes of place guardianship. Increasingly, criminologists are modelling ambient populations (see Andresen 2011; Felson and Boivin 2015) but suitable data was unavailable at the time of our study. Likewise, pervasive computing studies increasingly capture actual time-space flows of ambient populations using cellular network data (see Barabási, González, and Hidalgo 2008; Isaacman et al. 2011) but this data was also unavailable within our study frame. If the availability of these data broadens to the Australian context, and more specifically Brisbane, then it will become possible to revisit this topic. Alternatively, there may be study frames where these data are already available, which affords researchers with new opportunities to greatly expand understandings of how neighborhood guardianship influences greenspace crime.

The environmental burden of greenspace crime was the focus of our study, and we found the association to be more complex than is generally assumed. We found that *whether* and *when* crime occurs depends upon (1) greenspace type, (2) greenspace location, and (3) greenspace social context. Urban researchers, policy makers, and planners must be mindful of these three burdening factors when advocating, provisioning, and designing greenspace. This is necessary to continue to counteract many of the negative impacts of urbanism, without introducing further problems for residents to contend with. This approach will ultimately assist in actualizing Ebenezer Howard's ([1898] 1965) vision of urban settings as places that combine the best aspects of both town and country lifestyles for every urban resident.

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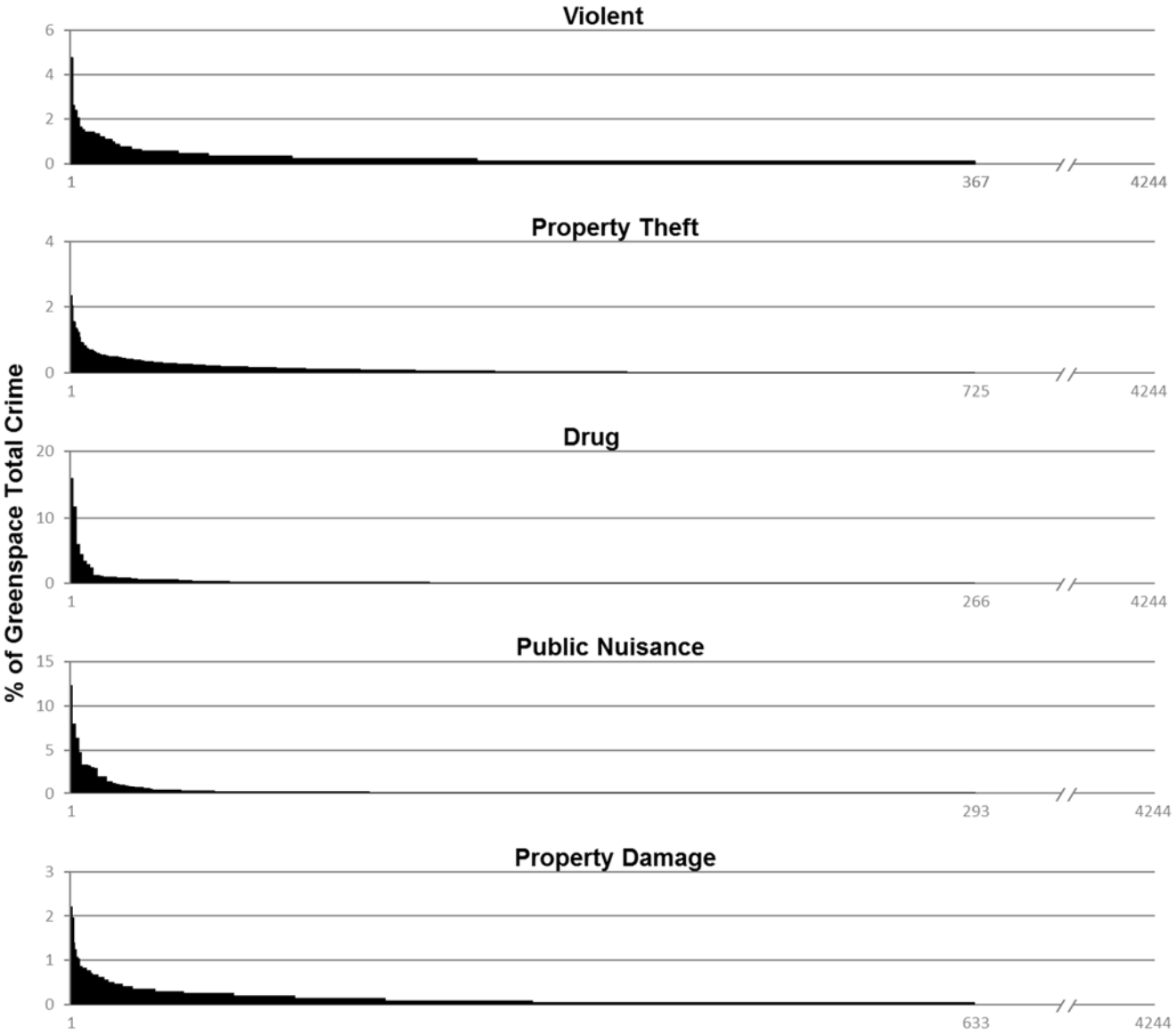

Figure 1. Percent of total greenspace crime by crime type and greenspace

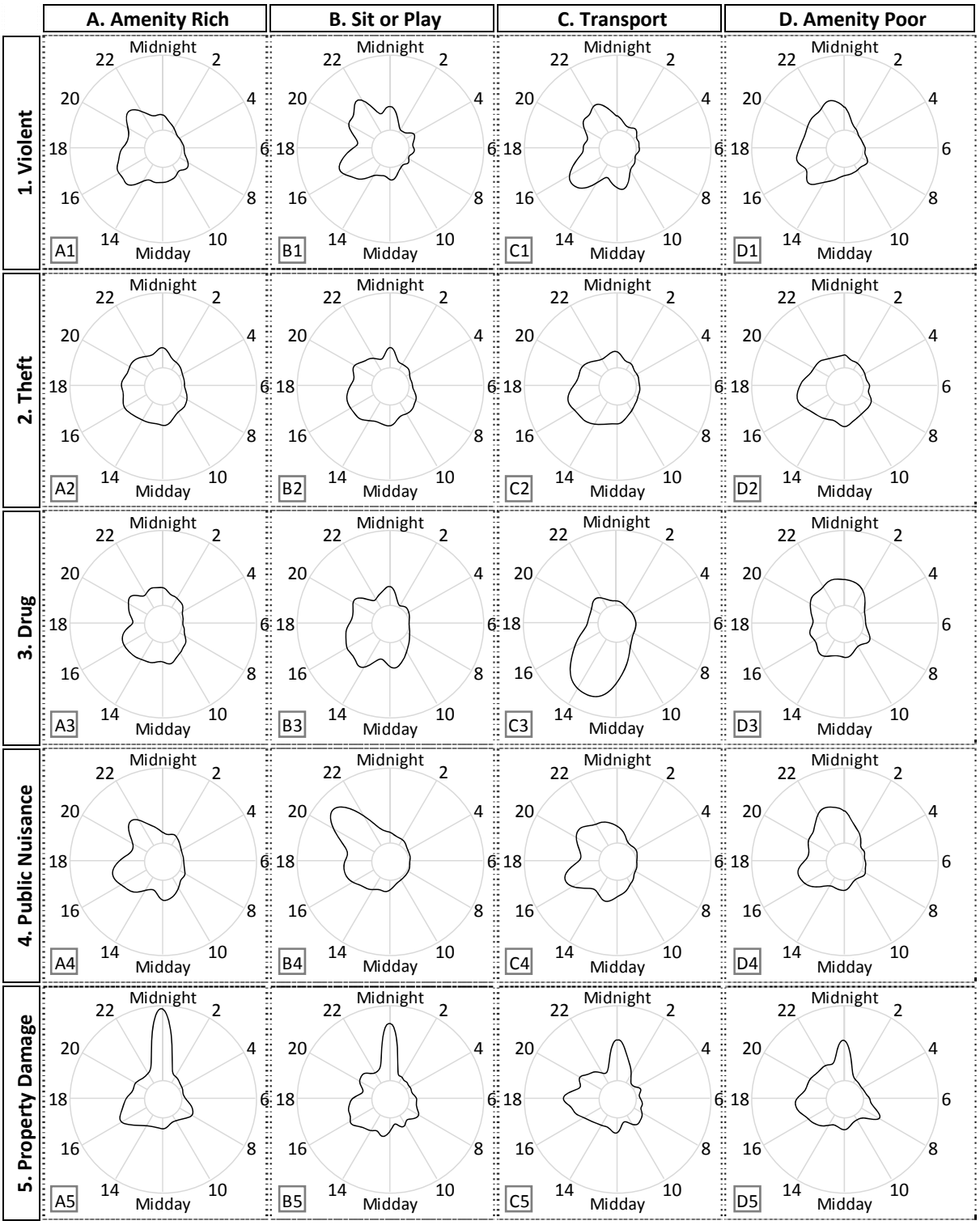

Figure 2. Greenspace type by crime type matrix containing circular plots across a daily period (each segment represents a 2-hour period

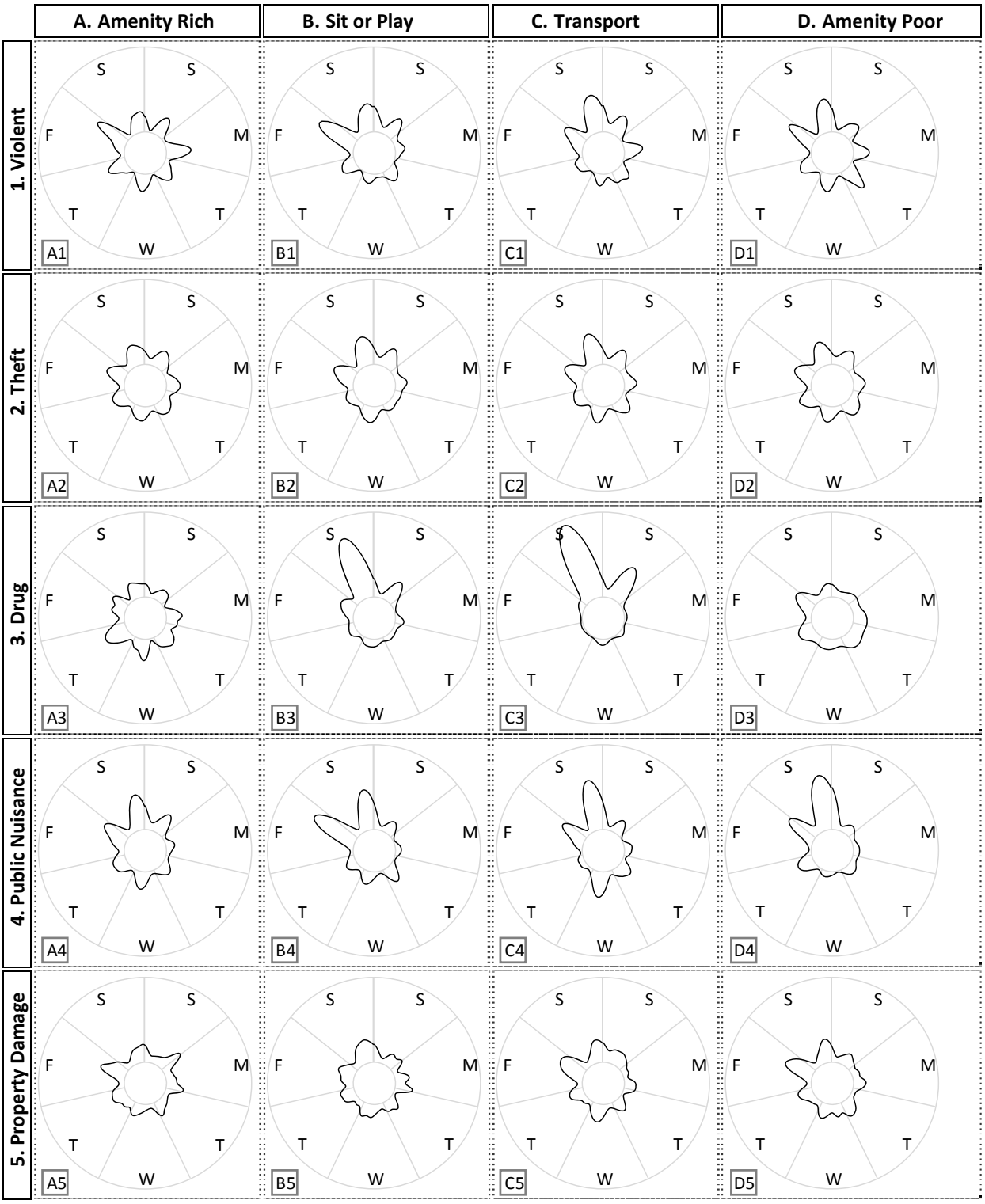

Figure 3 Greenspace type by crime type matrix containing circular plots across a daily period (each segment represents 1 day in the week)

Table 1. Greenspace Types and Amenity Presence.

Cluster Number	**1**	**2**	**3**	**4**	**Total**
Cluster Name	Amenity Rich	Sit or Play	Transport	Amenity Poor	
BBQs & Tables	77%	9%	0%	0%	12%
Buildings	31%	4%	0%	0%	5%
Dog Enclosure	6%	2%	0%	0%	1%
Managers	3%	0%	0%	0%	0%
Formal Sports	51%	9%	0%	0%	9%
Informal Sports	49%	32%	0%	0%	13%
Lights	58%	27%	0%	0%	13%
Playground	87%	49%	0%	0%	21%
Public Transport	26%	18%	100%	0%	13%
Seating	99%	66%	0%	0%	26%
Roundness (mean)	0.50	0.49	0.45	0.46	0.47
Hectares (mean)	5.46	2.66	4.00	3.26	3.49
Total	578	789	257	2,641	4,265

Table 2. Crime Incidence by Crime Type and Greenspace Type

Crime Type	Amenity Rich		Sit or Play		Transport		Amenity Poor	
	n	%	n	%	n	%	n	%
Violent	340	10%	129	7%	167	8%	291	11%
Theft	1,376	42%	616	35%	775	39%	1,237	49%
Drug	319	10%	291	17%	307	15%	166	7%
Public Nuisance	336	10%	460	26%	506	25%	294	12%
Property Damage	880	27%	261	15%	234	12%	560	22%
Total	3,251	100%	1,757	100%	1,989	100%	2,548	100%
Pearson chi2(12) = 683.3457		p < 0.001						

Table 3. Negative Binomial Regression of Crime Counts by Crime Type

	Crime Type:	**Violent**	**Theft**	**Drug**	**Nuisance**	**Damage**
		b	***b***	***b***	***b***	***b***
		(s.e.)	***(s.e.)***	***(s.e.)***	***(s.e.)***	***(s.e.)***
Greenspace	[Amenity Poor Type as the Reference Category]					
	Amenity Rich Type	1.502 ***	0.755 ***	1.461 ***	1.498 ***	1.454 ***
		(0.41)	(0.17)	(0.25)	(0.26)	(0.21)
	Sit or Play Type	0.176	0.190	0.650 *	0.801 *	0.599 **
		(0.24)	(0.16)	(0.31)	(0.32)	(0.19)
	Transport Type	1.130 ***	0.830 ***	0.956 *	2.322 ***	0.738 ***
		(0.31)	(0.22)	(0.40)	(0.57)	(0.20)
Time	Night	0.028 ***	0.039 ***	0.035 ***	0.030 ***	0.029 ***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Weekend	0.026 ***	0.044 ***	0.037 ***	0.042 ***	0.027 ***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Neighborhood	Crime Rate per 1000	-0.001	0.000 **	0.000 ***	-0.000	0.002 ***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Population Density	-0.001	0.006	-0.006	0.009	0.011
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Adolescents	-0.028	-0.030	-0.010	-0.114 ***	-0.019
		(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
	Residential Instability	-0.003	0.002	-0.014	-0.003	-0.006
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Ethnic Diversity	-0.026	-0.004	0.017	0.020	-0.105 **
		(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
	Economic Disadvantage	0.232 ***	0.114 ***	0.028	0.124 ***	0.172 ***
		(0.03)	(0.02)	(0.03)	(0.04)	(0.03)
	Schools	0.484 ***	0.275 ***	0.238	0.614 **	0.275 **
		(0.12)	(0.07)	(0.12)	(0.20)	(0.10)
	Licensed Venues	0.014 *	-0.004	0.003	0.020	0.011 **
		(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
	Constant	-4.500 ***	-3.356 ***	-3.465 ***	-4.291 ***	-3.270 ***
		(0.89)	(0.36)	(0.69)	(0.61)	(0.49)
	Observations	4233	4233	4233	4233	4233
	Moran's *I* of residuals	0.027 ***	0.020 ***	0.023 ***	0.019 ***	0.021 ***

Significance=* 0.05, ** 0.01, *** 0.001

Appendix I: Keywords associated with amenity types employed by the parsing program

Amenity Type	Keywords within the Amenity Description
Playground	"playground", "swing", "rocker (rota roca)", "spinner (supa nova)", "softfall", "pedal power", "play", "jungle gym", "giant revolving disk type e", "maze", "slide", "see-saw", "spring rocker", "digger", and "monorail"
Eating	"table", "bbq", "barbecue", and "firewood"
Seating	"furniture", "bench", and "seat"
Dog Off-Leash Area	"dog"
Managers	"museum/resource centre", "pcyc", "library", "visitor centre", "information booth", "information centers".
Formal Sports	"shot put", "hammer throw", "equestrian", "horse", "aussie rules", "afl", "sporting field", "stadium", "goal post", "goal", "club", "sporting clubhouse", "stand", "golf", "baseball", "cricket", "hockey", "rugby", "soccer", "basketball", "basketball_netball", "handball", "netball", "tennis", "volleyball", "sporting court", "basketball/netball", "boules court", and "lawn bowls/croquet green"
Informal Sports	"fitness exercise equipment", "upper body equipment", "exercise station", "bike", "bmx", "skate", "fitness exercise equipment", "upper body equipment", and "exercise station"
Enclosed Spaces	"shower", "toilet", and "change room"
Lights	"light"

Appendix II Pseudo-F and -T Scores calculated for the final 9 cluster sets

Clusters	*f*	*t*
2	7.05	30.27
3	9.07	1.02
4	6.88	11.89
5	7.30	34.04
6	5.93	2.98
7	5.02	15.38
8	5.49	13.94
9	4.90	0.78
10	4.49	4.83

Appendix III: Rayleigh, Kuiper, and Rao's tests of uniformity

Greenspace Type	Uniformity Test	Crime Type				
		Violent	Theft	Drug	Nuisance	Damage
Amenity Rich	*Rayleigh*	0.00	0.00	0.00	0.00	0.00
	Kuiper	0.00	0.00	0.00	0.00	0.00
	Rao	0.00	0.00	0.00	0.00	0.00
Sit or Play	*Rayleigh*	0.00	0.00	0.00	0.00	0.00
	Kuiper	0.00	0.00	0.00	0.00	0.00
	Rao	0.00	0.00	0.00	0.00	0.00
Transport	*Rayleigh*	0.00	0.00	0.00	0.00	0.00
	Kuiper	0.00	0.00	0.00	0.00	0.00
	Rao	0.00	0.00	0.00	0.00	0.00
Amenity Poor	*Rayleigh*	0.00	0.00	0.00	0.00	0.00
	Kuiper	0.00	0.00	0.00	0.00	0.00
	Rao	0.00	0.00	0.00	0.00	0.00

Appendix IV: Negative Binomial Models version reported using Incident Rate Ratios

	Crime Type:	Violent	Theft	Drug	Nuisance	Damage
		IRR	*IRR*	*IRR*	*IRR*	*IRR*
		(s.e.)	*(s.e.)*	*(s.e.)*	*(s.e.)*	*(s.e.)*
Greenspace	[Amenity Poor Type as the Reference Category]					
	Amenity Rich Type	4.493 ***	2.127 ***	4.309 ***	4.472 ***	4.280 ***
		(1.83)	(0.35)	(1.08)	(1.16)	(0.88)
	Sit or Play Type	1.192	1.209	1.916 *	2.227 *	1.820 **
		(0.28)	(0.20)	(0.60)	(0.71)	(0.35)
	Transport Type	3.096 ***	2.294 ***	2.600 *	10.197 ***	2.092 ***
		(0.97)	(0.50)	(1.03)	(5.79)	(0.41)
Time	Night	1.028 ***	1.039 ***	1.036 ***	1.030 ***	1.029 ***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Weekend	1.027 ***	1.045 ***	1.038 ***	1.043 ***	1.027 ***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Neighborhood	Crime Rate per 1000	0.999	1.000 **	1.000 ***	1.000	1.002 ***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Population Density	0.999	1.006	0.994	1.009	1.011
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Adolescents	0.973	0.971	0.990	0.892 ***	0.982
		(0.02)	(0.01)	(0.03)	(0.02)	(0.02)
	Residential Instability	0.997	1.002	0.986	0.997	0.994
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Ethnic Diversity	0.975	0.996	1.017	1.021	0.901 **
		(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
	Economic Disadvantage	1.262 ***	1.121 ***	1.028	1.133 ***	1.188 ***
		(0.04)	(0.02)	(0.03)	(0.04)	(0.03)
	Schools	1.622 ***	1.317 ***	1.269	1.847 **	1.316 **
		(0.19)	(0.09)	(0.15)	(0.37)	(0.13)
	Licensed Venues	1.014 *	0.996	1.003	1.020	1.011 **
		(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
	Observations	4233	4233	4233	4233	4233
	Moran's *I* of residuals	0.027 ***	0.020 ***	0.023 ***	0.019 ***	0.021 ***

Significance=* 0.05, ** 0.01, *** 0.001