4 Do green areas affect crime and safety?

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4.1 Introduction

People's satisfaction with and perceptions of the quality of green areas are thought to be important in the creation of sustainable cities (Chiesura, 2004; Iqbal & Ceccato, 2015; Mulliner & Maliene, 2011). A green area (or space)— be it a park, a forest, a meadow, a green belt—is often associated with environmental amenities in cities, place attachment, citizens' health and sustainability (Babey, Tan, Wolstein, & Diamant, 2015; Bogar & Beyer, 2015; Cohen et al., 2016; Gómez, Baur, Hill, & Georgiev, 2015; Troy & Grove, 2008). However, green areas are far from homogeneous in nature, function and other inherent qualities. Safety is one of the basic qualities that make a green area attractive and is an important component of sustainable environments (UN-Habitat, 2019; UNHSP, 2007). If a green area is unsafe, or at least felt so by its users, its quality most likely is compromised.

In this chapter we investigate the nature of green areas in relation to safety. This study builds on previous literature overviews (Bogar & Beyer, 2015; Kondo, Fluehr, McKeon, & Branas, 2018a) that assessed the state of evidence on relationships among green space, violence and crime. Bogar and Beyer (2015) focused on studies from the United States from 2001 and 2013. Overall, they found significant evidence to support the positive impacts of green space on safety, despite incompatible research designs and conflicting results. Kondo, Fluehr et al. (2018) found consistent negative associations between green space exposure and violence and health outcomes. They called for additional research and standardization among studies for a better understanding of the relationship between green areas and safety. This study responds to those calls by extending the review to literature from other parts of the world and looking into the relationship between green space and safety perceptions/fear of crime, which have been lacking.

The aim of this chapter is to identify and assess the nature of published, peer-reviewed literature in English on the relationship between green areas (parks, forests, neighborhood parks, green vacant land, interstitial spaces) and crime and perceived safety. This is achieved by performing a systematic literature overview from 1968 to 2018 from the major databases and assessing thematic

trends. We used the software VOSviewer (www.vosviewer.com) to manage and organize the vast material spanning five decades into two overarching themes: the relationship between green areas and crime, and the relationship between green areas and fear or poor perceived safety. This literature review aims to collect and systematize scholarly knowledge on the topic to respond to the following questions.

1. Which are the most common types of green areas associated with crime and/or poor perceived safety in the international literature?
2. Do green areas affect the occurrence of crime and disorder and, if so, how?
3. Do green areas impact on perceived safety and, if so, what are the mechanisms?

This chapter is structured as follows. First, we discuss the basic definitions and theoretical necessary principles, then report the methods, followed by the results. In the final section we identify gaps in the literature and suggest a research agenda on green areas and safety as well as policy implications of the current knowledge.

Note that in this study "green areas" and "green spaces" will be used interchangeably.

4.2 Theory and definitions of green areas and safety

Types of green areas and crime

Goode and Collins (2014) categorized green spaces in six groups according to their origin, development and walkability. Although the categories were created for green areas in the British context, they can be helpful to illustrate the spectrum of green areas found in other parts of the world. The first category is *"tended" green spaces for pleasure* and is composed of squares, parks and campuses, botanical gardens, gardens, tree-lined streets, flowerbeds, verges and pockets of space. The second category is called *"tended" green spaces for use*, and is composed of allotments, playing fields, greens and playgrounds, graveyards and cemeteries. Then, they suggest *"un-tended" green spaces*, such as disused railway lines and wasteland, and *water features*, such as those green areas close by rivers, streams, lakes and ponds, canals, conduits and millstreams, dockyards and waterfronts. In addition, there are *"natural" green spaces*, for example, meadows, heaths and woodland, and finally *"controlled" green spaces*, which include green belts and nature reserves.

Green areas (or spaces) tend to be associated with amenities and safety but not everywhere (Ceccato & Hanson, 2013; Groff & McCord, 2011; Iqbal & Ceccato, 2015). Vacant lands and/or interstitial spaces with greenery may be considered an indication not of environmental quality but quite the opposite, as they may attract problems, such as littering, and more serious crimes, such as drugs, robbery and rape, that seriously affect urban quality (Iqbal & Ceccato, 2015; Troyer & Wright, 1985).

The international literature on green spaces and safety covers a wide spectrum of environments, from parks to interstitial spaces, of varied sizes and functions. What are the most common types of green areas linked to issues of crime and poor perceived safety? Size, location and function are important determinants of safety in a green area (Iqbal & Ceccato, 2016), as are temporal factors that interact with the city structure and people's routine activity (Cohen & Felson, 1979). Brantingham and Brantingham (1984) suggested that offenders become familiar with the places that are relevant to them ("nodes") and the corridors that link them ("paths"). These nodes and paths constitute offenders' awareness space, and it is within or on the fringes of this space that they are most likely to commit an offense. Green areas can be nodes or areas in those paths located within many offenders' awareness space and can become a risky place.

Green areas as risky places

A green area can become a risky place, namely a place that concentrates a disproportionately high number of crimes in relation to its surroundings (Clarke & Eck, 2007). As a risky place, a green area can be a *crime generator* (Brantingham & Brantingham, 1995); in other words, people with criminal motivation can be drawn to, for example, a desolated park that provides the basic conditions for crime to happen. Crime generators are risky places with many criminal opportunities that are well known to offenders, such as an open drug market in a park. A park can also be a *crime attractor*; for example, a green area attracts large numbers of people for reasons unrelated to criminal motivation, creating many opportunities for crime (Groff & McCord, 2011; Hilborn, 2009; Iqbal & Ceccato, 2015). A green area can also become a *crime enabler* when there is little regulation of behavior at that place: rules of conduct are absent or not enforced (Clarke & Eck, 2005). The physical and social environment, the maintenance of the place (e.g., illumination) and the mechanisms that reinforce guardianship (e.g., "eyes on the park") are fundamental to keeping it safe. Green areas can also become *crime radiators* or *crime absorbers* (Bowers, 2014). Bowers (2014, p. 389) explored the nature of the relationship between a particular place and what occurs outside but near the place. *Crime radiators* "cause crime in the immediate environment as well as internally", while *crime absorbers* absorb risk from the external locale.

Whether a green area is a risky place depends on the context, not only spatially (by type of land use, inner city–outskirts, rural–urban) but also temporally (by hour of the day, day of the week, seasonally). The type of green area, its function and design influence what occurs in it as well as in places surrounding it. This implies that environments can be planned, built and modified following design principles that reduce the opportunities for crime. This can be done by stimulating surveillance at particular times, fostering territoriality and reducing areas of conflict by controlling access and improving overall perceived safety (Armitage, 2013; Cozens, Saville, & Hillier, 2005; Ekblom, 2011,

2019; Iqbal & Ceccato, 2016; Jeffery, 1971, 1977; Newman, 1972; Saville, 2019).

Green areas and safety perceptions

A desolate, unsafe park can reduce the walkability of the whole area where it is located. The mechanisms linking individuals and safety vary, but they are often associated with the inherent qualities of environments (streets and places) that encourage individuals to use them. People in the streets create "eyes on the streets" (Jacobs, 1961), which can affect the risk of crime and safety perceptions (Cohen & Felson, 1979; Reynald, 2010). Indeed, Talen and Koschinsky (2014) indicated that the quality of the urban environment, social interaction, safety and health are interrelated. Fear of crime can change and limit an individual's activities (Giurgescu et al., 2017; Jackson & Gouseti, 2012; Lorenc et al., 2013), restricting her/his own mobility and ultimately her/his health.

Yet, the way we perceive the environment is also a function of what we are. Individual factors play a role in defining perceptions of risk and safety. Previous research confirms that an individual's fears depend on individual physical abilities as well as on age, gender, sexual status, ethnicity and socioeconomic background (Box, Hale, & Andrews, 1988; Garofalo & Laub, 1979; Pain & Smith, 2008). Therefore, the nature of perceived safety (or the lack thereof, i.e., fear) is a multi-faceted and multi-scale phenomenon (Day, 2009; Los, 2002; Wyant, 2008), a result of the intersection of an individual's characteristics and the environments to which he/she is exposed.

4.3 Methodology

The literature search covered 50 years, from 1968 to 2018, of publications in the following databases: Scopus and Google Scholar. Although our search extended back 50 years, articles in this particular topic only started to appear in journals in the 1980s and 1990s. The bibliographic selection was conducted in two steps: first, we focused on the bibliometric analysis and then on in-depth analysis of the material.

Three combinations of keywords were used to search in each database, as shown in Table 4.1. The searches were conducted in July 2019 and aimed to combine terms related to crime, fear or different kinds of violence with the ones linked to green areas. This is a review of literature inspired by the principles of the *Cochrane Handbook for Systematic Reviews* (Higgins & Green, 2011) as well as the PRISMA checklist (Moher, Liberati, Tetzlaff, & Altman, 2009). One of the features that distinguish this type of review from others is the pre-specification of studies following a set of eligibility criteria (Higgins & Green, 2011). The flowchart in Figure 4.1 illustrates an approximate estimation of the articles during the process of collection and selection of the publications.

Table 4.1 Sets of keywords, number of results and documents selected from Google Scholar and Scopus

Database	Keywords	Results	Selected
Scopus	((crim* OR fear* OR safe*) AND (vegetation* OR green* OR park* OR "tended spaces" OR "vacant lots" OR natur* OR forest* OR tree OR trees OR planta* OR grass*) AND (hedonic* OR pay OR value OR pric*))	16	4
	((crim* OR fear* OR safe*) AND (vegetation* OR green* OR park* OR "tended spaces" OR "vacant lots" OR natur* OR forest* OR tree OR trees OR planta* OR grass*))	1,045	68
	((burglar* OR larcen* OR theft* OR murder* OR assault* OR robber* OR felon* OR aggressi* OR violenc* OR disorder OR offence) AND (vegetation* OR green* OR park* OR "tended spaces" OR "vacant lots" OR forest* OR tree OR trees OR planta* OR grass*))	640	23
Google Scholar	(crime OR fear OR safe OR safety) + ("tended spaces" OR "vacant lots" OR nature OR forest OR tree OR trees OR plantation OR grass OR green OR parks OR park OR vegetation) + (prices OR price OR value OR values OR pay OR hedonic)	20	3
	(crime OR fear OR safe OR safety) + ("tended spaces" OR "vacant lots" OR nature OR forest OR tree OR trees OR plantation OR grass OR green OR parks OR park OR vegetation)	2,940	6
	(burglary OR larceny OR theft OR murder OR assault OR robbery OR felony OR aggression OR violence OR offence) + ("tended spaces" OR "vacant lots" OR forest OR tree OR trees OR plantation OR grass OR green OR vegetation OR park)	328	4
Total		4,989	108

Bibliometric analysis

The bibliometric analysis included only 95 articles obtained and selected from Scopus (in *.ris) in the data collection process. VOSviewer version 1.6.12 (www.vosviewer.com) is a free-access software tool that was used to create bibliometric maps based on the keywords cited in each selected article and to group terms in clusters according to their linkages. The map in VOSviewer was
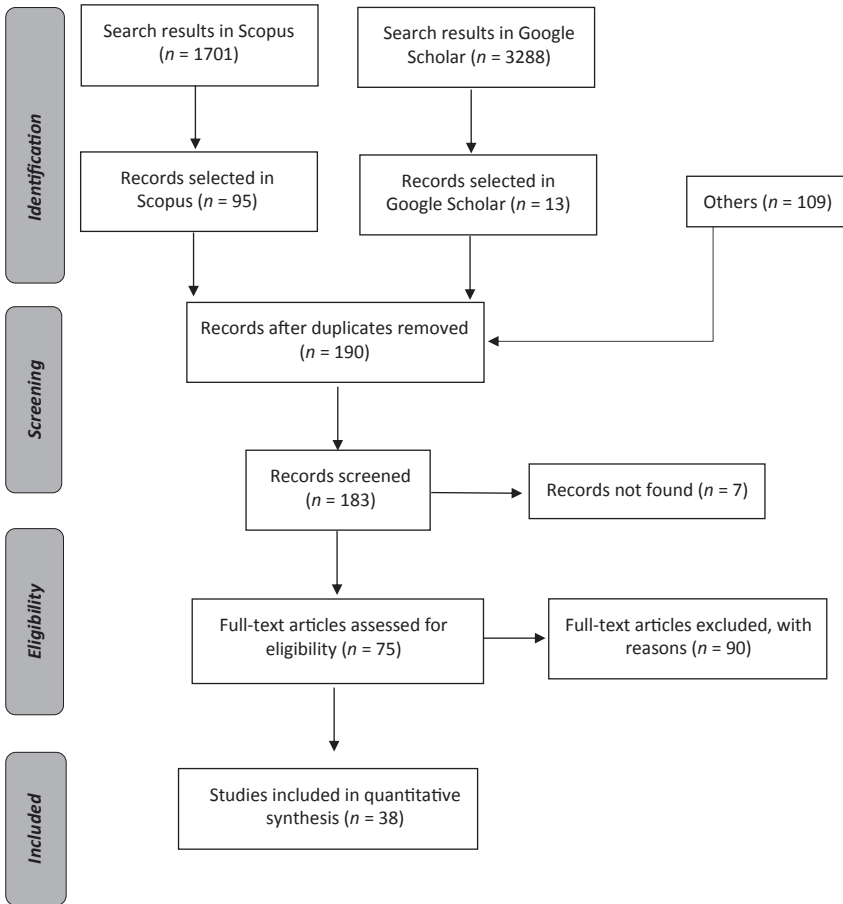
Figure 4.1 Data collection and selection in Scopus and Google Scholar, 1968–2018.

created based on the bibliometric data, and the 95 articles mentioned above were used as input data. The co-occurrence analysis was performed using the keywords adopting the counting method. It resulted in a total of 800 terms, of which only 244 met the threshold of the minimum number of two occurrences/repetitions. This criterion of a minimum of two repetitions was selected to avoid terms without links or with weak links to the theme and at the same time to ensure the coverage of the terms and representativeness of the articles. The final selection resulted in 95 items out of the 244 keywords, and the map was created using the default settings. We performed thematic content analysis. Output files from the database were used to produce informative network maps by theme. A number of themes were selected based on the clusters that emerged from the literature and are discussed in Section 4.4.
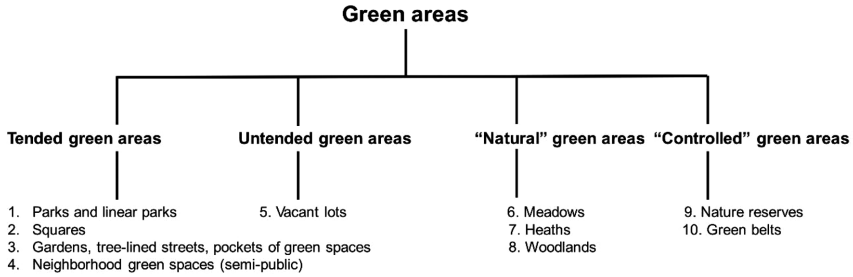
In-depth analysis

In addition to the search on Scopus, we also searched Google Scholar. In some cases, one of the keywords was excluded from one of the searches to make the results more specific to the target subject. Our inclusion and exclusion criteria for both databases are presented in Table 4.2. The total was 4,989 publications, of which 66 percent were from Google Scholar (Table 4.1). Unfortunately, the results were too general, so only the first 10 pages were considered for evaluation. The advantage of using Google Scholar is that this platform includes papers published before 1970, which were lacking in the Scopus search. Only 38 were eligible (articles that contained links between green areas, crime and/or fear) and constitute the base for the analysis (Tables A4.1–A4.3 in the Appendix). In a few cases, articles appear in two different tables because they evaluate both crime and fear. These themes support the selection of topics that are relevant to be investigated in detail and that are discussed in the literature overview, more specifically the correlation or effect of green areas on crime and/or safety:

- Positive: decline of crime and increase of safety perceptions, an expected effect
- Negative: green areas have unexpected effect on crime and/or safety/fear
- Inconclusive: different effects were observed in different variables
- No difference: no statistically significant impact or crime and/or fear of crime remained the same (before and after interventions, for example)

Table 4.2 Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion	Database
1. Year	1968–2018	Others	Scopus and Google Scholar
2. Language	English	Others	Scopus and Google Scholar
3. Document	Article, Book, Chapter, Review	Others	Scopus
4. Subject Area	Engineering; Medicine; Social Sciences; Environmental Science; Psychology; Economics, Econometrics and Finance; Multidisciplinary; Undefined	Others	Scopus
5. Field	Title	Others	Google Scholar
6.	Null	Include Patents, Include citations	Google Scholar
7.	Sort by relevance	Null	Google Scholar

Green areas

Tended green areas	**Untended green areas**	**"Natural" green areas**	**"Controlled" green areas**
1. Parks and linear parks 2. Squares 3. Gardens, tree-lined streets, pockets of green spaces 4. Neighborhood green spaces (semi-public)	5. Vacant lots	6. Meadows 7. Heaths 8. Woodlands	9. Nature reserves 10. Green belts

Figure 4.2 The categorization of green areas adapted from Goode and Collins (2014).

The cities in the studies are classified into the following five types: (1) global cities and/or capitals; (2) regional capitals; (3) local city centers; (4) small towns and/or communities; and (5) other. Green areas were also classified into the categories suggested by Goode and Collins (2014) and are numbered as suggested in Figure 4.2.

4.4 Results and discussion

This study builds on two current systematic literatures (Bogar & Beyer, 2015; Kondo et al., 2018a) that assessed the evidence on relationships among green space, violence and crime. These authors call for additional research and standardization among research studies to better understand the relationship between urban green space, violence and crime. Below we discuss the results, also including publications that deal with green areas and fear, in articles from around the world written in English.

Green areas and safety: overall patterns

The bibliometric analysis resulted in seven themes as an outcome of the literature search (Figure 4.3(a)). The themes vary from crime and safety, to design of the urban environment and neighborhood, residence characteristics and urban health, taken from Scopus and Google Scholar, 1968–2018. The greater the weight of an item, the larger the circle. Most of the articles link greenspace/areas, crime and safety, urban area, perception and neighborhood issues. The distance between two keywords indicates the relatedness of the keywords, in terms of co-citation links. Figure 4.3(b) corresponds to the density visualization of authors' keywords based on total occurrences, association strength. The analysis of the overall pattern has been complemented with an in-depth analysis of 38 articles, which is discussed below.

The vast majority of the studies focused on "type 1 green areas," namely those categorized as "tended green spaces for pleasure," as suggested by Goode and
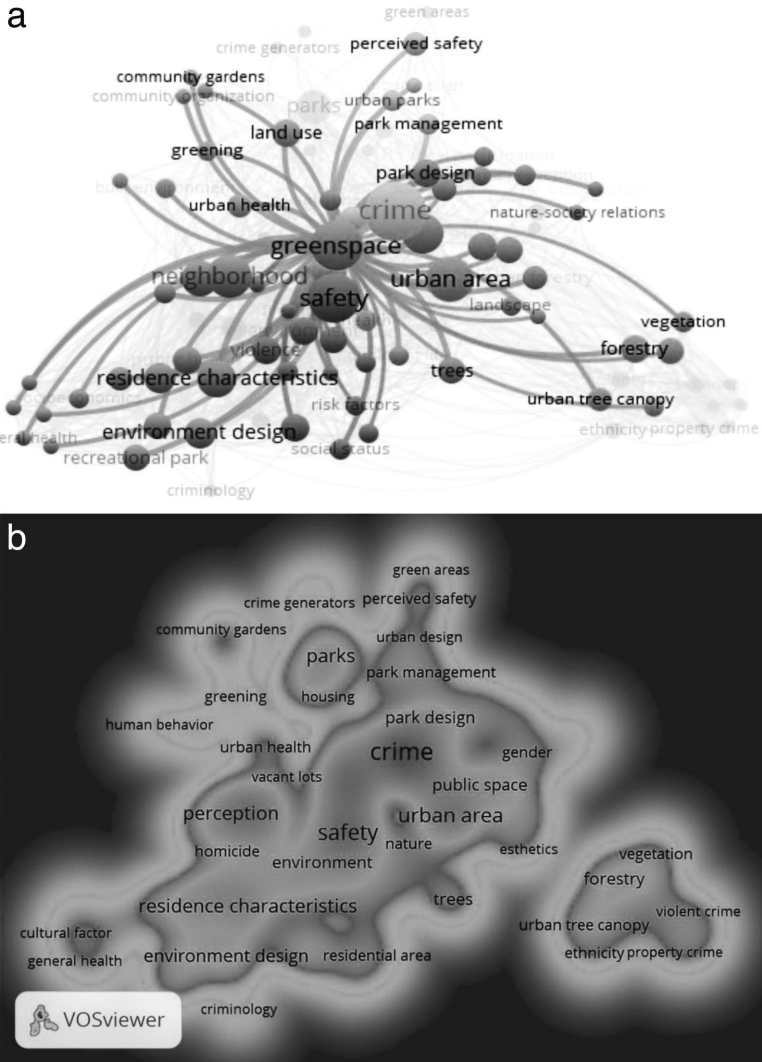
a

b

Figure 4.3 Literature search for keyword: "greenspace" in publications that relate to crime and fear of crime, 1968–2018. (a) Network visualization map with focus on "greenspace" as an example in Scopus, 1968–2018. (b) Density visualization of author keywords, 1968–2018, in Scopus based on total occurrences, association strength.

Collins (2014), including squares, parks and campuses (Figure 4.2). This finding is based on the in-depth analysis collected from 38 articles. Around 70 percent of these studies are from North America, 15 percent from European countries, and 15 percent from Asia, Australia and other countries. In North America, the sites

might vary between global/capital cities and regional capitals (Cleveland, Denver, Philadelphia, New Haven, Cincinnati, Portland). Only two were in the local urban centers of Youngstown, Ohio, and Flint, Michigan (Appendix).

Out of 38 articles, 43 percent deal with the relationship between crime and green spaces and 47 percent green spaces and safety perception/fear, while 10 percent dealt with both crime and fear in relation to a variety of types of green area (Figure 4.4(a)). As much as 41 percent of the articles show that green areas affect safety positively (for example: vegetation in abundance is associated with lower rates of assault, robbery and burglary; in low-income neighborhoods residents perceived nearby parks as being safe; and interventions in a park decreased
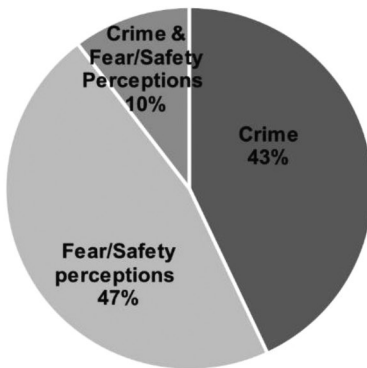
(a) Studies by safety measure

N=38 (16+18+4 = 38)
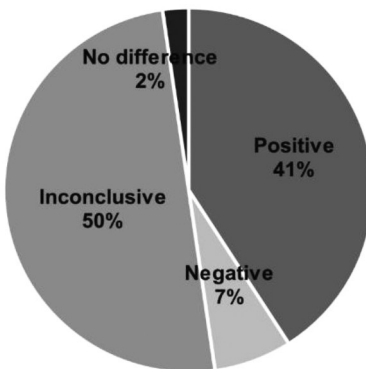
(b) Studies by relationship with green areas

Figure 4.4 Analysis of the relationship of green areas and crime and fear/perceived safety.

overall crime compared with those areas that did not receive an intervention), while 7 percent of the articles indicate that green areas have a negative impact (for example, increased crime), 50 percent of the articles show inconclusive/conflicting results (different effects were observed in different variables) and 2 percent showed no effect, or not statistically significant (Figure 4.4(b)).

Green areas and crime

Although the studies show conflicting results, the overall pattern is that green areas do not seem to be related to an increase in crime. On the contrary, there were certain studies that revealed that green areas had a decreasing effect on crime, or that safety interventions decreased crime in green areas and/or neighborhoods. Eight articles suggested that green areas are not associated with crime occurrence or increase (Gilstad-Hayden et al., 2015; Heinze et al., 2018; Kondo, Andreyeva et al., 2018; Kondo, Fluehr et al., 2018; Kondo, Han et al., 2017; Kondo, South et al., 2017; Kuo & Sullivan, 2001a; Wolfe & Mennis, 2012; Ye et al., 2018), and two did not show any evidence either way (Garvin et al., 2013; Kimpton et al., 2017). Among those studies that did not show the negative effect of green areas, two studies focused on vacant lots in urban areas, four investigated trees and vegetation coverage in cities, and two analyzed the neighborhood-scale green areas around big cities. Outcomes for crime were categorized by type of crime according to the articles as shown in Appendix, Table A4.1.

Nearly all studies are cross-sectional analyses. One exception was the study by Branas et al. (2018) that analyzed a total of 541 randomly sampled vacant lots that were assigned into treatment and control study arms; outcomes from police and 445 randomly sampled participants were analyzed over a 38-month study period. Participants living near "treated" vacant lots reported significantly reduced perceptions of crime, vandalism and safety concerns when going outside their homes as well as increased use of outside spaces for relaxing and socializing. Significant reductions in crime overall and nuisances were also found after the treatment of vacant lots in neighborhoods below the poverty line.

In our sample that covered studies on all continents, we found that regression models were used six times with varying research designs. Quasi-experimental, difference-in-difference analysis, autocorrelations, circular statistics and geocoded mappings were also applied. Mixed methods were also common. For example, Groff and McCord (2011) performed a field survey and combined it with statistical analysis (location quotients and comparison) to examine the relationship between parks and crime and disorder in Philadelphia.

Maintenance of green areas and parks plays an important role when it comes to the relationship between green areas and crime. Vacant lots that are well managed and maintained, for instance, have less crime (Branas et al., 2011; Heinze et al., 2018) and better perceived safety (Branas et al., 2011; Garvin et al., 2013; Heinze et al., 2018). Better maintained vacant lots have fewer assaults, gun assaults, vandalism and violent crimes than street segments with vacant, abandoned and untreated lots (Branas et al., 2011; Heinze et al., 2018).

In addition, being under and around tree coverage is associated with violence, property crimes, gun assault and total crime (Branas et al., 2011; Gilstad-Hayden et al., 2015; Kondo, Han, et al., 2017; Ye et al., 2018). This appears to support former findings from research conducted in big cities where trees and other vegetation were associated with total crime and disorder. In addition, the effect of good maintenance was noted in previous studies from the 1990s. Poyner (1994), for example, illustrated the effect of demolition in the UK, showing that robberies and snatches decreased. In the United States, Freedman and Owens (2011) showed that new construction and rehabilitation have led to significant reductions in violent crime that is measurable at the county level, although there are no detectable effects on property crime. Similarly, Aliprantis and Hartley (2015) estimated the effects of closures and demolition in Chicago; findings showed a significant decrease in homicides around demolitions. Note that these studies (Poyner, 1994, Freedman & Owens, 2011; Aliprantis & Hartley, 2015) were not included in our review because their primary focus was on demolitions, so they did not satisfy the selection criteria.

However, crime seems to have been associated with green areas in three studies. For example, the study of Kondo, Han et al. (2017) showed that tree damage caused by an invasive tree pest was associated with an increase in total crime (except damage/endangerment, burglary, robbery and rape). Further investigation revealed that certain types of green area are more crime-prone than others, meaning that when greenspaces are heterogeneous they can influence both the timing and the frequency of crime (Kimpton et al., 2017). Parks in an urban area, for instance, can be crime generators (Groff & McCord, 2011).

Green areas and safety perceptions

Appendix Table A4.2 summarizes 18 articles that deal with fear of crime and perceived safety in green areas. Almost 41 percent of them showed positive effects on safety of the presence of green areas (Branas et al., 2011; Coley et al., 1997; Farbod et al., 2017; Garvin et al., 2013; Kuo et al., 1998; Lindgren & Nilsen, 2012; Ward Thompson et al., 2013; Vaughan et al., 2018). These findings include the impact of green areas on health status (e.g., Branas et al., 2011). Among the types of green area reported in these articles, parks comprise 48 percent of studies, green areas in neighborhoods 30 percent and woodlands 13 percent. The remaining articles focused on the influence of woodlands and trees on perceived safety. In only six studies did fear of crime increase with green areas, but these findings mainly focused on specific groups and situations (Cohen et al., 2010; Loukaitou-Sideris & Sideris, 2010; Madge, 1997; Parra et al., 2010; Shackleton et al., 2015; Stodolska & Shinew, 2010). As many as 60 percent of articles were based in the United States, 23 percent Europe, 14 percent Asia and the remainder elsewhere.

Safety perceptions vary according to users' profiles in these green areas. Gender plays an important role in perceived safety in green areas, and women tend to report more fear of crime than men in these environments (Jorgensen et al., 2013;

Kuo & Sullivan, 2001b; Loukaitou-Sideris & Sideris, 2010; Madge, 1997; Shackleton et al., 2015). The fear of crime in green areas is also influenced by other factors. Particular uses of the park may affect safety negatively, especially among women (Jorgensen et al., 2013). Interestingly, park use leads to more park use (performing sports competitions and recreational activities) but not safety alone (Cohen et al., 2010; Loukaitou-Sideris & Sideris, 2010).

Four articles that relate fear of crime in green areas also link to the occurrence of crimes, such as vandalism and graffiti (Jansson et al., 2013; Maruthaveeran & Van den Bosh, 2015; Parra et al., 2010; Stodolska & Shinew, 2010). While Appendix, Table A4.3, demonstrates some overlap in outcome directions related to urban green areas, crime and fear (e.g., well-maintained neighborhood parks demonstrate consistent decreases in crime and fear), the table also shows evidence of specific crimes and fear with opposite relationships with urban green space, or at least varying by type of crime, resident or time of day (e.g., perceived safety was dependent on the number of people present in the park). As these results tend to be inconclusive, we will not discuss them further.

4.5 Final considerations

This chapter set out to assess the nature of published peer-reviewed literature in English on the relationship between green areas and safety from 1968 to 2018. We first defined what we meant by green areas in the urban context, then we associated green areas with both actual risk of being victimized by crime and in relation to fear of crime and/or safety perceptions by users. The literature shows a predominately positive trend in the effect of green areas on safety (both crime and fear/safety perceptions), but about half of the studies show inconclusive or conflicting findings. Despite the fact that these findings are similar to what was suggested by previous literature overviews (Bogar & Beyer, 2015; Kondo et al., 2018b), caution is necessary when drawing this conclusion.

First, the current body of literature is not extensive enough to determine the effects of all types of green area and all types of crime. As for the types of green area, our results were dominated by what Goode and Collins (2014) call "tended green spaces for pleasure", such as parks, botanical gardens and squares. In addition, the studies used different methods, which makes it difficult to compare conflicting findings. Various studies showed that the effect of green areas on safety was dependent on crime types, levels and contexts, but to what extent might these differences just be an artefact of the methods?

Second, although we report results and draw conclusions based on hundreds of publications, it is important to remember that publications in peer-reviewed journals are more likely to show positive "expected" results than results that are uncertain, negative or "unexpected". At the same time, it is impossible to estimate the "dark figure" of unpublished materials, in other words, to estimate how many studies had negative or unexpected results and were not published.

Third, what works internationally in terms of the impact on green areas may not work locally. The literature reported in this overview is dominated by studies in North America and the UK. Caution should be exercised when conclusions drawn from findings that are country- or city-specific are applied to the context of cities in the Nordic countries, which have different city structures, climate, political and cultural contexts, and distinct urban planning traditions.

Despite these limitations, the contribution of this chapter is to extend the results to publications in English for other parts of the world beyond the United States. We went beyond the "park-crime link" and looked for evidence of potential relationships between green areas and perceived safety and fear of crime. Finally, despite the fact that most articles were quantitative pieces, we also considered studies that adopted mixed methods, allowing for examples of interventions on parks and consequently on safety.

Research recommendations

The results of this literature overview show opportunities for improving our understanding through future research. One of these future research areas is the need to better understand why certain types of green area become a crime magnet and others do not; namely, why they become risky places that generate (and/or attract, absorb or radiate) crime. The temporal and spatial contexts of green areas are important aspects to be considered. Another area that remains open for further research is the relationship between the use of spaces and the well-known mismatches between the design of crime-ridden micro-places and safety perceptions in multi-functional parks (Ceccato & Hanson, 2013) (see also Chapter 5). Finally, one important area for future research is the testing of rigorous longitudinal methodologies that can provide assessments over time and be applied in contexts other than those that are tested here.

Policy implications

More than just risky places, green areas play an important role in the sustainability of cities, so it is essential to know about their safety qualities, as was the intention of this study. We have shown a predominately positive relationship between green areas and safety in the 38 studies. This impact must be contextualized both spatially and temporally to properly inform practices of maintenance of these public places.

Planning for a safe green area is part of creating a public place that is safe and inclusive for all. Park visitors, for instance, constitute only one group of users. There might be those who have the park as a working place (vendors), others who "just" pass by (transients and people waiting for a bus) or those who temporarily reside in them (homeless). Groff and McCord (2011) stated that parks and other green areas are contested spaces in cities. Since they are often publicly owned, they are at the same time everyone's and no one's. They may offer poor

guardianship and therefore are susceptible to be taken over by illegal activities or activities that trigger fear among visitors.

Like many other public places, parks and squares accommodate groups that are often viewed as a security problem rather than as individuals who have a right to be there and feel safe. In these circumstances, getting the right person or organization to be responsible for these environments is important (knowing who is in charge of delivering security services for whom, where and when). In most cases in public places—and in particular parks—there are no quick fixes for safety problems. They demand a multi-pronged approach, with long-term engagement of multiple authors in collaborative frameworks. Inspired by theoretical principles of environmental criminology and situational crime prevention, fieldwork protocols (Ceccato, 2019) can be used to detect particular safety problems in parks and help practitioners to think systematically about solutions that can be effective, inclusive and sustainable.

Chapter 4—Appendix

Table A4.1 Green areas (parks, forests, neighborhood parks, green vacant land, interstitial spaces) and crime

Author(s)	Year	Case study	Study's methods	Location and city type	Crime	Expected results	Green area
1. Kuo & Sullivan (2001a)	2001	Inner-city vegetation. (Examines the relationship between vegetation and crime in an inner-city neighborhood.)	Crime reports, vegetation photographs and ratings, and simple regressions.	Chicago, IL. 1	Total crime (−) Property crime (−) Violent crime (−)	Results indicate that although residents were randomly assigned to different levels of nearby vegetation, the greener a building's surroundings were, the fewer crimes were reported. This pattern held for both property crime and violent crime.	3
2. Wolfe & Mennis (2012)	2012	Green areas around the city. (Examines rates of assaults, robberies, burglaries and thefts in relation to remotely sensed vegetation abundance at the Census tract Level.)	Choropleth mapping, correlation, ordinary least squares regression and spatial econometric modeling.	Philadelphia, PA. 2	Assault (−) Robbery (−) Burglary (−) Theft (/)	Results indicate that vegetation abundance is significantly associated with lower rates of assault, robbery and burglary but not theft.	3
3. Donovan & Prestemon (2012)	2012	Trees. (Aims to understand the relationship between trees and crime (all crime, violent crime, property crime, burglary and vandalism).)	Quantitative data collection and regression models (Poisson count model and binary probit model).	Portland, OR. 2	View obstructing trees X all crimes (+) Larger trees X all crimes (−)	The relationship between crime and trees on a house's lot is mixed. Smaller, view-obstructing trees are associated with increased crime, whereas larger trees are associated with reduced crime.	1

	Year	Description	Method	Location	Findings	Results	
4. Groff & McCord (2011).	2011	Neighborhood parks. (Examines neighborhoods and their relationship with crime and disorder.)	Field survey and statistical analysis (location quotients and comparison).	Philadelphia, PA. 2	Overall crime in parks in urban areas (+) Supporting crime features in parks: Lack of activities (+) Accessibility (disorder crimes) (+) Surveillance in mixed land use (−)	Results indicate crime is concentrated near parks, and that park environments in urban areas are generators of crime.	1
5. Bogar & Beyer (2015)	2015	Urban green spaces. (Studies the relationship between urban green spaces, violence and crime. Major bibliographic databases were searched and compared.)	Systematic Review: Major bibliographic databases were searched for studies meeting inclusion criteria.	United States 5	Total crime (/) Violence (−)	Few studies, and conflicting methods and results in previous studies are not enough to determine the effects of green areas in crime and violence, even when preliminary research examined demonstrated positive associations between urban green space and decreased violence and crime.	3
6. Gilstad-Hayden et al. (2015)	2015	Trees—vegetation coverage. (Examines the relationship between vegetation and crime (violent and property crimes).)	Spatial lag analysis and autocorrelation.	New Haven, CT.2	Greater tree canopy coverage associated with: Murder, rape, robbery and assault (Violent) (−) Burglary, theft, motor vehicle theft and arson (property) (−) Total crimes (violent and property) (−)	The results support the general findings from studies conducted in larger cities such as Chicago, Portland, Baltimore and Philadelphia, where trees and other vegetation are inversely associated with crime.	1

Table A4.1 continued

Author(s)	Year	Case study	Study's methods	Location and city type	Crime	Expected results	Green area
7. Iqbal & Ceccato (2015)	2015	Green areas of different types (Sociotop). (Assesses whether crime in parks affects prices.)	Hedonic modeling.	Stockholm, Sweden. 1	Violence, vandalism	Parks in areas with high rates of violence and vandalism affect people's perception of safety and, in turn, apartment prices. Such effects vary by type of park.	1 + 2
8. Kondo et al. (2015)	2015	Urban Green Stormwater Infrastructure. (GSI). (Investigates health and safety effects of GSI installments.)	Difference-in-differences analysis of the effects of GSI installments.	Philadelphia, PA. 2	Narcotics possession (−) Narcotics manufacture (−) Burglaries (−) Homicides, assaults, thefts, public drunkenness, and narcotics sales (/)	Urban greenery is associated with reduction of crime. However, significant reductions in homicides, assaults, thefts, public drunkenness, and narcotics sales rates were not found.	–
9. Spader et al. (2015)	2016	Neighborhood green spaces. (Investigates the impact of Neighborhood Stabilization Program (NSP) investments on localized crime patterns.)	Difference-in-differences research design (empirical approach).	Cleveland, OH; Chicago, IL; Denver, CO. 2, 1, 2	Property crime (burglary and theft) (−) Violent crime (/)	There was a significant decrease in property crimes. However, violent crimes remained the same.	4
10. Kondo et al. (2016)	2016	Untreated vacant lots. (Analyzes the effects of a greening neighborhood program on crime. Compares crime around newly treated lots with crime around randomly selected and matched, untreated vacant lot controls.)	Difference-in-differences analysis.	Youngstown, OH. 3	Burglaries (−) Assaults (−) Motor vehicle thefts (+)	Reductions in burglaries around stabilization lots and in assaults around community reuse lots were found. However, significant increases in motor vehicle thefts around both types of lots were also found.	5

	Year	Methods	Location	Greenspace–crime	Findings	
11. Kimpton et al. (2017)	2017	Neighborhood. (Examines the spatial, temporal and neighborhood dynamics of greenspace crime, as well as violent, public nuisance, property and drug-related crimes within the greenspaces.)	Administrative, census and crime incident data, employing cluster analysis, circularstatistics and negative binomial regression.	Brisbane, Australia.1	Greenspace crime (x) (heterogeneous)	The findings reveal that certain types of greenspaces are more crime-prone than others. It also demonstrates that greenspaces are heterogeneous and the type influences both the timing and the frequency of crime.	4
12. Kondo, South et al. (2017)	2017	Trees in urban space. (Investigates whether being near urban tree cover during outdoor activities was related to being assaulted with a gun.)	Conditional logistic regressions to compare case subjects + geocoded mapping.	Philadelphia, PA. 2	Gun assault (−) (both low-income areas and overall areas)	Results suggest that being under tree cover was inversely associated with gunshot assault.	3
13. Kondo, Han et al. (2017)	2017	Trees. (Investigates the association between the emerald ash borer (EAB)—an invasive tree pest—and crime in Cincinnati, Ohio.)	Natural experimental approach. Statistical methods: propensity-score weighting.	Cincinnati, OH. 2	Overall crime (+) (except damage/ endangerment, burglary, robbery and rape).	EAB infestation was significantly and positively associated with relative increases in crime in all but four crime categories.	3
14. Heinze et al. (2018)	2018	Vacant neighborhood lots. (Investigates greening programs that engage community members to conduct routine maintenance on vacant lots within their neighborhoods in a mid-sized city. Focuses on violent crimes and assault.)	Mixed effects regression.	Flint, MI. 3	Well maintained vacant lots in relation to: Assault (−) Violent crime (−)	The lots with the implemented program had nearly 40% fewer assaults and violent crimes than street segments with vacant, abandoned lots.	5

Continued

Table A4.1 continued

Author(s)	Year	Case study	Study's methods	Location and city type	Crime	Expected results	Green area
15. Ye et al. (2018)	2018	Trees.(Investigates the correlations between tree coverage and property crime, and between road density and property crime.)	Ordinary least-squares (OLS) regression, spatial lag regression and geographically weighted regression (GWR).	Vancouver, Canada. 1	Property crime (−) (In both tree coverage and road density)	Findings show that there are inverse correlations between property crime rates and tree coverage, as well as road density.	3
16. Kondo et al. (2018a)	2018	Neighborhood. (Examines studies that use quasi-experimental or experimental designs to compare violence outcomes for treatment and control groups before and after a change is implemented in the built environment.)	Systematic review.	United States 5	Violent crime (−)	A share of studies reviewed support that green areas have a positive effect in reducing violent crimes.	4

Notes
(+) Decline of crime and/or increase of safety perceptions, an expected effect.
(−) Green areas have unexpected effect on crime and/or safety/fear.
(/) No statistically significant impact or crime and/or fear of crime remained the same (before and after interventions, for example).
(x) No results found.

Table A4.2 Green areas and safety perceptions/fear of crime

Author(s)	Year	Case study	Methods	Location and type	Fear/perceived safety, related safety effects	Expected results	Green area
1. Madge (1997)	1997	Park. (Investigates the geography of fear surrounding the use of public parks in the city.)	Questionnaire survey at nine street sites combined with in-depth small group interviews/ ethnographic research. Quota sampling.	Leicester, UK. 2	Fear of crime (+) (Varies with time, gender, age and ethnicity)	Fear is a significant factor structuring the use of public parks. Women were particularly fearful of sexual attack, the elderly of mugging and Asian and African-Caribbean people of racial attack.	1
2. Coley et al. (1997)	1997	Residential. Semi-private spaces. (Examines how natural elements influence the use of outdoor areas in housing developments.)	96 observations in locations with trees in the presence of youth and adults. Two by two chi-square analysis and regression analyses.	Chicago, IL. 1	Social interactions (+) Use of outdoor areas (+)	Natural elements such as greenery have a positive effect on social interactions and more usage of outdoor areas. Spaces with trees attracted larger and more diverse groups of people.	4
3. Kuo et al. (1998)	1998	Inner-city residential. Chicago's Robert Taylor Homes. (Examines how inner-city residents respond to the incorporation of trees and grass in their neighborhoods.)	Photo simulations, 100 residents rated the images with respect to preference and perception of safety.	Chicago, IL. 1	Well maintained trees and grass in relation to: Perceived safety (+) Preference (+)	Green areas contribute to an increased sense of safety and preference. When views are not blocked, the greener the better.	4

Table A4.2 continued

Author(s)	Year	Case study	Methods	Location and type	Fear/perceived safety, related safety effects	Expected results	Green area
4. Maas et al. (2009)	2009	Green spaces. (Investigates whether the percentage of green space in people's living environment affects their feelings of social safety positively or negatively. Special focus in rural × urban relationship.)	Interview-led, percentage of green calculated, different databases analyzed by usage of three-level latent variable model. (Statistical analysis.)	The Netherlands 5 (from 1 to 4)	Overall perceived social safety (+) Perceived social safety in "strongly urban areas" (−)	The perceived safety increased but not everywhere. In "strongly urban areas" (enclosed green areas), perceived safety varied.	From 1 to 8
5. Parra et al. (2010)	2010	Two low-income communities. (Examines the association between the built environment and perceived park usage among older adults.)	Cross-sectional multilevel study and multilevel logistic regression models.	Bogotá, Colombia.1	Park usage in high density park areas (+)	Older people living in higher park density areas and mixed land-use are more likely to use parks. However, the surrounding environment is important due to the result of an inverse relationship between connectivity and physical activity.	1

	Year		Method	Location	Variables	Findings	
6. Cohen et al. (2010)	2010	Parks. (Focuses on physical activity in parks, adding safety as a contributing factor.)	Observations of 30 parks, and interviews with 40,000 people.	Southern California. 5	Perceived safety by frequent users (+) Perceived safety in communities with higher population density (−) Perceived safety in places with higher percentage of households in poverty (−) Perceived safety in areas with higher percentage of Hispanics (−) Perceived safety associated with the number of people counted in the parks, the number of programs and activities offered by the park (x)	The perceived safety differed between designated places. No association was found between perceived safety, number of people and activities in the park.	1
7. Stodolska and Shinew (2010)	2010	Parks, multiple indicators. (Investigate environmental constraints on LTPA experienced by Latino residents of two predominantly low-income minority communities in the city of Chicago, IL.)	Observation and in-depth interviews.	Chicago, IL. 1	Fear of crime (+) Fear of discrimination and interracial tensions (+) Accessibility (cultural and physical) (−) Maintenance (−)	Lack of access to natural environments, poor maintenance, inability to obtain recreational equipment, safety issues, lack of Spanish info, racial tensions and discrimination as well as traffic problems limited Latinos' involvement in physical activities.	1

Table A4.2 continued

Author(s)	Year	Case study	Methods	Location and type	Fear/perceived safety, related safety effects	Expected results	Green area
8. Loukaitou-Sideris and Sideris (2010)	2010	Parks. (50 parks in inner city and 50 in suburbs, survey-based, regression models.)	Survey.	Los Angeles and San Fernando Valley region, California. 1	Perceived safety (−) (park safety variable was negatively related to the number of children at the park). Perceived safety by gender (−)(found some significant gender differences in the patterns of park use and non-use). − Safety in parks of inner city (variable) (+) −Safety in parks of the valley (variable) (−)	Overall perceived safety was associated in a negative way with parks, except in certain parks of the inner city (variable).	1
9. Alex and Jim (2012)	2012	Neighborhoods. (Survey gathered the opinions from residents in representative residential neighborhoods in old city and new towns. Implementation and development of green areas are the focus.)	Survey.	Hong Kong. 1	he urban dark and hiding places: Increase Fear of crime (+) Personal safety (+) (more females than males are concerned about safety, and elderly people are usually more afraid of crime)	Green areas are considered to be a positive factor for safety in this study.	4

10. Lindgren and Nilsen (2012)	2012	Residential.(The focus is on green spaces in residential areas with multi-family housing in Swedish towns, and possible actions to improve safety in this context are examined and discussed.)	Interviews.	Sweden. (small Swedish towns.) 5	Low vegetation and perception of safety (+) Well-lit green areas and perception of safety (+)	Residents expressed a positive attitude towards having flowers, trees and shrubs near their home, but the greenery was more appreciated during the day than during the night.	4
11. Ward Thompson et al. (2013)	2013	Woodland.(Close to disadvantaged urban community.)	Case-control study and cross-sectional survey.	Drumchapel and Milton woodlands. UK. 4	Perceived safety (comparison between woodlands after intervention) (+)	Findings revealed significant differences over time.	8
12. Jansson et al. (2013)	2013	Urban woodlands. (Focuses on perceived safety.)	Literature review.	Sweden.5	Vegetation of an open character with low-density undergrowth related to perceived safety (+)	Landscape design, overview and control, vegetation density, vegetation character and maintenance have important interactions.	8
13. Jorgensen et al. (2013).	2013	Parks.	Observation of parks in different seasons, survey with park users.	Albuquerque, NM, Chapel Hill/Durham, NC, Columbus, OH, and Philadelphia, PA. 332	Perceived park to be safe/very safe (/) (the relation between the number of park users was not associated with the perceived safety and other factors)	Neighborhood poverty level, perception of safety and the presence of incivilities were not associated with the number of park users observed. However, programmed activities and the number of activity facilities were strongly correlated with park use and energy expended in the park.	1

Table A4.2 continued

Author(s)	Year	Case study	Methods	Location and type	Fear/perceived safety, related safety effects	Expected results	Green area
14. Maruthaveeran and Van den Bosh (2015)	2015	Urban parks.(Aims to determine the attributes that evoke fear of crime and to determine the defensive behavior among urban park users.)	Interview-led.	Kuala Lumpur, Malaysia. 1	Fear of crime attributes: Concealment (+) Empty place (+) Environmental disorder (+) Incivilities (+)Familiarity (−) Crime experience (victimization) (+) Crime knowledge (+)	Findings revealed similarities to other cultures on fear of crime in urban green spaces.	1
15. Shackleton et al. (2015)	2015	Trees and parks in cities and towns.(The relevance of the results for urban planning and greening in low income areas is discussed here.)	Survey.	Bela Bela and Tzaneen, Limpopo Province, South Africa. 4	Fear of crime (+)	People often mentioned that parks are unsafe places. Trees would provide hiding places, and drugs and alcohol consumption inside the parks increased fear of crime, opposing several other positive aspects of implementation of greenery in the city, especially for poorer areas.	1 + 3
16. Farbod et al. (2017)	2017	Parks. (Determines the public's concerns and perceptions of safety regarding naturalisticlandscapes in urban parks.)	Survey.	Malaysia. 5	Perceived safety (+)	Results indicated that participants felt safe in naturalistic landscapes in urban parks.	1

	Year	Description	Method	Location / Outcome	Findings	
17. Vaughan et al. (2018)	2018	Neighborhood parks. (Examines individual and environmental influences on park use among residents of two low-income, predominantly African-American neighborhoods to identify determinants of park use in lower-income urban neighborhoods.)	Survey.	Pittsburgh, USA. 3 Perceived safety in nearby parks (+)	Most (73%) of low-income neighborhood residents perceived nearby park as being safe.	1
18. Hong et al. (2018)	2018	Neighborhood. (Examines the moderating effect of perceived safety on the association of green space with neighborhood social capital in older adults.)	Survey.	Seattle, WA, and Baltimore, MD. 1 2 Perceived safety and attractive natural sights (+) Perceived safety by older adults and parks and street trees in perceived less-safe neighborhood (–)	Perception of pedestrian safety may moderate the impact of green space on neighborhood social capital in older adults.	4

Notes
(+) Decline of crime and/or increase of safety perceptions, an expected effect.
(–) Green areas have unexpected effect on crime and/or safety/fear.
(/) No statistically significant impact or crime and/or fear of crime remained the same (before and after interventions, for example).
(x) No results found.

Table A4.3 Green areas and crime and safety perceptions/fear of crime

Author(s)	Year	Case study	Methods	Location and type	Crime	Fear/perceived safety, related safety effects	Expected results	Green area
1. Crewe (2001)	2001	Linear parks. (Tests the crime impact of the linear park and its surrounding neighborhoods, searching for crime spillovers as well.)	Interview-led and police data analysis.	Boston, MA. 1	Police calls in relation to: Proximity to linear park (+) Proximity to commercial areas (−)	Perceived safety by day (+) Perceived safety by night (−) Perceived safety during the twilight hours (+/−)	Park is perceived as safer during daytime, less safe during night time, and presented mixed results during evenings. Police calls were made in areas closer to the park corridor and less close to commercial areas.	1
2. Kuo and Sullivan (2001b)	2001	Residential without green space. (Random assignment to live in 18 public housing blocks with public green space.)	Crime reports examination. Data archive, multistudy.	Chicago, IL. 1	Self-reported intimate partner violence and aggression (−)	Women living in the greener housing: Mental fatigue (−)	Women living in the greener housing blocks experienced less mental fatigue and less self-reported intimate partner violence and aggression.	4
3. Branas et al. (2011)	2011	Untreated vacant green lots. (4,436 cleaned and greened vacant lots in Philadelphia between 1999 and 2008.)	Difference-indifference analysis.	Philadelphia, PA. 2	Gun assaults (in all four districts) (−) Vandalism (in one section of the city) (−)	Stress reported by residents (in selected areas) (−) Personal safety (x)	Significant reductions around greened vacant lots in gun assaults across the city and in vandalism in one section of the city.	5

	2013	Vacant land in the neighborhood scale. (Examines studies that use quasi-experimental or experimental designs to compare violence outcomes for treatment and control groups before and after a change is implemented in the built environment.)	Quasi-experimental (randomized controlled trial).	Philadelphia, PA. 2	Public disorder (x) Total crime (/) (very little difference) Assaults with guns (/) (very little difference)	Perception of disorder (/) Perception of safety in green vacant lots compared to non-green lots (+)	The study indicates a non-significant decrease in total crime and gun assaults around vacant lots compared with control. However, the perception of safety close to green vacant lots was higher compared with control. Well maintained, small-scale green space may increase perceptions of safety.	5
4. Garvin et al. (2013)								

Notes
(+) Decline of crime and/or increase of safety perceptions, an expected effect.
(−) Green areas have unexpected effect on crime and/or safety/fear.
(/) No statistically significant impact or crime and/or fear of crime remained (before and after interventions, for example).
(x) No results found.

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