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Examining perceived safety and park use in public open spaces: The case of Barcelona

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ABSTRACT

There is a current need for understanding existing relationships between park use and perceived safety. Six public open spaces were systematically observed for three months and sorted into three groups attending to a perceived safety questionnaire scores. Objective park use and environmental data were analyzed using polar coordinate analysis considering the perceived safety level as the focal behavior. We also considered socio-demographics, crime data, and district-level safety indicators. Sex and years living in the neighborhood influenced perceived safety scores but no association was seen with crime events. Perceived safety at the district level, neighborhood class composition, and disorder was also connected with perceived safety. Increasing perceived safety at the district level can promote physical activity and park use, especially among women, elders, young adults, and the disabled. Implications for public policy are discussed.

1. Introduction

The quantity and quality of public parks in a city are considered one of the main predictors of the general wellbeing of its inhabitants (Larson et al., 2016). Parks can promote exercise, which implies multiple physical and psychological benefits (Konijnendijk et al., 2013; Loureiro & Veloso, 2017), a feeling of community, and perceived support (Cattell et al., 2008). These benefits are not exclusive to large green spaces. Other small urban typologies, such as squares and gardens, can also increase physical activity, social interaction, and psychological health (Subiza-Pérez et al., 2020). Despite their benefits, public open spaces (POSs) are not equally distributed, and their accessibility is often highly stratified based on income and race, raising issues of environmental justice for these communities (Crawford et al., 2008; Dai, 2011; Hu et al., 2020; Wolch et al., 2014).

Several park use barriers have been identified (Crawford & Godbey, 1987), including intrapersonal (e.g., lack of interest), interpersonal (e.g., sex-role attitudes), and structural constraints (e.g., time available for leisure). Among the intrapersonal barriers, those psychological and internal to the individual, safety concerns have been oftenly cited as a significant factor explaining POSs avoidance (Koohsari et al., 2013; Lapham et al., 2016; Williams et al., 2020).

1.1. Fear of crime determinants

Fear of crime (FC) has been defined as an emotional response to a threat caused by the perception of physical danger, associated with contextual signs or symbols related to the possibility of becoming the victim of a crime (Ferraro & Grange, 1987). This emotional state is closely linked to cognitive processes (perceived risk), responsible for assessing the perceived likelihood that oneself or others may have of being a victim of a specific crime at a given time (Garofalo, 1981). Although it is a functional reaction that activates us to react against potential aggressions, FC becomes dysfunctional when the risk of being victimized is low (Jackson & Gray, 2009) and can have adverse effects at both the individual and social levels (Beatty et al., 2005; Box et al., 1988).

FC has been considered a transitory state influenced by different personal, spatial, and social factors. On a personal level, the perception of lack of control (the ability to cope with potential victimization), the

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probabilities of finding social support, and the severity of consequences contribute to potential victim's perceptions of physical and social vulnerability (Jackson, 2011; Valente et al., 2019).

Environmental research has shown that FC is strongly linked to spatial signs that indicate a certain level of disorder in the community (LaGrange et al., 1992). Physical (e.g., litter, vandalism, and graffiti) and social incivilities (e.g., homeless people, public drunkenness, and prostitution) can have a powerful influence on the inferences we make about the community living there (Miceli et al., 2004; Perkins & Taylor, 1996), especially when walking through unfamiliar neighborhoods (O'Brien et al., 2014). As the 'broken windows' theory showed (Wilson & Kelling, 1982), minor forms of public disorder can attract more incivilities and crime, as offenders assume that residents are indifferent to what goes on in the neighborhood (Sampson & Groves, 1989). Then, incivilities can promote fear and avoidance behaviors, weakening informal social control (Felson, 1995), and attracting new potential offenders (Markowitz et al., 2001).

Other environmental factors such as poor lighting and lack of visual control (the ability to have an open visual field without obstacles, reducing the potential risk of hidden offenders) systematically correlate with FC in public parks (Heft & Nasar, 2000). Regarding the effect of vegetation on FC, mixed results have been found. While it has been seen as a protective effect in residential settings in the sense that the greener the place, the safer is perceived (Kuo & Sullivan, 2001), other studies have shown that dense and unmaintained vegetation evokes fear by reducing visibility and creating dark areas where potential offenders could hide (Maruthaveeran & Konijnendijk van den Bosch, 2014). All of this evidence has been adopted as standards by the Crime Prevention Through Environmental Design (CPTED) strategies to reduce fear and crime by improving territoriality, surveillance, access control, and maintenance of the built environment (Cozens & Love, 2015).

FC seems also to be highly influenced by the level of knowledge of the environment. Familiarity explains why people living in environments with high levels of victimization can report less fear than expected (Ferraro & Grange, 1987). Related to this, what people hear from others about indirect victimization experiences, including the mass media, contribute to the representation of a concrete place as dangerous (Amerio & Roccato, 2005).

Lastly, the difficulty in interpreting behaviors of those who are racially, ethnically, and culturally different is another central element in the generation of FC (Merry, 1981). All those 'others' presenting differences in their appearance or behavior will be more likely to be considered dangerous, becoming the object of a new social representation of risk (Di Masso et al., 2014). Thus, FC can contribute to the stigmatization of certain groups and the deterioration of social cohesion (Hooghe & de Vroome, 2016; Taylor, 2009).

1.2. Rationale

Despite a substantial body of literature focused on identifying FC determinants, the study of its links with park use has received much less attention. Considering the role of POSs usage may contribute to a more complex conceptualization of the phenomenon in line with the model proposed by Rader (2004), in which FC (the emotive indicator), perceived risk (the cognitive indicator), and constrained behaviors (the behavioral indicator) are equally important.

Qualitative studies have found that FC can limit people's social and cultural activities and that these restrictions disproportionally affect women, older adults, and those with physical or mental disabilities (Lorenc et al., 2013). But little research has analyzed this issue with objective measures of park use rather than self-reported data, and findings are still inconclusive (Han et al., 2018). On the other hand, several studies have conducted systematic observations in public parks (Evenson et al., 2016). However, researchers have been more interested in the links between FC and physical activity, finding few associations (Humpel et al., 2002), rather than other sedentary but significant uses of POSs. Finally, as this topic has been primarily developed in the United States, there is a need to explore FC in other geographical and cultural contexts.

1.3. Study goals

To challenge these literature gaps and avoid conceptual confusion, we (a) propose a definition of perceived safety (PS) as a multidimensional construct related to four components (i.e., FC, perceived risk, experience of victimization, and opinion about the neighborhood), and identify demographics affecting reported scores for each dimension, (b) compare objective park use and environmental features between six POSs with different levels of PS, and (c) investigate relationships between PS and objective crime, safety indicators at district level, and the characteristics of the population living close to study sites. By doing so, we explore an innovative approach aimed to integrate results from a different range of sources to better understand the connections between PS and park use while assessing inequalities in park access according to age, sex, and race.

2. Materials and methods

We adopted a mixed-methods approach using systematic observation to assess park use and the environmental context where the activity occurred, and a questionnaire to measure how respondents perceived the sites studied in terms of safety. We also considered the demographic and socioeconomic characteristics of the population living close to study sites, crime data, and safety indicators at a district level.

2.1. Assessing park use

2.1.1. Design

We employed an N/F/M observational design (Anguera et al., 2011), where N refers to nomothetic (observing numerous POSs and groups of people), F refers to intersessional follow-up (recording of numerous sessions), and M refers to multidimensional (analysis of the multiple macrocriteria included in the observational instrument).

2.1.2. Study sample

The observational data comes from a parent observational study conducted from 31st August to December 3, 2010, including 40 POSs in Barcelona (Pérez-Tejera et al., 2018; Valera et al., 2018). In this work, we analyze observational data corresponding to six of these POSs (Fig. 1). The site selection was based on three indicators from the set of observational variables that literature has identified as relevant to inducing a perceived lack of safety: racial diversity (ratio of non-White park users), social disorder (frequency of social incivilities), and homelessness (frequency of homeless park users). All forty POSs were sorted according to these indicators and divided into quartiles. To try to ensure maximum diversification regarding the PS scores, we selected two sites on the third or fourth quartile for the three indicators (high level of racial diversity, social disorder, and homelessness), two sites in the opposite quartiles (low level of racial diversity, social disorder, and homelessness), and two more sites combining different quartiles for each indicator. Indeed, for each pair of parks, we selected POSs with different levels of green presence to control the potential effect of vegetation on people's perceptions of safety (Table 1).

2.1.3. Observational instrument

Park use was measured using EXOdES, an observational tool that we created ad hoc (https://exodes.es). The instrument conceptualized four dimensions: park users (both individuals and groups), park use, and an environmental description of where the activity was taking place. On the first one, individuals were coded attending to sex (i.e., male, female), age group (i.e., child, young adult, adult, elder), and race (i.e., White, Latinx, Arab, Asian, African). Groups of people were coded attending to

Fig. 1. Study sites.
Note. Images retrieved from Barcelona City Council website.

Table 1
Study sites according to selection criteria.

Study site	District	Level of green	Sample selection criteria		
			Racial diversity	Social disorder	Homelessness
Folch i Torres Square (FOLC)	Ciutat Vella	Low	Q4	Q4	Q4
Sant Pau del Camp's Gardens (SPAU)	Ciutat Vella	High	Q4	Q4	Q4
Lesseps Square (LESS)	Gràcia	Low	Q3	Q2	Q4
Pegaso's Park (PEGA)	Sant Andreu	High	Q1	Q4	Q4
Sóller Square (SOLL)	Nou Barris	Low	Q1	Q1	Q2
Infante's Gardens (INFA)	Les Corts	High	Q1	Q1	Q1

their size (i.e., 2, 3–5, 6–10, and 10–20), sex (i.e., men, women, mostly men, mostly women, and equally mixed), age composition (i.e., children, young adults, adults, elders, children with young adults, adults with elders, and children or young adults with adults or elders), and racial homogeneity (i.e., Whites only, non-Whites only, mostly Whites, mostly non-Whites, and equally mixed). To simplify the analysis, a reduced number of categories were used for race (i.e., Whites and non-Whites), sex composition (i.e., males only, females only, and mixed-sex groups), and racial homogeneity (i.e., Whites only, non-Whites only, and mixed-raced groups). Both individuals and groups were also coded regarding the presence or absence of signs of homelessness. Park use was described according to three indicators: main activity (i.e., chatting or enjoying the scenery, picnicking, sleeping, playing, walking, practicing sports, and cognitive activities such as reading a book or playing cards), use of vehicles (i.e., motorized vehicles, bicycles, strollers, wheelchairs, and skates or roller skates), and the presence or absence of social incivilities (i.e., public drunkenness, drug consumption or dealing, prostitution, urinating in public, and illegal street vending). Finally, the environmental assessment included the level of brightness (distinguishing between observational sessions performed before and after sunset), visual control, cleanliness, and graffiti. Brightness and visual control were assessed in two categories (i.e., adequate level and dark or hidden area, respectively). Cleanliness and graffiti were recorded with a 3-categories system (i.e., absence, moderate, and high presence), although both variables were recoded into two categories (i.e., absence and moderate to high presence) for this study.

2.1.4. Procedure

Six observers who were contracted half-time by the City Council of Barcelona conducted the observations. They were trained for four weeks by the researchers, including practicing the coding process with photographs and field-based observations until assuring high levels of inter-rater reliability. Once trained, each 45-min observational session was conducted by only one observer. The control of data quality was done through kappa Cohen's coefficient, exceeding 80%. POSs were visited eight times per day (observational periods) from 10:00 a.m. to 8:00 p.m. to guarantee representativity of uses. By the end of the study, sites were observed for a mean of 4.5 days for each observational period, by at least three observers, and on three different weekdays to diminish some bias. During an observational session, observers scanned the use of a site,

recording all observed individuals and groups as a configuration. They included information regarding the co-occurrent multidimensional criteria of the observational instrument (i.e., observer, POS, date, observational period, demographic characteristics of observed individuals or groups, activities, and the environmental features). The final database included 216 observational sessions (36 for each POS) completed on 59 days (Table 2).

2.2. Measuring PS

After concluding the observational study, an original questionnaire, tested and improved in previous works (Carro et al., 2010; Valera & Guàrdia, 2014, 2017), was administered in all six POSs. Thus, the individuals observed were not the same that answered the questionnaire. We adopted this strategy to avoid reactivity during the observational study and observe activity naturally. The final version included 65 items, most of them presented in a 6-point Likert Scale, distributed in six different scales: space usage, personal control/support, social representation, satisfaction/social cohesion, environmental quality, and the PS scale. This last included 13 items in the general dimension (*Cronbach's* $\alpha = 0.93$) and four subscales: FC (items 1, 2, and 9; *Cronbach's* $\alpha = 0.84$), perceived risk (items 3, 4, 5, and 6; *Cronbach's* $\alpha = 0.89$), experience of victimization (items 7, 8, and 10; *Cronbach's* $\alpha = 0.70$), and opinion about the neighborhood (items 11, 12, and 13; *Cronbach's* $\alpha = 0.94$). In this work, we only analyzed sociodemographics (i.e., sex, age, race, moment of the day when surveyed, weekdays/weekends, born in the neighborhood, living in the neighborhood, and years living in the neighborhood) and ratings on the PS scale (Table 3).

To limit where questionnaires had to be administered, for each POS, we defined a 0.1-mile radius Park Service Area (PSA). We added to the radius the length of the POS, measured from the center to the farthest limit, to maintain PSAs proportional to site dimensions. In each PSA, trained interviewers randomly chose adults aged 18 and over, located within (park users) and outside (non-park users) park boundaries, to avoid biases on PS.

2.3. Neighborhood characteristics and crime data

We considered residents' demographic and socioeconomic characteristics in the closest proximity to each POS. Our units were Census Sections (2011), obtained from Barcelona Open Data (https://bcn.cat/estadistica). Using GoogleEarth, all Census Sections having at least one-third of their territory within a PSA boundary were identified and included in the analysis (Fig. 2). Objective crime data occurred in 2010, and geocoded in each study site was provided by the Barcelona Police Department. Finally, indicators at district level, including the victimization rate and PS, were obtained from the Barcelona Victimization Survey (https://t.ly/bcnvictimizationsurvey), a study conducted by the City Council of Barcelona that provides analytical series on the state of urban security at a local level.

Table 3
PS scale.

1. Immediately before talking to me, you felt in this space … (1 = *unsafe*; 6 = *safe*) [a]
2. Usually, when you are in this place, you feel … (1 = *unsafe*; 6 = *safe*) [b]
3. Do you think that this place is … (1 = *unsafe*; 6 = *safe*)
4. In relation to other areas of Barcelona you frequent, you would say this space is … (1 = *unsafe*; 6 = *safe*)
5. Do you consider it likely that you may ever have a problem in this place? (1 = *not at all*; 6 = *very likely*)
6. Do you consider it likely that others may ever have a problem in this place? (1 = *not at all*; 6 = *very likely*)
7. In the last few weeks, how frequently have you heard other people close to you say that they had a problem in this place? (1 = *never*; 6 = *many times*)
8. In the last few weeks, how many times did you have a problem in this place or did you see others having it? (1 = *never*; 6 = *many times*)
9. In the last few weeks, how frequently have you been afraid that something might happen to you in this place? (1 = *never*; 6 = *many times*)
10. In the last few weeks, how frequently have you heard that people had a problem in this place? (1 = *never*; 6 = *many times*)
11. In your experience, you would say this neighborhood is … (1 = *unsafe*; 6 = *safe*)
12. In general, people close to me consider this neighborhood … (1 = *unsafe*; 6 = *safe*)
13. Most people in Barcelona probably consider this neighborhood to be … (1 = *unsafe*; 6 = *safe*)

Note. [a] Applied only to respondents surveyed within the park limits (park users). [b] Applied only when respondents reported using the park more than once.

2.4. Data analysis

2.4.1. Survey study, neighborhood characteristics, and crime data

We first performed a descriptive analysis of the items in the questionnaire. Questions from 5 to 10 were reverse-scored, allowing us to calculate an individual score for each respondent. Student's t and ANOVA tests were used to identify mean differences between the general dimension of PS, subscales, and demographics. We used the Scheffé test to assess differences in the PS means by study sites and classify them into three groups according to how safe they were perceived (PS Level). We also conducted Spearman correlations between the PS means by study sites and objective crime, indicators at the district level, and demographics of the population living close to studied POSs. Finally, two proportion z-tests were calculated to detect differences between demographics of residents in the selected Census Units and observed park users for each site. Data were analyzed with Stata v.14.2.

2.4.2. Park users estimation

We estimated the number of observed park users based on how individuals and groups were coded in the observational instrument. The exact number was obtained for individuals and groups of two people. When the size of groups was 3–5, 6–10, or 10–20, the numbers were estimated based on class marks. Regarding sex in groups, we considered that 75%, 50%, and 25% were women when the sex composition was coded as mostly women, equally mixed, and mostly men, respectively. The same rule applied to estimate the number of Whites and non-Whites.

2.4.3. Polar coordinate analysis

First of all, Chi-square tests were performed to identify which criteria

Table 2
Number of conducted observational sessions.

Observational period	Study sites							
	FOLC	SPAU	SOLL	PEGA	LESS	INFA	*n*	*M*
10:00 a.m to 11:00 a.m.	4	4	4	4	4	5	25	4.2
11:00 a.m. to 12:00 p.m.	4	5	5	5	5	4	28	4.7
12:00 p.m. to 01:00 p.m.	5	3	4	4	4	5	25	4.2
01:00 p.m. to 02:00 p.m.	3	4	5	5	4	5	26	4.3
04:00 p.m. to 05:00 p.m.	6	4	5	5	5	4	29	4.8
05:00 p.m. to 06:00 p.m.	4	5	4	4	4	3	24	4.0
06:00 p.m. to 07:00 p.m.	5	5	5	5	5	5	30	5.0
07:00 p.m. to 08:00 p.m.	5	6	4	4	5	5	29	4.8
	36	36	36	36	36	36	216	4.5

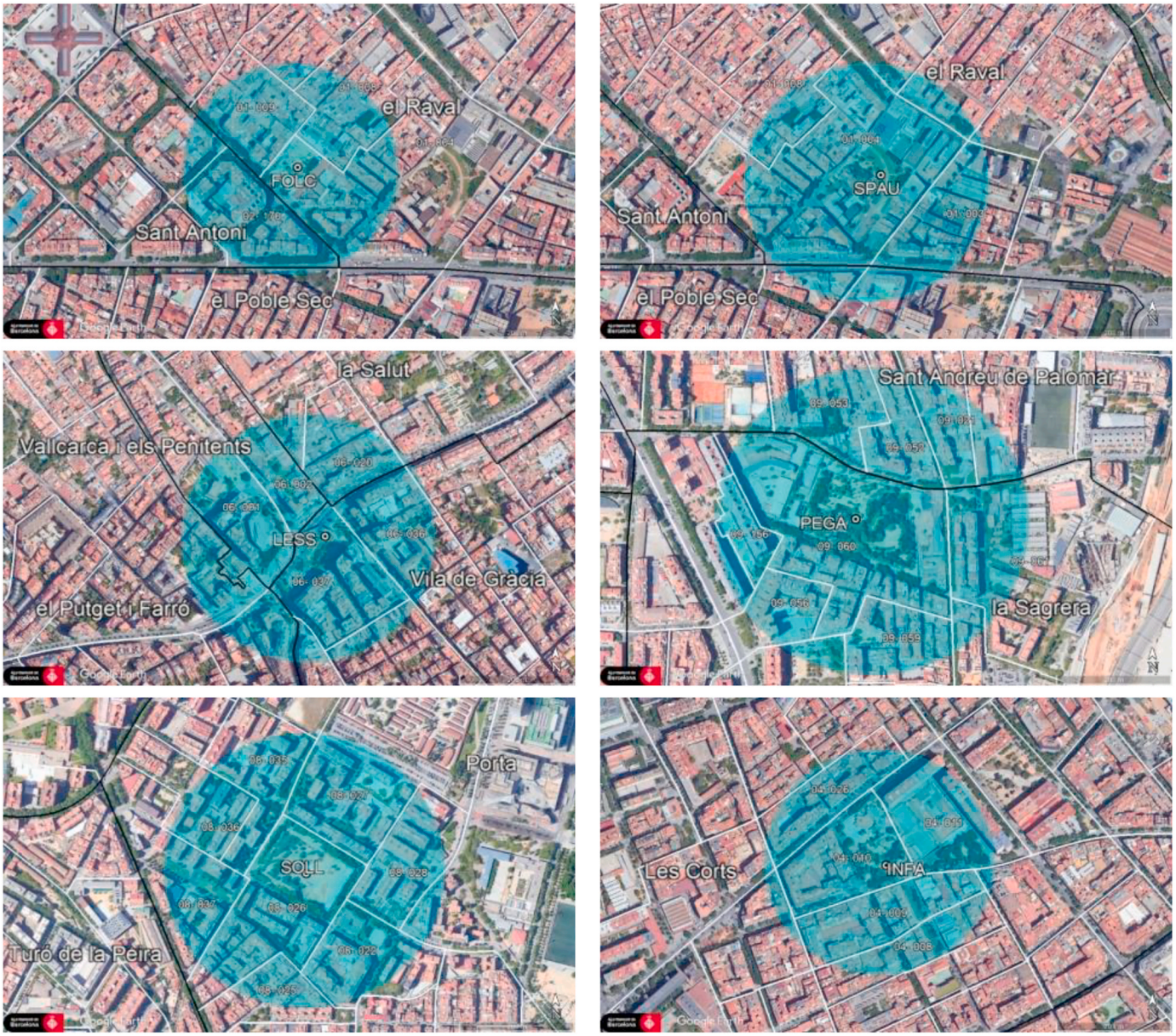


Fig. 2. Geographic location of study sites.
Note. Circles show PSA limits where questionnaires were administered. Lines indicate Census Sections limits; those labeled were included in the analysis. Black lines also reflect neighborhood boundaries.

from the observational instrument showed associations between observed frequencies and PS Levels. To identify the complex characterization of study sites with different levels of PS, we choose the polar coordinate analysis (Sackett, 1980). In this work, this analysis is based on building a map that shows the statistical association between the PS Level (focal behavior) and the rest of the criteria included in the observational instrument (conditional behaviors). This technique, which considers as data the adjusted residuals obtained in the lag sequential analysis (Bakeman, 1978), complements the prospective (forward feeding) and retrospective (backward feeding) perspectives. We performed a prospective and retrospective lag sequential analysis with multilevel data, from lag −5 to lag +5, using the software GSEQ 5.1 (Bakeman & Quera, 2011). Once standardized, Z values are reduced using the Z_{sum} parameter (Cochran, 1954). The calculation of the Z_{sum} parameter, whose formula is $Z = \frac{\sum x}{\sqrt{n}}$ (where n stands for the number of lags), allows for the obtention of as many Z_{sum} as lags for each specific category from the prospective and retrospective perspectives. Z_{sum} is based on the principle that the sum of a number n of independent Z scores is normally distributed with $\mu = 0$ and $\sigma = 1$. Each Z_{sum} may carry a positive or negative sign, which will therefore determine which of the four quadrants will contain the categories corresponding to the conditional behaviors in relation to the focal behavior being displayed. The technique allows for identifying the activation or inhibition relationship between the focal behavior and the conditional behaviors. The association is shown both quantitatively (length of the vector) and qualitatively (quadrant I, II, III, or IV). The length or radio parameters of the vector and the angle are calculated using the Z_{sum} criterium and Z_{sum} matching values for each of the conditional behaviors.

$$Length = \sqrt{(Z^2_{sum}Prospective + Z^2_{sum}Retrospective)}$$

$$\varphi = arc\ sen \frac{Z_{sum}Retrospective}{Length}$$

For a significance level of .05 and .01, the length of the vector has to

be ≤ −1.96 or ≥ +1.96, and ≤ −2.58 or ≥ +2.58, respectively. Once the length and the angle corresponding to each vector are obtained, the angle must be adjusted, taking the quadrant where each vector will be located into account. As a result, the vectors located in the first quadrant (Quadrant I) reveal that the focal and conditional behaviors are mutually activated, the vectors located in the second quadrant (Quadrant II) show that the focal behavior inhibits the conditional behavior but not inversely, the vectors located in the third quadrant (Quadrant III) indicate that both focal and conditional behaviors are mutually inhibited and, finally, the vectors located in the fourth quadrant (Quadrant IV) demonstrate that the conditional behavior is activated by the focal behavior but not inversely (Fig. 3). We used the free HOISAN software (https://menpas.com) to calculate the parameters (Hernández-Mendo et al., 2012). The resulting polar coordinate maps were optimized with the free program Hoisan_to_R (https://jairodmed.shinyapps.io/HOISAN_to_R_2021/).

3. Results

3.1. Questionnaire results

A similar number of questionnaires were conducted in each park, with 975 people recruited. After excluding those with missing answers, 924 questionnaires were finally included in the analysis.

3.1.1. Differences in PS by demographics

As shown in Table 4, the number of respondents according to demographics were correctly balanced. We first obtained total scores for the general PS dimension, showing that people perceived study sites as moderately safe (M = 4.60, 95% CI [4.5, 4.6]). Men reported significantly higher ratings on PS than women ($p < .001$), as also did respondents living in the neighborhood for five to 20 years ($p = .002$). No other associations were seen in the general dimension between PS and demographics. However, new relationships were observed in the subscales. Park users ($p < .001$), non-Whites ($p = .005$), young people ($p = .048$), males ($p < .001$), and those residing in the neighborhood for five to 20 years ($p = .021$) expressed lower levels of FC, attending to their higher scores on the first subscale. Females ($p < .001$) and those interviewed at night ($p = .052$) showed a higher level of perceived risk. Females ($p = .040$), those living in the neighborhood ($p < .001$), and park users ($p = .032$) reported having heard more often about experiences of victimization in study sites. Males ($p = .031$) and respondents living in the neighborhood for five to 20 years ($p < .001$) had better opinions about the neighborhood in terms of safety. Finally, we found significant differences between means by study sites, both in the general dimension and the four components ($p < .001$).

3.1.2. Grouping study sites according to PS scores

We decided to classify parks into three categories attending to mean differences in the general PS dimension by study sites (Table 5). Sóller Square and Pegaso's Park ($p = .146$) configured the medium PS group (MPS), while Lesseps Square and Infante's Gardens ($p = .956$) configured the high PS group (HPS). Although the means of Folch i Torres Square and Sant Pau del Camp's Gardens were not equal, both were lower than 4.0 and configured the low PS group (LPS) to preserve comparability between groups. The geographic location of study sites can be seen in Fig. 4.

3.2. Describing park use regarding PS levels

We estimate that 14,120 people (59.2 males vs. 40.8% females) were recorded at study sites during the observational study. We have structured these results in 4 sections: park user's characteristics (individuals and groups), activities, and environmental features. In every section, we enumerate the relationships observed by polar coordinate analysis, ordered by relevancy according to the length of vectors. Figures include the name of conditional behaviors and quadrants in which the vectors are located, together with the prospective and retrospective Z_{sum} values, ratio (Y/radius), length of the radius, and angle of the vector. To simplify the visualization of relevant results, polar coordinate maps only

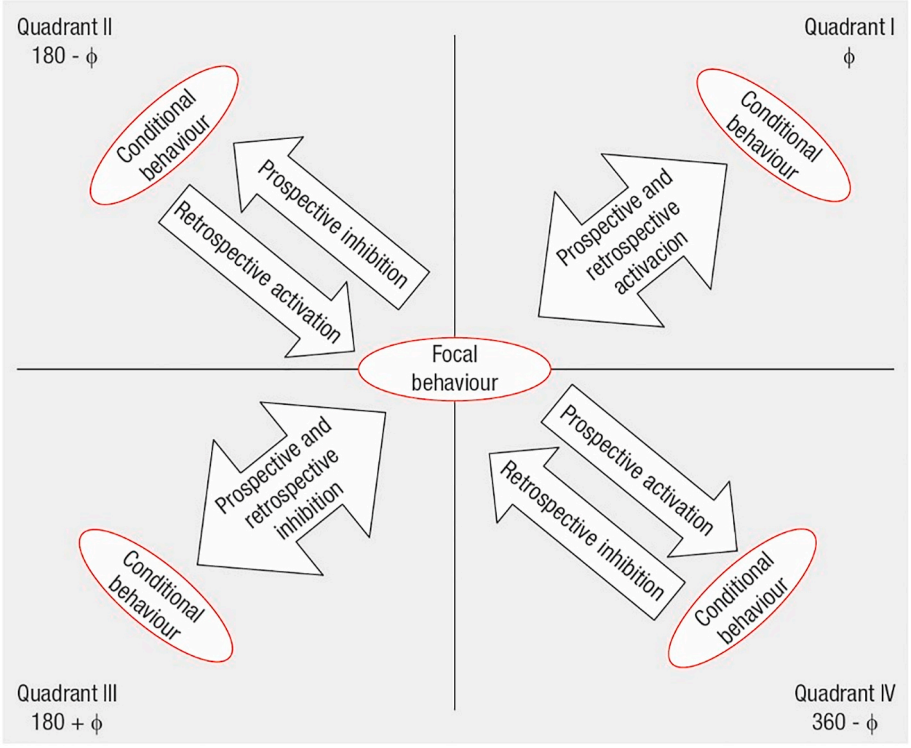


Fig. 3. Diagram showing relationships between focal and conditional behaviors in a polar coordinate map.
Note. Adapted from Aragón et al. (2016).

Table 4
Questionnaire results by demographics and study sites.

			PS			FC			PR			EV			ON		
Variables	*n*	%	*M*	95% CI	*p*	*M*	95% CI	*p*	*M*	95% CI	*p*	*M*	95% CI	*p*	*M*	95% CI	*p*
Total score	924	100	4.6	[4.5, 4.6]	-	4.0	[3.9, 4.1]	-	4.0	[3.9, 4.1]	-	5.7	[5.6, 5.7]	-	4.0	[3.9, 4.1]	-
Surveyed within park boundaries[1]																	
Yes (park users)	450	48.7	4.6	[4.5, 4.7]	.894	4.9	[4.8, 5.0]	**<.001**	4.0	[3.8, 4.1]	.920	5.6	[5.6, 5.7]	**.032**	4.0	[3.9, 4.2]	.486
No (non-users)	474	51.3	4.6	[4.5, 4.7]		3.2	[3.1, 3.3]		4.0	[3.9, 4.1]		5.7	[5.7, 5.8]		4.0	[3.9, 4.1]	
Moment of the day[2]																	
Morning	319	34.5	4.6	[4.5, 4.8]	.385	4.1	[3.9, 4.2]	.445	4.1	[4.0, 4.2]	**.052**	5.7	[5.6, 5.8]	.414	4.1	[3.9, 4.2]	.705
Afternoon	322	34.8	4.6	[4.5, 4.7]		4.1	[3.9, 4.2]		4.0	[3.8, 4.1]		5.6	[5.6, 5.7]		4.0	[3.8, 4.2]	
Night	283	30.7	4.5	[4.4, 4.6]		3.9	[3.8, 4.1]		3.8	[3.7, 4.0]		5.7	[5.6, 5.8]		4.0	[3.8, 4.1]	
Living in the neighborhood[1]																	
Yes	702	76.0	4.6	[4.5, 4.6]	.098	4.0	[3.9, 4.1]	.906	3.9	[3.8, 4.0]	.071	5.6	[5.6, 5.7]	**<.001**	4.0	[3.9, 4.1]	.199
No	222	24.0	4.7	[4.6, 4.8]		4.0	[3.9, 4.2]		4.1	[3.9, 4.3]		5.9	[5.8, 5.9]		3.9	[3.7, 4.1]	
Years living in the neighborhood[2]																	
Less than 1	45	6.4	4.2	[3.8, 4.6]	**.002**	3.6	[3.1, 4.2]	**.021**	3.5	[3.0, 4.0]	.039	5.4	[5.1, 5.7]	.107	3.5	[3.1, 4.0]	**<.001**
Between 1 and 5	86	12.3	4.4	[4,2, 4.6]		3.9	[3.6, 4.2]		3.8	[3.5, 4.1]		5.7	[5.6, 5.8]		3.8	[3.5, 4.1]	
Between 5 and 20	212	30.2	4.7	[4.6, 4.8]		4.2	[4.1, 4.4]		4.1	[3.9, 4.2]		5.7	[5.6, 5.8]		4.3	[4.1, 4.4]	
More than 20	359	51.1	4.5	[4.4, 4.6]		4.0	[3.8, 4.1]		3.9	[3.8, 4.1]		5.6	[5.5, 5.7]		4.0	[3.9, 4.2]	
Sex[1]																	
Males	450	48.7	4.7	[4.6, 4.8]	**<.001**	4.2	[4.1, 4.3]	**<.001**	4.2	[4.1, 4.3]	**<.001**	5.7	[5.7, 5.8]	**.040**	4.1	[4.0, 4.2]	**.031**
Females	474	51.3	4.4	[4.4, 4.5]		3.8	[3.7, 3.9]		3.8	[3.7, 3.9]		5.6	[5.6, 5.7]		3.9	[3.8, 4.1]	
Age[2]																	
18 to 24	162	17.5	4.6	[4.4, 4.7]	.590	4.1	[3.9, 4.3]	**.048**	3.9	[3.7, 4.1]	.510	5.7	[5.6, 5.8]	.116	4.0	[3.8, 4.2]	.983
25 to 45	383	41.5	4.6	[4.5, 4.7]		4.1	[4.0, 4.2]		4.1	[3.9, 4.2]		5.7	[5.7, 5.8]		4.0	[3.9, 4.1]	
46 to 64	239	25.9	4.6	[4.4, 4.7]		4.0	[3.8, 4.1]		3.9	[3.8, 4.1]		5.7	[5.6, 5.8]		4.0	[3.8, 4.2]	
≥65	140	15.1	4.5	[4.3, 4.7]		3.8	[3.6, 4.0]		3.9	[3.6, 4.1]		5.6	[5.4, 5.7]		4.1	[3.8, 4.3]	
Race[1]																	
Whites	612	81.1	4.7	[4.6, 4.7]	.592	4.0	[3.9, 4.1]	**.005**	4.1	[4.0, 4.2]	.420	5.7	[5.7, 5.8]	.132	4.1	[4.0, 4.2]	.923
Non-Whites	143	18.9	4.6	[4.5, 4.7]		4.3	[4.1, 4.5]		4.0	[3.8, 4.2]		5.6	[5.5, 5.8]		4.1	[3.9, 4.3]	
Study sites																	
FOLC	154	16.7	3.5	[3.4, 3.7]	**<.001**	3.2	[3.0, 3.4]	**<.001**	2.6	[2.4, 2.7]	**<.001**	5.5	[5.3, 5.6]	**<.001**	2.5	[2.3, 2.7]	**<.001**
SPAU	162	17.5	3.9	[3.8, 4.0]		3.6	[3.4, 3.8]		3.3	[3.1, 3.5]		5.2	[5.1, 5.4]		2.9	[2.8, 31]	
SOLL	157	17.0	4.6	[4.5, 4.8]		4.2	[4.0, 4.4]		4.0	[3.8, 4.2]		5.7	[5.7, 5.8]		4.1	[3.9, 4.2]	
PEGA	151	16.3	4.9	[4.8, 5.0]		4.2	[4.0, 4.3]		4.2	[4.0, 4.3]		5.9	[5.8, 5.9]		4.7	[4.5, 5.8]	
LESS	139	15.0	5.2	[5.2, 5.3]		4.4	[4.2, 4.5]		5.0	[4.8, 5.1]		5.8	[5.8, 5.9]		4.9	[4.8, 5.0]	
INFA	161	17.4	5.3	[5.3, 5.4]		4.6	[4.5, 4.8]		4.9	[4.8, 5.0]		6.0	[5.9, 6.0]		5.1	[5.0, 5.2]	

Note. PS = *perceived safety*, FC = *fear of crime*, PR = *perceived risk*, EV = *experience of victimization*, ON = *opinion about the neighborhood*. 6-point rating scales (1 = *unsafe*; 6 = *safe*). Results regarding two demographic variables are not included for not showing significant associations: *Moment of the week* (*working day*, *weekend*) and *Born in the neighborhood (yes, no)*. [1] Student's t-test for independent variables and equal variances. [2] ANOVA test. Significant differences are marked in bold.

include statistically significant associations between the focal and conditional behaviors ($p < .01$) located in quadrants I (prospective and retrospective activation) or III (prospective and retrospective inhibition). We present full descriptive results in Table A1 in the Supplementary materials section. Adjusted residuals results obtained in the lag sequential analysis and performed for the LPS, MPS, and HPS groups can also be found in Table A2, Table A3, and Table A4, respectively.

Table 5
PS means comparison by study sites.

	FOLC	SPAU	SOLL	PEGA	LESS
SPAU	0.358 (.001)				
SOLL	1.098 (<.001)	0.740 (<.001)			
PEGA	1.332 (<.001)	0.974 (<.001)	0.234 (.146)		
LESS	1.699 (<.001)	1.341 (<.001)	0.601 (<.001)	0.368 (<.001)	
INFA	1.785 (<.001)	1.427 (<.001)	0.687 (<.001)	0.453 (<.001)	0.086 (.956)

Note. Mean differences reported; *p*-values in parentheses.

3.2.1. Park users characteristics: individuals

We observed a total of 2,689 individuals being alone. Significant relationships located in quadrant I were seen between LPS and non-Whites, male adults, males, adults, male children, and children; while Whites, elders, females, male elders, female adults, female elders, female young adults, and young adults were located in quadrant III. Regarding MPS, significant relationships located in quadrant I were observed with Whites, elders, male elders, and female elders; and located in quadrant III with non-Whites, children, young adults, male children, female young adults, male young adults, female children, male adults, and adults. Finally, HPS showed relationships located in quadrant I with females, Whites, female young adults, young adults, female adults, female elders, elders, and male young adults; while male adults, male individuals, non-Whites, and adults were located in quadrant III (Fig. 5)

3.2.2. Park users characteristics: groups

Observers coded 3,262 groups with an estimated population of 11,431 people (57.2 males vs. 42.8% females). As seen in Fig. 6, significant relationships located in quadrant I were found between LPS and groups of non-Whites, males, adults, mixed-raced groups, and young adults; and located in quadrant III with groups of Whites, females, children and/or young adults with adults and/or elders, elders, mixed-sex groups, and adults with elders. MPS showed significant relationships in quadrant I with groups of Whites, elders, children and/or young adults with adults and/or elders, mixed-sex groups, and children only. In contrast, groups formed by non-Whites, young adults, mixed-raced groups, females, adults, and adults with elders were located in quadrant III. Finally, we identified significant relationships located in quadrant I between HPS and groups of Whites, females, children and/or young adults with adults and/or elders, adults with elders, elders, mixed-sex groups, and young adults; and located in quadrant III with groups formed by males, non-Whites, adults, mixed-raced groups, children, and children with young adults.

3.2.3. Park use

As shown in Fig. 7, significant relationships located in quadrant I were found between LPS and the presence of incivilities and homelessness, enjoying the scenery, sleeping, bicycles, no vehicles, motorized vehicles, and picnicking. In contrast, relationships with the absence of incivilities and homelessness, walking, cognitive uses, strollers, playing activities, wheelchairs, and practicing sports were located in quadrant III. MPS established significant relationships in quadrant I with walking, the absence of homelessness and incivilities, playing activities, and bicycles; and located in quadrant III with enjoying the scenery, the presence of homelessness and incivilities, picnicking, sleeping, cognitive uses, and no vehicles. Regarding HPS, mutually excitatory relationships (quadrant I) were detected with the absence of incivilities and homelessness, enjoying the scenery, cognitive uses, strollers, wheelchairs, picnicking, playing, and practicing sports. Mutually inhibitory relationships (quadrant III) were seen with walking, the presence of incivilities and homelessness, bicycles, sleeping, and no vehicles.

3.2.4. Environmental features

Fig. 8 shows the polar coordinates results for this dimension. LPS was prospectively and retrospectively activated (quadrant I) by park users in dirty areas, dark areas during daylight observations, close to tags or graffiti, and hidden spots. MPS showed significant relationships in quadrant I with park users in hidden spots, clean areas, close to tags and graffiti, and well-illuminated areas during daylight observational sessions. Finally, HPS was mutually activated by the presence of park users in clean zones, in areas where they were easily seen by the rest of the park users, in the absence of tags or graffiti, and in well-illuminated areas during daylight observational sessions.

3.3. PS, crime data, and sociodemographics

We wanted to address if there was a link between PS regarding a specific POS and (a) objective crime, (b) safety indicators at district level, and (c) sociodemographic characteristics of the neighborhood where POSs are located. To provide some evidence, we examined the

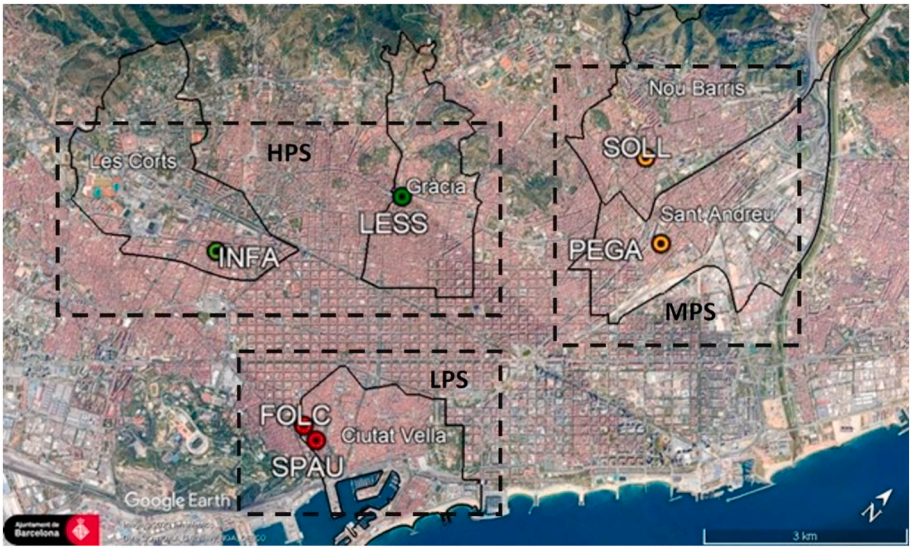
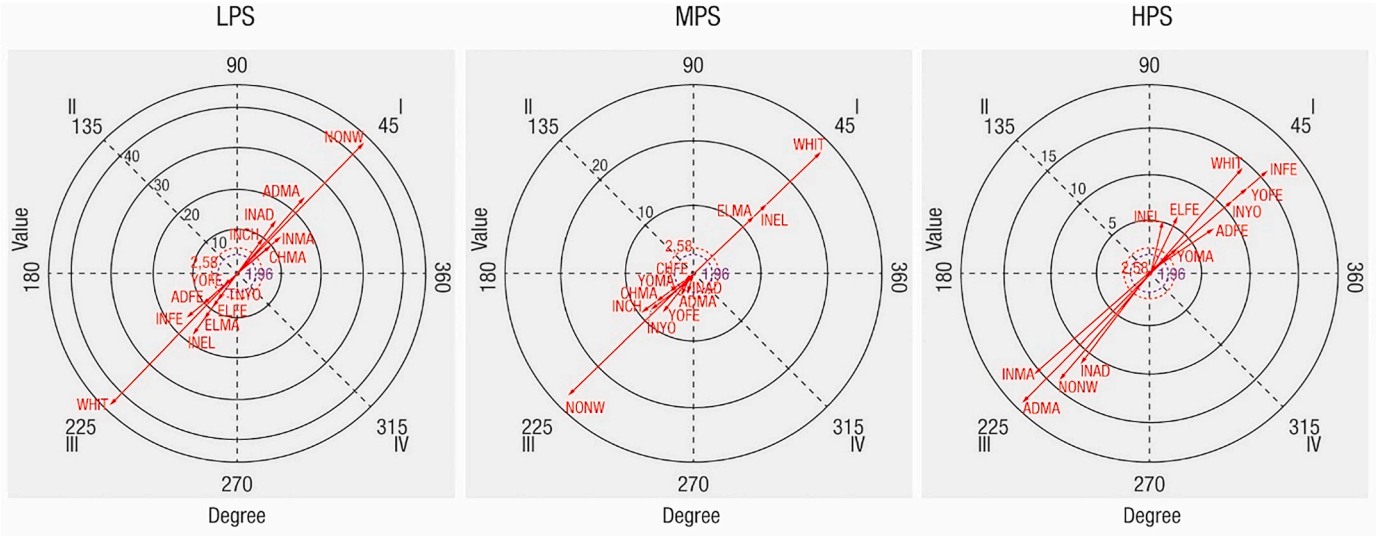


Fig. 4. Study sites and PS levels.
Note. PS Levels are low (LPS), medium (MPS), and high (HPS).



Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
INMA	I	12.30	10.67	0.66	16.29**	40.95
INFE	III	-12.30	-10.67	-0.66	16.29**	220.95
INCH	I	6.68	7.80	0.76	10.27**	49.41
INYO	III	-2.66	-2.80	-0.72	3.86**	226.45
INAD	I	9.58	12.88	0.80	16.05**	53.35
INEL	III	-11.20	-15.23	-0.81	18.91**	233.67
CHMA	I	7.81	6.80	0.66	10.36**	41.03
CHFE	II	-0.50	3.75	0.99	3.78**	97.61
YOMA	I	1.47	0.22	0.15	1.48	8.67
YOFE	III	-6.13	-4.74	-0.61	7.75**	217.73
ADMA	I	16.26	18.22	0.75	24.41**	48.25
ADFE	III	-7.86	-6.22	-0.62	10.02**	218.35
ELMA	III	-9.23	-12.31	-0.80	15.38**	233.14
ELFE	III	-5.25	-7.54	-0.82	9.19**	235.11
WHIT	III	-30.62	-31.55	-0.72	43.96**	225.86
NONW	I	30.62	31.55	0.72	43.96**	45.86

Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
INMA	I	1.03	0.91	0.66	1.38	41.31
INFE	III	-1.03	-0.91	-0.66	1.38	221.31
INCH	III	-7.75	-5.13	-0.55	9.29**	213.51
INYO	III	-6.46	-5.64	-0.66	8.57**	221.13
INAD	III	-1.37	-2.54	-0.88	2.89**	241.65
INEL	I	9.32	9.07	0.70	13.01**	44.22
CHMA	III	-7.01	-4.82	-0.57	8.51**	214.51
CHFE	III	-3.25	-1.80	-0.48	3.72**	209.00
YOMA	III	-4.76	-3.36	-0.58	5.82**	215.22
YOFE	III	-4.04	-4.58	-0.75	6.11**	228.56
ADMA	III	-1.72	-3.24	-0.88	3.67**	242.00
ADFE	I	0.41	0.80	0.89	0.89	62.92
ELMA	I	9.03	9.02	0.71	12.77**	44.97
ELFE	I	2.00	1.55	0.61	2.53*	37.74
WHIT	I	19.08	18.40	0.69	26.51**	43.95
NONW	III	-19.08	-18.40	-0.69	26.51**	223.95

Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
INMA	III	-11.94	-10.36	-0.66	15.80**	220.95
INFE	I	11.94	10.36	0.66	15.80**	40.95
INCH	IV	1.24	-2.16	-0.87	2.49*	299.97
INYO	I	8.38	7.76	0.68	11.42**	42.79
INAD	III	-7.28	-9.09	-0.78	11.64**	231.30
INEL	I	1.31	5.07	0.97	5.24**	75.51
CHMA	III	-0.46	-1.55	-0.96	1.62	253.62
CHFE	IV	3.47	-1.65	-0.43	3.85**	334.54
YOMA	I	3.12	2.93	0.68	4.28**	43.18
YOFE	I	9.23	8.50	0.68	12.55**	42.66
ADMA	III	-12.91	-13.19	-0.71	18.45**	225.62
ADFE	I	6.63	4.79	0.59	8.18**	35.86
ELMA	II	-0.18	2.53	1.00	2.54*	94.14
ELFE	I	2.83	5.26	0.88	5.97**	61.77
WHIT	I	9.46	10.81	0.75	14.37**	48.82
NONW	III	-9.46	-10.81	-0.75	14.37**	228.82

Fig. 5. Polar coordinate results considering PS levels as the focal behavior and criteria describing individuals as target behaviors.
Note. INMA = male, INFE = female, INCH = child, INYO = young adult, INAD = adult, INEL = elder, CHMA = child male, CHFE = child female, YOMA = young adult male, YOFE = young adult female, ADMA = adult male, ADFE = adult female, ELMA = elder male, ELFE = elder female, WHIT = White, NONW = non-White. *p < .05. **p < .01.

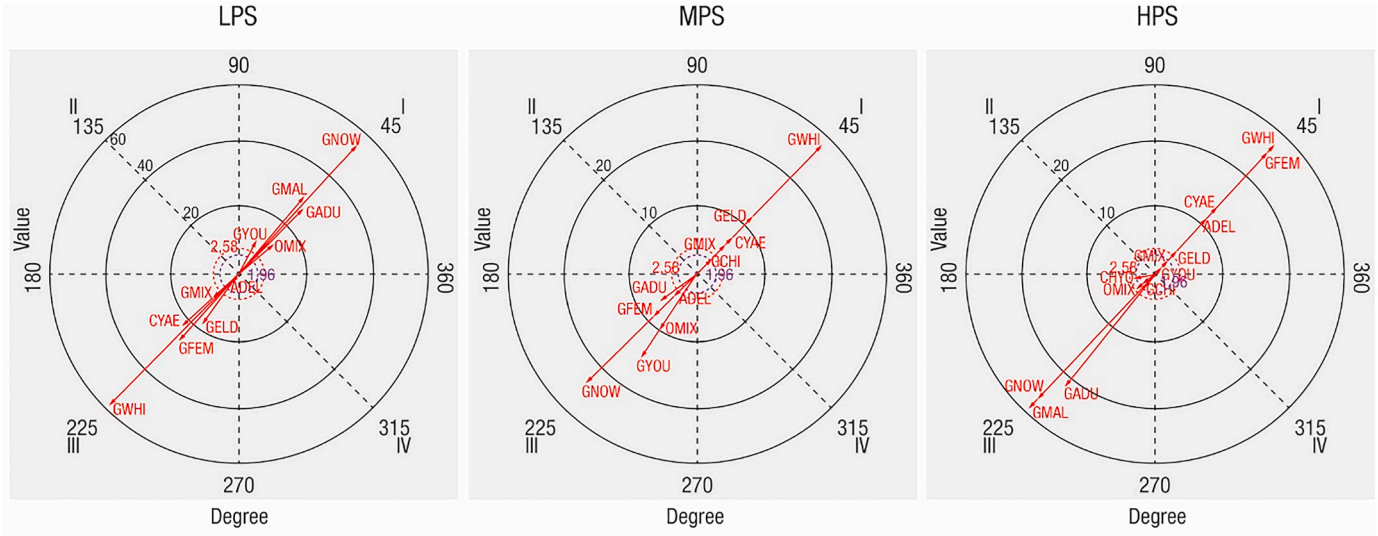
relationship between the PS scores by POSs and several indicators (Table 6). PS did not correlate with the total number of crime events or any specific type of crime event that occurred in each of the study sites, according to official police records. No association was also seen between PS and the victimization rate at district level. Contrarily, scores on PS by POSs strongly correlated with PS at district level, evidencing that PS regarding a specific POS is strongly connected to how safe the district is perceived. Among the demographic and socioeconomic characteristics of the population living close to study sites, PS correlated positively with the percentage of high school graduates and inversely with the percentage of unemployed residents.

Finally, we wanted to explore if the observed differences in the proportions of females and non-White park users could be explained by the population's demographic characteristics living close to study sites. As shown in Table 7, the estimated proportion of observed women was significantly lower than the percentage of female residents in all study sites, although differences decreased in POSs with higher scores on PS. In both parks of the LPS group, fewer females resided in adjacent Census Units than in the other two groups, although the difference was not enough to explain the low presence of females in sites perceived as less safe. Regarding the race, mixed results were found. In parks with medium scores in PS, the proportions of non-White park users and non-White residents were equivalent. Contrarily, the ratios in the LPS and HPS groups were different. In both cases, one park was used by a higher proportion of non-Whites and the other by a smaller proportion than expected according to the census. Estimations of park users according to their age group could not be performed due to limitations regarding how groups were coded in the observational instrument.

4. Discussion

In this work, we proposed a conceptualization of PS based on four inter-related components: FC, perceived risk, experience of victimization, and opinion about the neighborhood. We identified demographics affecting PS scores in the general dimension and the four subscales. Differences in park use between six POSs with different levels of PS were also described. We also performed an environmental assessment and considered objective crime data and the sociodemographic characteristics of the neighborhood where POSs were located.

Results from the questionnaire evidenced significant demographic differences. Women reported significantly less PS, higher levels of FC and perceived risk, having heard more often about experiences of victimization in study sites, and worst opinions about the neighborhood than men did. Older respondents also expressed significantly higher levels of FC than other age groups. Both results support the view that physical and social vulnerability may make certain groups more fearful



Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
GMAL	I	21.60	24.31	0.75	32.52**	48.37
GFEM	III	-15.00	-17.16	-0.75	22.79**	228.84
GMIX	III	-7.77	-8.49	-0.74	11.51**	227.52
GCHI	IV	0.23	-0.56	-0.93	0.6	292.20
GYOU	I	6.51	10.51	0.85	12.36**	58.22
GADU	I	21.10	20.62	0.70	29.50**	44.33
GELD	III	-11.52	-15.05	-0.79	18.96**	232.56
ADEL	III	-6.35	-5.01	-0.62	8.09**	218.31
CHYO	IV	3.54	-0.38	-0.11	3.56**	353.80
CYAE	III	-15.01	-14.71	-0.70	21.02**	224.43
GWHI	III	-41.00	-42.40	-0.72	58.98**	225.96
GNOW	I	38.15	40.73	0.73	55.81**	46.88
OMIX	I	11.36	9.70	0.65	14.93**	40.48

Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
GMAL	IV	0.44	-0.10	-0.23	0.45	346.79
GFEM	III	-5.21	-4.77	-0.68	7.07**	222.49
GMIX	I	4.74	4.86	0.72	6.79**	45.75
GCHI	I	2.83	3.30	0.76	4.34**	49.34
GYOU	III	-9.02	-13.60	-0.83	16.32**	236.46
GADU	III	-5.00	-0.32	-0.06	5.01**	183.68
GELD	I	7.96	7.79	0.70	11.13**	44.38
ADEL	III	-1.99	-3.22	-0.85	3.78*	238.25
CHYO	II	-0.22	1.36	0.99	1.37	99.19
CYAE	I	6.06	5.68	0.68	8.31**	43.15
GWHI	I	19.39	19.80	0.71	27.71**	45.60
GNOW	III	-16.87	-17.01	-0.71	23.96**	225.23
OMIX	III	-7.24	-7.74	-0.73	10.60**	226.90

Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
GMAL	III	-19.83	-21.77	-0.74	29.45**	227.68
GFEM	I	18.29	19.81	0.73	26.96**	47.29
GMIX	I	2.63	3.17	0.77	4.12**	50.29
GCHI	III	-2.81	-2.51	-0.67	3.77**	221.78
GYOU	I	2.46	3.04	0.78	3.91**	50.94
GADU	III	-14.36	-18.25	-0.79	23.22**	231.81
GELD	I	3.02	6.39	0.90	7.07**	64.68
ADEL	I	7.54	7.46	0.70	10.61**	44.69
CHYO	III	-2.97	-0.90	-0.29	3.10**	196.84
CYAE	I	7.89	8.03	0.71	11.26**	45.48
GWHI	I	18.98	19.98	0.73	27.55**	46.47
GNOW	III	-18.74	-21.04	-0.75	28.17**	228.31
OMIX	III	-3.53	-1.62	-0.42	3.89**	204.62

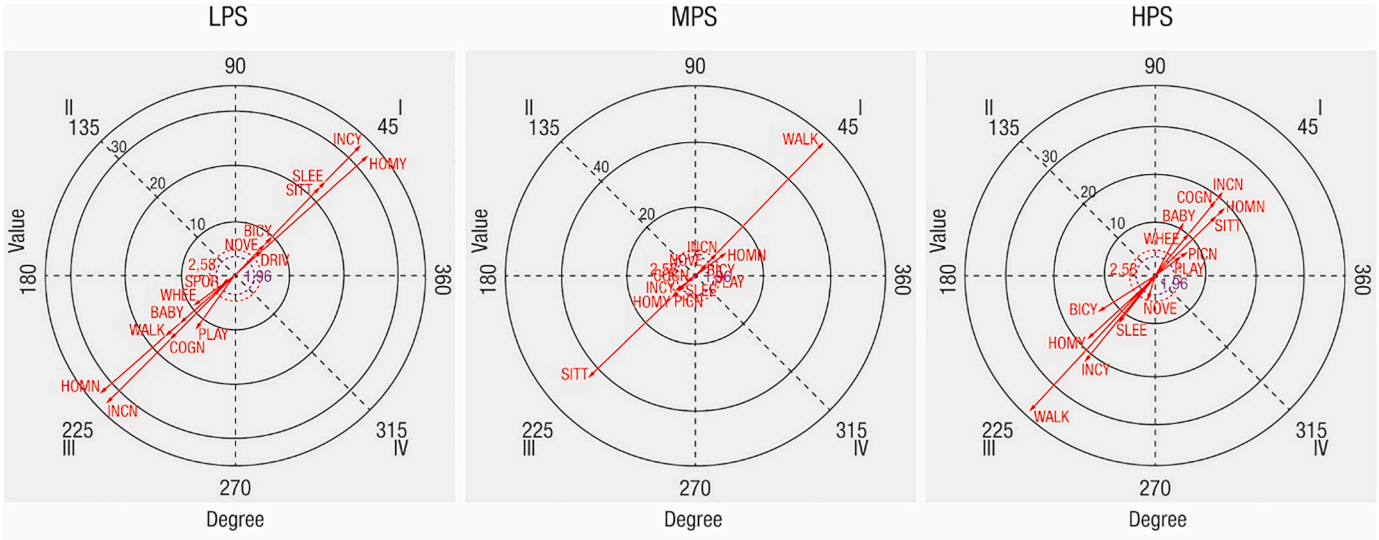
Fig. 6. Polar coordinate results considering PS levels as the focal behavior and criteria describing groups as target behaviors.
Note. GMAL = males only, GFEM = females only, GMIX = mixed-sex group, GCHI = children only, GYOU = young adults only, GADU = adults only, GELD = elders only, ADEL = adults with elders, CHYO = children with young adults, CYAE = children and/or young adults with adults and/or elders, GWHY = Whites only, GNOW = non-Whites only, OMIX = mixed-raced groups. *p < .05. **p < .01.

than others (Pantazis, 2000). PS was influenced by the time living in the neighborhood, being residents for five to 20 years those expressing more PS, less FC, and better opinions about the neighborhood, which is also consistent with previous works on residential stability and place attachment (Brown et al., 2003; Lee et al., 2021). The protective effect of familiarity with the environment can be seen when park users expressed less FC than non-park users and when respondents living in the neighborhood showed no differences in PS than those who do not live, although park users and residents heard more often about experiences of victimization. Although studies from other geographical contexts have traditionally shown higher levels of fear amongst ethnic minorities (Pain, 2000), in this work Whites expressed more FC than non-Whites.

Our results also showed that PS regarding a specific POS strongly and positively correlated with neighborhood poverty (measured by the percentage of unemployment and less educated residents) but not with neighborhood racial composition (measured by the percentage of residents from racial minorities). It has to be noted that Folch i Torres Square and Sant Pau del Camp's Gardens obtained low scores in PS, and both are located in Ciutat Vella, Barcelona's district with the highest proportion of non-White inmigrants, unemployment, and less educated residents. By contrast, Lesseps Square and Infante's Gardens, perceived as safer than other study sites, are located in two middle-class districts characterized by low levels of non-White residents, unemployment, and highly educated residents. The fact that a significantly higher proportion of non-Whites than expected by the census were observed in Lesseps Square reinforces the idea that neighborhood racial composition seems to play a role in the generation of perceived lack of safety that is mediated by socioeconomic status.

Regarding the victimization perspective, respondents who reported less PS were not those surveyed where crime mainly occurred, according to official police records and district-level victimization rates. The fact that a significantly higher number of pickpocketing events occurred in Lesseps Square, despite respondents perceived this POS as safer than most of the study sites, evidenced that PS needs to be explained by other factors rather than the objective risk of being victimized. However, no crime events were reported in Infante's Gardens, where respondents expressed the highest score on PS, which shows a partial relationship between PS and objective crime that needs further exploration.

Results from the observational study revealed important based-sex differences in park use. We estimated that significantly more males than females used study sites during the observational sessions. The difference was greater in individual park users than in groups, and it was seen among all ages, except for children. Polar Coordinate Analysis allowed us to identify the complex relationships between the criteria included on the observational instrument and PS. The presence of female individuals (especially young adults, adults, and elders), groups of women, and mixed-sex groups significantly increased in POSs with higher scores on PS. Polko & Kimic (2022) have recently shown that women attach more significance than men to certain factors of the places they choose for outdoor activities, which is coherent with the fact that



Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
SITT	I	16.26	16.23	0.71	22.97**	44.94
PICK	I	0.78	2.16	0.94	2.29*	70.05
SLEE	I	16.11	16.61	0.72	23.14**	45.86
PLAY	III	-6.71	-9.12	-0.81	11.32**	233.66
WALK	III	-13.30	-11.81	-0.66	17.79**	221.61
SPOR	III	-2.67	-2.68	-0.71	3.79**	225.05
COGN	III	-11.31	-11.32	-0.71	16.00**	225.02
NOVE	I	5.47	6.59	0.77	8.57**	50.32
DRIV	I	3.45	1.64	0.43	3.82**	25.39
BICY	I	7.24	5.92	0.63	9.35**	39.29
BABY	III	-9.50	-10.04	-0.73	13.82**	226.57
WHEE	III	-7.74	-6.18	-0.62	9.90**	218.60
INCN	III	-23.60	-24.03	-0.71	33.68**	225.52
INCY	I	23.60	24.03	0.71	33.68**	45.52
HOMN	III	-24.88	-22.17	-0.67	33.33**	221.71
HOMY	I	24.88	22.17	0.67	33.33**	41.71

Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
SITT	III	-30.38	-29.32	-0.69	42.22**	223.99
PICK	III	-7.07	-6.48	-0.68	9.58**	222.50
SLEE	III	-6.37	-5.87	-0.68	8.66**	222.66
PLAY	I	5.94	3.63	0.52	6.96**	31.39
WALK	I	40.07	41.04	0.72	57.36**	45.68
SPOR	I	1.19	0.31	0.25	1.23	14.49
COGN	III	-2.81	-3.08	-0.74	4.17**	227.57
NOVE	III	-3.43	-0.40	-0.12	3.45**	186.70
DRIV	II	-3.96	0.56	0.14	4.00**	171.90
BICY	I	5.64	2.63	0.42	6.22**	24.96
BABY	IV	2.50	-1.54	-0.52	2.93**	328.35
WHEE	I	0.02	0.49	1.00	0.49	87.92
INCN	I	7.82	5.04	0.54	9.31**	32.82
INCY	III	-7.82	-5.04	-0.54	9.31**	212.82
HOMN	I	9.23	7.31	0.62	11.78**	38.37
HOMY	III	-9.23	-7.31	-0.62	11.78**	218.37

Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
SITT	I	13.63	12.61	0.68	18.56**	42.77
PICK	I	5.85	4.06	0.57	7.12**	34.74
SLEE	III	-8.50	-9.43	-0.74	12.69**	227.96
PLAY	I	0.49	4.80	0.99	4.83**	84.20
WALK	III	-25.26	-27.40	-0.74	37.27**	227.33
SPOR	I	1.28	2.12	0.85	2.47*	58.75
COGN	I	12.72	12.98	0.71	18.18**	45.58
NOVE	III	-1.72	-5.53	-0.95	5.79**	252.71
DRIV	IV	0.58	-1.99	-0.96	2.07*	286.28
BICY	III	-11.70	-7.73	-0.55	14.03**	213.45
BABY	I	6.18	10.41	0.86	12.11**	59.29
WHEE	I	6.92	5.08	0.59	8.58**	36.27
INCN	I	13.87	16.83	0.77	21.81**	50.52
INCY	III	-13.87	-16.83	-0.77	21.81**	230.52
HOMN	I	13.71	13.07	0.69	18.94**	43.63
HOMY	III	-13.71	-13.07	-0.69	18.94**	223.63

Fig. 7. Polar coordinate results considering PS levels as the focal behavior and criteria describing park user's activities as target behaviors.
Note. SITT = enjoying the scenery, PICK = picnicking, SLEE = sleeping, PLAY = playing, WALK = walking, SPOR = practicing sports, COGN = reading or playing cards, NOVE = no vehicle, DRIVE = motorized vehicles, BICY = bicycle, BABY = stroller, WHEE = wheelchair, INCN = incivilities absence, INCY = incivilities presence, HOMN = homelessness absence, HOMY = homelessness presence. Individuals and groups using skates or rollers were excluded from the analysis for representing less than 1%. *p < .05. **p < .01.

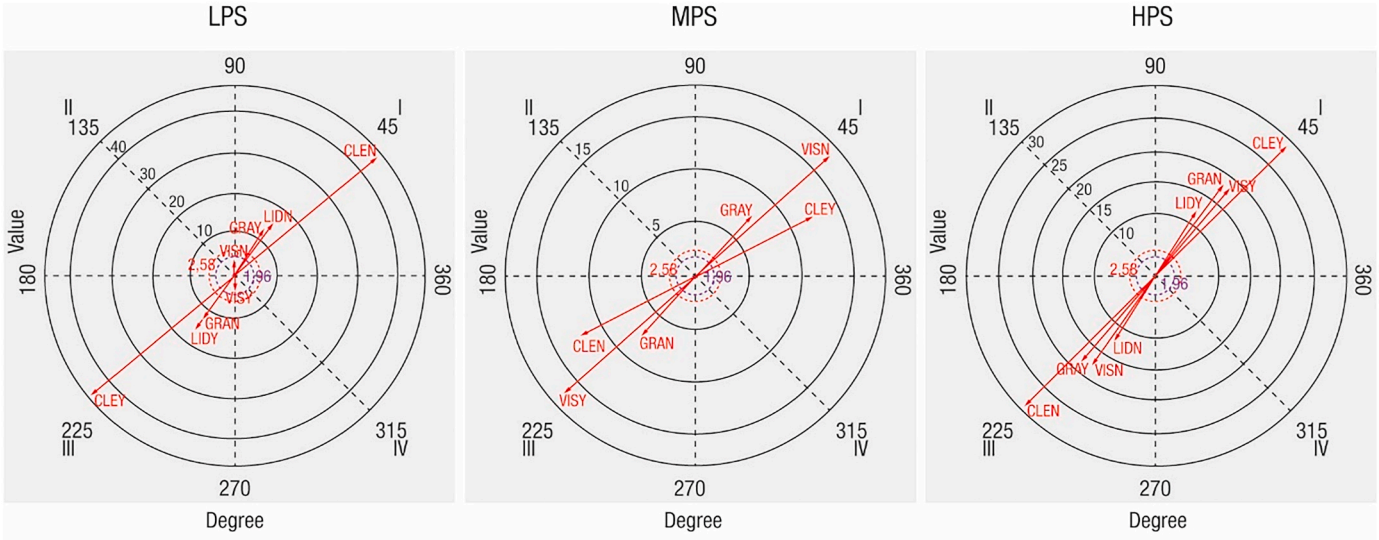
they were more present in POSs with high PS levels.

Regarding the age of individuals, adults were the most common group, followed by elders, young adults, and children, and this proportion remained constant in all three PS groups. POSs perceived as less safe were characterized by the presence of individual male adults and male children, while female young adults, elders, and female adults were underrepresented. Inversely, POSs with medium scores in PS attracted more individual elders, mostly male elders, while those perceived safer attracted significantly more female adults, female elders, and young adults of both sexes, to the detriment of male adults. Accordingly, in POSs perceived safer, we found a significantly higher proportion of groups formed by young adults, elders, adults with elders, and children and/or young adults accompanied by adults and/or elders. Meanwhile, in POSs with low PS, the groups more represented were those formed by adults only and young adults only, at the expense of other more vulnerable groups. In the light of these results, we can conclude that POSs with better perceptions of safety were more inclusive and democratic by attracting a more significant proportion of females and groups of different ages. This inclusivity was also supported by a greater proportion of park users with strollers and wheelchairs observed in POSs with higher scores on PS.

Among the demographic characteristics of park users, the race showed the most intense relationship with PS, according to the length of vectors shown in the polar coordinate maps. The proportion of non-White individuals and groups formed by non-Whites or mixed-raced was significantly higher in POSs with the lowest PS, which is congruent with the population's demographic characteristics living close to these sites. These results do not show a causal relationship between the presence of non-White residents and perceived lack of safety, but rather the fact that racial minorities often settled in low-income neighborhoods where is more likely perceiving lack of safety (Leventhal & Brooks-Gunn, 2000).

Different patterns of use and activities characterized POSs with different levels of PS. Where PS was low, a significantly higher proportion of sedentary activities were seen (i.e., sitting enjoying the scenery, sleeping). Inversely, more moderate and vigorous activities such as walking, playing, and practicing sports were observed in POSs with medium and high scores on PS. These results suggest that improving PS in POSs can also help to promote physical activity.

Finally, a significantly higher proportion of social incivilities (i.e., drinking alcohol, selling or consuming drugs, urinating, solicitation for prostitution, violence, and illegal street vending) and homeless park



Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
LIDY	III	-9.42	-12.83	-0.81	15.92**	233.72
LIDN	I	9.42	12.83	0.81	15.92**	53.72
VISY	III	-0.22	-3.89	-1.00	3.90**	266.71
VISN	I	0.22	3.89	1.00	3.90**	86.71
CLEY	III	-34.94	-29.06	-0.64	45.44**	219.75
CLEN	I	34.94	29.06	0.64	45.44**	39.75
GRAN	III	-6.55	-10.08	-0.84	12.02**	237.00
GRAY	I	6.55	10.08	0.84	12.02**	57.00

Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
LIDY	I	2.02	1.21	0.52	2.35*	31.00
LIDN	III	-2.02	-1.21	-0.52	2.35*	211.00
VISY	III	-12.69	-11.40	-0.67	17.06**	221.92
VISN	I	12.69	11.40	0.67	17.06**	41.92
CLEY	I	11.07	5.68	0.46	12.44**	27.18
CLEN	III	-11.07	-5.68	-0.46	12.44**	207.18
GRAN	III	-5.41	-5.74	-0.73	7.89**	226.70
GRAY	I	5.41	5.74	0.73	7.89**	46.70

Code	Q	Prosp.	Retrosp.	Ratio	Radius	Angle
LIDY	I	6.65	10.50	0.84	12.43**	57.67
LIDN	III	-6.65	-10.50	-0.84	12.43**	237.67
VISY	I	11.97	14.06	0.76	18.46**	49.58
VISN	III	-11.97	-14.06	-0.76	18.46**	229.58
CLEY	I	20.97	20.71	0.70	29.48**	44.65
CLEN	III	-20.97	-20.71	-0.70	29.48**	224.65
GRAN	I	10.88	14.36	0.80	18.01**	52.85
GRAY	III	-10.88	-14.36	-0.80	18.01**	232.85

Fig. 8. Polar coordinate results considering PS levels as the focal behavior and criteria describing environmental characteristics as target behaviors.
Note. LIDY = *well illuminated (before sunset)*, LIDN = *dark areas (before sunset)*, VISY = *high visual control*, VISN = *hidden areas*, CLEY = *absence of dirt*, CLEN = *moderate to high level of dirt*, GRAN = *absence of graffiti*, GRAY = *moderate to high level of graffiti*. Because association was not found between the proportion of park users regarding light conditions when observational sessions were performed after sunset, this criterion was excluded from the analysis. *p < .05. **p < .01.

Table 6
Recorded crime events in study sites, safety data at district level, neighborhood characteristics, and correlations with PS by POS.

Variables	Study site						r_s	p
	FOLC	SPAU	SOLL	PEGA	LESS	INFA		
Objective crime [1]								
Injuries	3	1	1	1	7	0	-.33	.518
Pickpocketing	23	9	2	4	339	0	-.37	.469
Robbery	10	2	3	2	10	0	-.44	.381
Total	41	12	8	11	364	0	-.37	.469
Safety at district level [2]								
Victimization rate	32	32	18.9	20.5	22.7	22.5	-.44	.381
Perceived safety	4.8	4.8	6	6.2	6.8	6.9	.98	**<.001**
Neighborhood characteristics [3]								
Population	9,849	9,329	10,344	9,575	6,128	6,391	-.66	.156
% Females	44.7	43.4	52.9	53.0	54.8	53.0	.76	.080
% 0–15 Years old	12.5	14.3	10.9	12.0	11.3	12.6	-.35	.492
% 15–24 Years old	10.3	11.2	7.9	8.5	7.8	10.2	-.35	.492
% 25–64 Years old	63.7	62.4	53.5	58.6	56.5	60.2	-.49	.329
% 65 Or more years old	13.6	12.1	27.7	20.8	24.5	17.0	.43	.397
% Non-White inmigrants	46.9	54.0	10.8	6.8	8.2	11.7	-.54	.266
% High school graduates	20.7	23.3	17.2	29.1	41.1	41.2	.81	**.050**
% Unemployment	26.0	25.2	23.5	22.2	23.0	17.4	-.94	**.005**

Note. [1] Number of criminal events recorded in 2010 in study sites (source: Barcelona Police Department). [2] Data referred to district (source: 2011 Barcelona Victimization Survey; 1 = *unsafe*, 10 = *safe*). [3] Data from selected 2011 Census Sections (source: Barcelona Open Data). Some types of crime events (i.e., drug trafficking, vehicle-related theft, domestic violence, threats, and indecent exposure) are not shown in the table for representing less than 1%.

users were observed in study sites with low PS. At the same time, their ratios were residual in study sites with medium and high scores. Accordingly, our results also showed that where respondents reported less PS, more park users were seen using environmentally degraded areas, including dirtier spots, darker areas during daylight observational sessions, hidden places, and next to tags or graffiti. Scholars have found a strong link between disorder and safety; nevertheless, most assessed the level of incivilities based on the responses of surveyed participants rather than independent observations (Skogan, 2015). This approach has been frequently questioned since people who report less PS also tend to perceive more disorder than those reporting more PS, despite living in the same neighborhood (Perkins et al., 1992; Sampson & Raudenbush,

Table 7
Two proportion Z-test comparing demographic characteristics between residents and park users.

PS level	Study sites	Variables	Residents		Park users		*p*
			N	%	*N*	%	
LPS	FOLC	Females	9,849	44.7	2,454	28.4	**<.001**
		Non-White inmigrants		46.9		58.2	**<.001**
	SPAU	Females	9,329	43.3	1,623	26.6	**<.001**
		Non-White inmigrants		53.9		45.8	**<.001**
MPS	SOLL	Females	10,344	52.9	2,036	41.0	**<.001**
		Non-White inmigrants		10.8		11.9	.155
	PEGA	Females	9,575	53.0	2,068	41.8	**<.001**
		Non-White inmigrants		6.8		7.1	.648
HPS	LESS	Females	6,128	54.8	3,127	49.9	**<.001**
		Non-White inmigrants		8.2		13.9	**<.001**
	INFA	Females	6,391	53.0	2,812	48.3	**<.001**
		Non-White inmigrants		11.7		8.4	**<.001**

Note. PS Levels are low (LPS), medium (MPS), and high (HPS). Significant differences are marked in bold.

1999). Similarly, people with high levels of social ties, attachment, and neighborhood identity also tend to minimize signs of disorder and report high PS (Poortinga et al., 2017; Ross & Jang, 2000). The environmental assessment performed in this study provides robust evidence that physical and social incivilities are connected with the lack of perceived safety in POSs.

The present study has several strengths. First, observational data, collected by trained observers, were used to assess POSs users, activities and the environmental characteristics of the place where they were located, providing valid and contextually rich information about how study sites were used. Second, the park selection, based on observed differences between 40 POSs according to the presence of racial minorities, homelessness, and social disorder, allowed us to obtain a reduced but diverse sample of study sites with different levels of PS. Third, the use of polar coordinate analysis permitted identifying which elements characterize POSs with low, medium, and high scores in PS, showing the informative potential of the technique when analyzing big observational data with results in the form of easy-to-understand maps. Fourth, including the sociodemographic characteristics of the population living close to study sites and crime data helped to further our understanding of the park use-PS relationship. Indeed, integrating results obtained through different methods may allow a better understanding of the behavioral component of PS in POSs.

The implications of this research are also crucial for public policy. Interventions to reduce disorder by cleaning up graffiti, picking up the trash, improving lighting, removing physical barriers, prostitution, and drug dealers are essential to increase PS in POSs. However, other different sets of interventions addressing the problem of racial stigma and poverty while promoting neighborhood revitalization and economic growth in low-income areas are needed. This conclusion is in line with results from a study conducted in urban alleys that found a low impact on PS of interventions aimed only to improve environmental conditions compared to those adding more urban functions (Jiang et al., 2017, 2018). Reducing social inequalities while preventing gentrification processes is also essential. Anguelovski et al. (2018) showed that green gentrification has occurred in Barcelona in parks located in more desirable neighborhoods, but creating new parks and gardens in Barcelona's old town seems to have benefited more vulnerable residents. Thus, creating new POSs or improving the existing ones should be considered to increase these communities' access to the benefits associated with environmental goods.

4.1. Limitations and future research

Some limitations must also be addressed. First, this study is cross-sectional, so the methodology applied does not determine cause-effect relationships. Second, as observations were conducted only on weekdays, from September to December, and from 10:00 a.m. to 8:00 p.m., any conclusion about the observed activity patterns should be restricted to this observational period. Future longitudinal studies could also examine POSs during weekends and identify seasonal changes affecting POSs park use. Third, because observational data was collected in 2010, some of our results may not reflect actual trends. For example, some sex patterns of public space use and PS regarding a specific site could differ today. The case of Folch i Torres Square is particularly relevant as it was renovated in 2018, eliminating architectural barriers and providing new amenities for sport and recreation. In that sense, our results could be helpful to evaluate the effect of park improvement on park use and PS. Fourth, safety concerns are not the only reason to avoid POSs. Future research could also consider the potential connections between park use and different types of landscapes, social cohesion, residential satisfaction, and social identity. Finally, the actual COVID-19 pandemic and the measures adopted to control it have drastically restricted access to POSs and increased social inequalities. It is essential to study the consequences of the pandemic on how we all interact again with POSs.

5. Conclusion

This research provided a more in-depth understanding of PS and park use connections. Increasing PS in low-income neighborhoods seems crucial to promoting park use, especially among women, elders, young adults, and the disabled, and physical activity as well. Although physical and social incivilities play a central role in the promotion of perceived lack of safety in POSs, PS seems to be evoked by a complex interaction of the environment with other attributes at a neighborhood level (e.g., social class, racial segregation). More than simply keeping the public space free of disorder, public interventions focused on improving the living conditions in deprived areas are most needed, emphasizing those providing better job and educational opportunities to its residents while increasing residential stability.

CRediT authorship contribution statement

Félix Pérez-Tejera: Conceptualization, Investigation, Data curation, Formal analysis, Writing – original draft, Visualization. **M. Teresa Anguera:** Methodology, Writing – review & editing, Supervision. **Joan Guàrdia-Olmos:** Formal analysis, Supervision, Writing – review & editing. **Albert Dalmau-Bueno:** Formal analysis, Writing – review & editing. **Sergi Valera:** Conceptualization, Methodology, Funding acquisition, Project administration, Writing – review & editing.

Conflicts of interest

The authors declare that this research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Appendix A. Supplementary data

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