Exploring the effect of demographic elements on the evaluation of the scenic beauty of various landforms – preliminary results

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Abstract

This paper reports on a piece of research which attempts to take 32 different images of landforms and to show how different classes of people perceive or "value" the scenic beauty of these landforms. This is an interesting question and one which bears research. In this case the term "scenic beauty" refers to the public preference of various forms of the earth's relief. It is a figure which, even though it depends on various subjective factors, aims to quantify the general preference of the public for various landforms. A questionnaire survey takes place in order to investigate the public preference, using a sample of 221 persons in the area of Athens and Piraeus, and the city suburbs. This area concentrates a very large proportion of Greece's population and can ensure variety in terms of social and demographic status of the sampled population. The means used to demonstrate the various forms of relief are 32 digital relief images, created with the use of an algorithm developed for this purpose. The representative selection of the sample of digital images took place after the classification of the forms of relief in Lefka Ori mountain range in Crete. The questionnaire included 11 questions describing the person questioned in relation to the environment he/she has experienced or knows and his/her contact with the countryside. Each question corresponded to a factor (e.g. age, sex, education, income etc.) that had been generalised in categories. Following this, a primary statistical analysis of variance was carried out for each of the factors examined and some preliminary results are reported. Little research in this specific area has been done and it is interesting to explore further the way people with different social backgrounds react or perceive the various landforms.
Keywords: scenic beauty, landscape aesthetic, perception, landforms, demographic elements.

WIT Transactions on Ecology and the Environment, Vol 89, © 2006 WIT Press
www.witpress.com, ISSN 1743-3541 (on-line)
doi:10.2495/GEO060331

1 Introduction

Landscape is the combined result of physiography, geological formations, vegetation, waters and the various cultural interventions that occur in a given area. This combination attributes shape, line, colour and texture to a landscape, while the aesthetic result is considered on the basis of the variety or the uniqueness offered and is usually classified into three main classes: 1) indistinctive, 2) common, 3) distinctive (USDA, [1]; USDA, [2]). This classification determines those landscapes which are most important and those which are of lesser value from the standpoint of scenic beauty. The classification is based on the premise that all landscapes have some scenic value, but those with the most variety or diversity have the greatest potential for high scenic beauty. The various approaches developed for determining landscape visual quality refer to the general output of the synthesis of all physical variables of the environment, physiography, soil, vegetation, hydrological elements, and not individually to each element. In these approaches, the visual quality of a landscape is evaluated either indirectly by thematic maps according to standardised criteria based on the experience of the scientists, or directly on the basis of psychometrical methods that quantify directly the public's preference by demonstrating through a certain means the landscape under evaluation (Kaplan et al [3]; USDA [1]; Kaplan [4]; Daniel and Boster [5]; U.S. BLM [6]; Palmer [7]; Smardon et al [8], Hunziker and Kienast [9]). Relief constitutes, however, a part of these approaches and not the main objective.

There are cases where it would be desirable to isolate the relief from the other elements which are making up the visual environment and to investigate its scenic beauty separately. Such cases include the technical works that cause major and permanent alterations to the relief, as well as the works, of which the spatial arrangement depends on the morphology of the ground. Slopes, distances, hypsometric difference values, viewsheds are elements of the relief that affect the visual quality of a landscape, but also the ability of a particular landscape to accept and absorb new activities.

The experience of the scientists show that the more mountainous the form of the relief, the more distinct the landscape category offered (USDA [1]; U.S. BLM [6]). It is interesting in this case to explore the way various persons react, based on different demographic elements, to the different forms of the relief. The way each observer evaluates any given landscape is a very complicated issue, a matter difficult to predict. Many factors can possibly influence this evaluation, ranging from factors that can be registered, such as the usual demographic elements, to imponderable factors, such as the mood of the observers at the time of the evaluation. Besides, what "one likes or dislikes" does not remain constant with time. As a person matures, his/her attitude towards many things in life changes. Therefore it would be utopia to try to predict with precision the preference of an observer for a given landscape, but this is not the aim of this research. This paper presents some preliminary results of a research work that aims to investigate the way in which the various demographic elements of the persons questioned influence the preference in the case of the evaluation of the

scenic beauty of a landform. Whatever conclusion can be drawn, even based on the few factors that can be registered, would be useful in the interpretation of the phenomenon.

2 Investigation methodology

2.1 Digital relief visualisation

The investigation of the public preference to the various landforms can be achieved with the use of questionnaires, by utilising some means for presenting the different forms of relief. In this case, it was not possible to use actual photographs as a means to demonstrate these different forms, because they would provide simultaneously information on the vegetation, the soil and the land uses of a given area, something that could influence the preference of the persons questioned. Therefore, the survey was effected using digital visual representations as a means to demonstrate the various forms of relief. These are images created with the use of a Digital Terrain Model and the respective shading image. The creation of these images relied on an algorithm that had been developed for this purpose, producing the perspective image of the relief, as this would look like if it had been photographed from a known shooting point in relation to a given target, with the use of a photo camera of known geometry (Tsouchlaraki [10]). All shootings are strictly horizontal, considering the geometry of a 35 mm camera with a normal lens (f=50 mm) and a predetermined data analysis scheme.

The study area was that of the Lefka Ori mountain range in Crete, owning to the variety of the forms of relief it includes. The IDRISI GIS package was used for the processing of information, as well as the creation of a DTM and of other derivative elements.

The representative selection of the sample of the digital representations that would be included in the questionnaire took place following a classification of the relief forms, based on a method developed for this purpose, which is a modification of Hammond's classification method (Tsouchlaraki [11,12]).

The classification resulted in 32 relief categories. A horizontal position was selected for each category, for creating a digital representation. The 32 images created are representative of the different forms of relief in the study area and are depicted in Figure 1. As far as the scenic beauty is concerned, the persons questioned were asked to rate it on a 1-10 scale (1 representing a very small preference concerning the scenic beauty of the landform and 10 representing a high preference). This scale was chosen because the studies of landscape aesthetics which use photographic imagery (both actual and simulated) and 1-10 scales for response are common in use.

2.2 Questionnaire design and execution

There are many rules for the design and execution of a questionnaire and also many decisions that have to be taken (Damianou [13], Koutsopoulos [14]). The

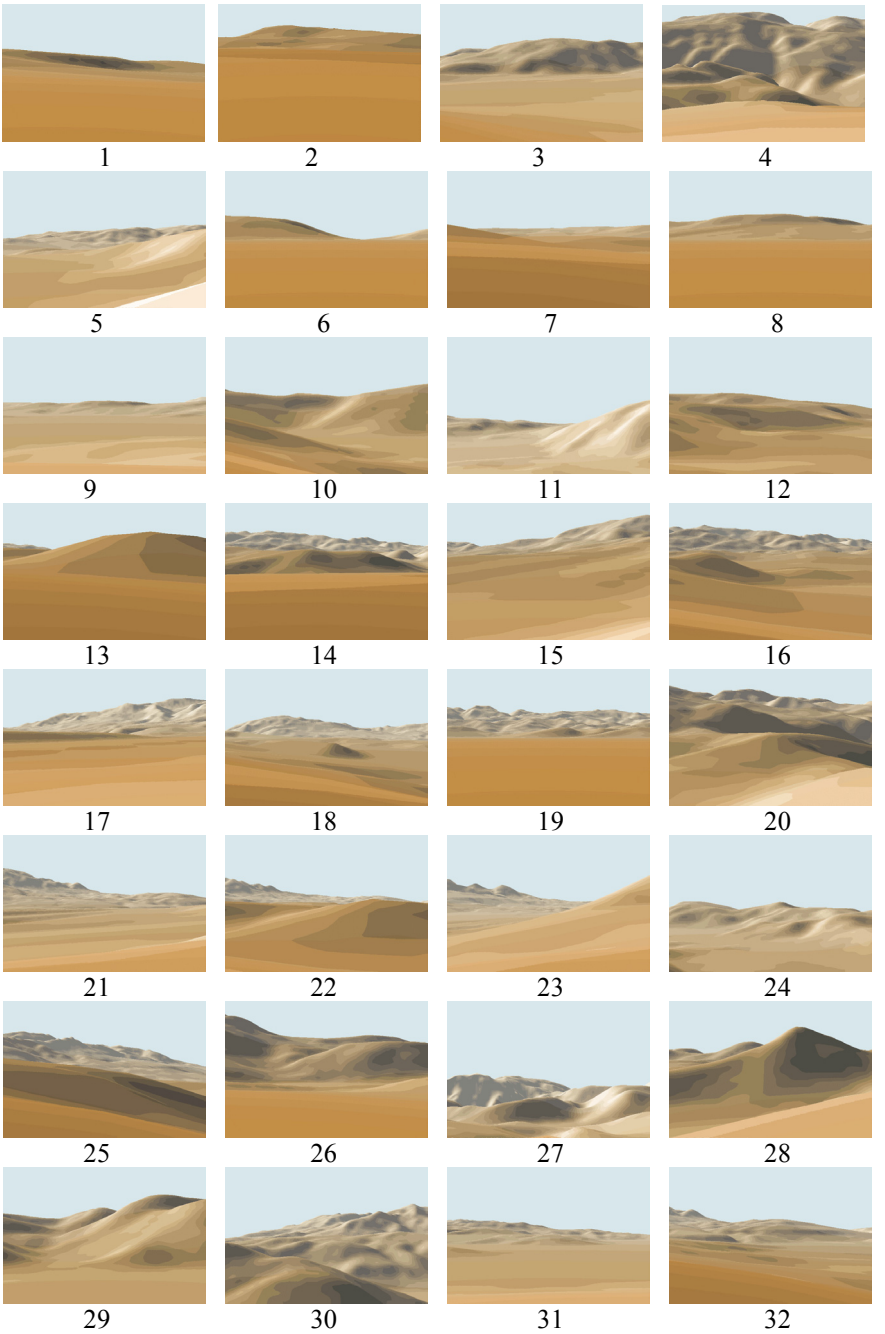

Figure 1: The 32 images of landforms included in the questionnaire.

size of the sample, the sampling methodology, the form and type of questionnaire, the duration of a questionnaire are some of the matters that have to be examined. This subsection is devoted to these matters.

The questionnaire was used in the area of Athens, Piraeus and the city suburbs, using a sample of 221 persons. This area, comprised of 52 municipalities and 5 communities, offered the following advantages:

A) It is an area of Greece's capital that concentrates a very large proportion of the population and is suitable for ensuring variety in terms of the different social and demographic characteristics of the persons questioned.
B) The population of Greece's capital comes mostly from different areas of Greece, and allows the inclusion of people from the provinces, with different experiences and mental representations of the various forms of the relief.

The total population of the study area is 3,020,562. The area includes both rich and poor quarters, both densely and scarcely populated, all of them being within the city plan limits so that they are mapped and facilitate the organisation and implementation of the questionnaire.

A stratification of the municipalities of Athens was effected before the selection of the persons to be questioned. In order to ensure the representation of the entire population, two individual layers were used prior to adopting the final sampling. Upon the first layering, the municipalities were classified in three categories, according to their population: small (X<30,000 inhabitants), average (30,000<X<70,000) and big (X>70,000 inhabitants). Upon the second layering, we used the existing classification of the prefectures: Athens, Eastern Attica, Western Attica and Piraeus. We thus created 3x4=12 layers.

In a simple random sampling, the sample size is calculated as follows (Damianou [13]):

$$P\left[|\bar{y} - \bar{Y}| < d \right] \geq 1-a \tag{1}$$

where:

$\bar{Y}$: the population average of the requisite characteristic, which in this case is the visual value;

$\bar{y}$: the population average estimate derived from the sample;

d: the error margin or the desired measurement accuracy of the average;

1-a: the confidence coefficient.

It is clear from equation (1) that the size of the "n" sample is determined by the following formula (Damianou [13]):

$$n = \frac{n_0}{1 + \frac{n_0}{N}} \tag{2}$$

in which:

$$n_0 = \left(\frac{SZ_{a/2}}{d}\right)^2 \tag{3}$$

where:

N: the total population;
s^2: the dispersion of the characteristic;
$z_{a/2}$: the upper a/2-point of the normal distribution N (0,1).

The term n_0/N, when the value of N is very big, tends towards zero and is ignored. In the layered sampling analysis, the same reasoning is followed, with the exception being that the above formulae (2,3) are applied in each layer, using the respective dispersion of the characteristic which each layer exhibits. In case the dispersion is unknown, we can use its value from previous studies related to the subject matter (Damianou [13]).

Because of the fact that there are no previous studies related to the certain subject matter, we used the results of an experimental implementation in 55 students of the 2nd and 8th semesters of the Department of Rural and Surveying Engineering of the National Technical University of Athens. This implementation was a simple questionnaire including the 32 images and asking students to evaluate them on a 1-10 scale, according to their preference. In this pilot study the previous experience of the scientists came true as the more mountainous the form of the relief, the higher the values that resulted from the students' preference. The results of this implementation showed that the standard deviation differs among images and ranges from 1.64 to 2.75 units. In order to determine the final sample, we assumed that all layers present the same dispersion and took the worst case to be the standard deviation: s=2.75 units. The desired measurement accuracy of the mean was determined to be d=0.40, a value lower than the unit half. Therefore, for a 95% probability, the application of the above formulae shows that the size of the sample is:

$$n=\left(\frac{2.75x1.96}{0.40}\right)^2=182 \tag{4}$$

This figure was increased, for the sake of safety, by about 20 percent and the final sample was thus determined to be 221 persons. This sample was selected for two main advantages: 1) it was small in relation to the size and therefore useful for carrying out a further research; 2) it could assure the required reliability in order to draw some initial conclusions. The students' responses were not used in this final sample or in the further analysis. The sample was distributed among the individual layers, based on the percentage of the population in each of the 12 layers in relation to the total population of the city. Following this, we proceeded to random sampling for the selection of the sample decided for each layer, using the files of the National Statistical Service of Greece.

The questionnaire included 11 questions and was accompanied with the 32 coloured images. The questions had a multiple choice form and were selected in such a way as to describe the person questioned in relation to the environment he/she has lived in or is familiar with, during his/her contact with the countryside. Also basic demographic elements, such as sex, age, education,

profession, income are included in the questionnaire. Each question corresponds to a single factor, generalised in a maximum of three categories. Besides, the relatively small size of the sample would not have benefited the larger in number categories. The questionnaire is presented in the following Figure 2. The eighth question was devoted to the scenic beauty of the various landforms presented in the coloured images. The responder was asked to rate the landforms on a 1-10 scale according to his/her preference. With regard to the ninth question about the profession, the third category entitled "other" refers to unemployed, students, housewives and in general people who do not work.

The technique used for the questionnaire was that of the interviews. The main advantage of this technique is the direct contact with the person questioned and therefore presents the highest participation rates. The time available for the interview depends mainly on the way it is conducted. In this case, we decided to visit the persons questioned at home, in order to allow for a 10-15 minutes interview.

2.3 Questionnaire results

Table 1 shows the descriptive elements of the results' distribution, as derived for the scenic beauty of the various landforms. For the other questions the results are shown in Table 2. For the sake of brevity, all references hereinbelow will use the symbolism of factors shown in Table 2.

It is clear from the frequency values that there is sufficient number of observations in each category. The sample includes individuals for all the categories of age, education, income, profession and also individuals that come from different places of Greece or abroad.

As pertains to sex, women are the majority, however, the percentages are close to the respective percentages of the official census, in which men correspond to about 49% of the population and women to 51%; therefore these percentages are considered to be satisfactory for the balance between the two sexes.

As pertains to the scenic beauty, all images were rated with values from 1-10. The average responses for each image range within 5.02-7.72, with standard deviations from 1.91 to 2.62. Therefore, the standard deviations are within the range of the values that had been observed from the experimental questionnaire to the students.

When observing the images in a descending order as to the mean scenic beauty, we can easily conclude that low values correspond to more plane forms, while high values to mountainous forms. As it has been already mentioned, this is one of the criteria used in landscape analysis and evaluation, because mountainous forms present greater variety in the relief elements (slopes, curvatures, crest etc.) in relation to plane forms.

An interesting observation may also derive, when we also look at the mean values and the respective deviations of the answers. Let's consider that the standard deviation is the measurement of disagreement among the respondents, then we observe a greater disagreement of opinions in image 1, and a greater agreement in image 21. By observing the remaining images, it seems that

disagreement tends to increase as the relief's visual value decreases. The respondents therefore seem to agree more on what is good rather than bad. This observation is not an object of this study, but we present it as an interesting issue for further investigation.

Scenic Beauty of Various Landforms

Please give a single answer to the following questions.

1. Sex:
   1. [ ] Male 2. [ ] Female

2. Age:
   1. [ ] 18-35 years 2. [ ] 35-50 years 3. [ ] more than 50 years

3. You come from:
   1. [ ] Athens 2. [ ] Outside Athens 3. [ ] Outside Greece

4. Where have you spent most part of your life?
   1. [ ] Big city (……name of the city) 2. [ ] Small town (…… name of the town)

5. How often do you visit the countryside?
   1. [ ] Very often, almost every month 2. [ ] Not very often, two or three times every year

6. Usually for what purposes do you visit the countryside?
   1. [ ] Leisure 2. [ ] Other

7. Using a scale of 1 (low preference) to 10 (high preference) how much would you evaluate the scenic beauty of the landform that is represented in each image?

Image 1: ___	Image 2:___	Image 3:___	Image 4:___	Image 5:___
Image 6: ___	Image 7:___	Image 8:___	Image 9:___	Image 10:___
Image 11: ___	Image 12:___	Image 13:___	Image 14:___	Image 15:___
Image 16: ___	Image 17:___	Image 18:___	Image 19:___	Image 20:___
Image 21: ___	Image 22:___	Image 23:___	Image 24:___	Image 25:___
Image 26: ___	Image 27:___	Image 28:___	Image 29:___	Image 30:___
Image 31: ___	Image 32:___			

8. Education:
   1. [ ] Primary 2. [ ] Secondary 3. [ ] Higher

9. Profession
   1. [ ] Employees 2. [ ] Self-employed 3. [ ] Other

10. Income yearly
    1. [ ] Less than 5 millions GRD 2. [ ] More than 5 millions GRD

11. Usually how long do your vacation last?
    1. [ ] Less than 15 days 2. [ ] 15-30 days 3. [ ] More than 30 days

Figure 2: The questionnaire.

Table 1: Descriptive elements of the distribution of results for the visual value of the landform of each image.

Image	Mean $\bar{x}$	Standard error $s(\bar{x})$	Standard deviation s
1	5.02	0.18	2.62
2	6.81	0.16	2.42
3	5.71	0.13	1.97
4	5.49	0.14	2.06
5	5.98	0.15	2.19
6	6.28	0.13	1.95
7	6.43	0.15	2.30
8	5.67	0.17	2.48
9	6.34	0.13	1.96
10	7.05	0.15	2.28
11	5.70	0.13	1.95
12	6.02	0.15	2.21
13	5.76	0.14	2.13
14	5.56	0.16	2.38
15	7.38	0.14	2.01
16	6.51	0.14	2.09
17	5.44	0.17	2.49
18	7.41	0.14	2.14
19	5.61	0.16	2.36
20	7.49	0.14	2.06
21	6.04	0.13	1.91
22	6.59	0.13	2.00
23	5.86	0.14	2.01
24	6.10	0.14	2.14
25	6.76	0.13	1.98
26	5.86	0.17	2.50
27	6.10	0.13	2.00
28	5.86	0.14	2.06
29	5.89	0.13	1.95
30	5.68	0.15	2.28
31	7.14	0.14	2.05
32	7.72	0.14	2.01

3 Analysis of variance – preliminary results

The results were proceeded with the analysis of variance for each individual factor (Bora-Senta and Moysiadis [15]). The dependent variable was the scenic beauty of landforms. For any one interviewee there is only one set of factors which are repeated against all 32 images. Repetition of characteristics in multivariate analysis has unpredictable results. In order to avoid this problem and get some preliminary results, instead of using all the ratings given by each interviewee we used the sum of ratings of all the images for each interviewee. In this manner the data matrix included 221 observations.

Table 2: Categories of factors.

Question/ Factor	General Categories	Occurrence Frequencies
Sex (SEX)	- male - female	93 128
Age (AGE)	- 18 - 35 - 35 - 50 - > 50	94 76 51
Origin (FROM)	- Athens - outside Athens - outside Greece	90 115 16
Where have you spent most part of your life? (LP)	- big city - small town	177 44
How often do you visit the countryside? (CVI)	- ≥ 1 / month - < 2-3 / year	65 156
For what purposes; (RCVI)	- leisure - other	161 44
Education (EDU)	- primary - secondary - higher	61 94 66
Profession (PROF)	- Employees - Self-employed - Other	85 61 75
Income (FIN)	- < 15,000 EURO - ≥ 15,000 EURO	151 70
Time of vacation (HOL)	- ≤ 15 days - 15 - 30 days - >30 days	59 122 40

From the results gathered from this preliminary factor analysis of variance, we can draw some conclusions. In general, and in almost all of the factors, the mean values of the individual categories differ from one another with a high degree of reliability. The F-ratio level of significance ranges from 0.00 to 0.0022. With a probability of almost 100%, this means that the average values of the individual categories are not equal. The sum of the squares of errors between the groups, which the higher it is, the better the factor classifies the dependent variable, can become also a benchmark for the factors. Factor analysis extracts factors which maximise the variance explained in order of the most important first and so on.

Considering the results of the analysis, the variation of the mean values in the categories of each factor leads to the following conclusions:

1. The persons who have spent most part of their lives in small towns or villages give higher ratings than those who have lived in cities or in city suburbs.
2. The persons who originate from areas outside Greece give ratings higher than those who come from areas outside Athens, and the latter give ratings higher than those who come from Athens.
3. Women give higher ratings than men.
4. The persons who spend more than 30 days annually for holidays give higher ratings compared to persons who spend 15-30 days, and the latter give higher ratings than persons who spend less than 15 days.

5. The persons with a family income below EURO 15,000 give higher ratings compared to those with a family income of more than EURO 15,000.
6. The persons aged 50 years or more give higher ratings compared to those in the 35-50 age group and the latter give higher ratings compared to persons in the 18-35 age group.
7. The primary education graduates give higher ratings compared to the secondary education graduates, and the latter give higher ratings compared to university graduates.
8. Persons visiting the countryside for leisure purposes only give higher ratings than persons visiting the countryside for other reasons.
9. Unemployed persons give higher ratings than self-employed and self-employed give higher ratings than employees.
10. The persons who visit the countryside more often than once a month give higher ratings compared to the persons who visit the countryside from time to time, 2-3 times a year or do not visit it at all.

The way the respondents used the same scale of values is different from person to person, however it seems feasible to group and generalize their behaviour. This is a first conclusion and perhaps one we would expect. What is that makes certain groups of people use higher values in relation to other groups? An important generalisation drawn from the observation is the following: the persons who have or had in the past more chances to come to contact with a physical environment use higher ratings. This probably explains why the persons who have lived in or come from the countryside, together with the persons who visit the countryside more often, the persons with more freedom in their work time, or the more aged persons who had more chances to visit the countryside, are the ones who know the physical environment better and thus give higher ratings. It is through the high degrees of freedom that they express their preference for nature.

Up to here, the previous observations derive from the whole sample of the respondents. However, the fact that women gave higher ratings than men is a matter of concern and shows that we should perform a further investigation for both sexes separately. This will be the main concern of the following phase of this research, in order to find out whether the factors that affect each sex remain the same or not.

4 Discussion

This study addresses the issue of the influence of the demographic data on the evaluation of the landforms scenic beauty. It is clear from the results that the factors examined might influence to a certain extent the scenic beauty of the landforms. Maybe there are many other factors, perhaps even more important than the ones examined. No relative research had been conducted in the past, so as to allow for a comparison. For example, perhaps the morphology of the place of origin of the respondent or the place where he/she has lived most of his/her life plays an important role in his/hers preferences and his evaluation, since each respondent is familiar, due to his experiences, to certain relief forms. The

investigation of such factors is not part of this study, however it is a very interesting issue for further research, in order to better understand and interpret the public's preferences.

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