Dimensions of Landscape Preferences from Pairwise Comparisons[1]

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Abstract: Analysis of landscape preferences allows the detection of major dimensions as:(1) the opposition between "natural and humanized", (comprising features like vegetation cover, cultivation, pattern of landscape elements, artifacts, excavations, etc.); (2) a polarity "precision/ambiguity" (involving opposition between: predominance of straight, vertical lines; contrast; recurrent patterns, etc./curved, diffuse forms, etc.) (3) a polarity "harsh, hostile, awe-inspiring/bland, welcoming" and (4) opposition between warm and cold colors. These trends are not completely independent and a more general trend opposing "unpredictable, uncontrolled" to "predictable, controlled environment" may be disclosed.

1. OBJECTIVE

This paper is a summary of the research studies carried out by our working group from 1973 at the University of Seville and continued at the Autonomous University of Madrid (González Bernaldez et al. 1973; Garcia Novo et al. 1974, Sancho Royo 1974, Ródenas et al. 1975).

Although subjectivity is an important factor, often evoked in assessing aesthetic values of the environment, more experimental work has been devoted to finding common factors of agreement than to explore variance or structure in preferences within given populations. Our work is aimed at finding out typologies or dimensions of preferences, i.e., analyzing landscape selection to discover definite trends or ways of choosing.

The simplification obtained by means of factor analysis may be useful in facilitating further psychological and sociological experiments. For example, in further experiments combined with socioeconomical and psychological research the 15 most characteristic picture pairs instead of the 140 originals have been used as stimuli (Maciá 1979).

2. PROCEDURES

2.1 Picture Pairs Collections

The methodology used in the first series of studies has been described in detail by Sancho Royo (1974). Subjects were asked to choose a picture of every pair from a collection of paired photographs or drawings. Picture-pairs collections portrayed different subjects:

2.1.1. A general landscape collection of 120 pictures from tourist books and drawings (González Bernaldez et al. 1973, Sancho Royo 1974).

2.1.2. A collection of 80 pictures portraying examples of large dams viewed

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in their landscape setting .(Ródenas et al. 1975).

2.1.3. A collection of 108 pictures portraying examples of the northern Madrid landscape (unpublished).

The picture pairs were mounted side by side on cardboard and bound into a booklet (2.1.1 and 2.1.2) or reproduced in slides (2.1.3).

After some trials the following procedure of pair arrangement was adopted:

(1) A broad subject for every experiment was selected (general landscape, large dams, northern Madrid landscapes).

(2) Picture subgroups within every subject were established ensuring within each subgroup similarity in subject distance, camera position and image cropping.

(3) Picture pairs within every subgroup were formed at random.

2.2. Data Processing

The results were coded as 1(left picture chosen) and 0 (right picture chosen) and punched on cards. 2 "coincidence" matrices (Sancho Royo 1974, Gonzalez Bernaldez et al. 1973) were computed: the landscape matrix and the subject matrix.

(1) In the landscape coincidence matrix, the elements a_{ij}, $i \neq j$, are the number of subjects that agree in selecting the picture at the same side of the image pairs i and j simultaneously. The elements a_{ij}, $i=j$ (main diagonal) are the total number of subjects.

(2) In the subject coincidence matrix, the elements a_{ij}, $i=j$, are the total number of image pairs.

(3) From both matrices correlation matrices were computed. In these matrices the elements r_{ij} are the correlations between row i and raw j of the former matrices (1) or (2). Correlation matrices were subjected to principal component analysis. A varimax rotation was applied to the first axes representing 70 percent of original variance.

Other varieties of factor analysis suited for binary data, like contingency matrix (Ivimey-Cook and Proctor 1967) or correspondence analysis (Benzecri 1969), require the duplication of the rows corresponding to picture pairs and need increased computation power.

3. INTERPRETATION OF RESULTS

3.1. Inspection of picture pairs with the largest factors.

For every component, pairs having the largest factor (in absolute value) were sought. During inspection of the pairs of pictures having negative factors, the position of images was inverted. Pairs with the largest factors were inspected for common characteristics present in one side of the series.

3.2. Finding coordinates for subjects in the picture space.

For every component, the coordinates are computed as $\Sigma f_i \delta$, where f. is the pictures factor for a given component and • is equal to +1 (left picture chosen) or -1 (right picture chosen). Similar coordinates may be used to identify pictures with a high discrimination effect when subject coincidence matrix 2.2(2) has been computed.

3.3. Correlation with adjective lists.

Sets of characteristics like: "contrasted, welcoming, abrupt, cultivated", etc. may be inspected for correlation with components of factor analysis. The value +1 was attributed to those pairs of pictures in which than left side picture exhibited the considered characteristic in greater degree then the right side picture of the pair; the value -1 if the reverse was true, and 0 if the characteristic was exhibited with equal intensity by both sides or was not applicable at all. This evaluation was carried out by a panel of three members. When a discrepancy occurred, the value 0 (both sides having equal potency) was adopted. In this way, a score for a given characteristic may be computed for every subject as $\Sigma a_i.\delta$, where a_i is the value of the picture pair determined as described, and • is equal to +1 (left picture chosen) or -1 (right picture chosen). Thus correlations may be computed between scores and factors (figures 1 to 4).

Table 1--Preference differences for subjects belonging to contrasting sociological categories (After Gonzalez Bernaldez et al. 1973, Ródenas et al. 1975 and Sancho Royo 1974)

Preference Polarity:

humanized landscape / natural landscape

Sex	women (students)	men (students)
Occupation	farmers	university students
Occupation	housewives	university students

4. SUBJECT POPULATIONS

Subjects were in most experiments university students but subjects belonging to different populations were used. Housewives, farmers and university students were considered representatives of large sociological categories but the groups were rather intended as "markers" or "tracers" to study distribution in the component space.

These experiments resulted in clear cut differences ($p < 0.01$) regarding one of the factors, the "humanized landscape" "natural landscape" for socio-professional differences (Gonzalez Bernaldez et al. 1973, Ródenas et al. 1975; Sancho Royo 1974). A summary is presented in table 1.

5. LANDSCAPE PREFERENCE DIMENSIONS

Repeated experiments with different populations and materials, and comparison of rotated and non-rotated solutions give information on the stability of some directions of variation that tend to recur under different circumstances. Reification contents have been grouped under more ample labels N, A, H, and C by the simultaneous application of the following criteria:

(1) Independency between groups and dependency within a group regarding their frequency of correlation in the different analyses.

(2) Similarity of the semantic content of the reification of the components obtained in the different analyses. Components have been classified under bipolar groups N, A, H and C, according to similarity:

Group N Nature/Culture	Experiment number (table 2)	Component (r=rotation)
-natural landscape/artificial landscape (involving low plant cover, cultivation, patterned distribution, artifacts)	(1)	I
-high vegetation cover/low vegetation cover	(1)	I_r
-natural landscape/artificial landscape (low tree cover, regular distribution, cultivation flat reliefs, buildings)	(2)	I
-high vegetation cover/low vegetation cover	(2)	II_r
-high vegetation cover, less stripping and excavation/low plant cover, stripping, excavation	(4)	V_r
-natural landscape/artificial landscape (low plant cover, etc.	(3)	I
-natural landscape/artificial landscape (excavations, machinery, buildings, muddy water, low plant cover)	(4)	I
-random distribution, diversity, lack of houses/patterned distribution, low diversity, presence of houses and roads (2)	(2)	I_r
-conspicuous artifacts enhanced by vertical pattern and contrast/dissembled artifacts	(4)	I_r

	Experiment (Table 2)	Component (r=rotation)
Group A : Precision/Ambiguity		
-rounded, broad trees/slender trees	(1)	III_r
-slender, sharp, straight forms/rounded, diffuse, sinu-ous forms	(1)	III
-sharp, straight, slender forms/rounded, diffuse, di-vagating forms	(2)	III
-sharp, straight, slender forms/rounded, diffuse	(2)	III_r
-sharp, precise contours/ blurred, diffuse contours	(3)	III
-rounded forms, horizontality /slender forms, verticality	(3)	IV
-contrasted/monotone	(3)	II_r
-verticality, contrast, pat-tern/horizontality, monoto-ny, random distribution	(4)	II
-clean shades/gray tonali-ties (in color pictures)	(4)	IV
-straight, vertical lines; contrast; cold colors, pat-tern/curvature, horizontali-ty, warm colors	(4)	III
-straight lines/curved lines	(4)	III_r
Group H : Harsh, Hostile, Awe Inspiring/Bland, Welcoming		
-harsh, contrasted/welcoming, monotonous	(1)	II
-rough, barren/fertile, friend-ly	(1)	V_r
-rough, harsh, hostile/wel-coming, friendly, bland	(2)	II
-contrasted, cold, abrupt, rocky, arid/monotonous, warm, flat, fertile	(3)	II
Group C : Warm Colors/Cold Colors		
-warm colors/cold colors	(4)	II_r

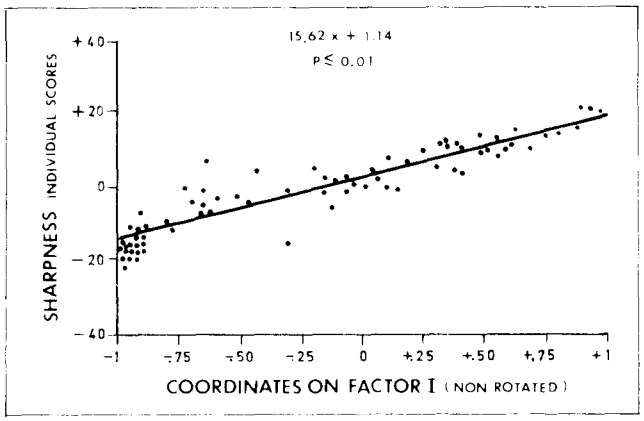
Bipolar group H (harsh, hostile, awe inspiring / bland, welcoming) fails to materialize with pictures of large dams. This may be explained by the rather restricted environment portrayed in this series.

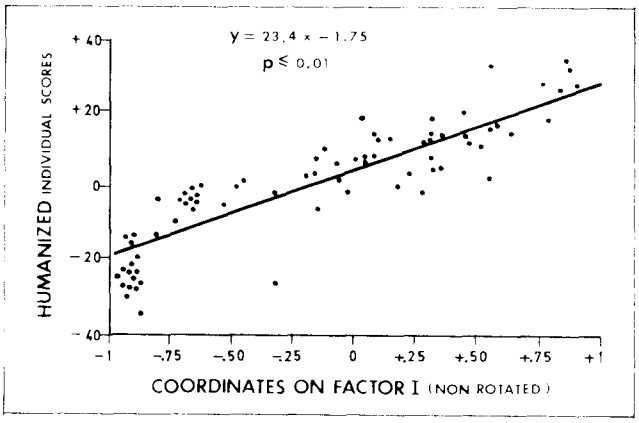
Different contents or reifications within the groups N, A, H and C may appear loose or united within each group, forming more or less complex entities. Rotations usually resulted in a decomposition of the content giving rise to simpler contents. For instance, the important component (in variance absorption terms) "natural landscape/humanized" involves differences in : vegetation cover, randomness of distribution of landscape elements, absence or presence of cultivation, buildings, machinery, traces of human activities, more or less abrupt relief, etc. When Varimax rotation is applied the content tends to become simpler, giving rise to new factors with reifications like : degree of vegetation cover (exclusively), regular pattern in element distribution (exclusively) etc. (Sancho Royo 1974).

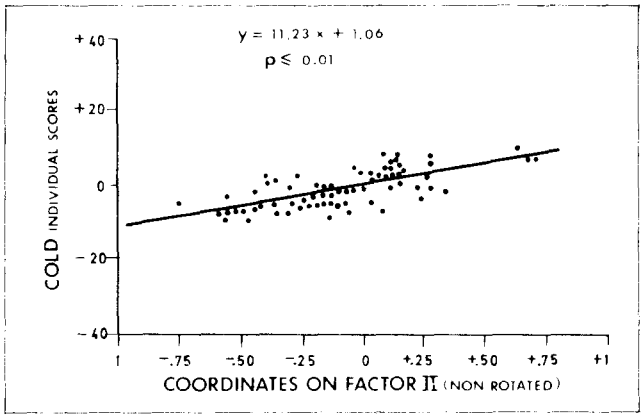
More rarely, rotation provokes fusion of simple contents in a more complex factor. This happens in the case of the first principal component of population (4) "natural landscape/artificial landscape" and the second component, "verticality, contrast/horizontality, monotony". Both contents are compounded in a new factor, "natural, horizontal, monotonous/artificial, vertical, contrasted" (first component) after rotation (Ródenas et al. 1975, page 170).

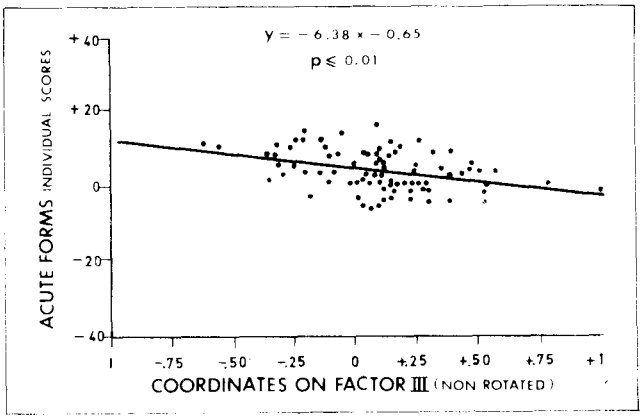
6. SIGNIFICANCE OF THE LANDSCAPE PREFERENCE DIMENSIONS

As expected, the dimensions obtained are rather general and abstract. They seem to apply equally well to photographs as to actual landscapes although some of them tend to represent more "content" than "formal" aspects. For instance groups N (nature/culture) and H (harshness/welcoming) coincide in representing a "content" that requires "perception" or interpretation of a scene to which a signification is attributed. On the contrary, groups A (ambiguity/precision) and C (colors) represent "formal" aspects that do no require interpretation and thus do not need true "perception" of the exhibited scene.









Figures 1 to 4--Examples of relationships between adjectives and principal components of landscape preference analysis. Experiment (3). Regressions are computed between subject factors and subject scores for adjective lists (3.3) (Data from Garcia Novo et al. 1974, and Sancho Royo 1974).

Table 2--Population of Subjects of the Experiments. GLC - General Landscape Collection 2.1.1. LD - Large Dams 2.1.2. NML - Northern Madrid Landscapes 2.1.3

Picture Material	Number of Pictures	Subject Population	N	Locality	Experiment Code for Reference
GLC	120	University students	60	Seville	(1)
GLC	120	University students, sex ratio 1:1	75	Seville	(2)
GLC	120	University students + farmers	80	Seville	(3)
LD	80	University students + housewives	84	Seville	(4)
NML	108	University students	279	Madrid	(5)

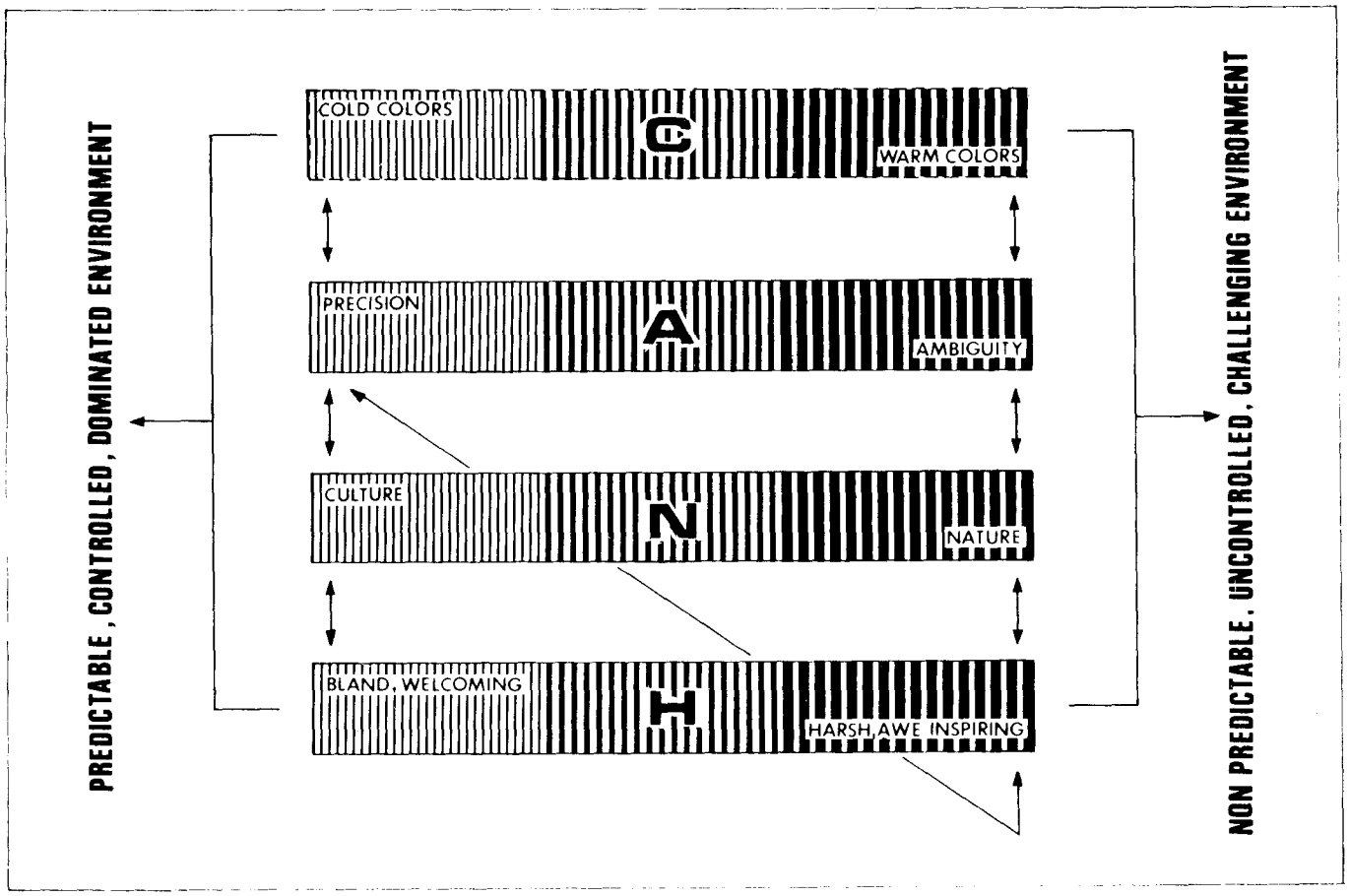


Figure 5--Reticulate relations (by occasional correlation) between bipolar groups N, H, A and C. Arrows represent between-groups correlation. Groups have been obtained by classification of trends of variation that tend to recur in the different experiments.

In figure 5 the structure of relations between the large groups is shown. Groups N (nature/culture) and H (harshness/welcoming) are somewhat related by the nature and harshness poles. It has been observed that the pole "precision" enhances the humanized or cultural character of the environment (Rǒdenas et al. 1975). Nevertheless, acute, sharp forms may be related to the "harshness" pole in some experiments (Sancho Royo 1974). This conflict results in the lack of linear relations between groups N, H, A in figure 5 where an inversion or crossing-over between "precision" and "harshness" is represented by the oblique arrow.

Occasional connections between two concepts classified in different groups may be interesting. As mentioned "verticality" (group A) may fuse with "artificial" (group N), "contrast" (group A) with "harshness" (group H), "curved forms" (group A) with "warm colors" (group C) and "natural" (group N) with "harshness" (group H).Arrows represent this occasional fusion between group correlations in figure 5.

It is interesting that concepts found while interpreting the main trends of choice seem to coincide with some intuitive ideas used in history of the fine arts. The tension between natural and humanized landscape has been amply commented as a polarity dominating opposite attitudes in gardening and landscaping (Lopez Lillo and Ramos 1969). The association between the pole "culture" and "precision" (fig. 5) can be expressed as humanization of the environment enhanced by the presence of straight lines, regular patterns, contrast as opposed to curves, sinuosities, lack of pattern and diffuse contours which corresponds to the classical/baroque opposition considered in style studies (Wolfflin 1950, Seldmayr 1959). This opposition represents the tension between predictability (precision) and

the lack of predictability (ambiguity) evoked by Bollnow (1963) as a characteristic of the opposition between renaissance and baroque.

Association of naturalism and lack of predictability versus humanization (culture) and predictability evokes the relation between painting or architectural styles and the "external control/internal control polarity" studied by Juhasz et al. (Juhasz and Paxson 1978a, Juhasz and Paxson 1978b). The external locus of control (fatalism) would be related to the naturalistic unpredictability trend. Relations with the nature/culture dialectics of some french structuralists are also evident.

Concepts of hostility, awe-inspiring, harshness, etc. (group H) have been noted many years ago as an important ingredient of man-environment relationship. Bollnow (1963) considers the tension between menacing space and welcoming space (or refuge) as the focal center of his theory of man-space relations. The role of alert and attention-arousing stimuli in relation to aesthetical preferences has been mentioned by Berlyne (1960). The association of the "harshness, risk-taking" pole of N is also coherent, having a romantic meaning (Bates 1960).

Most of the relations may be consistently structured in the way shown in figure 5. A very general polarity may be remarked in the form of a tension between:

(1) Non-predictable, uncontrolled (fatalistic?, random?) risk evoking, challenging environment.

(2) Predictable, controlled, dominated environment.

These extremes may represent a permanent tension in man-environment relations. It may be observed that passage from (1) to (2) types of environment sums up the development of human civilization. Preferences for type (1) of environment persist today as types of sensibility in aesthetics, sports, outdoor activities and environmental attitudes.

7. REMARKS

This work is a part of project number 514 of the Spanish MaB program in the area number 13: Perception of the environmental quality.

LITERATURE CITED

Benzecri, J. P.
1969. Statistical Analysis as a Tool to make Patterns emerge from Data. In Methodol. of Pattern Recogn. p. 36 - 40. Academic Press, New York.

Berlyne, O.E.
1963. Conflict and Arousal of Curiosity. McGraw-Hill, New York.

Bollnow, D.F.
1963. Mensch u. Raum. Kohlhammer. Stutgart.

Garcia Novo, F.; Gonzalez Bernaldez, F.
1974. Dimensions des réactions devant le paysage. Coll. Intern. Informat. et Envir. Fondat. Univ. Belge. Arlon.

Gonzalez Bernaldez, F. and Sancho Royo, F.
1973.Analyse des réactions face au paysage. Options Mediterr.17:66-81.

Ivemey-Cook, R.B. and M.C.F. Proctor
1967. Factor Analysis of Data from East Devon Heath. J. Ecol.55:405-413

Juhasz, J.B. and L. Paxson
1978 a. Personality and Preference for Architectural Style. Percep. and Motor Skills 46: 347-349.

Juhasz, J.B. and L. Paxson
1978 b. Personality and Preference for Painting Style. Percept. and Motor Skills 47 : 241-242.

Lopez Lillo, A. and A. Ramos
1969. Valoración del Paisaje Natural. E.T. Sup. Ing. Montes, Madrid.

Maciá, A.
1979. Contribution at this Conference.

Ródenas, M.; Sancho, F. and F. Gonzalez
1975. Structure of Landscape Preferences. Landscape Planning 2: 159-178.

Sancho Royo, F.
1974.Actitudes ante el Paisaje. Publ. Univ. Sevilla. Seville.

Seldmayr, H.
1959. El Arte Descentrado. Labor. Madrid

Wolfflin, H.
1950. Principles of Art History. Dover New York.