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Title Perceptions and use of urban green spaces on the basis of size

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Abstract

Urban green spaces have a beneficial effect on the health and well-being of citizens. The features of such spaces and users’ satisfaction with them determine the type and frequency of activities conducted inside parks. Understanding the relationships among these aspects is important for promoting adequate designs for these spaces. On the other hand, the limited availability of urban surface area in many cities determines the size of parks. The effect of size on people’s satisfaction and their use of parks is an aspect that has not been studied in depth in the scientific literature. Therefore, this study aimed to examine the relationships between citizens’ perceptions of the parks’ features and their uses as a function of their size. For this purpose, surveys were conducted in large and small green spaces. The results showed the importance of considering noise in the management of both types of parks to improve overall satisfaction. In addition, overall satisfaction was related to visual aspects (conservation) in large parks, and social aspects (safety and users) in small parks. Suitably designed canine and play areas in large parks and functionality for the streets surrounding small parks can contribute to reducing noise annoyance. This study showed that the size of green spaces has a positive correlation with the frequency of walking, exercising and relaxing. Furthermore, improving some environmental features would also help to increase the frequency of these activities. In this regard, the existence of groves played an important role in promoting physical activity in both types of parks, and the quality of the air and the absence of noise contributed to relaxation in large parks.

Keywords health; noise; park features; small parks; social and physical activities; urban management

Corresponding Author Guillermo Rey Gozalo

Corresponding Author's Institution Universidad de Extremadura

Order of Authors Guillermo Rey Gozalo, Juan Miguel Barrigón, David Montes González

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Highlights

- Study of users' perception as a useful tool for the design of urban green spaces
- Noise explained the greatest variability of overall satisfaction with parks
- Road traffic was significantly more annoying in small parks
- Walking, relaxing, and exercising positively correlated with the park area
- Positive correlation found between groves and exercising in both types of parks

Perceptions and use of urban green spaces on the basis of size

Guillermo Rey Gozalo[a,b], Juan Miguel Barrigón Morillas[a*], David Montes González[c,a]

[a] Departamento de Física Aplicada, Escuela Politécnica, Universidad de Extremadura, Avda. de la Universidad s/n, 10003 Cáceres, Spain.

[b] Facultad de Ciencias de la Salud, Universidad Autónoma de Chile, 5 Poniente 1670, 3460000 Talca, Chile.

[c] ISISE, Departamento de Engenharia Civil, Universidade de Coimbra, Luis Reis dos Santos 290, Coimbra, Portugal.

[*] Corresponding author at: Departamento de Física Aplicada, Escuela Politécnica, Universidad de Extremadura, Avda. de la Universidad s/n, 10003 Cáceres, Spain. Tel: 0034-927257234; Fax: 0034-927257203.

E-mail addresses: guille@unex.es (G. Rey Gozalo); barrigon@unex.es (J.M. Barrigón Morillas); davidmg@unex.es (D. Montes González).

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Keywords: health; noise; park features; small parks; social and physical activities; urban management

1. Introduction

Population growth in cities will bring environmental, social and health challenges (UN, 2017). Green spaces play an important role in modulating human health and social well-being in the urban environment (Bedimo-Rung et al., 2005).

The presence of urban green spaces in cities generates economic and environmental benefits. Urban green spaces help to improve air quality (Escobedo et al., 2011; James et al., 2015), reduce the urban heat island effect (Shisegar, 2014), mitigate runoff (Zhang et al., 2015), reduce healthcare costs (Cox et al., 2017), increase property values for homes that are nearby or overlook them (Morancho, 2003), maintain urban biodiversity (Fontana et al., 2011), promote green spaces as tourist destinations, and generate revenue (Jim and Chen, 2006).

Specifically analysing the direct benefits of green spaces to citizens, numerous studies show that the presence of parks in residential areas increases social contact and cohesion (Peters et al., 2010; Dadvand et al., 2016) and decreases stress (Nieuwenhuijsen et al., 2017). Their presence also promotes physical activity and may be linked with greater health benefits than in other settings (Mitchell and Popham, 2008; Vujcic et al., 2018).

Research has shown the positive influence of quiet urban areas as a possible measure to mitigate the effect of noise (Öhrström et al., 2006). However, some studies (Cohen et al., 2014; Tse et al., 2012) show that noise levels in urban green spaces are significantly higher than values recommended by the European Environmental Agency (EEA) for quiet areas (EEA, 2014). Koprowska et al. (2018) conclude that noise levels have the biggest influence on noise perception, even though people feel less annoyed by noise when surrounded by greenery (Cassina et al., 2017; Dzhambov et al., 2018). Although there are different sources of urban noise (Bunn and Zannin, 2016; Gagliardi et al., 2018; Bernardini et al., 2019), road traffic is the largest source of noise pollution (WHO, 2018). Prolonged exposure to noise can have negative effects on health, such as sleep disturbances (Halperin, 2014), annoyance (Miedema and Oudshoorn, 2001), cardiovascular diseases (Babisch, 2014), and learning impairment (Klatte et al., 2013). Thus, noise studies have been conducted around different aspects in urban environments: sampling strategies (Barrigón Morillas et al., 2018), sound sources (Barrigón Morillas et al., 2013), noise monitoring (Zambon et al., 2018), action plans (Licitra et al., 2017) or noise mitigation (Fredianelli et al, 2019).

Literature reviews conducted by Bedimo-Rung et al. (2005) and McCormack et al. (2010) show that the relationship between green-space use and health is well established, but research establishing a relationship between features of green spaces and the frequency of their use is lacking. These literature reviews have been cited recently, highlighting this deficiency in the literature (Triguero-Mas et al., 2015; Vujcic et al., 2018). Determination of green-space features that influence how often a certain activity is conducted constitutes useful information for urban planners and managers. This information allows for the configuration of an optimal environment to promote certain activities with health benefits. User perceptions of green-space features is used as a predictor of the presence and the quality of these characteristics (Dadvand et al., 2016; Kothencz and Blaschke, 2017). Dadvand et al. (2016) suggest that perceived availability of green spaces could be a better predictor than physical availability.

In addition, user characteristics such as age, education, and gender may relate to the use of green spaces (Bedimo-Rung et al., 2005). However, the relatively unchangeable nature of these demographic characteristics has led to an increased focus on green-space features that are modifiable (Schipperijn et al., 2010).

The presence and quality of urban green spaces should be considered in urban design. A recent World Health Organization (WHO) report provides evidence of public health benefits in relation to green-space access, and encourages urban managers to increase these spaces (WHO, 2016). The WHO recommends between 10 and 15 m^2 of green area per inhabitant (Brebbia et al., 2010). However, finding space for new parks is often difficult in increasingly dense cities. Smaller public green areas may perhaps provide some of the desired green space, increasing the availability of urban green spaces in this manner. Additionally, because of their smaller size, these green areas could be close to people's homes. The accessibility of green spaces will influence their use (Schipperijn et al., 2010; Wang et al., 2015). In this context, studies conducted in small parks about how people use and perceive green spaces are relevant (Peschardt et al., 2012, 2014; Brown et al., 2018).

The main objective of this study was to analyse the features and uses of two groups of green spaces having different sizes. The features of urban green spaces were evaluated through the perceptions of users. For this, some research questions were addressed and grouped as follows.

Questions that analyse the features of the parks, how they are perceived, and user satisfaction with them:

Q1. Do the two types of green spaces differ in users' overall satisfaction and in satisfaction with their features?

Q2. What is the relationship between the perception of features and overall satisfaction with the green spaces?

Question that analyses the annoyance caused by different usual sound sources in urban parks:

Q3. Do the two types of green spaces differ in how users perceive the annoyance caused by different sources of noise?

Questions that analyse the uses of parks and their relationship with their features:

Q4. Do the two types of green spaces differ in the frequency of activities conducted by users?

Q5. Is there any relationship between the frequency of these activities and the size of the green spaces?

Q6. Is the relationship between satisfaction with park features and the frequency of activities different for large parks than for small parks?

The answers to these questions are important in determining the features of green spaces that would help urban planners to improve citizen satisfaction and use. These features may differ depending on the size of the park.

2. Methodology

2.1. Selection of urban green spaces

The city of Cáceres was an optimal place for this study. Cáceres is located in southwest Spain and has 19.8 m^2 of green space per capita (http://sig.caceres.es/?lang=en). This value is one of the highest in the country (Fuller and Gaston, 2009). In 2014, Cáceres had an approximate population of 96,500.

Parks of different sizes close to the city centre (distance < 1.5 km) and emblematic of each district were selected for this study (Fig. 1). These green spaces are close to the population residing in the districts (distance < 1 km). The accessibility of green spaces is taken into account when considering their use (Schipperijn et al., 2017; Wang et al., 2015).

The green spaces were classified into two groups based on their size:

- Large urban green spaces: Príncipe (22.0 ha) and Rodeo (10.6 ha).

- Small urban green spaces: Valhondo (2.2 ha), Fernando Turégano (3.2 ha), Fray Pacífico (1.6 ha), Perú (1.5 ha) and, Antonio Canales (0.5 ha).

Parks with an area greater than 10 ha were considered large urban green spaces, considering that the total land area of Cáceres is approximately 17.7 km^2.

2.2. Questionnaire

This study was based on a questionnaire conducted in 2014 at selected sampling points within green spaces. These points were selectively located in frequented areas that contain different features and accommodate different uses, and collectively they cover approximately the whole surface of the park (Fig. 1b). A similar number of questionnaires were administered at each sampling site. The interviewers walked to the sampling point of the green space and users were asked to participate in the survey. If one user refused to participate, a new person was requested. Once the user was surveyed, the interviewers moved to another sampling point. All selected interviewees were over 18 years old. During the face-to-face questionnaire, interviewees were informed about the objectives of the study and, they voluntarily agreed to participate. Each interview lasted approximately 10–15 minutes. The response rate was 53%. Two hundred and ten questionnaires were completed in large and small green spaces. Recent studies in urban green spaces have used a similar sample size (Kothencz and Blaschke, 2017; Vujcic et al., 2018). The power of the subsequent statistical tests was at least 0.8 for the sample size obtained in this study (Cohen, 1988). The demographic characteristics of the respondents were similar in both types of parks. The share of males and females was close to even (53% females in large parks and 51% females in small parks). In addition, the age structure did not present significant differences between the two types of green spaces ($p > 0.05$ according to a Chi-squared test) as shown in Fig. 2.

Three categories were analysed in the questionnaire: satisfaction with green space features (12 items), noise annoyance (8 items), and use of green spaces (6 items). All items were evaluated using a 5-point Likert scale (0 - 'not at all' or 'never', 1 – 'a little' or 'rarely', 2 – 'moderately' or 'sometimes', 3 – 'quite' or 'often', 4 – 'a lot' or 'very often').

The following features were evaluated in the first category: cleanliness, air quality, absence of noise, aesthetics, safety, users, conservation, location, size, shade, and groves. Overall satisfaction was also assessed in one item. The level of user satisfaction with these features was questioned in this first category. These features were selected for their relationship with social, environmental, or design aspects that influence overall satisfaction with green spaces. Cleanliness, aesthetics, conservation, and groves influence the visual assessment of a green space. Some studies include all of these features within the aesthetic characteristic (McCormack et al., 2010). Absence of noise, air quality, groves, and shade are features considered when assessing the environmental benefits of green spaces (James et al., 2015). Location and size are design aspects that can influence the use of green spaces (Schipperijn et al., 2010). Social aspects, such as the relationship with users or security, were also considered. Crime and anti-social behaviour are perceived risks from urban green spaces (WHO, 2016).

Parks are potentially quiet areas. Conserving quiet areas is an objective given priority by the WHO (WHO, 2018). Rey-Gozalo and Barrigón-Morillas (2017) indicate that the absence of noise is the most influential environmental feature determining the overall perception of a quiet urban area. Thus, the degree of annoyance caused by the main sound sources in these green spaces (road traffic, children, screams, construction sites, maintenance services, animals, and water) was questioned in the second category of the questionnaire. Users were also questioned about overall noise annoyance in urban green parks. Moreover, sound levels were measured. Interviews and sound measurements were carried out simultaneously. Equivalent sound level (L_{eq}) recorded with a binaural recording device (Noise Book from Head Acoustics) was analysed for this study. The guidelines of the ISO 1996-2 standard were followed for measuring during favourable meteorological conditions and for locating the microphone (ISO 1996-2, 2007).

The frequency at which users conducted activities in these green spaces was analysed in the last category of the questionnaire. The following activities were analysed: reading, taking children outside, relaxing, exercising, walking, and talking.

2.3. Statistical analysis

The users' perception of the different variables was evaluated with a Likert ordinal scale. Non-parametric tests were used because the condition of normality (Kolmogorov-Smirnov and Shapiro-Wilks tests) was rejected. The Mann-Whitney test was used to compare the users' perceptions of the different variables between both types of green spaces. The Kruskal-Wallis test was used to compare perceptions of a green space among variables of the same category (satisfaction with features, noise annoyance, or use of parks) and create homogeneous subsets.

This study also aimed to analyse the relationships among different variables. First, the relationship between satisfaction with each feature and overall satisfaction with green space was investigated. For this purpose, Kendall's tau-b was used. Then, a multivariate analysis was conducted to analyse the features (independent variables) that contribute significantly to explaining variability in overall satisfaction (dependent variable). For this analysis, an ordinal logistic regression with forward and backward stepwise selection of independent variables was used. Finally, relationships among satisfaction with green-space features and green-space use were analysed (Kendall's tau-b). Pearson's correlation coefficient was used in the relationship between the park area and the activities of relaxing, exercising, and walking because the regression residuals did not present significant differences with respect to a normal distribution.

Statistical analyses were performed using SPSS version 22 and R version 3.2.3.

3. Results and discussion

3.1. Satisfaction with green-space features

Users were quite satisfied with the features of the green spaces in Cáceres as shown in Table 1. The average and median ratings given to the features were close to value 3 (‘quite’) or between values of 3 (‘quite’) and 4 (‘a lot’), except for satisfaction with the absence of noise (values between 2.5 and 3.0). Therefore, this high level of user satisfaction shows that local administrations are interested in managing these urban spaces. Despite this good assessment, do these two types of green spaces differ in users’ overall satisfaction and their satisfaction with features?

Users' perceptions of park features exhibited similarities in both types of green spaces. The absence of noise was in the group of features rated lowest by users, and this feature was even the least satisfactory feature in large parks (subset ‘f’ in Table 1). In contrast, the location of green spaces was in the group of most valued features (subset ‘a’ in Table 1).

Environmental (cleanliness, air, and noise), social (safety, users), and geographical (location) features did not present significant differences in user satisfaction between the two types of parks (Table 1). The selection of green spaces close to the city centre and their accessibility to the population within districts was corroborated with the perception of users. Features related to accessibility (proximity to residential areas, the public nature of parks, the existence of entrances through different pedestrian streets, the existence of parking and bus stops nearby, etc.) were similar in both types of parks. Cleaning and security services offered by local administrations are similar in all green spaces of Cáceres. There are also signs at the entrance to the green spaces with the rules of behaviour and regulations around opening and closing.

The perception of air quality was one of the least valued features in both types of green space. This feature was significantly correlated with the absence of noise (Kendall's tau-b of 0.42 in large parks and 0.58 in small parks with a $p < 0.001$). This association may have been because road traffic represented the primary source of chemical and acoustic pollution in cities (Perez-Prada and Monzon, 2017). Current studies predict air pollutants using environmental noise measurements (Löbig and Weber, 2017). Sound levels recorded in the two types of green spaces were not significantly different (Fig. 3; $p > 0.05$ according to a Mann-Whitney test). Some places in large green spaces were further away from urban roads. Greater distance from road traffic can lead to lower levels of environmental pollution. However, the type of the surrounding urban road (Rey Gozalo et al., 2014) and the presence of other sound sources influence their acoustic situation (Barrigón Morillas et al., 2013).

In contrast to the above features, satisfaction with aesthetics, conservation, size, groves, and shade in large green spaces was significantly higher than in small parks, as shown in Table 1. The difference in size between the two types of parks was perceived by those surveyed. Although the cleanliness of the two types of parks was perceived differently, the conservation of large green spaces presented greater satisfaction. Satisfaction with the aesthetic category was also perceived differently where the two groups of parks were concerned. Large parks had a greater variety of environments, even open-air museums, and this contributed to greater satisfaction. Perhaps satisfaction with groves and shade can influence some of these visual characteristics. There was a significant relationship among users' perception of groves, shade, and aesthetics ($p < 0.05$ according to the Kendall's tau-b).

Greater land area provides the capacity to plant a greater number and variety of tree species. Groves generate shadows, and this association was perceived positively by users. Normalised differential vegetation index (NDVI) values of the green spaces investigated in this study are shown in Fig. 4. NDVI was taken from the open-access web interface

Land Viewer (https://eos.com/landviewer/). This index was used to quantify green area within the urban parks. Considering that the satellite image was taken during the summer period (12th August 2014), this index also provided us with information relating to the ground surface area covered by trees. Large parks had a higher NDVI in addition to occupying a larger area (Fig. 4). The 2015 map of tree-cover density developed by the EEA was also consulted. Layers with tree-cover density level in the range of 0–100% are shown on the tree cover density map (https://land.copernicus.eu/pan-european/high-resolution-layers/forests/tree-cover-density/status-maps/2015). The area of the layers with a tree cover density greater than 40% was calculated in the two types of parks. In large parks, 45% of the total area had a tree cover density higher than 40%. However, only 30% of the total area of small parks had a tree cover density higher than 40%. Differential satisfaction levels among users with the two types of green spaces were justified according to both NDVI and tree-cover density.

Despite differences in levels of satisfaction with some features between the two types of green spaces, users provided similar overall assessments (Table 1).

The next proposed research question was as follows: What is the relationship between the perception of features and overall satisfaction with the green space?

Cleanliness, air quality, and the absence of noise were three of the four features that presented the greatest correlation with overall satisfaction with both types of green spaces (Table 2). Therefore, features related to environmental pollution were important to the overall assessment of a park. Additionally, in both types of green space, user satisfaction with size was not related to overall satisfaction. These results are of great relevance to the design of urban green spaces. Size can limit the variety of installations, but if actions are taken to improve some of the features (all the features were significantly correlated with overall satisfaction with small green spaces except for size), user satisfaction will improve regardless of park size.

The absence of noise was in the group of features with the lowest user satisfaction with both types of green spaces. The sound level recorded in both types of green space was similar to that of other Spanish parks (Calleja et al., 2017). The median sound level obtained during the day exceeded the range of 45 to 55 dBA recommended by the EEA for quiet areas (Fig. 3). Furthermore, satisfaction with the absence of noise was the most correlated feature with overall satisfaction (Table 2).

As indicated above, some features were significantly interrelated. Therefore, the bivariate relationships between individual features and overall satisfaction may be influenced by the effect of other features. In an attempt to detect these influences, a multivariate analysis was conducted using an ordinal logistic regression in each type of park (Table 3). The selection of independent variables was performed using the stepwise method and link function as logit. The values 0, 1, 2 and 3 shown in Table 3 are the values of the 5-point Likert scale used in the questionnaire. The value 4 is not shown in Table 3 because it was the reference category. Some features also do not include values because they were not provided by users. Satisfaction with the absence of noise was selected among independent variables in both regression models. This result corroborates the importance of satisfaction with the absence of noise to explain the variability of overall satisfaction with both types of parks. The remaining features selected as independent variables differed between the two types of green spaces. The visual feature conservation was selected in large parks, while the social features of safety and user features were selected in small parks. In previous studies, the importance of visual and sound features was also demonstrated to influence overall perception of large parks (Qi et al., 2017). Peschardt et al. (2014) identified the importance of social features in small parks. In a logistic regression model, in addition to the social features (i.e., user and safety), when noise satisfaction was taken into account, the variability explained in overall satisfaction with small parks was high (McFadden R^2 = 0.53) (Table 3). Therefore, these features should receive special consideration by urban planners when designing small urban green spaces. For example, modifying the type and functionality of nearby roads or increasing the presence of people who ensure the safety and coexistence of users are some of the actions urban planners can take.

3.2. Annoyance with sound sources

The previous results indicate that users' satisfaction with the absence of noise was one of the most poorly rated features and that absence of noise was significantly correlated with overall satisfaction. To improve the perception of the absence of noise feature, it is important to analyse noise sources. Do the two types of green spaces differ in how users perceive annoyance caused by different sources of noise?

The average and median of perceived annoyance with sound sources in both types of green spaces did not receive values greater than 2 'moderate annoyance' as shown in Table 4. This result was predictable given that satisfaction with the absence of noise was rated 'moderate' to 'quite'. The most annoying sound sources (in decreasing order) in large green spaces were (subsets ‘a’ and ‘b’ in Table 4): animals (mainly barking), screams of children, and road traffic. Road traffic and screams were the most annoying sources in small green spaces. Road traffic and screams were important in both types of green spaces, though the annoyance with road traffic was significantly greater in small parks. The size of large green spaces implies a greater distance from the sources of road traffic sounds. Therefore, urban design of small green spaces should consider the functionality of nearby urban roads (Rey Gozalo et al., 2014).

Annoyance due to barking (animals) in large green spaces was significantly greater than in small green spaces (Table 4). Large parks have specific canine areas. These areas represent approximately 5.2% of the total area of large parks (http://sig.caceres.es/?lang=en). This contributed to more dogs and, therefore, to this sound source. The annoyance of children was also significantly higher in large green spaces. Leisure activities for children in large green spaces were more diverse, and a greater percentage of users take their children outside to large green spaces. Of those interviewed in large parks, 32% brought children, while the equivalent value in small parks was only 24% of those interviewed. Liu et al. (2018a) show that surrounding speech and playing children were the most frequently perceived sound sources in parks of approximately 10 ha. Additionally, Liu et al. (2018b) found that dog barking was noisier than traffic in a large city park.

The sound source categories of construction, maintenance, and water presented low levels of disturbance (subsets ‘c’, ‘d’, and ‘e’ in Table 4), and the two types of parks did not differ significantly in these categories. Studies show that the presence of water sources improves the soundscape (Ekman et al., 2015).

Taking these results into account, city managers should consider the configuration of play and canine areas in large parks and the functionality of surrounding roads when designing small parks.

3.3. Uses of the green spaces and relationship with their features

In the design of green spaces, it is important that users can carry out activities that generate health benefits and that these activities are not exclusive to large parks. Do the two types of green spaces differ in the frequency of activities conducted by users? Is there any relationship between the frequency of these activities and the size of the green spaces?

The activities of reading, talking, and taking children outside had similar frequencies in both types of green spaces as shown in Table 5. Children's play areas were more abundant in large green spaces (http://sig.caceres.es/?lang=en). However, if children's play areas are standardised to the total area of both types of parks, children's play areas accounted for 0.6% of the total area of large parks, but 2.6% in small parks. Additionally, users who bring children to the parks will usually talk to other users in the children's play area. Thus, for example, the activities of talking and bringing children were significantly correlated in large parks ($p < 0.05$, Kendall's tau-b = 0.19).

The most frequent activities in both types of green spaces were talking and walking (subsets ‘a’ in Table 5). Walking was more frequent in large parks than in small parks. However, an asymptotic relationship was found between the average walking frequency and park area, indicating that the frequency of this activity tended to stabilise at a certain size of green space (Fig. 5a). Above approximately 5 ha, the frequency of the walking activity plateaued in this study. In Fig. 5a, a logarithmic function was fit to the data. This size (> 5 ha) was also considered reasonable for physical activity in a previous study (Schipperijn et al., 2010). Walking is related to physical activity, but it also has a social component since it is not generally conducted in isolation.

Exercising and relaxing were also more frequent in large parks than in small ones. The frequency of these activities was positively correlated to the size of the park (Fig. 5b and Fig. 5c). In Fig. 5b and 5c, linear functions were fit to the data. The physical activity most frequently conducted by users was running and large green spaces had a greater length of paths (http://sig.caceres.es/?lang=en). The average length was 9.6 km in large parks and 3.2 km in small parks. Exercising was an activity more frequently performed by users younger than 60 years old. Watts et al. (2013) found a linear relationship between tranquillity and relaxation and subsequently a linear relationship between tranquillity and the size of the green space (Watts, 2017).

Closely related to these studied aspects, the last research question was analysed. Is the relationship between satisfaction with park features and the frequency of activities different for large parks than for small parks?

Reading was not significantly related to satisfaction with different park features (Table 6). Caution is warranted when interpreting this result since few users engaged in this activity in these green spaces (8%).

The frequency of taking children outside was positively correlated with user satisfaction with large parks and safety in small parks. Contact with other users in play areas was common, and safety was important. In addition, talking had a positive correlation with user satisfaction with both types of parks. The presence of other users is necessary for this activity to develop.

The low frequency of the relaxation activity in small parks influenced the lack of a relationship between this and other features. As shown in large green spaces, this activity was related to satisfaction with air quality and absence of noise. A larger park will promote a greater variety of environments. In fact, users look for places with a lower noise level in order to relax. A significant relationship between sound levels and the frequency of the relaxation activity was found in large parks ($p < 0.05$, Spearman's rho = -0.50). Therefore, actions that reduce road traffic noise could favour the frequency of this activity in small parks. Relaxation activities favour the improvement of health problems related to psychological disorders (stress, anxiety, etc.). These health problems are becoming more frequent in today's society.

Promotion of physical activity is an aim of today's societies in the face of growing health problems resulting from inactivity and poor eating habits. The frequency of physical activity in large parks was negatively related to user satisfaction. This indicates that despite these parks' adequate size, they were not designed for this purpose. Authorities should improve the design of large urban parks to promote physical activity. The main physical activity conducted was running, and there were no paths specifically marked for this activity. However, satisfaction with groves showed a positive correlation with physical activity in both types of park. This relationship was also shown in a previous study (McCormack et al., 2010). The lower NDVI and tree cover density in small parks influence the frequency of physical activity. Additionally, improvement to other visual and environmental features (e.g., air and conservation) that were ranked as offering lower satisfaction (Table 1) might encourage this activity.

Walking was positively correlated with satisfaction with a large number of features in small green spaces. Thus, encouragement of this activity in small parks requires an adequate overall design. The absence of noise and social characteristics such as safety, as well as overall satisfaction, presented the highest correlation values with walking in small parks. However, people walk in large parks without consideration of satisfaction with features, except having a good relationship with users. At a certain age, walking becomes the only viable physical activity for many. For this reason, the design of parks should encourage this activity in an era of worldwide ageing (UN, 2015).

4. Conclusions

A sociological study was undertaken to analyse the different features that define the quality of urban green spaces with special attention given to the size of parks. From the comparison of users' satisfaction with the features between the two types of parks and the relationship between satisfaction with features and overall satisfaction, the following results were obtained:

- Satisfaction with large green spaces was significantly greater for 5 of 11 features analysed (aesthetics, conservation, size, groves, and shade). Despite this, overall user satisfaction was similar for both groups of parks.
- Cleanliness, air quality, absence of noise, and conservation were significantly correlated with overall satisfaction with large parks, but only noise and conservation contributed significantly to explaining overall user satisfaction in an ordinal logistic regression. On the other hand, all features analysed had a significant relationship with the overall assessment of small parks except for size. However, only noise, safety, and users were relevant in the ordinal logistic regression. The absence of noise was the feature that explained the greatest variability in overall satisfaction scores with both groups of parks.

Some conclusions can be drawn from an analysis of the annoyance caused by noise sources in both types of green spaces. Firstly, animals (mainly barking), screams, and children were the most annoying noise sources in large green spaces. However, road traffic was the most annoying source of noise in small green spaces. Secondly, if both types of parks were compared, animals and children caused significantly more annoyance in large parks, while road traffic was significantly more annoying in small parks.

The analysis of the frequency of activities conducted in both types of green spaces and their relationship with users' satisfaction level with features of green spaces showed the following:

- Walking and talking were the most frequent activities in both types of green spaces, while talking and taking children outside had a similar frequency.
- Walking, relaxation, and exercising were significantly more frequent in large parks. In fact, positive correlations were found between park area and the average frequency of walking, relaxing, and exercising. However, the relationship found between the average walking frequency and park area was asymptotic.

- In both types of parks, a positive correlation was found between satisfaction with groves and exercising. The frequency of walking was only positively correlated with user satisfaction in large parks. However, this activity was also significantly correlated with environmental (noise, air, groves, and cleanliness) and social (safety and user) features in small parks.
- In large parks, the relaxation activity was positively correlated with users' satisfaction with air quality and absence of noise. However, the frequency of physical activity was negatively correlated with user satisfaction.

Finally, some recommendations are made to urban planners based on the conclusions of this study:

- Noise and conservation are features to be taken into account in order to increase the number of satisfied users in large parks. On the other hand, aspects such as noise, safety and coexistence of users should be considered in the design of small parks.
- An optimal configuration of the play and canine areas should be implemented with the aim of reducing noise annoyance in large parks. Designing an appropriate functionality for the streets surrounding small parks would help reduce noise annoyance.
- Authorities should ensure the existence of groves if they wish to promote physical activity in both types of parks. In addition, the design of specific running paths would benefit this activity in large parks.
- Analysing the users' perception of the park's features would be a point of support for the design of urban spaces.

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Table 1

Level of satisfaction with the features of urban green spaces, homogeneous subsets for the level of satisfaction in large and small parks, and an analysis of the significance of differences in the level of satisfaction between the two types of green spaces.

Feature	Scale of satisfaction (scale 0 – 4)				Homogeneous subsets[1]		*P*-value[2]
	Large		Small		Large	Small	
	Mean	Median	Mean	Median			
Cleanliness	3.0	3.0	3.1	3.0	e	b, c	> 0.05
Air	2.8	3.0	2.8	3.0	e	c, d	> 0.05
Noise	2.5	2.5	2.7	3.0	f	d	> 0.05
Aesthetics	3.4	3.5	2.9	3.0	b, c, d	c, d	< 0.001
Safety	3.5	4.0	3.6	4.0	b, c	a	> 0.05
User	3.0	3.0	2.9	3.0	d	c, d	> 0.05
Conservation	3.3	3.0	2.9	3.0	c, d	c, d	< 0.001
Location	3.7	4.0	3.6	4.0	a	a	> 0.05
Size	3.8	4.0	3.3	3.0	a	b	< 0.001
Shade	3.5	4.0	2.9	3.0	a, b	c, d	< 0.001
Groves	3.6	4.0	2.9	3.0	a, b	c, d	< 0.001
Overall	3.2	3.0	3.2	3.0	–	–	> 0.05

[1]Kruskal-Wallis test

[2]Mann-Whitney test

Table 2

Relationships between satisfaction with each feature and overall satisfaction with urban green spaces (Kendall's tau-b coefficient correlation).

Feature	Overall satisfaction	
	Large	**Small**
Cleanliness	0.23^{**}	0.56^{***}
Air	0.26^{**}	0.58^{***}
Noise	0.29^{***}	0.60^{***}
Aesthetics	$0.17^{n.s.}$	0.38^{***}
Safety	$0.09^{n.s.}$	0.56^{***}
User	$0.12^{n.s.}$	0.32^{***}
Conservation	0.28^{**}	0.36^{***}
Location	$0.03^{n.s.}$	0.20^{*}
Size	$0.15^{n.s.}$	$0.08^{n.s.}$
Shade	$0.12^{n.s.}$	0.41^{***}
Groves	$0.10^{n.s.}$	0.40^{***}

* Significant at $p \leq 0.05$

** Significant at $p \leq 0.01$

*** Significant at $p \leq 0.001$

$^{n.s.}$ Non-significant correlation ($p > 0.05$)

Table 3

Estimated parameters and coefficients of determination from an ordinal logistic regression between overall satisfaction (dependent variable) and satisfaction with features (independent variables) selected by the stepwise method.

	Large green spaces		
		Estimate	Wald
Intercepts	Overall = 0	-7.6	31.6^{***}
	Overall = 1	-6.1	38.3^{***}
	Overall = 2	-5.4	36.0^{***}
	Overall = 3	-1.0	$2.5^{n.s.}$
Coefficients	Conservation = 2	-3.5	12.9^{***}
	Conservation = 3	-0.6	$1.7^{n.s.}$
	Noise = 1	-3.4	7.7^{**}
	Noise = 2	-1.8	6.9^{**}
	Noise = 3	-1.0	$2.2^{n.s.}$
R^2 McFadden = 0.13			
	Small green spaces		
		Estimate	Wald
Intercepts	Overall = 2	-11.6	32.9^{***}
	Overall = 3	-6.5	18.8^{***}
Coefficients	Noise = 1	-26.4	– (1)
	Noise = 2	-6.8	21.7^{***}
	Noise = 3	-3.5	8.0^{**}
	Safety = 3	-2.7	14.7^{***}
	User = 2	-3.1	10.7^{**}
	User =3	-3.5	15.1^{***}
R^2 McFadden = 0.53			

(1) Wald statistic is undefined because the error deviation is zero.

** Significant at $p \leq 0.01$

*** Significant at $p \leq 0.001$

$^{n.s.}$ Non-significant correlation ($p > 0.05$)

Table 4

Level of annoyance with sound sources in urban green spaces, homogeneous subsets for the level of annoyance in large and small parks, and an analysis of the significance of the differences in the level of annoyance between the two types of green spaces.

Sound source	Level of annoyance (scale 0 – 4)				Homogeneous subsets[(1)]		*P*-value[(2)]
	Large		Small		Large	Small	
	Mean	Median	Mean	Median			
Construction	0.3	0	0.3	0	d	d	> 0.05
Screams	1.2	1	1.1	1	a, b	b	> 0.05
Animals	1.4	1	0.2	0	a	e	< 0.001
Maintenance	0.6	0	0.6	1	c	c	> 0.05
Road traffic	1.0	1	1.4	1	b	a	< 0.001
Children	1.2	1	0.7	1	a, b	c	< 0.01
Water	0.4	0	0.2	0	c	e	> 0.05
Overall	1.2	1	1.1	1	–	–	> 0.05

[(1)]Kruskal-Wallis test

[(2)]Mann-Whitney test

Table 5

Frequency of activities conducted by users in large and small urban green spaces. Homogeneous subsets were used for the frequency of activities values, and an analysis of the significance of the differences in the level of frequency of activities between the two types of green spaces.

Activity	Level of frequency (scale 0 – 4)				Homogeneous subsets(1)		*P*-value(2)
	Large		Small		Large	Small	
	Mean	Median	Mean	Median			
Reading	0.3	0	0.1	0	d	d	> 0.05
Taking children outside	1.1	0	0.8	0	c	b, c	> 0.05
Relaxing	1.8	2	0.7	1	b	b	< 0.001
Exercising	1.3	1	0.5	0	c	c	< 0.001
Walking	2.9	3	2.0	2	a	a	< 0.001
Talking	2.4	3	2.4	3	a	a	> 0.05

(1) Kruskal-Wallis test

(2) Mann-Whitney test

Table 6

Relationships among satisfaction with features and the frequency of activities in each type of green space (Kendall's tau-b coefficient correlation).

Features	**Urban green-space use (Large/Small)**					
	Reading	**Taking children outside**	**Relaxing**	**Exercising**	**Walking**	**Talking**
Cleanliness	–	–	–	–	– / 0.18^{*}	–
Air	–	–	0.20^{*} / –	– / 0.20^{*}	– / 0.24^{**}	–
Noise	–	–	0.17^{*} / –	–	– / 0.33^{***}	–
Aesthetics	–	–	–	–	– / 0.27^{**}	–
Safety	–	– / 0.21^{*}	–	–	– / 0.35^{***}	–
User	–	0.19^{*} / –	–	-0.54^{***} / –	0.39^{***} / 0.21^{*}	0.69^{***} / 0.30^{***}
Conservation	–	–	–	– / 0.21^{*}	–	–
Location	–	–	–	– / 0.21^{*}	–	–
Size	–	–	–	– / 0.21^{*}	–	–
Shade	–	–	–	–	–	–
Groves	–	–	–	0.18^{*} / 0.29^{**}	– / 0.22^{*}	–
Overall	–	–	–	– / 0.21^{*}	– / 0.44^{***}	–

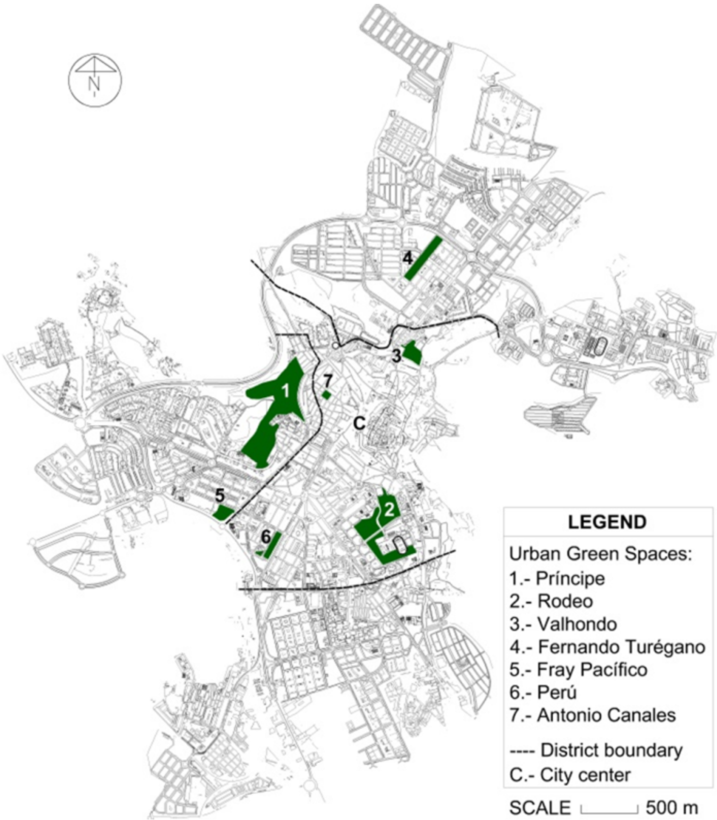
* Significant at $p \leq 0.05$

** Significant at $p \leq 0.01$

*** Significant at $p \leq 0.001$

– Non-significant correlation ($p > 0.05$)

a)



b)

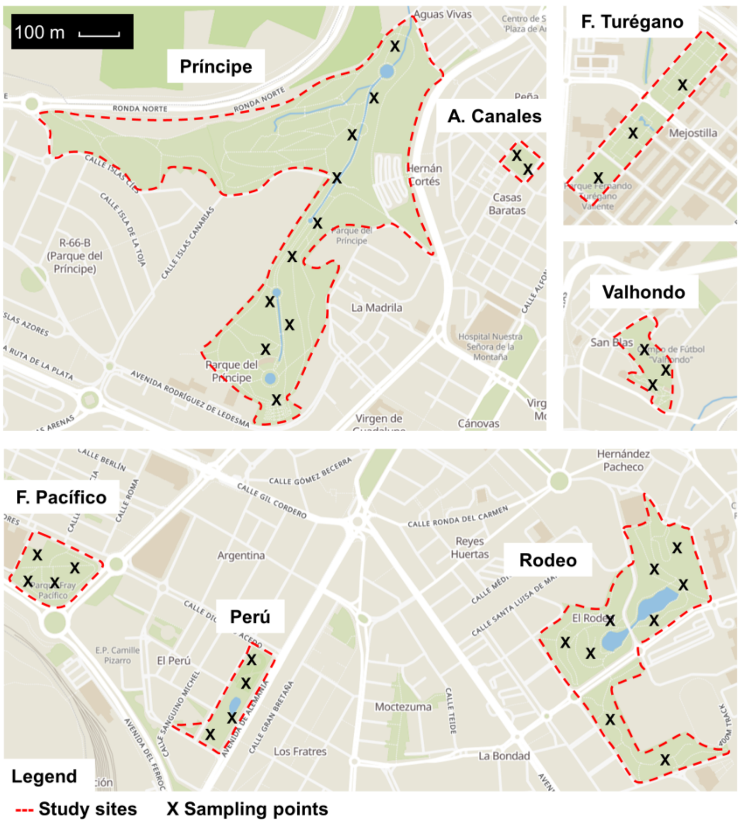
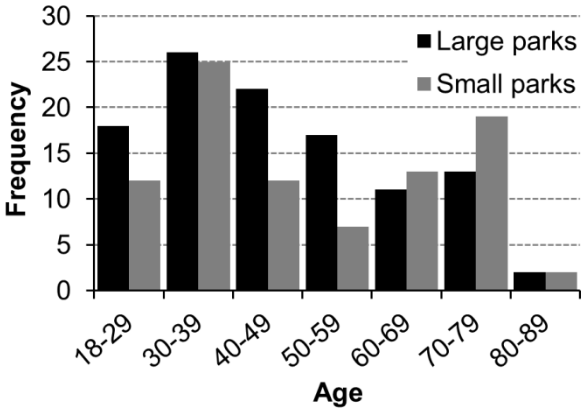


Fig. 1. Location of the selected green spaces in the city of Cáceres (a) and sampling points within the studied green spaces (b).



702 **Fig. 2.** Age structure of the selected samples in the two types of green spaces.

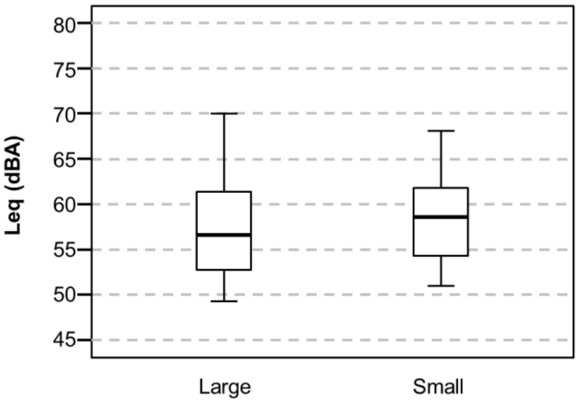


Fig. 3. Equivalent continuous sound levels (dBA) measured in the small and large urban green spaces.

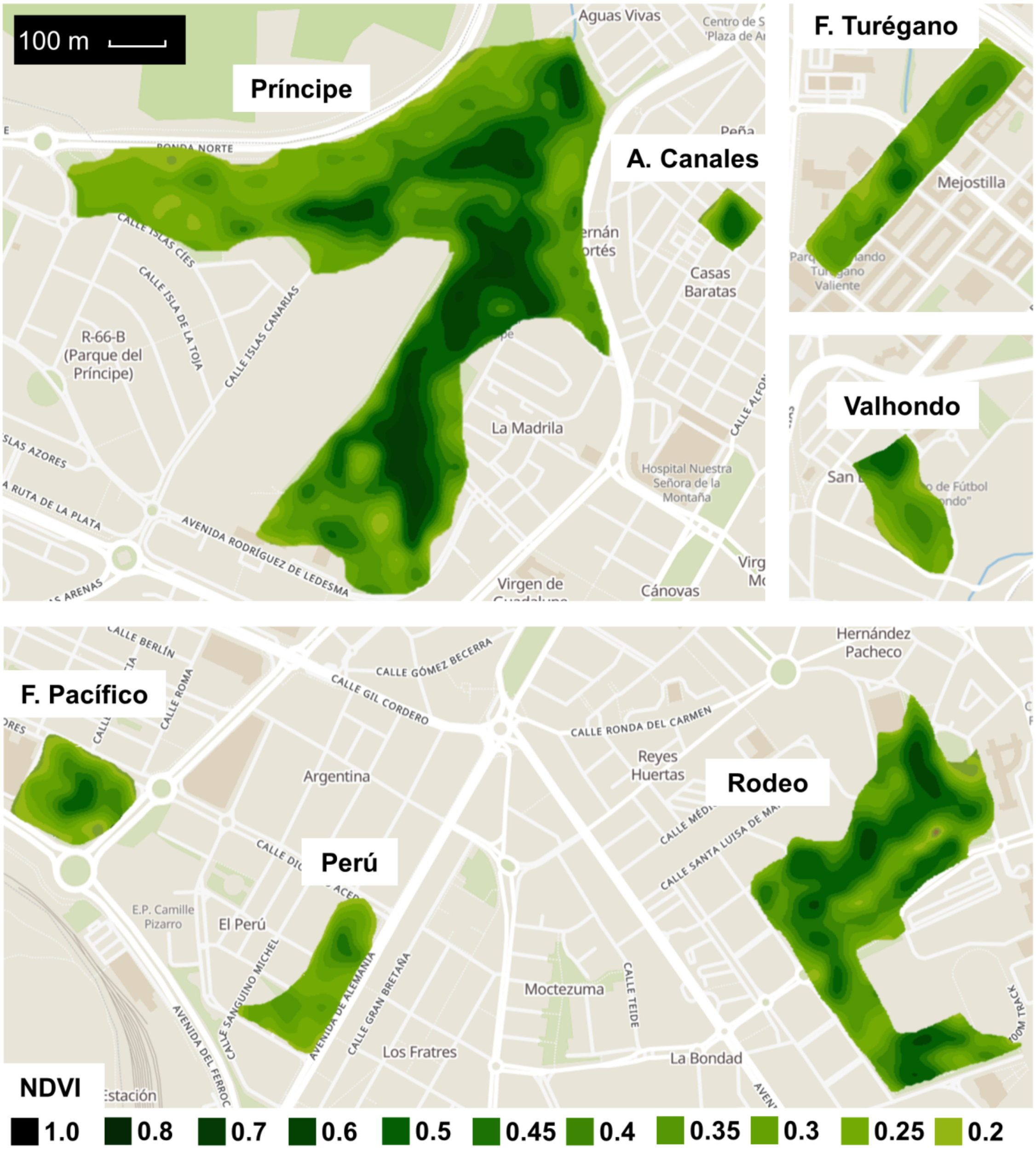
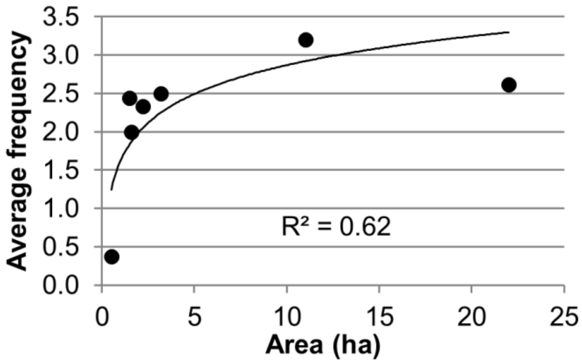
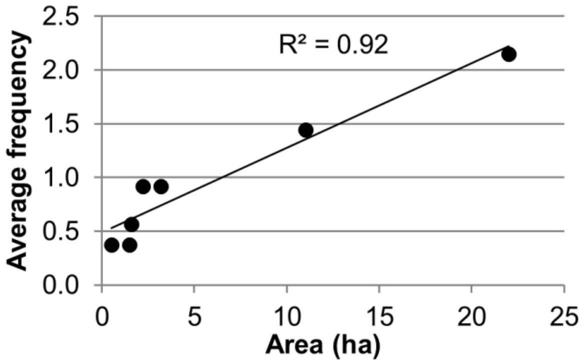


Fig. 4. Normalised difference vegetation index (NDVI) obtained from the parks studied. This image was taken from the open-access web interface Land Viewer (https://eos.com/landviewer/).

a)



b)



c)

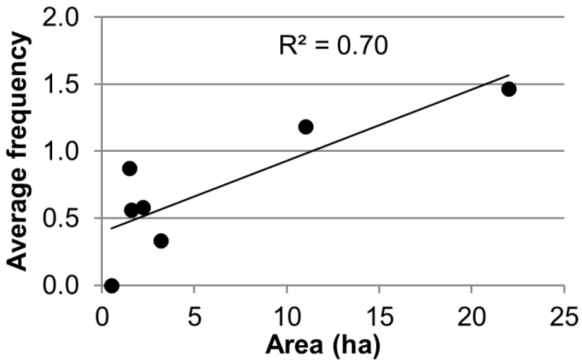


Fig. 5. Relationships between park area and the average frequency of the following activities: walking (a), relaxing (b), and exercising (c).