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Abstract:

Psychological restoration is a widely study topic in environmental health, environmental psychology and urban studies literatures. Most of the attention has been directed towards the benefits of the contact with natural/green spaces. On the contrary, the study of the restorative properties of built settings, even though it has experienced a relative increase in recent years, remains greatly understudied. In this work, we assessed the objective design features of a sample of 6 urban squares and conducted a survey study to measure the patterns of use of such settings and restorative experiences of their users. Regression analyses revealed that both objective variables and the patterns of use were scarcely associated to the experience of restoration whereas psychological variables such as the perception of the restorative qualities of the squares and the psychological bonding to them remained strongly associated even in the presence of the rest of the variables included in the study. The implications of the study for this line of research and for urban planning initiatives are discussed.

Keywords: Psychological restoration, place bonding, stress recovery, built environment, urban planning,

Introduction:

Cities have been often considered as physically and psychologically demanding, harmful, and stressful environments, due to the exposure to traffic, crowds, and information overload, as well as the reduced presence of natural elements (Corcoran et al., 2017; Fischer, 1984; Marsella, 1998; Milgram, 1970; Moser, 2014; Nelson, Schwirian, & Schwirian, 1998; Páramo, 2017). In spite of the former, citizens and researchers worldwide stress the role of nature or green environments for the satisfaction of a wide range of human needs such us physical and psychological health promotion, aesthetic enjoyment and social interaction and identity (Matsuoka & Kaplan, 2008). These objectives have been also assumed and publicized by international agencies and institutions (European Commision, 2013; United Nations, 2018) and inspired local urban strategies in diverse locations (City of Copenhagen, 2015; Forum, 2016; Madrid, 2017; Senate Department for Urban Development and the Environment, 2015).

In all, the quality of the urban environment is a basic indicator of human quality of life and well-being (Cattell, Dines, Gesler, & Curtis, 2008; Jennings, Larson, & Yun, 2016; Villanueva et al., 2015) and there remains its potential to improve people's lives. However, for various reasons, it is not always feasible to insert new big green spaces or infrastructures into the urban matrix. Thus, urban forests and parks could not be the only urban environments offering health-related benefits and therefore not all the efforts should be directed towards the amelioration of large green infrastructures in cities. Subsequently, there is a patent need of studying the potential of other urban typologies, and that is the need that motivated this study.

For this study we focused on urban squares. Square are tri-dimensional open spaces limited by the ground, the adjacent buildings and the sky dome (Zucker, 1959) or, simpler, open sections of space surrounded by buildings (Moughtin & Mertens, 2003). Urban squares are a very characteristic feature of European cities that endows with historicity, identity, and relational and symbolic qualities (Faye & Le Fur, 2012). They usually present different levels of greenness and are provided with equipment to support resting, social interactions and/or physical activity (e.g. benches, water fountains or playgrounds). Oppositely to urban parks or forests, their ground tends to be grey (e.g. concrete or tile) and they tend to have a reduced scale compared to the former. Urban squares have been presented as the *community's living room* for their value to make people come together, help to stablish relationships between them and create a healthy sense of community (Crowhurst Lennard, 2019; Talen, 1999). For all these reasons they integrate several health city indicators as defined by the World Health Organization: access to green spaces, presence of sport and leisure facilities, the availability of pedestrianized environments and the provision of living spaces (Webster & Sanderson, 2013). If well-planned, cities count on a high number of squares which assure proximity to citizen's residences and work and study places and might therefore guarantee daily use. And, as Ward Thompson (2016) proposed, squares might be a be a public version of the paradise garden.

1.1 The contribution of environmental psychology

Environmental psychology has already done a remarkable contribution to the study of the interconnection between places and human health and. Central to this topic, literature on environmental psychology has usually highlighted the benefits of natural environments in terms of stress alleviation, mood enhancement and cognitive recovery which has been called restoration (Kaplan & Kaplan, 1989; Ulrich, 1993). Restoration is usually defined as the renewal of physical, psychological, and/or social resources diminished in ongoing efforts to meet

everyday demands (Hartig, 2004) and is triggered by particular environmental configurations[1] (Joye & van den Berg, 2013). Therefore, restorative environments are the ones providing this renewal of resources when people visit, use or spend time in them[2]. Multiple restoration papers focus on the health benefits of visiting distant nature places such as national parks, natural reserves or forests can be easily found (Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010; Wolf & Wohlfart, 2014; Wöran & Arnberger, 2012). In the urban realm most of the previous works have chosen green settings such as university campuses, urban forests or parks (Bielinis, Takayama, Boiko, Omelan, & Bielinis, 2017; Plante et al., 2007; Takayama et al., 2014; Tyrväinen et al., 2014), which may be the greenest environments in our cities.

Nevertheless, the study of urban built environments' restorative potential has been scarcely studied. Could the *grey*[3] city -or at least, certain grey places within the city- have a design that is not psychologically negative, or even offers some restorative potential, in order to compensate the effects of daily demands? Most of current evidence cannot be of use to answer this question due to the research habit of comparing beautiful and tranquil natural/green environments such as parks and forests – which are designed and used mainly for recreation and resting – with limitedly aesthetical and busy urban environments such us streets – which are usually designed for other purposes (e.g. transportation) (Karmanov & Hamel, 2008; Staats & Henk, 2016; Weber & Trojan, 2018). Thus, apart from possibly being partial and inaccurate, current knowledge and evidence on restoration does not support the restorative potential of some other built urban settings.

This is why some authors have pointed at the need of further studying psychological restoration in other urban settings (Karmanov & Hamel, 2008; San Juan, Subiza-Pérez, & Vozmediano, 2017; Staats, Jahncke, Herzog, & Hartig, 2016). In this study, as appeared earlier, we wanted to focus on public urban squares, which might be of particular interest for this discussion (Peschardt, Schipperijn, & Stigsdotter, 2012; Peschardt & Stigsdotter, 2013). Survey-based studies have already shown the relevance of natural elements such as grass, trees or water in the achievement of restoration (Lorenzo, Corraliza, Collado, & Sevillano, 2016; Nordh, Hartig, Hagerhall, & Fry, 2009) in urban squares or similar designs. The work of Lorenzo and colleagues (2019) also informed about the relation between the activity performed in the setting and its perceived restorative potential. Thus, it could be the case that the activity carried out when spending time in an urban square affects the outcome of a possible restauration process. Social landscape seems to play also a role, with a study showing that reduced numbers of users prompt more restoration rates than the absence or great presence of them (Nordh, Alalouch, & Hartig, 2011). On the contrary, external features such as noise coming from traffic were found to be negatively related to it (Nordh & Østby, 2013; Peschardt, Stigsdotter, & Schipperrijn, 2014). A small group of pretest-posttest experimental studies have also supported the role of urban squares as restorative environments. San Juan et al. (2017) reported that spending 30 minutes

[1] For further information in the spatial elements and configurations associated to restoration see Kaplan & Kaplan (1989), Ulrich (1993) and Ulrich et al. (1991).

[2] Even though these general conceptualizations do not refer to any specific kind or kinds of settings (e.g. natural, urban, green or built) literature on psychological restoration has clearly set a precedent for natural natural/green environments over other typologies. Attention Restoration Theory (Kaplan & Kaplan, 1989) and Stress Recovery Theory (Ulrich, 1981; Ulrich et al., 1991) – the two main theories explaining restoration – focus on nature as the privileged restorative environment.

[3] The adjective *grey* is used here to distinguish green environments (parks, forests, green roofs) from other environment which- even presenting some levels of greenness, are much more built in essence, such as squares and streets.

walking and contemplating in an urban square led to significant improvements in emotional and attentional measures. Herranz-Pascual and colleagues (2019) included one square in their set of settings and found that it reduced negative emotions and perceived stress indicators in shorter visits. This evidence is also supported by other studies analyzing restorative experiences during urban walks (Bornioli, Parkhurst, & Morgan, 2018a; Bornioli, Parkhurst, & Morgan, 2018b; Gidlow et al., 2016;; Johansson, Hartig, & Staats, 2011).

The study of the restorative potential of urban squares reveals its importance for the configuration of a network of small restorative places along the urban matrix to provide citizens with everyday micro-restorative experiences (Thwaites, Helleur, & Simkins, 2005). The provision and enlargement of such a network may entail a triple effect: 1) the direct reduction of stress-related conditions due to the general improvement of the urban environment, 2) the improvement of citizens' health and well-being through the increase of contact with nature, social interactions and physical activity, and, 3) the reduction of leisure-related environmental impacts due to the greater accessibility to salutogenic destinations within the city boundaries.

1.2 A new development in restoration research: the role of person-place bonds

Main theories and approaches to restoration understand that it is an evolutionary-based response to certain environmental features, although such positions have been recently questioned (Joye & Dewitte, 2018; Joye & van den Berg, 2011; Menatti, Subiza-Pérez, Villalpando-Flores, Vozmediano, & San Juan, 2019). One of the evident shortcomings of evolutionary-based explanations is the neglect of possible personal which might be also involved in the process (Felsten, 2014; Ratcliffe & Korpela, 2016; Subiza-Pérez, Vozmediano, & San Juan, 2019; Weber & Trojan, 2018). Here, the use of place attachment and place identity might result crucial. The former is a positive affective tie that people establish with places relevant to them (Hidalgo & Hernández, 2001; Lewicka, 2011). This emotional link makes people seek for spending time there and feel at ease when being. On the other hand, place identity is a section of the self that includes ideas, preferences and values regarding the place a person is identified with. That place forms a part of the personal or group self-concept and people feel a sense of belonging to it (Scannell & Gifford, 2010; Uzzell, Pol, & Badenas, 2002; Valera & Pol, 1994).

The influence of person-place bonding variables in the restorative experiences that environments can elicit in their users has been tested in recent studies. For example, Ratcliffe and Korpela (2016, 2017) showed that place attachment and place memories are significant predictors of restoration achieved through the visits to favorite places. Besides, being in a place relevant in terms of personal or social identity can strengthen self-steem, increase intrinsic over extrinsic motivations and ameliorate attentional performance (Morton, van der Bles, & Haslam, 2017; Ysseldyk, Haslam, & Morton, 2016). It has been also shown that environmental preferences, defined as place identification with a certain environment typology (e.g. natural or urban) affects to perceived restorative potential (Wilkie & Clouston, 2015; Wilkie & Stavridou, 2013). Of particular interest for this study are the results obtained by Menatti and collaborators (2019), which showed that place attachment exerted a positive predictive role on expected restoration when visiting urban squares whereas place identity contributed negatively to such outcome.

Therefore, due to the fact that plazas are frequently used by citizens as a part of the scenario of their daily lives, they might be suitable to further develop the line of inquiry about the role of place bonding in the restoration outcomes. The general objective of this work was to make a comprehensive approach to the study of restorative experiences in urban squares, also

assessing the role of potential predictors related to uses of the square and person-place bonding. Using a double data-gathering process we obtained information both about the physical/design features of the study settings and the use routines and psychological experience of their users. It was hypothesized that the objective characteristics of the settings, the patterns of use and the psychological bonding to the place would be related with the experienced restoration when being there.

2. Methods

2.1 Participants

The sample for this study was composed by 296 people, of which 159 indicated their gender as female (53.9%) and who were 46.87 years old on average (*SD* = 16.42). They were recruited among the users of 6 urban squares in a medium size European city. Genders [$\chi^2(2) = 5.46$; $p = .362$] and age groups [$\chi^2(15) = 24.69$; $p < .054$] were similarly distributed across the squares selected for the study.

2.2 Instruments

The objective assessment of the study settings was conducted using an instrument used elsewhere (San Juan, Subiza-Pérez, & Vozmediano, 2017; *unpublished data*) that allows measuring the presence of natural elements in the site (e.g. trees, grass and masses of water) and the degree of several psycho-environmental features (e.g. coherence, mystery and enclosure).

The questionnaire for users of the squares -designed *ad hoc*- had two sections. The first one, inspired in previous research (Carrus et al., 2015; Lafortezza, Carrus, Sanesi, & Davies, 2009), included some general questions about the user profile (age and gender) and how they use the square (distance from residence, week and month use frequency, length of use and performed activities). We registered 8 different activities: walking, meeting friends and relatives, physical activity performance, reading, landscape contemplation, drinking/eating something, spending time with dependent persons (e.g. children) and walking the dog. Participants had to indicate whether they usually perform those activities in the square where they were interviewed.

The second section gathered information on several psycho-environmental variables and included the following scales. The short version of *Perceived Restorativeness Scale (PRS;* Negrín, Hernández-Fernaud, Hess, & Hernández, 2017*),* a scale composed by 5 items measuring *being away, fascination, coherence, compatibility* and *scope*. The *Spanish version of the Restoration Outcome Scale* (ROS-S; Subiza-Pérez, Vozmediano, & San Juan, 2017), an 8-item scale measuring the main aspects of a restorative experience: *relaxation and calmness*, *attention restoration*, *clearing one's thoughts* and *reflection*. And finally the *Place Attachment* and *Place Identity Scale* (Ruiz, Hernández, & Hidalgo, 2011), in a version by Subiza-Pérez et al. (2017) consisting of 9 items (6 for attachment and 3 for identity). All the scales were presented in a 0-5 Likert scale.

2.3 Procedure

One of the authors and three trained research assistants visited the six study sites and assessed them using an objective assessment tool (San Juan et al., 2017; authors, *submitted for publication*). Pictures of the settings are shown in Table 1.

After this task, the data collection group visited the settings in different times of the day both during the week and the week-end. Different time slots were selected in order to gather the maximum variability regarding users and activities. After arriving to the study sites they individually approached square users and informed them about the nature of the study. Two eligibility criteria were set in advance: 1) participants must be frequent users of the place (tourists and first/second-timers were not interviewed) and 2) age of at least 18 years old. Informed people, meeting the criteria, that decided to take part were given the questionnaire in a clipboard and fully instructed to complete it. When finished, participants were briefly debriefed and, after answering questions or comments if posed, they were kindly thanked. Following this procedure, data was collected from September to November 2016.

2.4 Data analyses

Firstly, ratings of the objective assessment of each study site were compiled calculating an average score. ICC was calculated for each of the objective variables. We compared those ratings running a MANOVA with post-hoc analyses (HSD-Tukey) in order to detect possible differences between the study sites. Secondly, we descriptively assessed the profile of users of each square, the activities they performed there and their frequency and moment of use; and a set of chi-squared analyses were done to check if the squares showed different patterns of use. Thirdly, another MANOVA was run in order to compare square ratings for perceived restorativeness, place attachment, place identification and experienced restoration.

Finally, with the objective of building a predictive model of the restoration achieved in the study settings, a hierarchical linear regression was run. We began running correlation analyses to detect if any of the data gathered in the questionnaire (e.g. objective measures, gender or performed activities) was significantly associated to the restorative outcomes reported by participants. Variables significantly related to the outcome were then introduced in the regression in the corresponding block; 1) objective assessment variables, 2) use of the square and activities and 3) psycho-environmental variables. Due to the limitations of correlations and standardized regression coefficients as indicators of the contribution of each predictor variable in regression models (Budescu, 1993; Darlington & Hayes, 2017; Johnson, 2000), we used two SPSS utilities to analyze the role of each of the variables maintained in the final step of the hierarchical regression model. Specifically we conducted a dominance analysis and estimated the relative weights of each predictor by using RLM (Darlington & Hayes, 2017) and MIMR-Raw (Lorenzo-Seva, Ferrando, & Chico, 2010) programs respectively.

3. Results

3.1 Objective assessment of the squares

Results of the objective assessment of the squares are shown in Table 1. Reliability analyses revealed that most of the objective variables included in the objective assessment performed excellently (ICC > .75) for density, diversity and aesthetic potential of natural elements, orientation, enclosure, imageability, prospect, mystery, singularity, identity and uniqueness indexes. Coherence and exploration showed however a fair internal consistency (ICC between .40 and .59).

Table 2 shows statistically significant differences that were found between the study sites in most of the variables. Post-hoc HSD Tukey comparisons revealed some differences between the squares. More specifically, Place 4 and Place 5 were more and less green

respectively than the other four settings. Thus, apart from size, the squares were quite comparable in terms of design.

Table 1. Results of the objective environmental evaluation of the study settings

	Place 1	Place 2	Place 3
Picture			
Size (m^2)	7,720	1,601	3,212
Natural elements: density [0-15]	4 (0.82)	4.75 (0.96)	4.75 (0.50)
Natural elements: diversity [0-15]	4.25 (0.5)	3.25 (0.5)	5.50 (1.29)
Natural elements: aesthetic potential [0-50]	12.75 (2.63)	17 (2.16)	20.25 (3.86)
Psycho-environmental indexes:			
Orientation [0-4]	4 (0)	2.75 (0.5)	3.25 (0.50)
Exploration [0-5]	3.08 (0.96)	1.92 (0.74)	2.58 (0.17)
Coherence [0-5]	4.25 (0.5)	4 (0.27)	3.92 (0.74)
Enclosure [0-5]	4.58 (0.42)	3.83 (1)	3.92 (0.32)
Imageability [0-5]	4.08 (0.69)	3.42 (0.50)	4.17 (0.33)
Prospect [0-5]	4.50 (0.58)	3.50 (0.58)	4 (0.82)
Mystery [0-5]	1 (1.41)	2.50 (0.58)	1.50 (1)
Singularity[0-5]	3.25 (0.96)	2.25 (2.06)	4.25 (0.50)
Identity [0-5]	3.50 (1)	1.25 (0.50)	3.75 (0.50)
Uniqueness [0-5]	3 (0.82)	1 (0.82)	3.50 (1.29)

	Place 4	Place 5	Place 6
Picture			
Size (m^2)	5,525	1,649	3,265
Natural elements: density [0-15]	9.25 (1.71)	1 (0)	5.75 (0.50)
Natural elements: diversity [0-15]	8.25 (0.96)	1(0)	5 (0.82)
Natural elements: aesthetic potential [0-50]	33.25 (10.08)	5.25 (0.96)	22.50 (4.12)
Psycho-environmental indexes:			
Orientation [0-4]	2 (0.82)	2.75 (0.50)	3.75 (0.50)
Exploration [0-5]	3.17 (0.43)	1.67 (0.67)	2.42 (1.23)
Coherence [0-5]	3.67 (1.19)	3.25 (0.50)	4.17 (0.58)
Enclosure [0-5]	1.58 (0.50)	3.42 (0.17)	3.25 (0.57)
Imageability [0-5]	4.42 (0.69)	3 (0.38)	4 (0.38)
Prospect [0-5]	1.75 (0.96)	3.75 (0.50)	3.75 (0.50)
Mystery [0-5]	4.25 (0.50)	2.25 (1.50)	2.25 (1.50)
Singularity[0-5]	4.75 (0.50)	3 (0.82)	4 (0)
Identity [0-5]	5 (0)	2.75 (0.50)	3.75 (0.50)
Uniqueness [0-5]	5 (0)	1.75 (1.25)	3 (1.41)

Note: the table shows the mean score and standard deviation (in brackets) for each environmental variable assessed by the raters. Greater ratings indicate a higher presence of these environmental features in the setting. Numbers inside square brackets define the range of possible scores for each variable.

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Table 2. Comparison among the objective evaluation variables by setting

	F (5,18)	*p*	ηp^2	*Pairwise comparisons*
Size (m^2)	-	-	-	
Natural elements: density [0-15]	34.28	< .001	.905	P4 > P1,P2,P3,P5,P6 P5 < P1,P2,P3,P4,P6
Natural elements: diversity [0-15]	37.35	< .001	.912	P4 > P1,P2,P3,P5,P6 P5 < P1,P2,P3,P4,P6
Natural elements: aesthetic potential [0-50]	14.71	< .001	.803	P4 > P1,P2,P3,P5 P5 < P2,P3,P4,P6
Psycho-environmental indexes:				
Orientation [0-4]	7.80	< .001	.684	P1 > P2, P4, P5 P4 < P3, P6
Exploration [0-5]	2.42	.076	-	-
Coherence [0-5]	1.14	.377	-	-
Enclosure [0-5]	13.21	< .001	.786	P4 > P1,P2,P3,P5,P6 P1>P6
Imageability [0-5]	4.22	.010	.540	P5 < P3, P4
Prospect [0-5]	6.22	.002	.633	P4 < P1,P2,P3,P5,P6
Mystery [0-5]	3.67	.018	.505	P4 > P1,P3
Singularity[0-5]	2.89	.044	.445	P2 < P1
Identity [0-5]	18.80	< .001	.839	P2 < P1,,P3,P4, P5,P6
Uniqueness [0-5]	6.434	.001	.641	P2 < P3,P4 P4 > P5

Note: F test statistic, *p*-value, effect size index (ηp^2) and pairwise comparisons (HSD-Tukey) for each variable.

3.2 Activities and user profile by square

Square users' residence was located between 0.5 and 300 minutes (*M* = 19.14, *SD* = 34.17) walking from the squares. They visited the specific square where they were interviewed 3.80 (*SD* = 7.26) times a week and 15.06 (*SD* =28.89) a month on average, and usually spent 53.18 (*SD* = 50.12) minutes each time. Most common activities in the setting were looking after dependent people (49.7%), meeting friends and relatives (49%), walking (43.6%) and eating/drinking something (41.2%). A 27.4% and a 20% of the sample respectively used to contemplate the landscape and read when in the square. Least reported activities were practicing physical activities (9.5%) and walking the dog (5.7%).

Statistical analyses revealed that there were statistically significant differences in the home-square distance [$F(5,290) = 3.31$; $p = .006$] and the average length of use [$F(5,290) = 9.81$; $p < .001$]. Post-hoc comparisons showed that users of place 5 lived significantly closer to it than place 1 and 6 respectively. Similarly, they tended to spend more time there than users of places 1, 4 and 6 respectively. Some other dissimilarities on the stay length were detected too (P4 < P2 & P3; P6 < P2 & P3).

When analyzing the dissemination of activities by square we found an unequal distribution for walking [$\chi^2(5) = 27.77$; $p < .001$], practicing physical activities [$\chi^2(5) = 14.56$; $p = .012$], reading [$\chi^2(5) = 22.13$; $p < .001$], landscape contemplation [$\chi^2(5) = 39.83$; $p < .001$], spending time with dependent people [$\chi^2(5) = 63.44$; $p < .001$] and eating/drinking something [$\chi^2(5) = 24.15$; $p < .001$]. In place 1 the frequencies for walking, practicing physical activity and

contemplating the landscape were significantly lower than it might be expected whereas the opposite happened with spending time with dependent people. Place 2 was a better setting for spending time with dependent people and seemingly less suitable for eating/drinking something and contemplating the landscape. Place 3 only had a lower rate of people contemplating the landscape. Place number 4 is apparently a suitable context for walking and contemplating the landscape whereas it is not for practicing physical activity or spending time with dependent people. People using square 5 were more prone to spend time with depending people and less to walk, practice physical activity and contemplate the landscape. In the case of place 6, users were more likely to walk, read and contemplate the landscape. Oppositely, they spent time with dependent people to a lower extent than expected.

3.3 Psychological experience of the squares

Table 3 depicts the *perceived restorativeness*, *place attachment*, *place identification* and *experienced restoration* reported by users of each of the squares. Most ratings fall between 2 and 3 in a 0 to 5 scale, meaning that the restorativeness and psychological bonding with the squares were moderate. Statistically significant differences of a very small size were detected, with place 5 raising lower levels of perceived restorativeness and attachment than place 4 and granting less restorative outcomes than place 1. Despite the latter, it can be generally stated that all the squares selected for the study had a comparable restorative potential –both perceived and experienced- and that users showed similar levels of attachment and identification with them.

Table 3. Survey psycho-environmental variables by place, Cronbach's α, MANOVA *F* statistic, *p* value and differences between groups

	Perceived restorativeness [0-5]	*Place attachment [0-5]*	*Place identification [0-5]*	*Experienced restoration [0-5]*
Place 1	3.05 (1.10)	2.64 (1.13)	2.85 (1.60)	2.94 (1.35)
Place 2	2.74 (1.20)	2.26 (1.50)	2.05 (1.66)	2.34 (1.45)
Place 3	2.87 (1.03)	2.54 (1.30)	2.49 (1.55)	2.17 (1.33)
Place 4	3.15 (1.03)	2.83 (1.08)	2.56 (1.41)	2.48 (1.15)
Place 5	2.47 (1.22)	2.01 (1.29)	2.18 (1.48)	1.95 (1.35)
Place 6	2.91 (1.14)	2.60 (1.30)	2.44 (1.73)	2.65 (1.30)
Cronbach's α	.82	.92	.93	.94
F (5,290)	2.27	2.57	1.62	3.50
p	.048	.027	.155	.004
ηp²	.038	.042	-	.057
Pairwise comparisons	P5 < P4	P5 < P4	-	P5 < P1

Note: the table shows the mean score and standard deviation (in brackets) for each psycho-environmental variable reported by participants. Numbers inside square brackets define the range of possible scores for each variable. Only statistically significant differences between sites appear in the table.

3.4 Prediction of psychological restoration in the squares

An initial set of correlation analyses (see table 4) revealed that *size*, *mystery* and some of the activities performed by users were significantly associated to experienced restoration. Moreover, *perceived restorativeness*, *attachment* and *identification* with the square were highly correlated with such an outcome.

Table 4. Correlation between experienced restoration and other study variables

	Experienced restoration
Objective assessment	
	.141*
Size	-
Natural elements: density	-
Natural elements: diversity	-
Natural elements: aesthetic potential	-
Orientation	-
Exploration	-
Coherence	-
Enclosure (inverse)	-
Imageability	-
Prospect	-
Mystery	-.120*
Singularity	-
Identity	-
Uniqueness	-
Use of the square and activities	
Frequency of use (week)	-
Frequency of use (month)	.149*
Time of use (minutes/time)	-
Walking	.166*
Meeting friends and relatives	-
Practicing physical activity	-
Reading	.145*
Landscape contemplation	.325**
Walking the dog	.136*
Spending time with depending people	-.184*
Eating/drinking something	-
Psycho-environmental variables	
Perceived restorativeness	.808**
Place attachment	.760**
Place identification	.564**

Note: *= *p* value < .05; **= *p* value < .01. Non statistically significant coefficients are not reported.

This information was then used to build a hierarchical regression model to predict *experienced restoration* through the significantly associated variables of the three domains (objective assessment, activities and psycho-environmental variables). As it is shown in table 5, variables coming from the objective assessment and the activities performed at the square did

an almost irrelevant contribution to the predictive model whereas perceived restorativeness and place attachment were associated to the outcome to a greater extent.

Table 5. Hierarchical regression model to predict experienced restoration through study variables

	Step 1		Step 2		Step 3	
Model variables	β	*p*	β	*p*	β	*p*
Size	0.13	.028	0.14	.012	0.09	.009
Mystery	-0.10	.073	0.01	.801	0.02	.566
Frequency of use (month)	-	-	.06	.292	0.01	.780
Walking	-	-	0.09	.125	0.01	.879
Reading	-	-	0.01	.081	0.07	.031
Landscape contemplation	-	-	0.24	< .001	0.06	.094
Walking the dog	-	-	0.12	.024	0.03	.387
Spending time with dependent people	-	-	-0.13	.024	-0.02	.517
Perceived restorativeness	-	-	-	-	0.56	< .001
Place attachment	-	-	-	-	0.26	< .001
Place identification	-	-	-	-	0.01	.775
Model statistics						
F	4.60		7.40		61.51	
Degrees of freedom	2 , 293		8 , 287		11 , 284	
p	.011		< .001		< .001	
Adjusted R^2	.02		.15		.69	
Δ Adjusted R^2	-		.13		.54	

Note: Durbin-Watson = 1.98, β = standardized regression coefficient.

As explained in section 2.4 we finally conducted both dominance and relative weight analyses in order to furtherly assess the contribution of the four significant predictors in step 3. Dominance indexes are shown in Table 6. This analysis revealed that the order of dominance between predictors is perceived restorativeness > place attachment > size > reading. All the cases but one (size > reading – partial dominance) are examples of complete dominance.

Table 6. Dominance matrix with the 4 significant predictors of experienced restoration

	Size	*Reading*	*Perceived restorativeness*	*Place attachment*
Size	-	.75	0	0
Reading	.25	-	0	0
Perceived restorativeness	1	1	-	1
Place attachment	1	1	0	-

Note: Dominance indexes range from 0 to 1 and indicate the proportion of times when the predictor in a row makes a more relevant contribution to the model (in terms of explained variance) than the predictor in the column. Dominance analysis compares the contribution of each paired predictors in all the possible regression models that could be built using the complete set of predictors.

316 The total variance in experienced restoration explained by the regression model (see
317 Table 5) was 69%. Thanks to the relative weight analysis we discovered that perceived
318 restorativeness was responsible of the 58.4% of that rate whereas place attachment contributed
319 with 37.2%. Of much minor importance were size (2.8%) and the activity of reading (1.6%).

320 **4. Discussion**

321 In this study, we wanted to comprehensively approach restorative experiences in urban plazas.
322 As explained in the introduction, we consider that this specific urban typology might be of great
323 interest for the improvement of citizens' quality of life and well-being through the offer of
324 restorative experiences. Despite these considerations, researchers have tended to focus on
325 urban forests and parks when addressing restoration in urban settings and, thus, this work
326 contributes to a gap in recent literature. We assessed the psycho-environmental attributes of a
327 set of 6 public squares in a medium-size European city. Additionally, a questionnaire allowed us
328 to gather information about people's square-use patterns, their bonding to them and the
329 psychological benefits they usually obtain when in the squares. Despite some differences in
330 design features and size, particularly for places 4 and 5, the settings selected for the study were
331 quite comparable examples of Mediterranean/south European squares. In general, they seemed
332 to offer moderate restorative experiences, with ratings between 2 and 3 in a 0-5 scale (ROS-S).
333 This fact is congruent with which has been proposed by other authors, who claimed that urban
334 places might provide with lower-end or moderate restorative experiences (Nordh et al., 2009;
335 Thwaites et al., 2005; authors). Nevertheless, medium-level restorative experiences could be
336 enough if our aim is to promote healthy urban environments since urban population is growing
337 and sustainable life and leisure styles need to be fostered (Dubois & Ceron, 2006; Kabisch, van
338 den Bosch, & Lafortezza, 2017; McKercher et al., 2010; United Nations, 2014).

339 The results of this work invite to consider what the selected squares have in common
340 instead on focusing on the objective differences among them. First, all the squares were
341 correctly integrated in the urban matrix and were adequately equipped for citizens' use (e.g.
342 benches, water fountains, playgrounds, trees…). These squares offered opportunities to rest,
343 socialize and be physically active, activities that might be undermined in the rest of the urban
344 landscape. All in all, these findings sustain previous research on urban restoration (Bornioli et
345 al., 2018a, 2018b; Herranz-Pascual et al., 2019; Lorenzo et al., 2016; Nordh et al., 2009; Nordh
346 et al., 2011; Peschardt et al., 2012, 2014; Peschardt & Stigsdotter, 2013; San Juan et al., 2017)
347 and expand the empirical support for at least a medium-level restorative experiences being
348 possible in urban plazas. Visiting nature for restoration can be seen as an optimal option, but we

should acknowledge that not every citizen will have an easy access to nature: those older, with disabilities or with economic problems, for example, may have very limited or not access at all to natural environments (Rigolon, 2017; Scopelliti & Vittoria Giuliani, 2004). Even adults with medium or high economic level but long working days may find it challenging to access to this type of environment. Even when possible, it is not always desirable; the impact of travelling to distant nature could not be sustainable as a society. Therefore, to look for an improvement in our psychological health using the net of urban plazas already available to us seems a good idea.

The fact that different squares led to the practice of a different set of activities may inform about the effects of square design in terms of use patterns. This finding is consistent with a recent study also showing that activity patterns vary through urban squares and times of the day (Valera, Pérez-Tejera, Anguera, & Sicilia, 2018). James Gibson (1979) proposed that environments will offer different behavior or performance options to their users. Due to the relative homogeneity of the squares used in this study, this possibility must be tested by the means of measuring more design variables and counting on a greater squares sample.

Still in the physical dimension, and once having established the potential benefits of restorative urban plazas, the next step is to consider which elements could optimize the level of restoration achieved by their users. When analyzing differences across squares, we found that the most and least green ones elicited the greatest and lowest restoration rates. Paradoxically, results also indicated that the least restorative square –being also the one with lowest attachment rates- was however the most used. These differences may hinge on the different activity patterns observed in both squares. In this line, classic texts on squares posit that, to be effective, a square must allow for different activities and gather users all along the week and the year (Moughtin & Mertens, 2003; Zucker, 1959). Thus, an evident line of improvement is the provision of suitable equipment to support resting, socializing and looking after other people regardless of the moment of the day and the weather. However, focusing only in greenness and performed activities would not be a long shot here. Further studies could further expand this line of inquiry by manipulating architectural variation and naturalness (Coburn et al., 2019; Lindal & Hartig, 2013) and the arrangement of green elements (Tabrizian, Baran, Smith, & Meentemeyer, 2018). For this purpose, digital and virtual reality tools might provide with insightful data that then could inspire actual developments in cities to be tested afterwards. We should remind here that using the Attention Restoration Theory and the Stress Recovery Theory, developed for explaining the restorative effects of nature, as main source of inspiration for studies on urban psychological restoration might be bring the limitation of overlooking other relevant variables, maybe specific of built environments (San Juan et al., 2017).

Our study revealed that the perceived restorative qualities of a place and the psychological attachment towards it resulted to be very relevant predictors. This easily converges with the results of recent studies challenging the evolutionary assumptions of restoration theories and resorting to attachment and identity explanations for this phenomenon (Menatti et al., 2019; Morton et al., 2017; Ratcliffe & Korpela, 2016, 2017; Wilkie & Clouston, 2015; Wilkie & Stavridou, 2013; Ysseldyk et al., 2016). In this study, place identification was not significantly associated to reported restoration, which might be relatively in line with the results of a recent group of studies (Knez & Eliasson, 2017; Knez, Sang, Gunnarsson, & Hedblom, 2018) finding that attachment is a stronger predictor of restoration. Altogether, this might be a point supporting the subjectivist perspective of landscape studies suggesting that beauty is in the eye of the beholder (Heras-Escribano & de Pinedo-García, 2018; 2) and that perceptions of restoration are closely linked to the actual restorative experience (Ruiz, Pérez, & Hernández,

2013). The inclusion of place bonding processes as made in this work is only one example of a broader set of variables (and ideas) that could expand the original framework of restoration with a better understanding of how it happens in urban (and non-urban) environments. Hence, it would to expand the possible additional variables that could be potentially linked to the experience of psychological benefits.

The application of these results might invite to foster public initiatives to make people more aware about the psychological benefits they could obtain from the use of squares close to their homes and work locations. Similarly, in the light of our findings, initiatives aimed at increasing citizens' bonds with their surroundings and neighbors could be of use to increase the psychological and health-related benefits obtained this way. Examples of this kind of initiatives could be the *Quiero mi barrio* program (Gobierno de Chile, 2018; Vidal, Berroeta, Masso, Valera, & Peró, 2013) implemented in Chile or the urban walks in tribute to Jane Jacobs organized every year all over the world (https://janeswalk.org/, 2019).

5. Conclusion

XXI century cities have to evolve in order to meet the manifold challenges we are facing today. Urban planners and designers must devote their efforts to provide answers to the rise of climate change outcomes and non-communicable diseases - among other phenomena- in order to reduce the environmental impact of city life and promote citizens' health. In addition, open urban places might serve also to address the social needs of societies more and more complex, multicultural and diverse. In this context, the regeneration and potentiation of public space is key. The constitution of a network of places fostering physical activity and social interaction and improving psychological health along the urban grid might constitute a remarkable initiative in such a context and this piece of research might be of use for this crucial endeavor.

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