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Using Native Vegetation Screens to Lessen the Visual Impact of Rural Buildings in the Sierras de Béjar and Francia Biosphere Reserve: Case Studies and Public Survey

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Abstract: Tree screens have a demonstrated role in lessening the visual impact of buildings nonintegrated aesthetically by means of filtering façades. This is particularly useful on village fringes and in areas bordering urban green spaces. However, the role of other vegetal structure such as climber species, and their optimal percentage for façade filtering, have not been measured yet. The main objectives of present study were: (1) To guess if climber species have a similar positive role to lessen the visual impact of a façade than tree species, and (2) to compare optimal percentage of coverage for both vegetal structures. To explore them, we designed three percentages of partial-concealment vegetation screens (0% none, 40–50% medium, 70–80% high), comprising tree or climber native species from a study area, in eight buildings from the same region. As a result, 24 final infographics were evaluated by two groups of interviewees: 27 local people and 39 non-local university students. Respondents had to assess the integration of the building in terms of visual preference using an ascending scale with 5 options from "Very poor" = 1 to "Very good" = 5. The results show a clear linear positive response of participants when increasing the percentage of coverage by both types of vegetal screens. However, positive significant valuation over 3 points on average was reached before in tree species screens (3.06, in 40–50% of façade coverage) than in climbing species screens (3.02 in 70–80% of façade coverage). Finally, there was a high consensus in responses when both groups polled were compared.

Keywords: borderland; cross-border; landscape; buildings; native vegetation; vegetation screens; visual impact

1. Introduction

The need to minimize the visual impact of buildings on the landscape is imposed by society's growing awareness of environmental respect and conservation in recent years [1–3]. In urban environments, this task has been partially achieved by the particular characteristics of built landscapes that are able to absorb negative impacts in a way which, paradoxically, could be defined as "natural". However, in rural environments, there is clearly a need to maintain the functionality of this space, while also attempting to reduce as far as possible the perception of the effects of building development and human action on the landscape [4–6]. The emergence of new construction materials and techniques has led to a proliferation of buildings which, in many cases, fracture the harmony of a landscape that society considers natural and had remained so for many years. The current approach is to integrate buildings into the aesthetics of the rural environment to harmonize the two concepts [7,8].

From an architectural point of view, vegetation offers a multitude of options for creating more comfortable and aesthetically pleasing spaces around buildings [9–13]. Vegetation is used to complement the design of bioclimatic houses, particularly in countries with many hours of sunlight and high summer temperatures [14–16]. It can also be used as a tool to improve the visual relationship between a building and its surroundings by softening the cognitive reading of visual variables of the building, such as lines, forms, and scale [17], or aesthetic variables, including colors and textures [18–20]. Vegetation is therefore one of the most important external parameters in building integration analysis.

Since the 1980s, several authors have examined the role of vegetation in the perception and aesthetics of the environment [21–24]. The use of vegetation screens to reduce the visual impact of buildings has been widely studied as an option to improve the visual acceptance of a building. This is especially important when, due to the building's morphological features (shape, height, materials, etc.), effective integration into the landscape is not possible [25].

Vegetation has not always been studied explicitly, but rather indirectly, through associated concepts. "Mystery", defined as the promise of new information if one could travel deeper into the environment, has been studied by several authors [26–29]. Although this definition is subjective, it is directly related to the degree to which the scene is concealed or filtered by natural elements such as vegetation. Studies have shown how, together with topography, the amount of vegetation concealing a scene is relevant in determining the visual quality and quantity of the observed landscape [30]. Ikemy [29] made a preliminary study of the degree or amount of filtering by trees in frontal planes to a building as an integration tool, establishing filtering thresholds (low to high) without numerical quantification. Other studies have analyzed percentages of filtering in frontal planes of buildings [31].

Screens can be used to either totally or partially conceal a building. Total concealment of a building by vegetation screens is an interesting option when, due to the morphological characteristics of the building (form, height, materials, etc.), effective integration into the landscape is impossible [25]. However, other researchers concluded that total concealment of a scene may be counterproductive, because the human brain needs to complete the visual information of the concealed elements (e.g., the building) to satisfy the mystery of a hidden object [30]. A partial-concealment vegetation screen appears to be the best solution to improve the perception of some defining features of a building, such as line, form, and scale [32].

Barriers should be of appropriate size and foliage density to partially conceal lines and forms [33]. If necessary, plant screens can be suitably staggered, using tree and bush species native to the area of varying size, foliage density and growth rate [22]. Screens should be placed in front of or behind edges, such as the ends of a building, to avoid the cut-out effect against the skyline. Adding natural vegetation elements whose forms have a similar orientation to that of the building achieves better integration with the surroundings by reducing contrasts.

Much work remains in the analysis of the design of buildings targeted for improved integration using vegetation. Other aspects, such as species type and layout in the foreground of a building and the degree of filtering, require further investigation to achieve satisfactory building integration.

The main objective of this work is to determine how varying the percentage of a building covered by vegetation screens can affect the visual perception and evaluation of the building in its immediate surroundings. Digital image analysis techniques are applied, as well as scenario simulation using real photos, working with several practical cases chosen in Northwest Spain and simulating a range of filtering percentages with varying vegetation types on the initial buildings.

2. Study Area

2.1. Description of the Study Area

The study was conducted in the Sierras de Béjar y Francia Biosphere Reserve (Figure 1), in the Northwest Iberian Peninsula (UNESCO 2017). Despite Euro-Siberian influences, the reserve is part of the Mediterranean region and includes 88 municipalities in an area of 199,140 hectares. Zoning of the area is shown in Table 1.

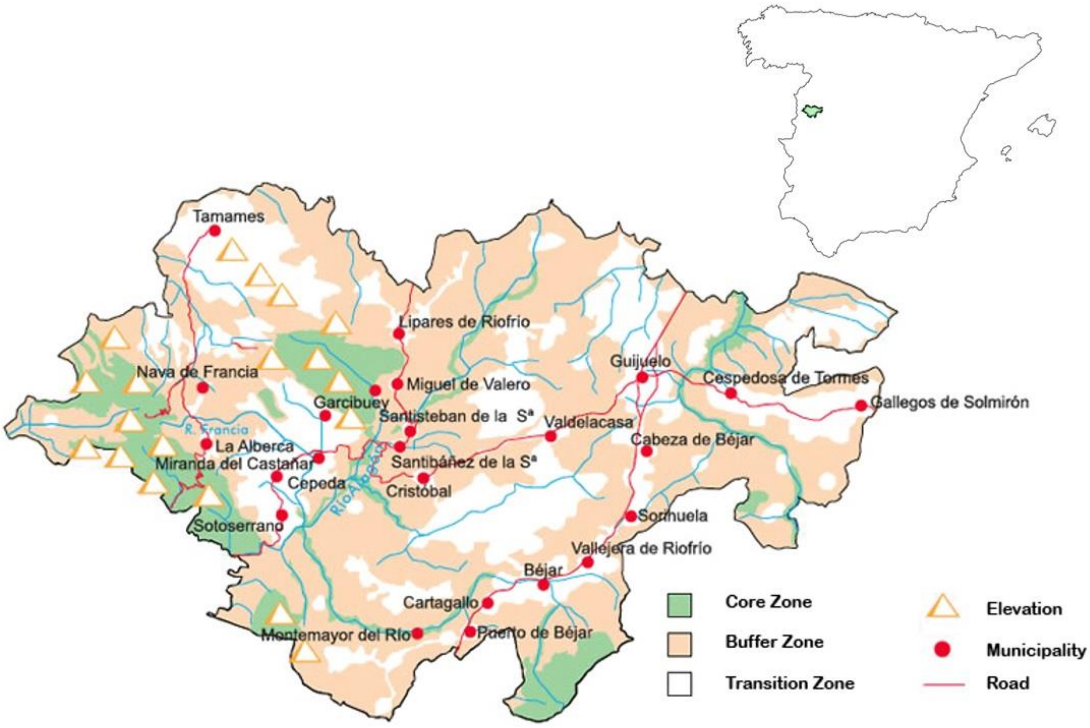

Figure 1. Location of Las Sierras de Béjar y Francia Biosphere Reserve. Source: UNESCO. Spanish Committee of the MaB.2006 program. National Geographic Institute.

Table 1. Zoning of the Sierras de Béjar y Francia Biosphere Reserve.

Zoning	ha	%
Core Zone	24,385	12.24
Buffer Zone	113,197	56.84
Transition Zone	61,558	30.91

The core zone comprises the most representative areas of the reserve. Little used by humans, it is not subjected to activities of great environmental impact and contains no human settlements. The buffer zone surrounds the core zone and similarly includes no settlements, although it is constantly used by humans for the main economic activities of the area: Agriculture and livestock farming. It also includes most of the forestry land and hunting grounds. The transition zone is where most of the anthropogenic action occurs. Ensuring sustainable management of the territory is essential in this zone, because it is where traditional crops are grown around the villages, traditional architecture is preserved, and most of the tourism takes place.

The area is mountainous, with abrupt relief and altitudes ranging from 360 to 2425 m. In addition to the mountain ranges (Sierra de Béjar and Sierra de Francia), it has pronounced valleys, such as those formed by the rivers Alagón, Tormes, Francia, Quilamas, Sangusín, and Cuerpo de Hombre. The differences in altitude, extensive hydrographic network, and varied climate conditions have created a wide variety of ecosystems, ranging from high mountain to riverside woodlands, including rocky areas and granite outcrops, peat bogs and woodland of tree species, notably holm oak, Pyrenean oak, Portuguese oak, sweet chestnut, strawberry tree, dehesa systems, ash, and pine. The main activity in the district is livestock farming, with traditional extensive farming practices, although arable farming has also played an important part in its human history and landscape formation, with traditional hillside terracing common in the area. Local relief and climate have determined the traditional architecture. The traditional mountain Mediterranean house has two main typologies: Stone houses and half-timbered buildings. Wooden framing has traditionally been used for the construction of the upper stories, away from moisture and xylophages, and masonry for the lower story as the mainstay of the entire building. Framing is limed in some buildings and visible in others, creating greater visual complexity (Figure 2) [34].

Figure 2. Traditional mountain Mediterranean houses.

Threats have been detected in all the municipalities of the reserve, and if they are not taken into consideration and acted on correctly, they could have adverse environmental and socioeconomic effects on the region. The most significant threats are neglect of residential areas, architectural heterogeneity, incomplete or unfinished town planning for the transition area, loss of land use or inappropriate use in the buffer zone, and large infrastructure and changes in dominance in the core zone.

2.2. Information Gathering

This study is part of a collaboration agreement funded by the Salmantina Association of Mountain Agriculture (ASAM). After an initial meeting with experts from the association and in a first phase of work, eight municipalities in the study area were proposed for participation. The selection criteria were:

- The natural and landscape context;
- A lack of unification of legal criteria in the aesthetic regulation of new buildings;
- Forecasts for increasing tourism in the medium term.

The eight municipalities chosen were La Calzada de Béjar (population 87), Navacarros (population 125), Lagunilla (population 549), Valero (population 361), Valdefuentes de Sangusín (population 257), Horcajo de Montemayor (population 170), Cepeda (population 400), and Sotoserrano (population 655).

In a second phase, within each municipality, criteria were defined for selecting the buildings for the case study.

Vegetation has been reported as the element with the most important role in the integration of building if designs show some impact related to scale, color or building materials [35], although these authors did not quantify the role of vegetation. Based on this work, all final buildings selected for the study complied with the following criteria:

- Not to be built in the style of local traditional architecture;

- To be in a state of severe neglect;
- To be taller than the other dominant elements.

The fixation of these criteria allowed the subsequent statistic comparison of results among scenarios, avoiding mask results with other noisy variables not considered in this study such as color or texture variations effects.

In a third phase, extensive field work was carried out in the eight selected municipalities to locate test cases that met the criteria defined. Two municipalities (La Calzada de Béjar and Navacarros) were excluded because they had no potential cases.

For each selected case, a scoreboard was drawn up to gather the following data: Case number, coordinates, altitude, photos, vegetation, height, and width. The coordinates and altitude of buildings were determined using GPS Garmin Colorado 300. All photos were taken on a Canon 350D camera, and building height was measured using a VERTEX Laser Hypsometer. Photos were taken at distances and from angles that captured as many details of the selected buildings as possible. The distances considered suitable allowed for 30–50% scene occupation by the building [36]. Unlike viewpoints with perspective, frontal viewpoints do not appear to have a negative impact on the visual analysis of a façade [37], and therefore, both types were used indiscriminately in the study photos. Photos were taken exclusively according to determining factors of accessibility and visibility of the building, from well-used roads or streets, keeping the direct line of observation as perpendicular as possible to the façades under study [38]. From each case, the most representative photo was chosen to determine the final cases for the study (Table 2).

Table 2. Final cases selected for the study. Superscript indicates the type of vegetation used: Tree (**1**) or climber (**2**).

Village	Id_case	X	Y	Height of Building (m)	Vegetation
Cepeda	CEP07	29T0751255	4484252	11.8	*Quercus pyrenaica*[1]
Horcajo de Montemayor	HOR05	30T254697	4479007	8.5	*Quercus pyrenaica*[1]
Lagunilla	LAG05	29T248318	4468147	8.7	*Hedera helix*[2]
Lagunilla	LAG09	29T248111	4468336	7	*Castanea sativa*[1]
Sotoserrano	SOT02	29T0751896	4480517	10	*Hedera helix* and *Buxus sempervirens*[2]
Valero	VAL02	30T0250674	4491342	8.7	*Hedera helix*[2]
Valero	VA05	30T0250802	4491561	8.9	*Vitis vinifera*[2]
Valdefuentes de Sangusín	VDS01	30T259958	4483514	9.5	*Quercus pyrenaica*[1]

In a fourth phase, eight sets of three façade simulations were prepared, based on the eight buildings selected and three different degrees of vegetation filtering in the foreground. This generated 24 pictures for evaluating visual stimuli (Figure 3).

The thresholds for filtering modification were chosen as follows:

(1) No vegetation on the infograph, providing 0% filtering (real and control case). Expected to be the scenario worst evaluated by observers;
(2) Vegetation providing filtering of around 40–50%;
(3) Vegetation providing maximum filtering of around 70–80%.

Figure 3. Thumbnails created using Adobe Photoshop CS5 ® software, in which the vegetation produces: (**a**) Filtering of 0% in the left-hand column (real cases), (**b**) 40–50% in the middle column, and (**c**) maximum of 80% in the right-hand column.

Thresholds 2 and 3 were chosen based on other studies [31]. These authors proposed a methodology of filtering analysis of rural buildings according to concealment percentages by trees (a: >80%, b: 60–80%, c: 60–20%, d: <20%). They considered sharpness of the contour lines of the building as a secondary variable closely related to the impact of color, concluding that the (b) and (c) thresholds had positive differences in the integration of buildings with high impact because of their design, like those in the present work, and threshold (b) was better than (c).

The diverse vegetation vs. building concealment percentages ranges of modification were laid out according to the Weber–Fechner Law (WFL) [39]. WFL describes the relationship between the magnitude of a physical stimulus and its perceived intensity and is considered to be an important principle in psychophysics. According to this principle, the sensory system is able to notice differences as soon as the basic physical stimulus changes for more than a constant proportion of its actual magnitude [40,41]. An expert panel, constituted by landscape architects, planners, geographers, and ecologists, performed a prior evaluation of different concealment percentages according to the WFL. Ratios of about 40–50% were found to render significant changes, and the following were selected for the study on the basis of it. Therefore, percentages within these ranges are those proposed for cases 2 and 3 of this present study.

To increase the statistical study by one variable, we decided to study two types of vegetation on the frontal plane: Trees (analyzed by other authors) and climbing plants (not reported in previous studies).

To define the 24 scenarios, three infographs were made for each case study by modifying the quantity of vegetation in the foreground of the building using Adobe Photoshop CS3® software, without altering the composition of the original image. The infographs were modified by altering the percentage of filtering on the building produced by the vegetation. Climbing plants were used in four cases and tree species in the other four (Table 2). All species were native to the area. The percentage of filtering achieved by the vegetation was determined using Adobe Photoshop CS3® software, Figure 4.

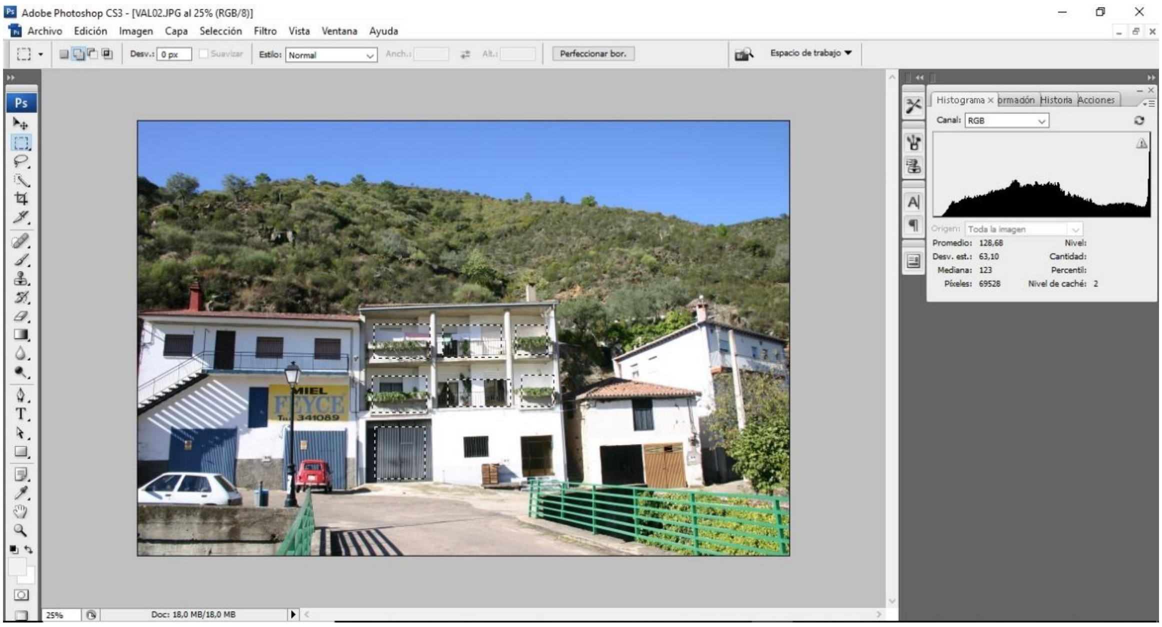

Figure 4. Procedure for calculating vegetation filtering with Adobe Photoshop CS3®.

3. Materials and Methods

3.1. Selection of Participants

University students have been proven to be a suitable group for analyzing visual façade preferences [42–44]. Other works have even demonstrated which students' assessment of visual quality is comparable to a general population valuation [45]. However, other previous researchers have found how local people compared to the general public could present some differences on landscape perception, since their familiarity with the context of scenarios polled could be affecting results [24], so the controversy remains open. In order to take into account these considerations, the survey conducted to evaluate visual acceptance of each scenario developed was performed in two groups of respondents: 27 local people from *La Calzada de Béjar* with no university studies, and 39 non-locals studying at the University of Extremadura who had no links to the municipalities.

3.2. Survey Preparation

To compare possible results, a survey was conducted to analyze the visual integration of rural buildings to determine how varying the percentage of a building covered by vegetation screens can affect the visual perception and evaluation of the building in each scenario on respondents.

The 24 infographs were shown to respondents randomly so that the results would not be affected by the presentation order of the images [44,46]. On seeing each infograph, respondents had to evaluate the integration of the building in terms of visual preference using an ascending scale with 5 options from "Very poor" = 1 to "Very good" = 5. An ascending value scale is a simple and efficient measure of the hedonic tone of a respondent to a visual stimulus, as shown by other researchers [47,48], and is therefore considered suitable for the study objectives.

3.3. Statistical Analysis

Respondents' answers (RA) are the dependent variable of the study; their ascending ordinal nature permits continuous analysis of averages [49]. As well as the observed frequencies, the means of the respondents' preferences were determined for each photo. Vegetation type (VT) (1 = tree, 2 = climber), percentage or degree of filtering (PF) (none = 0%, medium = 40–50%, high = 70–80%), and respondent origin (RO) (1 = university student, 2 = local) are the independent variables or study factors. The aim was to analyze whether these factors carry weight in the dependent variable. Two statistical analyses were performed: (1) Repeated measures analysis of variance (rANOVA) and (2) frequency analysis using the chi-square test.

Analysis (1) allowed us to detect possible effects and interactions between the study factors and the variable response. The mean of the response was analyzed with a factorial ANOVA: (VT (2) × PF (3) × RO (2)). The first two variables are subject to an analysis of repeated measures (intra-subject analysis), while the respondent origin (RO) comprises inter-subject analysis (classic variance analysis).

Factors affecting responses with statistical weight were analyzed in depth by post hoc analysis (Bonferroni test). This makes it possible to locate where the significant differences arise within the categories of each factor and to detect, among other aspects, whether intermediate filtering percentages are significantly more poorly rated than high percentages or no vegetation. Possible interactions between factors (e.g., vegetation type and degree of filtering) can also be analyzed with this sort of test.

The effect size of significant results is also a very commonly used statistical indicator in visual impact studies. Cohen's d measures the strength with which a phenomenon is produced. This indicates not only if two photos or scenarios have significant differences ($p < 0.05$), but also how different they are. For Cohen's d, an effect size up to 0.2 might be a "small" effect, around 0.5 a "medium" effect, and 0.8 to infinity a "large" effect; $d > 0.2$ is accepted as good threshold for distinguishing significant from non-significant differences in environmental visual assessment [50]. In analysis (2), the significant results obtained in (1) were applied to perform a frequency analysis using the Chi-square test. The results of the analyses are illustrated using frequency bar graphs or histograms. The two analyses are complementary.

4. Results and Discussion

All the field trips followed the same procedure of locating and photographing buildings that clashed with their urban or natural setting. The cases evaluated were residential buildings in urban settlements. Farm and industrial buildings and other building typologies beyond the built-up area were left for later studies. Buildings with poor access or visibility for correct photo capture were excluded (Figure 5). A total of 30 potential case studies were recorded. Cases analyzed in Horcajo de Montemayor are shown below as an example.

Figure 5. Location and case studies in Horcajo de Montemayor (Salamanca). Source: Own elaboration based on data from the National Geographic Institute.

From a total inventory of 30 cases, eight were selected at random. This initial number is considered high enough by other authors for subsequent modification of survey scenarios and statistical analysis [35,42].

The percentage of filtering of each building was calculated by dividing the number of pixels occupied by vegetation on the façade by the total number of pixels of the façade. The filtering calculated in each infograph is shown in Table 3.

Table 3. Summary of the filtering calculated in the 16 infographs generated from the eight real photos. Numeration comprises the identifier of each real case (Table 2) followed by 50 or 80 depending on the percentage of filtering applied.

Village	Case	Pixels Building	Pixels Vegetation	% Filtering
Valero	VAL02 50	214,182	111,509	52.06
Valero	VAL02 80	214,182	168,162	78.51
Lagunilla	LAG09 50	243,826	125,496	51.47
Lagunilla	LAG09 80	243,826	191,219	78.42
Horcajo	HOR05 50	48,683	22,162	45.52
Horcajo	HOR05 80	48,683	35,994	73.94
Valdefuentes	VDS01 50	79,467	35,736	44.97
Valdefuentes	VDS01 80	79,467	59,370	74.71
Valero	VAL05 50	135,648	76,424	56.34
Valero	VAL05 80	135,648	101,015	74.47
Sotoserrano	SOT02 50	105,378	48,868	46.37
Sotoserrano	SOT02 80	105,378	76,020	72.14
Lagunilla	LAG05 50	39,866	19,438	48.76
Lagunilla	LAG05 80	39,866	31,930	80.09
Cepeda	CEP05 50	65,953	28,522	43.25
Cepeda	CEP05 80	65,953	54,426	82.52

The repeated measures ANOVA results show that VT, PF, and RO have a significant main effect on the response. Therefore, on average, the presence of tree vegetation was more highly rated than the presence of climbing plants (*Tree:* 2.897 (SE = 0.049), *Climber:* 2.603 (SE = 0.056)), degree of filtering was always valued more highly in ascending order (*None = 0%:* 2.133 (SE = 0.088), *Medium = 40–50%:* 2.876 (SE = 0.057), *High = 70–80%:* 3.240 (SE = 0.077)), and university students rated slightly better than locals (*Students:* 2.848 (SE = 0.061), *Locals:* 2.651 (SE = 0.073)).

However, no interactions were observed between RO and the study factors, VT and PF (Tables 4 and 5), indicating that even if the university students have a significant tendency to give a higher rating, the response pattern according to the degree of filtering and vegetation type is similar (Figure 6).

Table 4. Repeated measures ANOVA of within subject effects regarding percentage or degree of filtering (PF) and vegetation type (VT).

Source	Type III Sum of Squares (SS)	df	Mean Square (MS)	F	Sig.[1]	d (Cohen) [2]
PF	81.237	2	40.618	63.739	0.000	1.996
Error (PF)	81.569	128	0.637			
VT	8.257	1	8.257	42.719	0.000	1.634
Error (VT)	12.370	64	0.193			
PF ^{x} VT	3.275	2	1.637	13.147	0.000	0.906
Error (PF ^{x} VT)	15.941	128	0.125			
PF ^{x} RO	1.029	2	0.514	0.807	0.448	0.225
VT ^{x} RO	0.408	1	0.408	2.111	0.151	0.363
PF ^{x} VT ^{x} RO	0.170	2	0.085	0.684	0.506	0.207

[1] Significance level was set at 0.05. PF, VT, and PR^{x}VT interaction presented significant effects on dependent variable (RA). [2] *Cohen's d* > 0.8 indicates that these differences are visually important with a large effect size.

Table 5. Repeated measures ANOVA of within subject effects regard to respondent origin (RO).

Source	Type III Sum of Squares (SS)	df	Mean Square (MS)	F	Sig.[1]	d (Cohen) [2]
Respondent_Origin (RO)	3717	1	3717	4311	0.042	0.519
Error	55.180	64	0.862			

[1] Significance level was set at 0.05. CO presented significant effects (alpha < 0.05) on dependent variable (RA, respondents' answers). [2] Cohen's *d* around 0.5 indicates that these differences are visually important with a medium effect size.

This means that a global response pattern can be assumed, irrespective of origin and education level. Similar results were obtained by Coeterier [51] and Kongjian [52], assuming that familiarity with the scenarios viewed has a slightly negative effect on assessments by local people, although it is insufficient to affect the global response pattern of the remaining study variables.

From this point, respondent origin is assumed to be not relevant in the vegetation filtering analysis. However, filtering and vegetation type have a significant interacted effect, as shown in Figure 6 and Table 4.

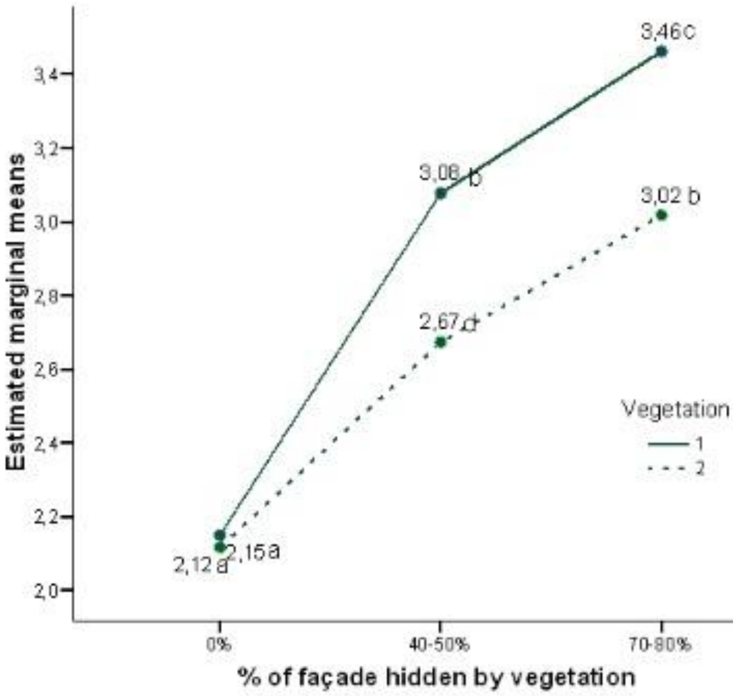

Figure 6. Interaction of means of Filtering x Vegetation. 1 = Tree; 2 = Climbing plants. Different letters indicate significant differences; identical letters indicate similarity (Bonferroni test). (ANOVA data $PF^{x}VT$: F [2.128] = 13.15; $p << 0.01$; d = 0.906).

In addition to the higher evaluation of trees than climbers, the significant differences between degree of filtering are found only in phases 2 (40–50%) and 3 (70–80%) of plant coverage. This means that as the degree of filtering increases, differences in acceptation increase significantly, with the highest ratings occurring for buildings with a high filtering coverage (70–80%) in both vegetation types (Figure 6). In phase 1 (no filtering), the response pattern is similar for both vegetation types, shown by the convergence of valuation means in Figure 6. They are also the cases with the lowest value (2.1), or worst acceptance. Another interesting effect occurs on comparing the medium filtering means (40–50%) of trees (3.08, Figure 6) with the high filtering means (70–80%) of climbing plants (3.02, Figure 6). The values are statistically equal, close to score category 3 = "acceptable". The interpretation of this result suggests that to achieve positive integrations higher than 3 on a scale from 1 to 5, two combinations could be used: Trees with a medium filtering threshold or climbing plants that densify the façade to a high percentage. This information is relevant for town planning management, because plant type or species and the degree of filtering should not be combined at random, as shown in the results. Further research with other species could extend these results.

The effect size of the interrelation between VT and PF (d = 0.906 Table 4) is high enough (d > 0.8) to be taken into consideration. This enhances the relevance of this work, given that, with a relatively small sample of respondents ($n = 66$), considerable effects were obtained for filtering and vegetation type in front of a façade. Increasing the sample would not increase the significance level or give greater consistency to the results. Both variables (vegetation type and degree of filtering) thus have a considerable impact on the visual effect of a façade and could be generalized for any average respondent.

Related to the frequency analysis, the Chi^2 test confirmed the paired differences between the five response types (Very poor to Very good) and the three degrees of plant density (Figure 7). These analyses no longer consider the effect of the respondent, in view of the rANOVA results. Thus, it is clear that if the entire façade is visible, the rating of the whole scenario drops. The best situation is when façade vegetation coverage is much higher than 50%, regardless of vegetation type, although climbers have a lower overall rating (Figure 8).

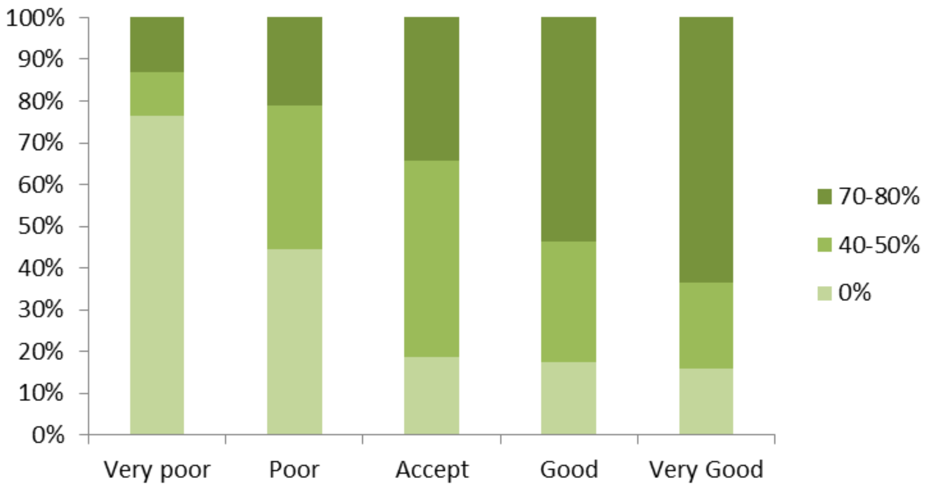

Figure 7. Percentage of total responses by degree of filtering (PF) (Chi^2 [8, 1584] = 386.3; $p << 0.01$).

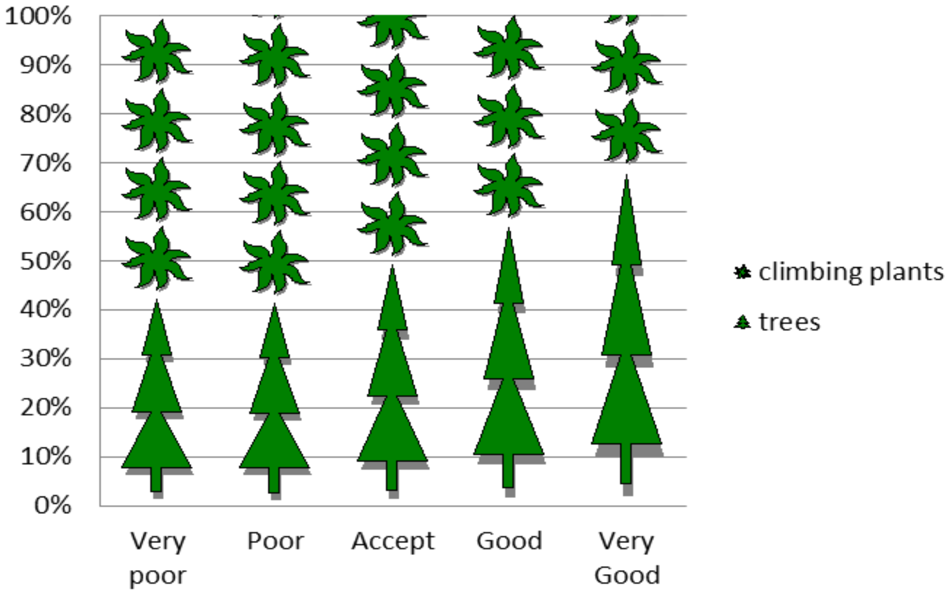

Figure 8. Response pattern by vegetation type (VT) (Chi^2 [4, 1584] = 34.93; $p << 0.01$).

Screening around this threshold (50%) clearly increases the likelihood of finding ratings of at least "Acceptable" in the case of trees (Figure 9), although for climbers, plant coverage should once again be increased to 70–80% for good probabilities of acceptance (Figure 9).

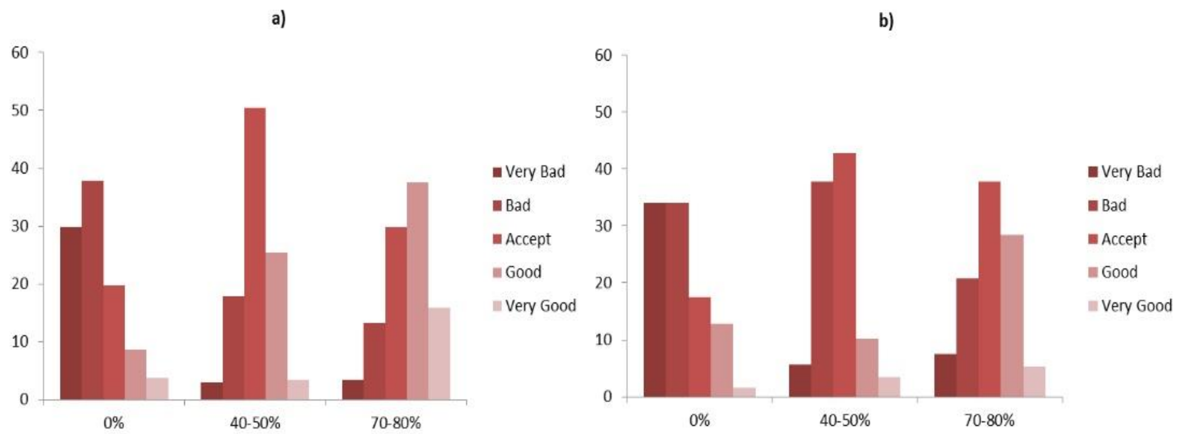

Figure 9. Responses by degrees of filtering and vegetation type: (**a**) Trees (Chi^2 [8, 792] = 262.54; $p << 0.01$); (**b**) climbers (Chi^2 [8, 792] = 162.53; $p << 0.01$).

Although some authors question the validity of the photographic method and express doubts about whether a photo can represent a complex scene and if it is possible to evaluate in the office attributes that are not perceptible via photos, such as sounds, smells and shades of color [53,54], most studies vouch for the usefulness of this technique in landscape assessment [55–61]. Moreover, infographic simulation from a photographed scene allows viewers to compare and evaluate a range of possible scenes [62–66]. Therefore, the experimental approach used in the present investigation can be defended as being valid and suitable.

5. Conclusions

The design of buildings targeted for improved integration could be enhanced by attention to detail in visual aspects linked to species type, plant density, and plant layout in the building's foreground, to achieve a determined filtering level. The conclusions and methodology of this study could assist in town planning design and landscape protection by proposing improvements with a scientific base, including recommendations on the type and form of vegetation screen depending on the purpose and the characteristics of new projects.

The main conclusions of this work on vegetation, based on the results, agree with the findings of other research groups working on similar projects. The practical, concrete nature of the study means that many of the conclusions can be used by architects, planners, designers, and technicians. The most important conclusions are:

(1) Using vegetation to filter the view of a building, in general terms and regardless of which species is used, enhances the integration of a project into the surroundings;
(2) Using vegetation with an intermediate degree of filtering in the frontal plane of a building (40–50%) increases the possibility of the perception of the façade improving from Poor or Very poor to at least Acceptable;
(3) A higher percentage of filtering with vegetation (ca. 70–80%), stopping short of total concealment, always improves evaluation, increasing the probability of the integration being rated Good or Very good.

Building integration is typically improved more by trees arranged as a screen than by climbing plants on the façade.

6. Future Lines

- Future lines of research could be the incorporation of new native plant species, characteristic of riverine areas, in order to expand the study areas and scenarios considered. It is also possible to advance the method of conducting the surveys, looking for not only the public opinion, but also recording their behavior and attitude during the completion of them;
- Generate an interactive virtual environment that allows respondents to modify the modelled scenarios and different elements, in addition to allowing them to freely navigate inside the modeling space.

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