



Research Paper

Unearthing the picturesque: The validity of the preference matrix as a measure of landscape aesthetics



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HIGHLIGHTS

- The findings support the validity of the preference matrix.
- Natural character was a positive predictor of scene attractiveness.
- Built character and low levels of familiarity predicted scenic quality negatively.
- Coherence and complexity interact in predicting scenic quality.
- The size and type of the relationship varied between predictor variables.

ARTICLE INFO

Article history:

Received 8 February 2013

Received in revised form

10 December 2013

Accepted 12 December 2013

Available online 25 January 2014

Keywords:

Landscape aesthetics

Preference matrix

Natural environment

Built environment

Familiarity

ABSTRACT

Previous research has provided inconclusive support for the preference matrix; a psychological framework of landscape aesthetics rooted in a long tradition of studying scenic quality. Given recent insights into the important implications that aesthetics have for health and well-being, the aim of the present study was to re-assess the validity of the preference matrix following the implementation of a series of methodological improvements. These entailed: a set of item definitions piloted for high comprehension; adequate statistical control for confounding influences by scene content and user experience; a substantially sized, highly varied image database; and the employment of statistical instruments to formally test for nonlinear relationships. An ordinal mixed effects model provides convergent evidence for our hypothesis that each of predictors in the preference matrix is independently predictive of scene aesthetics. In addition, we find support for an interaction between the constructs of Coherence and Complexity and show that levels of both natural and built character, as well as familiarity, are uniquely predictive of scene attractiveness. The present findings underline the role of the preference matrix as a potential tool in informing evidence-based design.

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1. Introduction

Despite a long and rich history of enquiry into landscape aesthetics, and its purported role in influencing both levels of stress and attentional functioning (Kaplan & Kaplan, 1989; Ulrich, 1983), a consensus on its explanatory attributes is lacking (Lothian,

1999). For instance, following a meta-analysis encompassing studies attesting the most influential model on landscape aesthetics – the preference matrix – it was concluded that: “the postulated theory has not generated reproducible results” (Stamps, 2004, p. 14).

Although this could imply that the preference matrix is simply invalid as a theory of landscape aesthetics, it could alternatively be that: (1) the measures of the informational qualities have been unreliable, (2) confounding variables have influenced how the informational variables load on scenic quality, (3) specific scene content of images have influenced the type or direction of the relationship between the informational variables and scenic quality or (4) the relationships could have been better mapped by nonlinear polynomials.

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	Understanding	Exploration
Immediate	Coherence	Complexity
Inferred	Legibility	Mystery

Fig. 1. The preference matrix.

To address these alternative explanations, the methodological approach of the present study diverged from that of previous research with regard to: (1) *item definitions*, (2) *control for confounding variables*, (3) *variety of stimulus material*, and (4) *presupposed type of relationship between predictor and target variables*. We present evidence showing support for each of the variables in the preference matrix following a series of methodological improvements addressing these limitations.

1.1. The preference matrix

The preference matrix by Kaplan and Kaplan (1989) is an evolutionary theory which is based on the assumption that the ability for aesthetic appraisal has evolved to encourage adaptive habitat selection. It coincides with other evolutionary theories (Appleton, 1975; Orians & Heerwagen, 1992; Ulrich, 1983), which all have been popular to account for the strong cross-cultural similarities in preferences for particular configurations of landscapes and the elements therein (Parsons & Daniel, 2002). Kaplan and Kaplan (1989) reason that a good *Understanding* (i.e., having a valid mental map) of the physical environment is crucial to human survival (also, see S. Kaplan, 1987). For that reason, they postulate that humans are attracted to landscapes that provided a sense of order. Furthermore, they argue that ongoing exploration of new habitat conveyed adaptive benefits as well. Hence, environments that incite further *Exploration* – due to high levels of complexity and/or mystery – will also be experienced as attractive. The four variables of the preference matrix – *Coherence*, *Complexity*, *Legibility*, and *Mystery* – are defined by crossing the two needs of *Understanding* and *Exploration* with a time perspective (immediate or inferred/predicted; see Fig. 1 and Table 1).

The preference matrix is an example of a perception-based approach to explaining landscape aesthetics. This implies that the authors of this theory consider the aesthetic response to originate from the interplay between objective, quantifiable landscape features and the subjective appraisal of these attributes (Daniel & Vining, 1983; Daniel, 2001). The *Understanding* and *Exploration* vector of the preference matrix can be regarded as experiential conceptualizations of objective attributes such as: “uniformity and variety” as well as “order and complexity”, which have been contemplated as predictors of landscape aesthetics by philosophers for centuries (Lothian, 1999). It has been argued that such informational are experienced as attractive because these enticed our ancestors to continuously build upon and extend their mental map of the environment, yet prevented them from wandering off to potentially unsafe settings for which such an overview could not be readily achieved (Kaplan, 1987; Kaplan & Kaplan, 1989).

The time perspective vector was, however, a relatively new addition within the preference matrix by Kaplan and Kaplan (1989, but see Woodcock, 1984). It was introduced to account for the high preference of natural scenes which included an element of *Mystery* such as a path disappearing around a bend or a partly precluded clearing within a forest (Kaplan, 1987). The authors noted that this informational quality does not have a one-to-one relationship with the visual features of an environment; it requires a process of cognitive inference or prediction to be coded. This is unlike the informational qualities which are immediately available (e.g., *Complexity*). At first sight, such inferential processing seems

to run counter to the evolutionary backbone of the model, based on which we would expect affective responses to spatial qualities to be intuitive and automatic. However, the authors make explicit that the cognitive operations required for making predictions about functioning do not require any conscious processing and therefore are made very rapidly. In agreement with this contention, recent research in visual cognition has shown that the scene exposure time that is required to detect the navigability of a scene – a concept related to the inferred *Legibility* construct of the preference matrix – at a 75% accuracy threshold is very low (i.e., 35–45 ms) and alike to that required for detecting qualities of the “immediate” environment such as openness and concealment (Greene & Oliva, 2009a).

Given the rootedness of the preference matrix in a long-lasting research tradition on landscape aesthetics and recent empirical support for the ability to derive both immediate and inferred informational qualities rapidly and automatically, we wanted to address the current status quo whereby conclusive support exists for neither one of the informational qualities of the preference matrix as predictors of scenic quality (Stamps, 2004). To this end, methodological limitations of previous research which could have contributed to inconsistencies between findings regarding this theoretical model need to be addressed.

1.2. Methodological considerations

1.2.1. Item definitions

Stamps (2004), when discussing the findings of his meta-analysis, touches upon the high variability between previous studies with regard to the size and direction of reported correlations between each of the variables in the preference matrix and scenic quality. He then goes on to suggest that a replacement of questionnaire items tapping on the variables from the model by objective measurements (e.g., estimates of visible area from GIS maps as indicator of *Mystery*). Although we concur with the contention that measurement error might have been introduced in previous research, we are less convinced by the suggestion that this is addressed most effectively by downgrading the preference matrix to a mere objective landscape aesthetics paradigm. Instead, we reconsidered the standard definition of the variables in the preference matrix. To this end, we conducted two pilot studies to measure participant understanding of item definitions in relation to a set of 20 images highly variable in terms of scene content (see Table 1).

Participants in the pilot studies rated all images on the variables of the preference matrix, which were operationally defined in line with previously used definitions in the literature (e.g., Stamps, 2004). Subsequently, participants indicated their level of comprehension of each of the items on a scale from 1 (*very low*) to 7 (*very high*). Additionally, participants were invited to comment on those definitions for which comprehension was low. An analysis of these comments showed that the ease of rating items varied between different images. For instance, the item definition of *Legibility* (“It would be easy to find my way around the environment depicted”) is derived based on the assumption that the environment affords locomotion. Rating the legibility of a scene, however, proved to be challenging with regard to images depicting inaccessible ground surface like rugged mountaintops or seascapes. The standard definition of *Mystery* (“The setting promises more to be seen if you could walk deeper into it”) obviously brings about similar limitations. We found this surprising as Kaplan claims that: “The variables in the matrix apply to a large variety of environments and situations” (S. Kaplan, 1987, p. 11). We therefore employed alternative definitions with could also be interpreted to imply visual exploration. The definition of *Mystery*; “This would be an interesting scene to explore further”, was adopted from Van den Berg, Vlek,

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