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Visual Cues As a Predictor for Better Design:
An Integrated Approach to Observers' Evaluation of Aesthetic Beauty

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Abstract

In order to examine theoretical underpinnings of preference for built forms, 129 subjects are asked to rate a series of 9 slides of residential houses depicting a wide range of architectural styles on a 5 point scale, for coherence, complexity, excitement, familiarity, and natural harmony, respectively. Based on Lee's (2002a, 2002b) two previous studies addressing the issue of aesthetic beauty evaluation for man-made creatures (e.g., residential housing scenes), this study summarizes several meaningful findings. As reported by all the subjects, first, both "desire to visit " and "desire to live in " turned out to be a good predictor of preference as the two measures are highly correlated in statistically significant levels (99.9%). People who desire to visit a spot are more likely to desire to live in it. Second, Pearson's correlations showed that coherence is the opposite end of complexity. The more likely a housing setting is hanging together, the less likely it looks to be complex. Overall, though, it is not clear that the two variables work directly in that way, as weighted on preference ratings. That is, coherence and complexity are likely to be totally two independent systems that affect the ratings of preference. Third, both excitement and environmental sensitivity (e.g., harmony of a house with its surrounding nature) most highly account for the preference for various housing scenes, while familiarity has only a little effect on preference ratings. Possibly, people like or dislike a visual thing, no matter how much they are familiar with it. Finally, this study suggested that design professionals could communicate effectively with their clients if sets of visual standards as an appropriate communication tool for better design are properly established.

Keywords: Visual Cues or Standards, Architectural Styles in Housing, Aesthetic Beauty Evaluation

1. INTRODUCTION

One of the most urgent needs in design professions is to seek a variety of objectively valid standards to satisfy environmental needs people commonly hold. Although this scientific approach to environmental design is not applicable directly to all aspects of architecture, some consensuses among environmental professionals might be useful in specifying a set of design standards.

Thus far, coherence and complexity have been most frequently cited as visual cues, which are useful in determining the perceived aesthetic quality of physical environments (Nasar, 1985; Prak, 1977). As Nasar (1985) pointed out, satisfactory design can be obtained if various architectural elements of a physical setting are spatially organized to make sure that they look like to be hanging together in a consistent fashion (e.g., coherence). Prak's (1977) theory of a need for variety, on the other hand, posited the idea that human needs can be resolved by providing a sufficient range of environmental diversity in visual terms (e.g., complexity). As a result, an ideal shape of built environments can be sought by appropriately adjusting the levels of both coherence and complexity in a complementary manner. On intuitive grounds, one is not supportive without the other, because both, though contradictory in nature, are closely related to each other.

Coupled with the utility of complexity in predicting environmental preference, excitement is regarded as another category of visual information. Based on S. Kaplan's (1973) theory of human informational needs, physical settings covering a wide range of contents and diverse organizational properties are of potentially great interest to observers, which, in turn, is largely preferred. Nasar (1985) construed excitement to be highly related to pleasantness to some degree. Overall, though, it is not clear that all exciting things are always favored. Thus, the relationship between excitement and environmental preference needs to be examined in some detail.

Mandler (1982) related a sense of liking to the concept of familiarity. Based on his familiarity theory of evaluative judgments, people are supposed to like what they know and are familiar with. As R. Kaplan (1973) suggested, on the other hand, surprises or novelty are desired in all kinds of visual settings. Of particular interest in the present study is to see if environmental displays can be judged solely based on an observer's prior frequency of exposure (e.g. the degree of familiarity), independent of how much they are perceived to be exciting or interesting.

Additionally, it is often pointed out, natural contents tend to elicit higher aesthetic preference than do built ones (Ulrich, 1983). From an ecological point of view, contemporary architects have paid attention to the environmental sensitivity of their works. As Schroeder and Anderson (1984) posited, perception of aesthetics is largely influenced by nearby features that are not part of a target object itself (e.g., buildings). Thus, natural landscapes immediately affecting it need to be carefully considered in the overall evaluation process. In this regard, green design has turned out to be one of the most popular architectural solutions to the creation of environmentally sensible man-made features (Steele, 1997). This study primarily concerns with the role of natural harmony in evaluating the visual quality of built forms.

Thus far, design professionals have paid attention to urban versus natural scenic beauty evaluations. Empirical analysis of perceived quality of a built form, which combines all the relevant visual information together, lags behind. By using a 5 set of "visual cues or information" - coherence, complexity, excitement, familiarity, and natural harmony – this study proposed to examine a variety of visual influences on the aesthetic beauty evaluation of residential housing scenes. It might be that desirable levels of visual quality can be reasonably obtained if all of these cues are extensively considered in a structured fashion. Consideration of any single visual information may not be enough to explain the pattern of environmental preference. For the present study, it is plausible to posit the idea that there is a composite image of visual cues that affect observers' evaluations of aesthetic beauty for built forms.

The findings of this study will find a receptive audience among design-related environmental professionals such as architects, community developers, urban designers and etc. Additionally, this study is expected to contribute to the formulation of architectural standards that are useful in creating an ideal type of building facades or shapes.

2. VISUAL CUES AS A POTENTIAL PREDICTOR OF ENVIRONMENTAL PREFERENCE

2.1 Coherence Versus Complexity

S. Kaplan and R. Kaplan (1982) interpreted the perceived visual quality of a target object as the product of two fundamental human needs. One is related to the theory of a need for variety. That is, people usually pay attention to a visual object that provides an optimal level of arousal or stimulation. In order to fully comprehend and appreciate the object, additionally, a need for more information exists among observers (S. Kaplan, 1973). This quality of visual information is attributed to the notion of "complexity," which is defined in terms of the amount of variation in its visible features (Nasar 1985). In support of Kaplans' visual richness assertion of environmental preference, Herzog and Shier (2000) found a linear, positive role of complexity in environmental preference. Nasar (1985) pointed out an inverted U-shaped relationship between complexity and pleasantness. That is, people favor moderately complex scenes than the other two extremes (e.g., most and least complex scenes; Wohlwill, 1976). Nasar and Hong (1999), on the other hand, found no relationship between visual diversity (e.g., complexity) and preference.

The other is related to the concept of legibility. Lynch (1976) argued that spatial or organizational relations of all architectural components of an environmental setting should be clearly articulated and also ordered so as to allow it make sense. Based on the legibility concept, Nasar (1985) defined the notion of coherence as the degree to which the setting is hanging together. From an evolutionary point of view, people are predisposed to have a simplified organizational mechanism of their own to understand and evaluate a visual object in an absolute sense. According to R. Kaplan (1973), a sense of simplicity can be obtained by making sure redundancy of the elements and textures that help make the object hang together. Consequently, it is important for man-made features to be spatially well organized and patterned in a legible manner. Based on Nasar's (1985) findings, pleasantness is likely to be an incremental function of coherence, that is, the degree of how much a scene looks like to be hanging together.

R. Kaplan (1973) explained that both legibility and predicted information in a form of coherence and complexity, respectively, are important in predicting the overall pattern of environmental preference. From an aesthetic point of view, as Nasar (1985) pointed out, both moderately complex and highly coherent scenes should be most attracted by observers. Nasar and Hong's (1999), nonetheless, found coherence (e.g., as treated in a harmony-obtrusive term) as a sole predictor of environmental preference. With regard to preference ratings, furthermore, it is somewhat surprise to note that a considerable amount of consensus among observers exists in the ratings of coherence and complexity, despite differences in professional experiences and educational training. R. Kaplan (1973) interpreted this finding in terms of "halo effect." As long as the greatest appreciation is made for a particular scene, it tends to be rated high in coherence and complexity as well, regardless of its actual or objective qualities. In this regard, S. Kaplan et. al. (1972) also found that highly preferred nature scenes are usually judged on the average less complex than urban scenes, although the former is deemed more complex than the latter. Overall, though it is not clear that complexity is the opposite end of coherence, each turned out to be effective as a predictor of environmental preference, either independently or in a composite fashion.

2.2 Excitement

Prak (1977) argued that people do not favor a highly redundant environment, if there is a complete lack of stimulation. That is because certain levels of visual stimulation leading to a sense of interest might be necessary for organisms to be properly functioning. Mandler (1982), additionally, addressed the notion of interest as a subjective sense of good. Although a basic level of visual interest is needed to promote a sense of liking, not all interesting target objects are always favored, or visa versa, largely due to the subjective relationships between the objects and the subjects. In this regard, it is interesting to note Nasar's (1985) finding that a highly complex visual array of scenes are more likely than the counterparts to get attention. Overall, though not all complex scenes are highly valued, there is probably an upper limit to a supposed preference for somewhat interesting visual settings (S. Kaplan et. al., 1972). In support of this proposition, Hull and Revell (1989) explained novelty to be something good, which leads to a higher sense of liking.

2.3 Familiarity

Mandler (1982) related the concept of familiarity to a basic sense of liking. That is, people tend to like what they know and are familiar with. Under his notion of evaluative cognitions, on the other hand, people are likely to consciously judge a target object based on its judged value. A sense of liking is usually the output of positive valuations derived primarily from observers' prior experiences with the target object. As a result, value judgments are an important first step toward an understanding of the structure of liking or disliking. On intuitive grounds, thus, observers favor not all familiar objects, because some interesting features or images are not related to a sense of liking. In partial support of this position, Prak (1977) pointed out the possibility that unknown objects are more likely to be preferred over familiar ones. On theoretical grounds, it might be a problem for observers to be forced to respond to something outside the realm of their experiences (Hull and Revel, 1989). Some familiar features to a group of people may possibly mean totally different things to others of different culture. By definition, the unknown can be defined as well as perceived in terms of the known. Consequently, it is strongly believed that Mandler's (1982) familiarity theory of environmental preference can be validated by understanding the very nature of value judgments previously made through observers' personally based long-standing visual experiences with a set of target objects.

2.4 Natural Harmony

Numerous studies have obtained a commonly shared idea that natural and urban contents might lead to significant differences in environmental preference, independent of rated complexity or coherence. Kaplan et. al. (1972) strongly argued that nature scenes are greatly favored over urban scenes. Additionally, R. Kaplan (1973) found cross-cultural similarities of scenic preference for natural contents relative to urban materials. Shafer and Richards (1974) pointed out that natural contents could be used effectively to mitigate the negative effects of nearby visual pollution. Ulrich (1983) construed natural contents, such as vegetation and water, as "preferenda," which is highly effective in eliciting positive reactions to natural settings. According to Hull and Revell (1989), furthermore, cross-cultural similarities between tourists and Balinese in preferable reactions to natural over urban contents turned out to be stringent.

In this regard, there are two different, but supplementary theoretical explanations. One is related to the evolutionary theory of aesthetic preference for nature over urban scenes. Under the notion of habitat selection, Orians (1986) put that human beings are innately predisposed to respond positively to many natural settings as opposed to built contents. From a long-term evolutionary point of view, thus, it might be reasonable to posit that natural environments better fit to human's needs. The other is the learning-based explanation of positive responses to natural settings. All throughout the evolutionary process of human beings, that is, people might have learned that natural contents are usually useful and beneficiary for human life. This proposition is further supported by Orians's (1986) utilitarian explanations of scenic preference for natural settings. On this theoretical base, it might be that environmental preference is something learned. Under the evolutionary point of view, preference attitude is environmentally determined, while, as applied to the learning-based explanation of scenic beauty, people control it.

Ulrich (1983) found that preference ratings usually rise significantly, if natural elements are added to urban scenes. In support of Ulrich's finding, Schroeder and Anderson (1984) argued that as much as natural features are essential for upgrading scenic beauty, man-influenced features are, in some degree, also important to promote a sense of safety, which has a positive effect on observers' evaluation of scenic beauty. Consequently, an appropriate consolidation of both natural and man-made dimension is highly recommended. As Nasar (1985) further pointed out, design professionals should find specific ways of creating focal man-made features that are largely compatible with the surrounding natural conditions.

3. CONCEPTUAL FRAMEWORK

Figure 1 presents a conceptual model developed to show the linkages between visual information or cues and environmental preference. Of particular interest in the present study is to examine the proposition that visual cues affect the pattern of environmental preference. The dependent measure is the pattern of environmental preference as applied to a set of visual stimuli (e.g., residential housing scenes). Visual cues, hereafter, defined as a set of simplified visual hints or images used by observers to better understand overall aspects of an object from an aesthetic point of view, are posited as independent variables. No matter what a particular type of objects are approached or avoided, the pattern of evaluative judgments might be explained better by understanding the nature of visual cues.

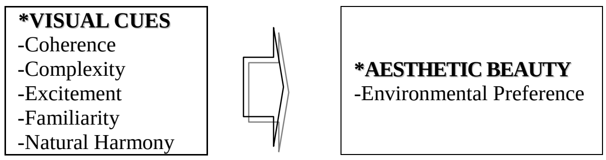


Figure 1. Conceptual Model of the Present Study

First of all, this study is organized under the assumption that environmental preference is by and large the outcome of subjective visual interpretations that take place between observers and observed (Lynch, 1960). That is, it might be that people give aesthetic values to a built thing based on what they understand by immediate visual contacts with its overall features. Based on the model developed (figure 1), the following theoretical positions are addressed for further analysis and interpretation.

[H_1] As Nasar and Hong (1999) pointed out, people usually favor a residential scene that is visually perceived to be hanging together. This study examines the relation between coherence and environmental preference.

[H_2] Nasar and Hong (1999) proposed the idea that a sense of liking has nothing to do with complexity. This study examines the relation between complexity and environmental preference.

[H_3] S. Kaplan et al. (1972) explained that a highly exciting scene is more likely to be preferred. This study examines the relation between excitement and environmental preference.

[H_4] Mandler (1982) proposed that people positively respond to what is familiar and known, relative to the unknown. This study examines the relation between familiarity (e.g., the frequency of prior exposure to a target visual stimulus) and environmental preference.

[H_5] Ulrich (1983) pointed out that the presence of natural features works to upgrade the visual quality of a man-made feature. This study examines the relation between compositional harmony of natural and man-made features (e.g., natural harmony) and environmental preference.

[H_6] Finally, the study examines the proposition that there might be any combined effect of coherence, complexity, excitement, familiarity, and natural harmony in predicting the pattern of environmental preference.

4. METHODS

4.1 Study Population

University students were used as a sampling framework for this study on two grounds. First, university students usually represent most of potential client groups for design professionals, because universities offer a diverse field of studies or programs for educational purposes. Second, access to university students is usually easy, which helps collect data more efficiently and reduce survey costs. Andong national university (ANU) in a rural setting and K-university (KU) in downtown Seoul were chosen.

The subjects for this study are (1) a sample of junior students in two architectural design studios, one from ANU and the other from KU (e.g., the design professional group) and (2) a sample of university students from other fields in two liberal arts and science classes at the time of survey, one from ANU and the other from KU (the layperson group). Consequently, (3) a sample of both junior architecture and university students in ANU (e.g., the rural resident group) and (4) a sample of both junior architecture and university students in KU (e.g., the urban resident group) are included in the present study. As shown in table 1, a total of 129 survey respondents are participated in the study.

Table 1. Frequency Distribution of the sampled groups

Group Characteristics		Statistics Frequency (%)				Group Characteristics	
Architects[1]	Female	64 (50)	29	27	65 (50)	Female	Urban Residents[1]
	Male		35	38		Male	
	Young[2]		33	36		Young[2]	
	Old[2]		30	28		Old[2]	
Layer Persons[1]	Female	65 (50)	35	37	64 (50)	Female	Rural Residents[1]
	Male		30	27		Male	
	Young[2]		48	45		Young[2]	
	Old[2]		17	19		Old[2]	
Sub-total		129 (100%)				Sub-total	

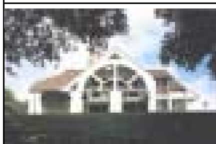
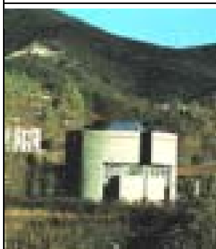
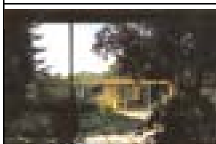
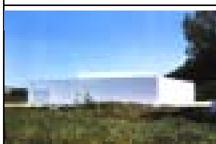
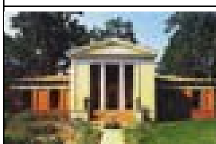
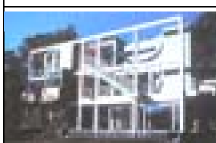
Note 1. The sample comprises urban plus rural architecture students (34 and 30, respectively), and urban plus rural university students (31 and 34, respectively).
Note 2. Young and old groups are defined by mean age as reported by all the respondents (23.2 years old). Respondents below 23 years old are classified into young group, while more than 23 years old respondents into old group.

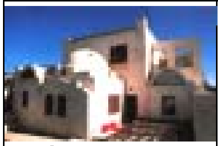
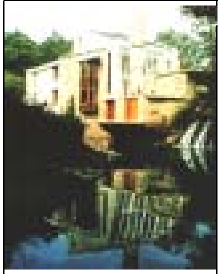
Cha-square ($\chi 2$) tests showed no group difference in gender distribution between architects and laypersons, urban and rural residents, respectively. That is, pretty much equal distribution of the study population into the two gender groups (e.g., female and male) is obtained. Additionally, young respondents turned out to be a little bit dominant over old counterparts in number all throughout the 4 group domains. Especially, the architect group is more likely than the layperson group to be old at a statistically significant level ($\chi 2 = 6.34$, df = 1, $p>0.05$). This was quite predictable in that laypersons are supposed to represent university students in a relatively low grade of educational programs of other fields unrelated to architecture, who were taking an introductory liberal arts and science class at the time of survey. The architects group, on the other hand, comprises junior architecture students.

4.2 Target Objects As Visual Stimuli

One of the most important tasks for the study was to select a set of visual stimuli, which are largely comparable in terms of contents and structural quality, but differ in the overall image as characterized by different configurations of architectural elements. As a result, a total of 9 scenes were taken from Steele's (1997) book, "architecture today." Each is characterized as containing a residential housing unit as a focal point that is immediately surrounded by its adjacent natural scenery, representing one of the 9 popular contemporary architectural styles. Wohlwill (1970) suggested that visual cues (e.g., the level of judged complexity) could be used as an effective standard for predicting the pattern of environmental preference regardless of the content. Overall, though identical in content, it might be reasonable to include various types of visual stimuli for valid comparisons. Table 2 describes each of the 9 residential housing scenes, providing a brief summary of its architectural style and features as well.

Table 2. Residential Housing Scenes Used As Visual Stimuli

Visual Stimuli[2]	Architectural Style[1] / Characteristics[1]
 Delaware House	[1] Modernist Legacy During the transitional era form modernism to post-modernism in architectural style, Robert Venturi and Denise Scott Brown (1978) represented the modernist rule of classical orders by placing cartoon-like, flattened Doric columns in front of the barn-like structure.
 Casa Rotonda House	[2] European Rationalism Located on the outskirts of Stabio, Switzerland, this single-family house is very well known as so-called, "round house" or "Stabio house," because of its building shape as well as its location, respectively. As a contextual architect, Mario Botta (1982) emphasized place-specific ecological solutions to architectural problems. Casa Rotonda is the output of Botta's positive intervention into the pre-existing context.
 Wimbledon House	[3]High-Tech Under the modernist rule of technological reflection on architecture, Richard Rogers (1969) utilized a low-rise metal box as a key design concept. The high-tech architecture can be fully understood as a technology-based interpretation of modernism.
 Casa Gaspar	[4]Minimalism By taking his architectural desire for simplicity or honest of building materials and structure in use, Alberto Campo Baeza (1991) actualized Mies van der Rohe's minimalist point of view (e.g., less is more) through Casa Gaspar, Cadiz.
 Vitruvian Villa	[5]Classical Revival With respect to the notion of classical tradition in architecture, Thomas Gorden Smith (1990) tried to revive a series of classical rules or pattern language (e.g., symmetric building structure and authoritarian color) through his contemporary work of Vitruvian Villa, Indiana.
 Snyderman House	[6]Post-Modernism Unlikely Mies van der Rohe's minimalist point of view, Michael Graves (1972) promoted richness and ambiguity over harmony and simplicity through his work of Snyderman House, Indiana. Color (e.g., brown and blue) is used to balance the form.

 Halawa House	[7]Contemporary Vernacular As a nation-wide vernacular architect, Abdel Wahed El-Wakil (1975) sought a traditional way of recovering regional identity and heritage through his Halawa project in Egypt. Halawa House is a vernacular expression as opposed to architectural globalization.
 Waterfall House	[8]Ecological Architecture Located on the upside of a little waterfall valley, Ireland, this bridge-type house is named as Waterfall House to reflect its topographical characteristics. Under the notion of sustainability and also with Frank Lloyd Wright's philosophy of humanistic architecture in mind (e.g., Falling water, Philadelphia), GAIA Associates (1990) tried to provide an environmentally sensible building solution. Like Falling water, Waterfall House is largely a part of nature, not isolated in any sense.
 Schnabel House	[9]LA Avant-Garde As a revolutionary experimental model of contemporary architecture, Schnabel House, Brentwood, Los Angeles, is designed by Frank Gehry (1990) to represent his idiosyncratic personal style. Frank Gehry tried to create a typology of stylistic and newly conceived regional identity through his Schnabel project. Not as a LA landmark but as a self-contained compound, it symbolized a New England village in an abstract form.

Note 1. Each architectural style and its characteristics are presented here as primarily defined by Steele (1997).

Note 2. Most of the residential housing scenes were selected for the study as they include varying degrees of grass, trees, and clean blue sky, simultaneously, except Halawa House, which contains no grass and trees. Additionally, the Waterfall House scene is pretty interesting in that it conveys water feature, instead of grass. As construed by Ulrich (1983), water feature also is one of the "preferendas," which elicit positive reaction to scenic beauty evaluation. Overall, each of the 9 scenes is considered to represent its unique architectural image in a largely comparable manner.

4.3 Response Format

For all 6 ratings – coherence, complexity, excitement, familiarity, natural harmony, and preference – a 5-point ordinal scale was used in a close-ended form as follows; 1 refers to as "not at all," 2 as "somewhat unlikely," 3 as "neither unlikely not likely," 4 as "somewhat likely," and 5 as "a great deal." Each concept or variable was measured by addressing the following questions.

[1]For <u>coherence</u>, the subjects were asked to indicate "the degree to which the scene is hanging together," or "the degree to which all the architectural components involved in the scene are ordered to be just like one."

[2]<u>Complexity</u> was defined as "the degree of how much intricate the subjects find the scene," or "the amount of variation in the scene."

[3]The rating of <u>excitement</u> was a measure of "the degree of how exciting or fascinating the subjects find the scene."

[4]For <u>familiarity</u>, the subjects were asked to indicate "the degree of how much familiar they find the scene," or "the degree to which they have previously seen or known the scene on a personal base."

[5]<u>Natural harmony</u> was defined as "the degree of compositional balance of natural and man-made features in the scene," or more specifically "the degree to which natural contents as background material are devoted to upgrading the value or quality of house described in the scene."

[6]Finally, <u>environmental preference</u> was measured in two different ways. One is related to "the degree of how much the subjects would like to visit the spot," while the other refers to "the degree of how much the subjects desire to live in the house. This dual approach is expected to overcome the loss of response sensitivity, which may occur if a single question is asked (e.g., forced question). Nasar and Hong (1999) related either preference or pleasantness to spatial behavior (e.g., desirability as a place to visit).

For all the 6 ratings, the close-ended question structure with ordered answer choice was used, as it is ideally suited for measuring a graduation of a single dimension of such things as intensity of feeling and degree of involvement (Dillman, 1978). Overall, though, 9 open-ended questions, as applied to the 9 residential housing scenes, were used to minimize the potential of overlooking significant options or opportunities for volunteered responses. Subjects were asked to simply write down their personal answers (e.g., feeling or opinion about each of the 9 scenes) on large blank boxes within the survey questionnaire. The open-ended questions were used as a qualitative base of data analysis for the study. Qualitative data of this type could be used as a valuable source of well-grounded, rich descriptions, and explanations of meanings or values attached to the quantitative data (Miles and Huberman, 1984). Consequently, using the quantitative and qualitative approach together can substantiate internal validity. That is, the data would be internally valid if the quantitative data are supported by the qualitative data.

In order to facilitate prompt, accurate and honest answers, as suggested by Dillman (1978), all the questions were set up and printed in the survey questionnaire, which is designed as a booklet. Babbie (1973) pointed out that subjects are unwilling to provide personal information without assurance that individual survey data are held in confidence. Dillman (1978), additionally, suggested that subjects are more likely to provide their personal information only after they identify the purpose of a survey questionnaire. For the present study, as a result, questions regarding the subjects' personal information such as gender and age were asked in the latter part of the questionnaire. The systematic ordering of individual questions resulted an overall positive image on the survey questionnaire.

4.4 Data Collection

The slides were presented in a classroom setting. Four subject groups – urban architects, urban laypersons, rural architects, and rural laypersons - were asked to complete the survey questionnaire. The presentation was held in classrooms in which each group was supposed to appear on a scheduled time from April 25 to May 4, 2001. The subjects did not know what the survey was supposed to undertake in their classrooms at the particular time in point. External validity for the study was largely ensured in this way. Response biases may occur if the survey's purpose or contents are acknowledged to the subjects in advance (Babbie, 1973)

To be effective, as Dillman (1978) suggested, the questionnaire needs to be pre-tested by the potential survey respondents. After general discussion of the meaning of the 6 ratings, the 9 slides were presented for 5 seconds each on a random base. Preview of the slides was essential, because the subjects need to know what things they are supposed to evaluate are all about. The condition of each slide appeared to be visually good, as printed in a high resolution. Additionally, the subjects were asked to review the questions for a few minutes. Further discussion was then allowed as much as the subjects desire. Pre-testing of the questionnaire was necessary to verify the interpretation of the questions, the appropriateness of the words, and the concept of the questions (Dillman, 1978). As validated by verbal feedback from in observation, all the words and questions were understood and interpreted similarly by all the respondents. Consequently, internal validity for the study was insured in a sense that the subjects know exactly what the questions really mean (Bailey, 1994).

Finally, the slides were shown for 10 seconds for each of the first 3 ratings – coherence, complexity, and excitement – and 5 seconds for each of the latter 3 ratings – familiarity, natural harmony, and preference. After the completion of the first 3 ratings, the subjects become quite familiar with the slides' overall image and contents. For the rating of environmental preference, additionally, the subjects were asked to complete the "desire to visit" question and the "desire to live in" question, simultaneously. Dillman (1978) pointed out that survey questionnaire response rate could be increased through careful treatment of the implementation procedure. Instead of a mail survey, the self-administrated group survey was used as a tool for collecting the data for two reasons. First, the survey on the spot may facilitate the flow of information that is appropriate to the purposes of the study. Warwick and Lininger (1975) supported this position by noting that a survey is a social interaction process involved in knowledge exchanges between experts and lay-people. Second, a sense of progress might result with each phase of survey administration. Overall, the survey was performed in a good shape, due to the relatively small but well-defined sample.

4.5 Data Treatment

Based on the data reported by the survey respondents, mean distributions, t-test, multivariate regression, and similar statistical procedures were used to validate the hypotheses posited for the study.

Although most of the survey questions were completely answered by the respondents, some were left unanswered. As a result, there was a need for missing values to be carefully treated as a valuable source of information, as they are beneficiary to the overall interpretation of the study results but otherwise ignored without any care. Basically, missing values were coded by the following rules. First, regarding the 6 ordinal rating questions – coherence, complexity, excitement, familiarity, natural harmony, and environmental preference – all missing values were coded as "neither unlikely nor likely (3)." For the gender question, second, all missing values were coded as zero where one denotes male and zero denotes female. Finally, missing values in the age question were substantiated by mean age (23 years old) as reported by all the respondents.

5. FINDINGS

The first part of this section provides the test results of the research hypotheses as verified by both bivariate and multivariate analyses. The version 8.0 of SPSS program for windows was used for the analysis purposes. Tables are primarily used to summarize the test results. Based on the survey questionnaire, additionally, some secondary findings as related to the study are presented in the latter part.

5.1 An Appropriate Measure of Environmental Preference

Pearson's correlations showed that the two different preference measures, so-called "desire to visit the spot" and "desire to live in the house," are highly correlated each other at 99.9% confidence levels all throughout the 9 dependent variables. As reported by all the subjects, additionally, mean desire to visit the spots (3,46) turned out to be much higher than mean desire to live in the houses (2.96). As a result, this study used "desire to visit the spot" as a surrogate for environmental preference. Environmental preference, hereafter, refers to "the degree of how much the subjects wish to visit the spot, alternatively." If the subject ratings are successfully made (e.g., internal validity) and no other aspects affect the ratings (external validity), the higher mean might reflect the greater response sensitivity among the subjects.

5.2 Bivariate Approach to Testing Hypotheses

Table 3 provides a clear picture of the independent two group t-test results. Several significant two-group differences in population mean are identified in the test procedure. Based on the results, the study hypotheses as described in the model (figure 1) are tested on theoretical grounds (see Lee, 2002a).

5.2.1 Coherence & Environmental Preference [H_1]

Nasar's (1985), Nasar and Hong's (1999) position that environmental preference is an incremental function of coherence is partially supported. This position is applied only to Casa Rotonda House, Wimbledon House, and Casa Gaspar, while others not. One interesting finding is that Snyderman House is highly preferred by the low coherent group. That is, an inverse relationship between environmental preference and coherence is found. This finding may result due to its pretty complex, mystery structural shape (e.g., mean complexity is 3.64, the highest value among the 9 scenes). People are likely to avoid approaching visual features that are too difficult to understand. For Snyderman House, coherence turned out to be the opposite end of complexity ($r = -.31$; $p < .001$).

5.2.2 Complexity & Environmental Preference [H_2]

As validated by the result of t-tests (table 3), complexity did not explain the pattern of environmental preference, supporting Nasar and Hong's (1999) findings. Consequently, Nasar's (1985) inversed U-type complexity explanations of environmental preference could not be tested. For Delaware House, nonetheless, the low complex group is more likely than the counterpart to be highly value the scene. As verified by results of the open-ended question, many of the subjects did not understand the overall architectural configurations of the front part of the barn-like housing structure. This may affect the preference ratings.

Table 3. Mean Environmental Preference As Related to the 5 Set of Visual Cue Ratings (t-tests)

Dependent Measure[1] (Env. Preference)	No.	Statistics[3]	Independent Measure[2]									
			Coherence		Complexity		Excitement		Familiarity		Natural Harmony	
			Low	High	Low	High	Low	High	Low	High	Low	High
[1]Delaware House	129	Mean	2.73	3.15	3.23	2.67	2.50	3.27	2.87	3.11	2.52	3.33
		SD	1.36	1.09	1.20	1.15	1.31	1.06	1.13	1.28	1.21	1.09
		p	NS[3]		**.009 (--)**		**.000 (+++)**		NS[3]		**.000 (+++)**	
[2]Casa Rotonda House		Mean	2.78	3.54	3.24	2.43	2.77	3.71	3.40	3.23	3.11	3.52
		SD	1.10	1.18	1.22	1.19	1.07	1.15	1.21	1.21	1.32	1.06
		p	**.001 (+++)**		NS[3]		**.000 (+++)**		NS[3]		NS[3]	
[3]Wimbledon House		Mean	2.88	3.36	3.32	3.15	2.87	3.71	3.39	3.11	2.99	3.69
		SD	1.19	1.20	1.25	1.20	1.17	1.12	1.12	1.25	1.11	1.32
		p	**.037 (+)**		NS[3]		**.000 (+++)**		NS[3]		**.002 (++)**	
[4]Casa Gaspar		Mean	3.85	4.30	4.12	4.16	3.62	4.33	4.27	4.01	4.04	4.25
		SD	1.10	1.04	1.16	1.00	1.13	1.00	1.04	1.11	1.19	.94
		p	**.021 (+)**		NS[3]		**.001 (+++)**		NS[3]		NS[3]	
[5]Vitruvian Villa		Mean	3.03	3.10	2.94	3.24	2.53	3.77	3.00	3.13	2.70	3.25
		SD	1.19	1.19	1.22	1.13	1.03	.98	1.26	1.13	1.20	1.14
		p	NS[3]		NS[3]		**.000 (+++)**		NS[3]		**.015 (+)**	
[6]Snyderman House		Mean	3.97	3.55	3.78	3.80	2.80	4.16	3.85	3.74	3.54	4.06
		SD	1.02	1.23	1.18	1.11	1.35	.77	1.19	1.09	1.27	.88
		p	**.033 (-)**		NS[3]		**.000 (+++)**		NS[3]		**.008 (++)**	
[7]Halawa House		Mean	3.35	3.24	3.09	3.33	2.84	3.75	3.33	3.25	2.53	3.58
		SD	1.14	1.20	1.25	1.16	1.17	1.01	1.29	1.15	1.29	.99
		p	NS[3]		NS[3]		**.000 (+++)**		NS[3]		**.000 (+++)**	
[8]Waterfall House		Mean	3.85	3.84	3.77	3.88	3.47	4.19	3.56	4.09	3.13	4.16
		SD	1.13	1.15	1.12	1.15	1.22	.93	1.29	.93	1.22	.95
		p	NS[3]		NS[3]		**.000 (+++)**		**.008 (++)**		**.000 (+++)**	
[9]Schnabel House		Mean	3.46	3.50	3.55	3.46	2.71	3.85	3.60	3.43	2.90	3.77
		SD	1.54	1.23	1.42	1.27	1.25	1.19	1.43	1.26	1.43	1.17
		p	NS[3]		NS[3]		**.000 (+++)**		NS[3]		**.000 (+++)**	

Note 1. Each of the dependent measures was rated on a 5-point ordinal scale, where larger number means greater preference.
Note 2. Based on mean values of each of the independent measures as reported by all respondents, low and high groups were defined for analysis purposes.
Note 3. NS indicates that relations are "not statistically significant" at 95% confidence level. Additionally, +, ++, and +++ mean relationship is positive and statistically significant at 95%, 99%, and 99.9% confidence level, respectively, while -, --, and --- indicate negative relationships.

5.2.3 Excitement & Environmental Preference [H_3]

This study completely supports S. Kaplan et al.'s (1972) notion of a supposed preference for somewhat visually interesting things. For each of the 9 scenes, positive and significant relationships between excitement and environmental preference are obtained. As reported by all the subjects, Casa Gaspar is the most exciting scene (mean value = 3.89), which, thus, is ranked to be the most preferred scene (mean value = 4.14). For Casa Gaspar, its simple box-like structure might increase a sense of novelty, as supported by Hull and Revell (1989), leading to a great sense of liking. Unexpected coherence may produce a feeling of excitement. For the present study, overall, excitement turned out to be the best predictor of environmental preference.

5.2.4 Familiarity and Environmental Preference [H_4]

Mandler's (1982) familiarity theory of environmental preference is not supported by this study. That is, the degree of environmental preference is likely to be determined, regardless of how much observers are familiar with or know about a given visual array. For Waterfall House, nonetheless, a positive and significant relationship between familiarity and environmental preference is found. That is, the high familiarity group tends to give a higher preference value to the scene. One possible explanation is that the scene contains water feature, so-called one of preferendas (Ulrich, 1983), which leads positive reactions to it. For the Waterfall House scene, familiarity is most highly correlated with the natural harmony rating (r = .33; p < .001). People are largely familiar with specific natural features such as tree and running water. This may lead to a higher preference, regardless of the house's architectural features.

5.2.5 Natural Harmony & Environmental Preference [H_5]

Ulrich's (1983) theoretical position that background natural features usually work to upgrade the visual quality of man-made things is largely supported by this study. Except Casa Rotonda and Casa Gaspar House, the pattern of environmental preference for all the remaining scenes could be predicted by utilizing the natural harmony ratings. The subjects recognized Wimbledon House and Waterfall House as the most environmentally sensible settings (mean value = 4.05 and 3.85, respectively), while Casa Gaspar as the second lowest (mean value = 2.62). Once again, it is interesting to find that Casa Gaspar is most preferred, while it is not environmentally sensible and, furthermore, is mysterious in its architectural shape. In fact, excitement turned out to be not a surrogate of environmental sensitivity.

5.3 Multivariate Regression Approach to Test Hypotheses [H_6]

In order to test the combined effect of the 5 ratings (e.g., coherence, complexity, excitement, familiarity, and natural harmony) on the dependent measure (e.g., environmental preference), a total of 9 backward stepwise regression models

Table 4. Results of the Best-Fit Regression[1] of the Visual Cue Variables on Environmental Preference

Dependent Measure (Env. Preference)	Regression Validity[1]		Statistics[2]	Independent Measure				
				Coherence	Complexity	Excitement	Familiarity	Natural Harmony
[1]Delaware House	F	16.51	β	NI	-.220	.257	NI	.301
	p	.000	p	NS	**.006 (--)**	**.002 (++)**	NS	**.000 (+++)**
			PC (r)	NS	-.297 **(---)**	.341 **(+++)**	NS	.436 **(+++)**
			Adjusted R^2	**.267**				
[2]Casa Rotonda House	F	31.94	β	.233	NI	.500	NI	NI
	p	.000	p	**.002 (++)**	NS	**.000 (+++)**	NS	NS
			PC (r)	.290 **(+++)**	NS	.528 **(+++)**	NS	.203 **(+)**
			Adjusted R^2	**.321**				
[3]Wimbledon House	F	10.29	β	.261	.169	.313	NI	.201
	p	.000	p	**.001 (+++)**	**.038 (+)**	**.000 (+++)**	NS	**.012 (+)**
			PC (r)	.242 **(++)**	NS	.362 **(+++)**	NS	.253 **(++)**
			Adjusted R^2	**.225**				
[4]Casa Gaspar	F	12.23	β	.192	NI	.329	NI	NI
	p	.000	p	**.021 (+)**	NS	**.000 (+++)**	NS	NS
			PC (r)	.238 **(++)**	NS	.356 **(+++)**	NS	NS
			Adjusted R^2	**.149**				
[5]Vitruvian Villa	F	37.16	β	NI	NI	.550	NI	.146[3]
	p	.000	p	NS	NS	**.000 (+++)**	NS	.051
			PC (r)	NS	NS	.593 **(+++)**	NS	.308 **(+++)**
			Adjusted R^2	**.361**				
[6]Snyderman House	F	25.49	β	-.189	-.132[3]	.607	NI	.161
	p	.000	p	**.010 (--)**	.068	**.000 (+++)**	NS	**.022 (+)**
			PC (r)	-.206 **(-)**	NS	.629 **(+++)**	NS	.229 **(++)**
			Adjusted R^2	**.434**				
[7]Halawa House	F	39.93	β	NI	NI	.421	NI	.326
	p	,000	p	NS	NS	**.000 (+++)**	NS	**.000 (+++)**
			PC (r)	NS	.209 **(+)**	.545 **(+++)**	NS	.486 (+++)
			Adjusted R^2	**.378**				
[8]Waterfall House	F	18.49	β	NI	NI	.237	.178	.379
	p	.000	p	NS	NS	**.002 (++)**	**.023 (+)**	**.000 (+++)**
			PC (r)	NS	NS	.364 **(+++)**	.323 **(+++)**	.508 **(+++)**
			Adjusted R^2	**.320**				
[9]Schnabel House	F	31.52	β	NI	NI	.469	NI	.243
	p	.000	p	NS	NS	**.000 (+++)**	NS	**.002 (++)**
			PC (r)	NS	NS	.527 **(+++)**	NS	.356 **(+++)**
			Adjusted R^2	**.323**				

Note 1. Models regressed are final models of backward stepwise processes, which provide the best predictability of the preference ratings. Also, All background variables are entered at .05 levels of partial correlations and the regression procedure is terminated at .10 probability value of F-to-remove (POUT).

Note 2. β is standardized coefficient of each independent variable in the multivariate model. PC (r) refers to "Pearson's correlations," which means simple linear relations between independent and dependent variables as weighted on all survey responses. Adjusted R^2, additionally, indicates the coefficients of determination for each of the multiple regression models. NI means variables "not included" in the final multivariate model, while NS refers to relations "not statistically significant" at 95% confidence level. Additionally, +, ++, and +++ mean relationship is positive and statistically significant at 95%, 99%, and 99.9% confidence level, respectively, while -, --, and --- indicate negative relationships.

Note 3. β and p-values are presented, though not statistically significant, because they turned out to be useful in predicting environment preference in the multivariate context.

are obtained as shown in table 4. The backward stepwise regression explains a positive and significant relationship between complexity and environmental preference for Wimbledon House. That is, the more complex the scene, the more likely it is favored. Pearson's correlation coefficients, additionally, are added to compare bi-variate relations between variables. For Casa Rotonda House, natural harmony is highly positively correlated with environmental preference. Overall, though, this study found a pretty similar pattern of relationships between t-tests, Pearson's correlations, and regressions, respectively. Consequently, the extra combined or interaction effect of background variables on the dependent measure, not explained by t-tests and Pearson's correlations, turned out to be relatively weak. However, this finding is meaningful in that it proved the validity of each individual test by producing a similar pattern of results.

Table 4 also summarizes the values of adjusted R^2 (coefficients of determination) for each of the 9 full regression models. For Snyderman House, roughly 43% of the total response variability on the preference rating is accounted for by the three independent ratings (e.g., complexity, excitement, and natural harmony); this results in a 27% reduction in the prediction error. For Casa Gaspar, on the other hand, only 15% of the total response variance on the preference rating is explained by its linear relationship with the two independent ratings (e.g., coherence and excitement); as a result, a 15% reduction in the prediction error is obtained. Concerning the values of adjusted R^2 involved in the other regression models, readers may see table 4.

5.4 Secondary Findings

Group differences in mean preference are examined by independent two-group t-tests (see Lee, 2002b). Overall, though, this study suggests that preference evaluations are cross-regionally valid, no matter what clients are rural or urban residents. This value-free position of aesthetic preference is also partly supported by the finding that there is no significant group difference between rural and urban university students in terms of personally motivated architectural interest as validated in the survey. That is, architectural interest is deemed totally a personal matter, independent of the subjects' current places to stay. As expected, additionally, it turned out to be that architects are more likely than laypersons to express personal interest in architecture ($r = .27$; $p < .01$).

Observers' other background characteristics such as age, gender, and major in education, additionally, are not effective in predicting the pattern of environmental preference. In this regard, it is interesting to find that, as validated by independent two group t-tests, the young subject group is quite similar with the layperson group in terms of the pattern of responses. That is, young and layperson groups favor both Delaware House and Vitruvian Villa, simultaneously, in statistically meaningful ways. Design background (laypersons coded as 0, while architects as 1) is highly correlated with age ($r = .30$; $p < .001$); that is, laypersons are significantly younger than architects. Female respondents also are more likely than the counterpart to positively value Vitruvian Villa at a 99.9% confidence level. Gender (female coded as 0, while male as 1) is strongly and positively correlated with age ($r = .45$; $p < .001$); that is, female turned out to be younger than male. For the present study, consequently, age is related either directly or indirectly to the explanation of preference particularly for Delaware House and/or Vitruvian Villa.

6. CONCLUSIONS

This study addressing the issue of aesthetic beauty evaluation for man-made creatures (e.g., residential housing scenes) has found several design implications. As measured by Pearson's correlation coefficients, first, both "desire to visit the spot" and "desire to live in the house" turned out to be a good predictor of environmental preference, while the former is a little bit more likely to be a reliable measure. More studies should be continued in order to verify this finding and further develop better and appropriate instruments for measuring the concept of environmental preference, particularly as applied to visual environments of this sort. This is, adequate aesthetic beauty can be ultimately obtained if measurement instruments measure exactly what they intend to measure in a right way (e.g., internal validity).

Second, coherence turned out to be the opposite end of complexity. The more likely a housing scene is hanging together, the less likely it looks to be complex. Overall, though, it is not clear that the two variables work directly in that way, as regressed on preference ratings. Consequently, the combined effect of coherence and complexity on environmental preference could not be verified in the present study. Additionally, coherence and complexity, respectively, are not so effective in predicting the pattern of environmental preference.

Third, higher preference ratings are largely attributed to somewhat visually interesting scenes and environmentally sensible man-made features (e.g., so-called, green architecture), respectively. In order to provide an ideal type of man-made features, therefore, it is important for design professionals to keep in mind the utility of excitement and environmental sensitivity all throughout the design process. For example, Casa Gaspar is most preferred as validated by all the subjects, because of its novel or unusual exterior feature. This finding is pretty interesting in that the house is a simple box-like building structure and is not environmentally sensible in any sense. Possibly, unexpected or extraordinary visual scenes (e.g., say "novelty"), if architecturally well defined, could help increase a sense of excitement, which, then, positively work for environmental preference. Thus far, it has been a long tradition for design professionals (e.g., architects) to consider the issue of environmental sensitivity (e.g., natural harmony) for all kinds of residential housing development. This tradition cannot be sustained or even legitimized without efforts of this sort to prove its validity. In reality, the environmental consolidation by background natural contents turned out to be effective in upgrading the overall quality of man-made features.

Though Mandler's (1982) familiarity theory of environmental preference is not supported by the present study, fourth, it is meaningful to develop a theoretical proposition that familiarity may have an indirect impact on environmental preference through environmental sensitivity. For Waterfall House, for example, the scene is highly preferred, possibly because of observers' familiarity with the natural scenery (e.g., grass and water) surrounding the house, not simply because of the house's architectural features. Again, this explanation is quite meaningful under the concurrent issue of environmental sensitivity. Finally, the combined effect of the visual cue group variables on environmental preference is not salient. Future studies of this sort need to verify a set of visual cues that may interact to affect the dependent measure, sorting out specific effects of in-between interactions.

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