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# A COGNITIVE ANALYSIS OF PREFERENCE FOR URBAN NATURE

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**Abstract**

Preferences for urban environments containing prominent natural elements were studied as a function of content categories, viewing time, and nine predictor variables: spaciousness, refuge, coherence, legibility, complexity, mystery, typicality, nature, and age. A nonmetric factor analysis of the preference ratings for the longest viewing time yielded four dimensions: Older Buildings, Concealed Foreground, Tended Nature, and Contemporary Buildings. Tended Nature was best liked, Older Building least liked, and there was very little difference in preference ratings with brief and longer viewing times. Regression analyses revealed three variables as independent positive predictors of preference: coherence, mystery, and nature. Practical and theoretical implications of the results were explored. Overall, the results support the usefulness of the Kaplans' informational model of environmental preference.

The research reported in this paper had two goals. The first was to investigate preferences for urban environments containing prominent natural elements in the form of trees, foliage, and other vegetation. The second goal of the study was to test the usefulness of a theoretical approach to environmental preference known informally as the informational approach and described in detail by the Kaplans (Kaplan and Kaplan, 1978, 1982; S. Kaplan, 1987). The approach fits within what Zube, Sell, and Taylor (1982) called the cognitive paradigm, Daniel and Vining (1983) the psychological model, and Zube (1984) the behavioural viewpoint. The approach will be described below.

Although the literature dealing directly with preferences for urban nature is not extensive, it does emphasize the importance of nature in urban settings. R. Kaplan (1983) provides a review of early studies supporting the following conclusions: (a) natural settings in general are strongly preferred over urban settings; (b) among urban settings, those containing nature are most preferred; (c) so-called 'unmanaged' nature is relatively less preferred than landscaped areas; (d) trees are highly-valued components of urban nature. In addition to these general conclusions, the studies reviewed by Kaplan also point to the importance of certain informational variables to be described below. Recent studies highlighting the influence of nature in urban preference judgments include Im (1984), Hudspeth (1986), and Talbot and Kaplan (1986). In addition, there is a line of research suggesting that urban nature has therapeutic effects (Ulrich, 1984; Heerwagen and Orians, 1986; Verderber, 1986). A similar theme emerged from another set of studies reviewed by R. Kaplan (1983) which emphasized the

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satisfactions derived by urban residents from activities such as gardening or simply from the knowledge that natural areas are available nearby in the urban environment. Schroeder's (in press) review of research on urban forests reiterates many of these same issues and themes.

As noted above, the present study of preferences for urban nature was guided by the informational approach of the Kaplans. This approach asserts that evolving humans found spatial information processing crucial to survival. Therefore, the analysis of environmental preference should focus on the kinds of settings (or contents) and the kinds of cognitive processes that would be important to such an organism. In addition to the references listed earlier, which provide details of this approach, R. Kaplan (1984) has contributed a helpful discussion of the approach as it applies specifically to urban nature.

The informational approach stresses both content and process. Contents are of two types: general and specific. General contents refer to configurations that determine what one can do in an environment. Thus, they are similar to Gibson's (1979) concept of affordances. Appleton (1975, 1984) suggested two very important affordances, refuge and prospect [1]. Refuge refers to potential hiding places in an environment, prospect to vantage points from which one can see unhindered into the distance. Woodcock's (1982) empirical investigation of primary and secondary versions of these affordances showed that primary prospect (the view from a vantage point like that described above) was positively related to preference. The other predictors based on Appleton's theory fared less well; in fact, primary refuge (the view from within a hiding place) was negatively related to preference.

The present study investigated two affordances, refuge and spaciousness. Refuge was defined as how much the setting provides the opportunity for being hidden and thus seems closer to Woodcock's secondary refuge (seeing a potential hiding place) than his primary refuge. Spaciousness was defined as the feeling of depth conveyed by a setting, the feeling that one would have to go a long way to reach its farthest point. Spaciousness thus defined can be seen as a stand-in for primary prospect. Spaciousness plays a dual role in the informational approach since it also depends on how well-organized a setting is in depth. Such organization contributes to the overall understanding of an environment, a process discussed below. In any event, the expectation was that refuge and spaciousness would be positively related to preference.

Specific contents, in contrast, refer to what S. Kaplan (1987) calls 'primary landscape qualities', certain particular contents that seem to have a special effect on preference, perhaps the result of fairly specific evolutionary biases. Candidates include water, foliage, and trees. In the context of urban nature, the general question raised by the possibility of specific salient contents is whether the category can be subdivided meaningfully. This question can be answered by using empirical procedures, described below, to form categories based on preference ratings, and then considering whether the categories make sense, both intuitively and in the further empirical analysis of preference. Past studies of urban preference (Herzog, Kaplan, and Kaplan, 1976, 1982) strongly suggest that one basis for forming urban categories will be the age of built structures in the settings. It is also possible, as S. Kaplan (1979) suggests, that some categories may be based on the spatial configuration of natural elements.

The informational approach proposes that two general cognitive processes are involved in environmental preference, understanding and exploration (S. Kaplan, 1987). Understanding refers to comprehending or making sense of an environment,

exploration to having one's interest aroused and held by the environment while being attracted toward sources of additional information. Both processes have survival value, and thus environments that engage both should be preferred. Variables promoting understanding include the degree of order or organization in the immediate setting (coherence) and the apparent ease of wayfinding in the larger environment that includes the immediate setting (legibility). (Spaciousness, as defined above, could be considered one component of legibility, and thus contribute to understanding the environment.) Exploration would be promoted by the richness or diversity of the immediate setting (complexity) and by the promise of new information if one could travel deeper into the environment (mystery). The empirical utility of mystery and coherence has been demonstrated many times (Herzog, 1984, 1985, 1987; Herzog, Kaplan, and Kaplan, 1976, 1982; S. Kaplan, 1987; Herzog and Smith, 1988), but the other two variables have received less consistent empirical support, perhaps because of difficulties in defining them clearly to raters. In the present study, all four variables were investigated.

A variable that cuts across both the understanding and exploration processes is the resemblance of the current setting to environments the observer knows well. This 'sense of familiarity' should aid understanding but, if overdone, may detract from exploration. Under the name 'identifiability', this variable has been a generally positive predictor of preference in several studies (Herzog, Kaplan, and Kaplan, 1982; Herzog, 1984, 1987). Recently, Purcell (1986) found a very similar variable, ratings of 'how good an example of a category' a given setting was, useful in accounting for preferences for churches. In the present study, Purcell's definition was used, and the variable was called typicality.

Two more rated predictor variables were included in the study primarily because past research (Herzog, Kaplan, and Kaplan, 1976, 1982) had emphasized their importance. The first was the amount of foliage or vegetation in a setting (nature). This variable was also included because it qualifies as one of S. Kaplan's (1987) 'primary landscape qualities' and because it could serve as a check on how sensitive participants were to the amount of nature in urban settings. Second, the age of the 'elements' in each setting was assessed (age). If age is a basis for category formation, ratings of age would provide supportive evidence for such an interpretation. In addition, it seemed possible that age might be directly related to preference, regardless of category effects. Finally, inclusion of age in the set of predictor variables should shed light on the circumstances under which age might be related to higher or lower preference reactions. Thus, aside from their theoretical interest, the results for age could have practical implications in guiding strategies for preserving older structures.

A final variable investigated was viewing time. Preference reactions were assessed with a very brief viewing time (100 ms) and an extended viewing time (15 s). There are both empirical and theoretical grounds for expecting an effect of viewing time on preference. Empirically, viewing-time effects have been found repeatedly in past research on environmental preference (R. Kaplan, 1975; Herzog, Kaplan, and Kaplan, 1982; Herzog, 1984, 1985, 1987). Theoretically, such effects make sense if one assumes that with very brief viewing times the quality of the sensory data is sometimes limited, leading to what information-processing theorists call data-limited processing. In such instances, extended viewing time could very well yield a difference in preference. The nature of the difference would depend on which information is successfully processed from the brief glimpse of the scene. For example, if the brief glimpse picks up features

suggesting that safety may be an issue, then extended viewing time might yield reassurance and a higher preference rating. On the other hand, if information that would normally evoke safety concerns is missed in the brief glimpse, then extended viewing would probably reveal it and lead to a lower preference rating. Thus, there are theoretical grounds for expecting a variety of viewing-time effects and, in some instances, no effect. Therefore, it is worthwhile to investigate viewing time.

In summary, the major objective of the study was to investigate preferences for urban nature in the context of the Kaplans' informational model of environmental preference. To do so required an assessment of content and process as predictors of preference. A methodological issue should be noted. Colour slides were used as surrogates for actual environments. Although some researchers seem dogmatically opposed to this approach, a thorough review of landscape simulation research by Zube, Simcox, and Law (1987) gave it a strong endorsement on grounds of reliability and validity.

## Method

*Participants*

The sample consisted of 354 undergraduate students, 236 females and 118 males, at Grand Valley State University. The students received extra course credit for participation. Twenty-seven sessions of from 5 to 21 participants were conducted.

*Stimuli*

The settings consisted of 70 colour slides of urban environments containing prominent natural components. An attempt was made to sample a variety of natural elements (trees, shrubs, flowers, weeds, grass) ranging in condition from well-tended to completely neglected. No settings contained water or other prominent non-vegetation natural elements. No settings contained people since they have been found to be powerful distractors (Herzog, Kaplan, and Kaplan, 1976). Since age of buildings has been shown to affect preference reactions (Herzog, Kaplan, and Kaplan, 1976, 1982), settings contained structures ranging in age from very new to relatively older. All settings were drawn from the western half of Michigan's lower peninsula, the vast majority from the city of Grand Rapids and its suburbs.

*Procedure*

Participants rated each of the 70 settings on one of ten variables. All ratings used a 5-point scale ranging from 1 = 'not at all' to 5 = 'a great deal'. There were nine predictor variables. *Spaciousness* was defined as 'the feeling of spaciousness or depth the scene conveys, how much room there is to wander into it. To what extent does the structure of the scene suggest that one would have to go a long way to each its farthest point?' *Refuge* was 'the opportunity for being hidden, the chance to see without being seen'. *Coherence* was 'how well the scene "hangs together". How easy is it to organize and structure the scene?' *Legibility* was 'how easy it would be to find your way around in the environment depicted ... to figure out where you are at any given moment or to find your way back to any given point in the environment'. *Complexity* was 'how much is going on in the scene, how much there is to look at', how much 'the scene contains a lot of elements of different kinds'. *Mystery* was present when a setting 'promises more to be seen if you could walk deeper into it'. *Typicality* referred to the 'extent the scene seems

to be a representative example of its class. How good an example is the scene of whatever category it belongs to?' *Nature* was 'how much foliage or vegetation there is in the scene'. *Age* was 'how old the elements in the scene seem to be'. The criterion variable was *preference*, defined as 'how much you like the scene, for whatever reason'.

Sessions proceeded as follows. First, five sample slides were rated to help participants get used to the task and the rating scale. Then participants rated 80 slides, presented in two sets of 40 each, with a brief intermission between sets. In both sets, the first three and the last two slides were considered filler slides. The remaining 70 slides from both sets yielded the data for analysis. These 70 slides were presented in three different orders, with each order used for nine of the twenty-seven sessions. Each order of slide presentation was used in one-third of the sessions in which each variable was rated. One of the orders of slide presentation was generated randomly. The second presentation order was the reverse of the first order, and the third presentation order was devised by interchanging the halves of the first order.

Eighteen of the sessions were devoted to the predictor variables. In such sessions, three predictor variables were rated simultaneously, with each participant rating for only one variable and approximately one-third of the group rating each variable. For each order of slide presentation, three sets of three predictors were chosen randomly without replacement from the pool of nine predictor variables. Each such set of three predictors was used in two sessions with its designated order of slide presentation. Viewing time was 15 s for each slide. Final sample sizes were 29 each for spaciousness, mystery, and age, 28 for nature, 27 each for complexity and typicality, and 25 each for refuge, coherence, and legibility.

Nine sessions were devoted solely to the criterion variable, preference. Viewing time was 15 s for six of these sessions and 100 ms for the other three. One-third of the sessions for each viewing time used each order of slide presentation. The brief viewing time was achieved by using an electronic shutter mounted in front of the projector lens. Final sample sizes were 76 and 34 for the 15-s and 100-ms viewing times, respectively. The larger sample for the 15-s viewing time was necessary as a basis for the factor analysis described below.

*Analysis*

To evaluate reliability of measurement for each variable, final samples were divided into half samples, and mean ratings for each setting were computed based on each half sample. The two sets of 70 mean-per-setting scores were then intercorrelated for each variable. The resultant correlations were corrected by the Spearman-Brown formula to yield split-half reliability coefficients for each variable.

To discover the content categories embodied in the participants' preference reactions, the preference ratings from the 15-s condition were analysed by nonmetric factor analysis, specifically the Guttman-Lingoes Smallest Space Analysis III (SSA–III) (Lingoes, 1972). SSA–III is a nonmetric version of principal-axes factor analysis. It uses squared multiple correlations in the diagonal of the input correlation matrix and a varimax rotation of the final solution. The procedure finds a solution of the user-specified dimensionality that best fits the rank order of the original correlation matrix rather than the more stringent linear transformation of the original correlations required by metric factor analysis. Proponents of nonmetric analysis argue that more stable solutions in fewer dimensions can be found. For descriptive purposes, dimensional composition was determined by including all settings with a factor

loading greater than |0·40| on one dimension only. With this criterion, for each dimension containing enough settings to provide a basis for interpretation, all factor loadings for included settings had the same sign. Hence, such dimensions may be treated as clusters or categories of similar settings.

To evaluate the effects of content categories and viewing time, two types of scores were computed as raw data for analysis. The first, a category score, was simply the mean rating for all settings comprising a category. Thus, for each rating variable, every participant had a category score for each of the environmental categories resulting from the nonmetric factor analysis. The second type of score was a setting score, the mean for each setting based on all participants who rated each variable. Thus, for each rating variable, every setting had a setting score. Two analyses of variance were carried out for each ratings variable. The first used category scores as the dependent variable, and the second used setting scores. The first analysis allows conclusions to be generalized to the population of participants, the second analysis to the population of settings. For both analyses, the independent variable was environmental category. For preference ratings only, a second independent variable was viewing time. Significant effects were explored further by the Tukey-B test (Wike, 1971), with Cicchetti's (1972) modification for interaction tables and Kramer's (1956) modification for unequal samples where appropriate. For all tests of inference, only effects with $P < 0{\cdot}05$ in both category-score and setting-score analyses were considered statistically significant. In addition, for setting scores, a multivariate analysis of variance was performed on all nine predictor variables as a set. The multivariate test statistics provide further protection against Type I errors. Such an analysis was not possible for category scores.

Two kinds of additional analyses were carried out on the setting scores. First, to understand better how the variables of the study worked together, two multiple regression analyses were performed with preference (15-s viewing time) as the criterion variable. The first analysis included all 70 settings, and the other nine rated variables served as predictors. A second stepwise multiple regression included only the 37 settings in the environmental categories. The nine rated predictors were entered first as a block of variables followed by a set of dummy vectors representing the degrees of freedom for environmental categories. Second, prediction of preference (15-s viewing time) within each of the environmental categories was assessed by examining the simple correlations between the rated predictor variables and preference and also the simple correlations among the rated predictor variables. This approach was necessary because of the limited number of settings per category, which meant that multiple-regression analysis was not feasible within categories.

## Results

*Reliability of measurement*

The Spearman-Brown reliability coefficients for the rating variables ranged from 0·77 for typicality to 0·98 for both preference (15-s viewing time) and nature. All exceeded 0·90 except for complexity (0·88), mystery (0·78), and typicality (0·77). The minimum acceptable reliability for basic research suggested by Guilford (1954) and Nunnally (1967) is 0·50. Thus, reliability of measurement exceeded conventional standards.

*Environmental categories*

Nonmetric factor analysis (Smallest Space Analysis III) of the 15-s preference ratings yielded four interpretable dimensions. The six-dimensional solution is reported here. It

TABLE 1
*Means and standard deviations (in parentheses, for category scores, left, and settings scores, right) as a function of environmental category for each rated predictor variable*

| Variable | Environmental category | | | |
|---|---|---|---|---|
| | Older buildings | Concealed foreground | Tended nature | Contemporary buildings |
| Spaciousness | 2·03 (0·42, 0·51) | 2·45 (0·47, 0·49) | 3·05 (0·48. 0·63) | 2·61 (0·45, 0·77) |
| Refuge | 3·58 (0·48, 0·72) | 2·97 (0·51, 0·58) | 2·54 (0·51, 0·49) | 2·26 (0·57, 0·61) |
| Coherence | 1·84 (0·58, 0·30) | 2·82 (0·52, 0·53) | 3·63 (0·42, 0·46) | 3·23 (0·50, 0·59) |
| Legibility | 1·99 (0·65, 0·27) | 2·64 (0·58, 0·50) | 3·30 (0·49, 0·29) | 3·30 (0·60, 0·31) |
| Complexity | 2·32 (0·65, 0·44) | 2·66 (0·73, 0·49) | 2·83 (0·59, 0·54) | 3·00 (0·60, 0·37) |
| Mystery | 2·89 (0·83, 0·36) | 3·40 (0·64, 0·24) | 3·31 (0·61, 0·37) | 2·67 (0·59, 0·40) |
| Typicality | 3·17 (0·78, 0·50) | 3·01 (0·57, 0·49) | 3·25 (0·55, 0·31) | 3·29 (0·59, 0·45) |
| Nature | 3·22 (0·54, 0·60) | 3·79 (0·47, 0·71) | 3·74 (0·49, 0·46) | 2·59 (0·35, 0·51) |
| Age | 4·10 (0·87, 0·27) | 3·21 (0·49, 0·74) | 2·90 (0·49, 0·83) | 2·60 (0·59, 0·50) |

yielded communalities ranging from 0·15 to 0·63. The criterion for dimensional composition was discussed in the Analysis section.

The dimension or category with the greatest number of settings (12) consisted of older buildings and was named *Older Buildings*. A second category (10 settings) was characterized by prominent (though not complete) foreground concealment involving natural elements (trees, hedges, foliage). It was named *Concealed Foreground*. The third category (8 settings) consisted of carefully tended or cultivated natural elements usually accompanied by relatively contemporary buildings. The distinguishing feature of this group was carefully arranged flower plots, well-trimmed hedges, or other noticeably manicured natural elements. The category was named *Tended Nature*. The last category (7 settings) consisted of contemporary buildings accompanied by nature that varied greatly in its perceived degree of care or cultivation. It was named *Contemporary Buildings*.

One way to differentiate the categories empirically is to examine differences across categories in the mean ratings on predictor variables. Table 1 contains means and standard deviations for all nine predictor variables as a function of environmental category. Results for both category and setting scores are included. The means are the same for either type of score. Table 2 presents analysis of variance summaries for the category effect based on both types of scores. As mentioned in the Analysis section, it was possible to perform a multivariate analysis of variance on all of the predictors in the case of setting scores. All of the multivariate test statistics (Pillai, Hotelling, Wilks) for the effect of environmental category were significant at $P < 0{\cdot}001$. As Table 2 indicates, the univariate tests of the category effect were significant for all of the predictor variables except typicality.

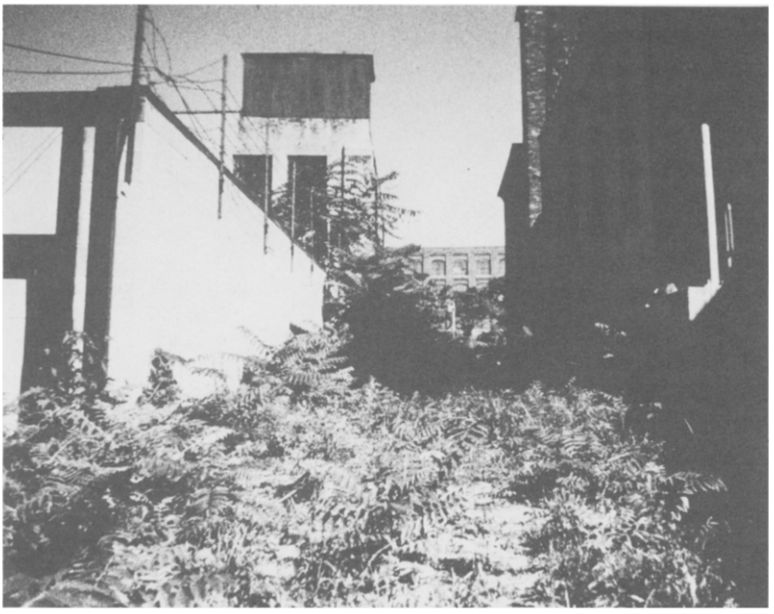

FIGURE 1. Scene from the Older Buildings category.

The following is a brief summary of post-hoc tests, indicating significant ($P < 0{\cdot}05$) pairwise differences among means for both category and setting scores. Tended Nature was higher in spaciousness than Older Buildings. On the other hand, Older Buildings exceeded both Tended Nature and Contemporary Buildings in refuge. Tended Nature exceeded both Concealed Foreground and Older Buildings in coherence, and Concealed Foreground was higher than Older Buildings. Both Contemporary

FIGURE 2. Scene from the Concealed Foreground category.

FIGURE 3. Scene from the Tended Nature category.

Buildings and Tended Nature exceeded the remaining two categories in legibility, and Concealed Foreground was higher than Older Buildings. Contemporary Buildings exceeded Older Buildings in complexity. Both Concealed Foreground and Tended Nature exceeded the other two categories in mystery, and both exceeded Contemporary Buildings in nature. Finally, Older Buildings exceeded all other categories in age.

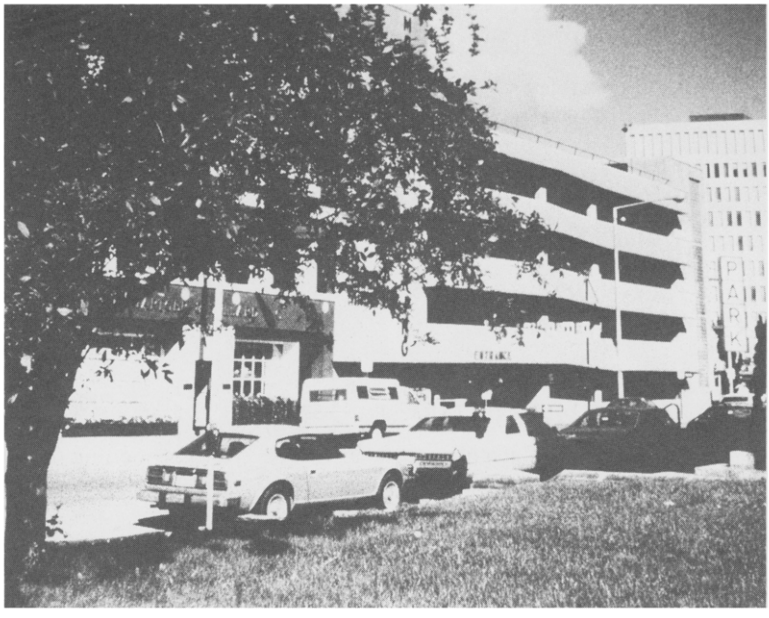

FIGURE 4. Scene from the Contemporary Buildings category.

TABLE 2
*Analysis of variance summaries for each predictor variable as a function of environmental category*

| | Category scores | | | Setting scores | | |
|---|---|---|---|---|---|---|
| | F | df | p | F | df | p |
| Spaciousness | 76·12 | 3,84 | 0·000 | 5·00 | 3,33 | 0·006 |
| Refuge | 54·59 | 3,72 | 0·000 | 8·19 | 3,33 | 0·000 |
| Coherence | 77·16 | 3,72 | 0·000 | 27·67 | 3,33 | 0·000 |
| Legibility | 48·57 | 3,72 | 0·000 | 30·03 | 3,33 | 0·000 |
| Complexity | 9·39 | 3,78 | 0·000 | 3·77 | 3,33 | 0·020 |
| Mystery | 11·30 | 3,84 | 0·000 | 8·83 | 3,33 | 0·000 |
| Typicality | 1·56 | 3,78 | 0·205 | 0·66 | 3,33 | 0·583 |
| Nature | 116·76 | 3,81 | 0·000 | 7·08 | 3,33 | 0·001 |
| Age | 42·37 | 3,84 | 0·000 | 11·36 | 3,33 | 0·000 |

*The prediction of preference*

*Categories and viewing time.* Table 3 contains preference means and standard deviations, for both category and setting scores, as a function of environmental category and viewing time. The cell means are the same for either type of score. The table also contains analysis of variance summaries for both types of scores. As is evident, both main effects and the interaction were statistically significant. Post-hoc tests were carried out as described in the Analysis section. For the main effect of environmental category, Tended Nature was rated highest in preference, Older

TABLE 3
*Means (top row), standard deviations (for category scores, middle row, and setting scores, bottom row), and analysis of variance summaries for preference scores as a function of environmental category and viewing time*

| | Environmental category | | | | Mean | |
|---|---|---|---|---|---|---|
| Viewing time | Older buildings | Concealed foreground | Tended nature | Contemporary buildings | Category scores | Setting scores |
| 15 s | 1·53 | 2·83 | 3·58 | 2·64 | 2·64 | 2·53 |
| | 0·46 | 0·64 | 0·54 | 0·57 | | |
| | 0·36 | 0·58 | 0·41 | 0·57 | | |
| 100 ms | 2·05 | 3·23 | 3·46 | 2·86 | 2·90 | 2·83 |
| | 0·58 | 0·55 | 0·49 | 0·58 | | |
| | 0·45 | 0·35 | 0·52 | 0·56 | | |
| Mean: | | | | | | |
| Category scores | 1·69 | 2·95 | 3·54 | 2·71 | | |
| Setting scores | 1·79 | 3·03 | 3·52 | 2·75 | | |

| | Category scores | | | Setting scores | | |
|---|---|---|---|---|---|---|
| | F | df | p | F | df | p |
| Category (C) | 224·23 | 3,324 | 0·000 | 30·34 | 3,33 | 0·000 |
| Viewing Time (V) | 10·77 | 1,108 | 0·001 | 13·38 | 1,33 | 0·001 |
| C × V | 8·30 | 3,324 | 0·000 | 4·18 | 3,33 | 0·013 |

Buildings lowest, and Concealed Foreground and Contemporary Buildings did not differ from each other. The significant interaction was characterized by a somewhat different pattern of category differences for brief and extended viewing times. At 15-s viewing time, the pattern of category differences duplicated the pattern for the main effect of environmental category. However, at 100-ms viewing time, only Older Buildings were rated lower than the remaining categories. A different, perhaps clearer, perspective on the interaction can be obtained by examining viewing-time differences within each category. The preference advantage for the 100-ms viewing time held only for Older Buildings and Concealed Foreground.

*Predictor variables.* Table 4 presents intercorrelations among the rated variables based on setting scores for all 70 settings. All of the predictor variables except typicality were significantly correlated with preference. However, 21 of the 36 intercorrelations among predictor variables were also significant. The results of the multiple regression analyses, which take correlations among predictors into account, are presented in Table 5. In the analysis of all 70 settings (left third of Table 5), the nine rated predictors accounted for 87% of the preference variance, with significant contributions from coherence, mystery, and nature. Settings high in these variables were most preferred. In the analysis of the 37 category settings, summarized in the rest of the table, two points are noteworthy. First, when only the rated predictors were entered into the analysis (middle third of Table 5), the results duplicated those of the preceding analysis. Second, when environmental categories were added as predictors (right third of Table 5), there was virtually no improvement in prediction (increase in preference variance accounted for of 0·01, $P > 0·05$), and the same three rated predictors continued to play the most powerful roles although nature was only marginally significant ($P = 0·06$).

Since there were not enough settings for multiple regression analysis within each environmental category, simple correlations were examined. Only correlations significant at $P < 0·05$ are reported. Coherence was positively correlated with preference in all four environmental categories ($r = 0·59$, 0·79, 0·86, and 0·93 for Older Buildings, Concealed Foreground, Tended Nature, and Contemporary Buildings, respectively). The pattern of positive correlations with preference in all categories also held for mystery and nature, but in each case the correlations were significant only for Concealed Foreground (0·70 and 0·80 for mystery and nature, respectively) and Contemporary Buildings (0·96 and 0·89, respectively). The only other significant

TABLE 4
*Intercorrelations among the rating variables for all 70 settings*

| | Spa | Ref | Coh | Leg | Com | Mys | Typ | Nat | Age |
|---|---|---|---|---|---|---|---|---|---|
| Preference (15 s) | 0·46 | −0·29 | 0·83 | 0·58 | 0·32 | 0·49 | −0·02 | 0·49 | −0·57 |
| Spaciousness | | −0·33 | 0·55 | 0·65 | 0·57 | 0·19 | 0·44 | 0·08 | −0·28 |
| Refuge | | | −0·45 | −0·66 | −0·28 | 0·16 | −0·03 | 0·34 | 0·53 |
| Coherence | | | | 0·77 | 0·40 | 0·21 | 0·16 | 0·19 | −0·71 |
| Legibility | | | | | 0·63 | −0·04 | 0·34 | −0·10 | −0·63 |
| Complexity | | | | | | 0·13 | 0·37 | −0·18 | −0·26 |
| Mystery | | | | | | | −0·18 | 0·45 | −0·04 |
| Typicality | | | | | | | | −0·26 | 0·00 |
| Nature | | | | | | | | | 0·07 |

*Note*: Column abbreviations are Spaciousness, Refuge, Coherence, Legibility, Complexity, Mystery, Typicality, Nature, and Age. For $|r| > 0·23$, $P < 0·05$; for $|r| > 0·30$, $P < 0·01$.

TABLE 5

*Multiple regression analysis summary results: regression weights (B), partial correlations ($r_p$), F-ratios (F), significance levels (p), and squared multiple correlations ($R^2$)*

| | All settings (N = 70) | | | | All category settings (N = 37) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | B | $r_p$ | F | p | B | $r_p$ | F | p | B | $r_p$ | F | p |
| Spac | −0·08 | −0·13 | 1·07 | 0·30 | −0·08 | −0·16 | 0·69 | 0·41 | −0·04 | −0·09 | 0·20 | 0·66 |
| Refu | −0·09 | −0·14 | 1·27 | 0·26 | −0·07 | −0·14 | 0·54 | 0·47 | −0·01 | −0·01 | 0·00 | 0·95 |
| Cohe | 0·62 | 0·60 | 34·39 | 0·00 | 0·68 | 0·75 | 35·51 | 0·00 | 0·56 | 0·65 | 17·42 | 0·00 |
| Legi | 0·11 | 0·09 | 0·51 | 0·48 | 0·29 | 0·27 | 2·08 | 0·16 | 0·24 | 0·24 | 1·41 | 0·25 |
| Comp | 0·10 | 0·13 | 1·11 | 0·30 | 0·05 | 0·07 | 0·13 | 0·72 | 0·03 | 0·05 | 0·06 | 0·81 |
| Myst | 0·46 | 0·45 | 15·34 | 0·00 | 0·45 | 0·51 | 9·63 | 0·00 | 0·40 | 0·46 | 6·28 | 0·02 |
| Typi | −0·02 | −0·02 | 0·03 | 0·86 | −0·17 | −0·26 | 1·91 | 0·18 | −0·16 | −0·24 | 1·52 | 0·23 |
| Natu | 0·39 | 0·55 | 25·98 | 0·00 | 0·24 | 0·44 | 6·64 | 0·02 | 0·21 | 0·38 | 3·95 | 0·06 |
| Age | −0·08 | −0·14 | 1·21 | 0·28 | −0·00 | −0·00 | 0·00 | 0·98 | −0·00 | −0·01 | 0·00 | 0·97 |
| Catl | | | | | | | | | −0·25 | −0·31 | 2·47 | 0·13 |
| Cat2 | | | | | | | | | 0·00 | 0·00 | 0·00 | 0·99 |
| Cat3 | | | | | | | | | 0·24 | 0·41 | 4·95 | 0·04 |
| $R^2$ | | | 0·87 | | | | 0·95 | | | | 0·96 | |
| p | | | 0·00 | | | | 0·00 | | | | 0·00 | |

*Note*: Variable abbreviations are Spaciousness, Refuge, Coherence, Legibility, Complexity, Mystery, Typicality, Nature, and Age. Catl–Cat3 refer to the dummy vectors generated to test the Environmental Category effect. The criterion variable is Preference (15 s viewing time).

correlations with preference involved Older Buildings (0·76 with complexity), and Contemporary Buildings (−0·77 with age). These simple correlations with preference should be treated with caution because there were several significant correlations among predictor variables [2].

## Discussion

*Environmental categories*

Two of the categories obtained in this study appear to be based primarily on the age of the buildings depicted (Older Buildings and Contemporary Buildings). In contrast, the other two categories appear to be based primarily on spatial configuration. For Concealed Foreground, the emphasis is on partial concealment in the foreground, which should enhance mystery. Tended Nature focuses on neatness and order in the configuration of natural elements, which should enhance coherence. As characterized, these two categories bear some resemblance to S. Kaplan's (1979) categories of enclosed spaces and open, well-defined spaces, respectively. These may not be the most important distinctions among the categories, but they are the most noticeable. They also correspond fairly closely to the speculations about bases for categories offered in the introduction.

The mean ratings on the predictor variables permit a more empirical approach to the issue of validity of category interpretation. The age-based categories should be at opposite ends of the rank ordering of categories for age. As Table 1 indicates, they were. Likewise, Tended Nature had the highest mean rating for coherence, and Concealed Foreground was relatively high in mystery. These results are consistent with the proposed category interpretations. Finally, note that the categories were not

perceived as equal in nature content. The two configurational categories, where natural elements were the primary focus for categorization, were rated highest in nature. The two age-based categories, where the focus was on buildings, were rated lowest in nature.

One problem with the above scenario is that although Concealed Foreground was relatively high in mystery, as demanded by the interpretation offered, so was Tended Nature. Therefore, mystery does not distinguish between the two categories. This problem may be more apparent than real. Mystery has several different components which have been explored empirically (Gimblett, Itami, and Fitzgibbon, 1985). The proposed interpretation for Concealed Foreground focuses on one component of mystery, foreground screening, which should yield fairly high mystery ratings for the category. It does not follow that another category cannot also be fairly high in mystery. In fact, the scenes in Tended Nature have a number of mystery components including screening (but not as prominent as in the Concealed Foreground category), interposition, and visual access via pathways. The point is that foreground screening appears to be the most noticeable characteristic of the Concealed Foreground category, whereas orderliness and tendedness are most noticeable in the Tended Nature scenes. In the final analysis, it is wise to acknowledge that category names are convenient labels for tentative interpretations. The appropriateness of such interpretations is always subject to further empirical testing.

*The prediction of preference*

*Viewing time.* There was a slight advantage in preference ratings for the brief viewing time, but it held for only two of the categories, Older Buildings and Concealed Foreground. This may mean that certain details of those settings were missed in the brief glimpse but seen with extended viewing time, and those details depressed preference. For Older Buildings, information about the surrounding neighbourhood might well lead to safety concerns. For Concealed Foreground, extended viewing might lead to a greater awareness of these settings as hiding places for muggers. For Tended Nature and Contemporary Buildings, there is little reason to think that extended viewing would raise safety concerns. This interpretation is highly speculative and should be taken as a proffered hypothesis to be verified by further research.

*Categories.* It is abundantly clear from the analyses of variance summarized in Table 3 that the categories make a difference in preference reactions. Tended Nature was most preferred, in agreement with R. Kaplan's (1983) review of the literature on urban nature preference. Least liked by far was the category of Older Buildings. It is very important to zero in on the reasons for the dislike of the Older Buildings category. Is it simply a matter of age, or are other factors involved? The answer matters because it would affect the kind of practical advice offered to urban planners and because it bears on theories of environmental preference. It is worth noting that older-building categories have fared differently in past research. The category was among the least liked in Herzog, Kaplan, and Kaplan's first study (1976), but not in their subsequent study (1982). Thus, age alone may not be the determining factor.

*Predictor variables.* The regression analyses show that (a) among the rated predictors, only coherence, mystery, and nature had power to predict preference independently from all other variables, and (b) the categories added nothing to the predictive power possessed by these three variables. Thus, it is not surprising that the rank order of the categories for mean preference (Table 3) can be predicted by

examining the means for just three of the predictor variables: coherence, mystery, and nature (Table 1). Tended Nature, the most-preferred category, has high ratings on all three predictors. Concealed Foreground, next most preferred, has high ratings on two of these predictors, mystery and nature. The third most-preferred category, Contemporary Buildings, has a high rating only on coherence and low ratings on mystery and nature. Older Buildings, least liked, is high in none of these predictors but is relatively low in mystery and very low in coherence. Clearly, these three predictors do a very good job in accounting for preference differences across categories.

Two consequences of these results follow immediately. First, note that age is conspicuously absent from the set of effective preference predictors. It is somewhat paradoxical that the Older Buildings are clearly low in preference (Table 3), their age is clearly noticed (Table 1), and yet age does not predict preference (Table 5). In this study, the reason seems to be that age is strongly correlated (negatively) with coherence (Table 4), and coherence is the dominant predictor. This makes some sense. A problem with many older buildings is that they are unkempt and their grounds are both unkempt and disorderly. As far as preference is concerned, the culprit is not age but upkeep and orderliness. This proposal offers interesting possibilities for further research on preferences for older buildings. Meanwhile, it seems likely that age alone need not be a drawback to preference.

The second consequence of the regression results is theoretical. Note that of the three effective predictors, one is, in the language of the informational model, a primary landscape variable (nature), one is an understanding variable (coherence), and one is an exploration variable (mystery). Thus, several components of the model received empirical support, and the general usefulness of the model is nicely illustrated.

It should be noted that although the categories added nothing to the predictive power already possessed by the three effective predictors, the reverse was not true. Coherence, mystery, and nature predicted preference independently of category differences. In other words, these three predictors were consistently and positively related to preference within categories as well as across categories. The analysis of simple correlations within categories led to the same conclusion. The power of these three predictors within categories lends further support to their importance in accounting for preference.

The fact that the categories did not predict preference apart from the rated predictors in no way diminishes the importance of the categories. The present finding is exceptional. In most past research on preference where this issue has been assessed, categories did predict preference independently of rated predictors (Herzog, 1985, 1987; Herzog and Smith, 1988). More importantly, even when categories do not predict preference, they provide valuable insights into how the environmental settings are perceived and grouped by observers.

What about the six predictor variables that were ineffective in accounting for preference? One, typicality, stands alone. Not only was it uncorrelated with preference in any of the analyses, but it had only moderate correlations with a few of the other predictors (Table 4). Apparently typicality worked for Purcell (1986) because all his settings came from one category explicitly identified by the researcher. When settings come from several unspecified categories, subjects may be overwhelmed by the task of judging how good a category exemplar a specific setting is. It would probably be advisable to revert to the 'sense of familiarity' approach which, as noted in the introduction, has worked well in the past. The other five ineffective predictors appear to

be part of a six-variable cluster dominated by coherence [3]. The network of strong correlations among these variables can easily be traced from Table 4. Coherence dominates the cluster in that none of the other variables was able to predict preference independently from coherence. For the informational approach, there is some good news here, but mostly bad news. The good news is that spaciousness was strongly related to legibility, as anticipated. The bad news is that in predicting preference, legibility could not be distinguished from coherence, and neither could complexity. The latter is supposed to be an exploration variable, not part of an understanding cluster. The generality of these findings about relationships among rated predictors is open to question. Still, as noted in the introduction, coherence and mystery have been the most successful predictors of preference in past research. Thus, the informational approach might benefit from improved definitions of its other two predictors, complexity and legibility. Finally, note that the independent status of refuge as an affordance was not confirmed in this study.

Two potential problems with the regression analyses should be mentioned. The first is the strong correlations among some of the rated predictors. In regression analysis, this is known as multicollinearity. When it exists, the replicability of regression coefficients for the predictors involved is called into question. This may be a problem for the cluster of predictors dominated by coherence. On the other hand, the primacy of coherence in this study is compatible with past research, as noted above. A related problem is the ratio of predictor variables to cases. In the last step of the stepwise regression, there were 12 predictors and only 37 cases (or scenes), clearly a less than ideal ratio. Although this problem also suggests caution in reaching conclusions, it is noteworthy that the set of effective predictors remained stable across all regression analyses.

In conclusion, this study has shown that preferences for urban settings with prominent natural components can be studied profitably from the informational perspective. The results have both practical and theoretical implications. Practically, the importance of age as an organizing principle for perception in urban settings has once again been emphasized. In addition, the results provide several suggestions about how to offset negative features of older urban settings. In particular, planners may wish to concentrate their efforts on manipulating three variables: coherence, mystery, and nature. Theoretically, the results point to the importance of primary landscape qualities and the cognitive processes of understanding and exploration in accounting for urban preferences. Many intriguing and researchable questions remain unanswered. Two examples: Does age ever have an effect on urban preference apart from its typically negative relationship with coherence? How can one distinguish empirically between properties of the immediate setting, like coherence, and those of the larger environment that contains the immediate setting, like legibility? Answers to questions like these will deepen our understanding of urban preferences and will contribute to the further development of a comprehensive cognitive theory to explain them.

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*Notes*

[1] Appleton's third theoretical concept, hazard or danger, is clearly relevant to environmental preference, as demonstrated empirically by Herzog and Smith (1988), but it is not clearly an affordance. It seems to depend more on one's knowledge of what can happen in certain environments rather than on one's interpretation of specific configurations.

[2] For Older Buildings, there were six significant correlations among predictor variables. Spaciousness was positively correlated with legibility (0·80), complexity (0·62), and typicality (0·61). Legibility was also positively correlated with complexity (0·61) and typicality (0·59). Nature was positively correlated with refuge (0·89). For Concealed Foreground, there were four significant correlations among predictor variables. Legibility was positively correlated with coherence (0·82) and spaciousness (0·75), nature with mystery (0·82), and typicality with complexity (0·72). For each of the remaining two categories, there were two significant correlations among predictor variables. For Tended Nature, typicality was positively correlated with coherence (0·75) and spaciousness (0·76). For Contemporary Buildings, mystery was positively correlated with coherence (0·85) and nature (0·97).

[3] The discussion here implies that the nine predictor variables form three groups, one consisting of mystery and nature, a second of typicality, and the third of the remaining six predictors. This three-group interpretation has been supported empirically by the results of both nonmetric factor analysis and hierarchical clustering analysis of the intercorrelations among the nine predictor variables.