This article presents research confirming the generalizability of previous research on urban form and memory for buildings. Additional structural characteristics, including landscape and unique architectural style, enhance memory for buildings above and beyond the original features developed by Appleayd. It is also shown that elderly residents use some of the same physical features as younger adults to remember buildings but rely more heavily on historical cues and ease of pedestrian access as salient building characteristics. Finally, memory for the location of structures as a function of physical and sociocultural features is examined for the first time in the literature. Different structural features influence location memory than influence verbal memory for buildings.

Over two decades ago, Kevin Lynch proposed a theory of urban perception that continues to influence urban planning and design (Lynch, 1940). People cognitively organize and conceptualize cities and, in part, in terms of paths, landmarks, nodes, edges, and districts. The most concrete manifestation of Lynch's work is the M.L.T.-Harvard Joint Center for Urban Studies development of Ciudad Guayaquil in Venezuela. The planning of this new city has largely adhered to the principles of urban legibility proposed by Lynch. A critical extension of Lynch's urban perception perspective is Donald Appleayd's research in Ciudad Guayaquil on the physical and sociocultural aspects of features that influence memory for buildings and landmarks (Appleayd, 1969, 1976).

This article has two goals: (1) to examine the stability and generalizability of Appleayd's model of landmark form and urban cognition, and (2) to extend his work in three important directions. First, it is shown that additional structural characteristics can increase adult residents' recall of buildings above and beyond the original features identified by Appleayd. Second, how structural characteristics affect memory in elderly urban residents is discussed. Finally, how building form affects memory for the locations of buildings is explored. Appleayd's work focused on memory for the names or descriptions of buildings. He did not examine how building characteristics affect location memory.

Stability and generalizability of research on building form

One of the pillars of empirical research is replication, and a related concept is external validity. Will the data obtained with a particular sample of people or in a particular place generalize to other persons or other places? Several planners, geographers, and psychologists have replicated and externally validated Lynch's theory of urban form (Bauerje 1971; Evans 1980; Moore 1979). Unfortunately, no research has been published on replications or extensions of Appleayd's research on building form and urban perception.

Concern with replication and generalizability is not a matter of scientific detail but touches on central assumptions of the empirical method. The probability based, mathematical models that underlie correlation and regression techniques are seriously jeopardized when a large number of variables are interrelated. One cannot assume that all of the statistically significant correlations that Appleayd found between building characteristics and the recall of the buildings by adults are meaningful. This point is acknowledged by Appleayd as well (1976, Chapter 5, Note 10). Type I errors, the probability that a significant coefficient is different from zero, cannot be assumed to be .05 when a large number of coefficients are calculated in a data set. Parallel arguments hold for regression equations with large numbers of predictor variables. Thus it is not only prudent but in fact critical to evaluate the stability of multivariate findings.

The generalizability issue is also of importance to planners. Are the principles of user satisfaction or urban legibility found in Venezuela also operative in American urban centers? The planning with which researchers sample different user groups is typically not matched by careful attention to the sampling of settings. As professionals concerned with the design and form of physical places, planners need to exercise care in the application of theories and data emanating from only one geographic focus.

Appleayd derived his model of building form by comparing expert taken's judgments of various physical and cultural aspects of buildings in Ciudad Guayaquil to residents' recalls of buildings on sketch maps or in verbal interviews. Ciudad Guayaquil in 1964 was a new city, undergoing substantial development from U.S. corporate investment. Predominant images of the city included:

- the extensive complex of the Altamira Steel Mill...new housing areas and recently built schools and facilities...the old warehouse and the Molin and gasoline station at the main intersection were among the best recalled buildings in the city, the main road turned into the ranch settlement of Castillo usually crowded with people and traffic...and carried on through the market area... (Appleayd 1976, pp. 18-21.)

Building characteristics that were rated by Appleayd were evaluated along building form, building visibility, and building use and symbolic significance. Form attributes included movement around the building, clarity of contour, size, shape complexity, surface color and texture, maintenance quality, and signage. Visibility included three characteristics—the number of people likely to daily pass the most prominent viewpoint of the building, the proximity of the building to a major orientation decision point (e.g., street intersection), and the proximity and centrality of the building to the circulation system. Use measured both how often a building was typically used and the uniqueness of its function. Symbolic significance reflected cultural and historical importance.

This study was conducted in Orange, California, which is a city of 85,000 incorporated in 1888. The focus of the present study was downtown Orange, an area of approximately two square miles. The city is laid out on a city block, square grid plan interrupted by a traffic circle containing bubbling water in the middle of the central business district. This area consists primarily of stores, commercial offices, and municipal buildings.

Orange has a historical preservation policy and relatively strict zoning controls aimed at maintaining a coherent, well bounded street system. Orange differs from Ciudad Guayaquil in several respects. Obviously there are cultural differences between the two sample areas. Physical features differ as well. Ciudad Guayaquil was in transition from a small, undeveloped cluster of villages to a developed, metropolitan area. Orange has a relatively stable downtown area with some new commercial development but considerable development in suburban areas. Orange is also already developed with paved streets, sidewalks, and extensive municipal services. In 1964 these amenities were just beginning to take hold in Ciudad Guayaquil.

Utilizing the dimensions of Appleayd's building rating code (i.e., attributes of form, visibility, and significance), three independent judges were asked to recall as many buildings as they could. Participants were asked to name buildings (e.g., Woolworth's), or to describe them (blue building on corner of Chapman and Main) if they did not know the name. Only buildings that two independent judges could identify and that were located in the proscribed area were counted as recalled. A total of 107 different buildings were recalled.

In the present study only verbal recall was used to measure residents' memory of urban structures. Appleayd found that data from sketch maps and verbal descriptions of trips were, in general, highly correlated with verbal recall of building names (Appleayd 1976). This study used visual recall for two reasons. First, sketch maps are difficult to construct and understand people's knowledge of their surroundings. More land marks will be listed in a free recall task than drawn on a sketch map (Evans 1980). Second, one of the objectives was to compare location memory with verbal memory. Verbal recall as opposed to trip recall or map drawings provides a more clearcut measure of verbal memory with less of a spatial component.

Seventy-two young adults (aged 18-45 years) who had lived in Orange for at least one year participated in this first study. All participants were paid for their participation and were members of the various groups of men from Orange (PTA, church groups, etc.). Participation was motivated to perform the memory task was also provided by the fact that the women who participated in the survey, and participants were informed that their cooperation and effort would be helpful to both future local and national urban planning projects. The data indicates that the model is significantly correlated with building recall for both Appleayd's study and this research. Multiple correlations for form, visi-
Table 1. Building characteristics significantly related to recall

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Recall Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movement</td>
<td></td>
</tr>
<tr>
<td>the amount of persons and other objects moving in and around the building</td>
<td></td>
</tr>
<tr>
<td>Contour</td>
<td></td>
</tr>
<tr>
<td>the clarity of building contour ranging from blurred, partially obscured to free standing</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td></td>
</tr>
<tr>
<td>vertical height of the building</td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td></td>
</tr>
<tr>
<td>complexity of shape ranging from simple, block shape to more complexity with multiple shapes</td>
<td></td>
</tr>
<tr>
<td>Use intensity</td>
<td></td>
</tr>
<tr>
<td>extent of building use ranging from limited use by a small segment of the population to daily use by large numbers of people</td>
<td></td>
</tr>
<tr>
<td>Use singularity</td>
<td></td>
</tr>
<tr>
<td>uniqueness of building function ranging from only one of its functions to many buildings with shared function</td>
<td></td>
</tr>
<tr>
<td>Significance</td>
<td></td>
</tr>
<tr>
<td>the extent of cultural, political, aesthetic, or historical importance of the building</td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td></td>
</tr>
<tr>
<td>the amount of physical maintenance as reflected by the upkeep of the structure</td>
<td></td>
</tr>
</tbody>
</table>

1. Significant building characteristics from Appleyard.
2. Significant building characteristics in Orange, California.
3. Significant building characteristics in Orange study only.

Activity, use and symbolic significance with verbal recall are shown in Table 2 for both studies. Appleyard grouped the building characteristics into these three dimensions. The form dimension consists of physical characteristics of the buildings including size, shape, quality of maintenance, and the separation of the building from adjacent structures. Visibility attributes describe how visible the building is from pedestrian and vehicular paths. Use and symbolic significance refer to how frequently the structure is used, the uniqueness of its function, and whether the building has cultural, political, or historical significance. Table 2 also contains multiple regression equations, illustrating the best set of predictor variables for the two respective studies. Building recall is the criterion variable.

An important feature of both Tables 1 and 2 is the general stability of Appleyard's findings. Six of the seven building features significantly correlated with building recall in the Venezuela study, are also significantly correlated in Orange, California. Thus there is strong evidence that certain characteristics of building structure and location enhance urban knowledge. Buildings that are relatively large, easily visible, distinctive in shape, and free standing are better remembered by urban residents.

Furthermore, buildings that are frequently used and have much kinetic activity surrounding them (e.g., pedestrian moving in and out, cars transferring passengers) are also better recalled. These findings are noteworthy because they replicate Appleyard's results in a different cultural and environmental milieu.

The uniqueness of a building's function (use singularity), which was significantly correlated with recall in the Appleyard study ($r = .27$), did not correlate with recall in this research ($r = .01$). Furthermore, building symbolic significance, which was not related to recall in Appleyard's data ($r = .08$), significantly correlated with recall in this study ($r = .43$), as was quality of building materials ($r = .21$ for this study, $r = .17$ for Appleyard).

There are several explanations for differences in results. Cultural variation between the subject populations, or differences in environmental features of the two settings might explain different results. Alternatively, some differences could reflect statistical characteristics. Correlations that are not replicated may be due to chance factors and may not indicate meaningful association.

Two factors significantly related to building recall in the Orange study, quality of building maintenance and symbolic significance, were not statistically significant in Appleyard's study (see Table 1). Since maintenance quality was marginally correlated with recall in the Ciudad Guayana study ($r = .17, p < .06$), this difference between the two studies is inconsequential. Well-maintained buildings are associated with better recall.

Symbolic significance probably played a minor role in the Venezuela study because Ciudad Guayana is a new city undergoing rapid growth and development. Orange, California, on the other hand, has a long history and an active historic preservation policy in its downtown area. This difference between the two settings could explain the greater prominence of symbolic significance in the Orange study. Appleyard (1976) also noted that the highly symbolic buildings (e.g., a hydroelectric plant) were frequently not used, whereas in Orange several of the historic buildings are highly familiar, well frequented places.

It is uncertain why use singularity did not appear as an important building feature in the Orange study (see Table 1). One reasonable hypothesis is that many buildings in Ciudad Guayana have one, sharply defined function. In Venezuela one goes to one store for food, to another for liquor, another for pharmaceuticals, and still another for household items. In Orange these items can be found under one roof. Further, few structures in Orange serve a unique function. There are several gro-
...buildings that are frequently used and have much kinetic activity surrounding them (e.g., pedestrians moving in and out, cars transferring passengers) are also better recalled...”

<table>
<thead>
<tr>
<th>Form</th>
<th>Visibility</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciudad, Guayana</td>
<td>0.49</td>
<td>0.15</td>
</tr>
<tr>
<td>Orange, California</td>
<td>0.53</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Multiple correlations with verbal recall

**Ciudad, Guayana best prediction equation**

\[ A = 2.5 \text{(Contour)} + 3.1 \text{(Movement)} + 1.2 \text{(Viewpoint Intensity)} + 2.9 \text{(Immediacy)} + 1.75 \text{(Viewpoint significance)} - 2.87 \text{(Use intensity)} + 3.5 \text{(Use singularity)} \]

Multiple R = 0.67

**Orange, California best prediction equation**

\[ A = 6.2 \text{(Size)} - 9.01 \text{(Use Intensity)} + 4.7 \text{(Movement)} + 7.4 \text{(Viewpoint Intensity)} + 3.4 \text{(Immediacy)} + 4.1 \text{(Contour)} + 3.26 \text{(Signs)} \]

Multiple R = 0.69

**Viewpoint significance** presence at important decision points in the city’s circulation pattern

**Viewpoint intensity** visibility of the building from tertiary, secondary, or primary road

**Immediacy** range from: distant objects, poorly seen on main roads or near objects off-axis on secondary roads; to near objects cutting across line of vision on major roads

**Signs** no signs, small signs, large signs, visible at a distance

care stores and department stores and more than one bank, for example, whereas in Ciudad, Guayana there are several buildings with unique functions.

The regression equations which reflect the best combination of independent predictors of building recall indicate moderate overlap between the two studies. Movement, use, viewpoint, immediacy, and contour are stable, independent building characteristics that contribute to residents' knowledge of buildings in urban areas. Size and signage that emerge in the prediction equations for Orange, California replace aspects of building viewpoint and use as significant predictors in the Ciudad, Guayana sample.

To summarize, differences in the respective prediction equations for the two studies may be caused by cross cultural or environmental differences, or by statistical characteristics. In addition to use singularity (which was discussed above), viewpoint significance was not a significant predictor of building recall in Orange as it was in Ciudad Guayana. There is probably a statistical reason for this nonreplication. Stepwise regression generates the best predictive model, given the variance explained in the criterion (recall) by the predictors (building attributes) already in the equation. In other words, in Table 2 the significant variance explained for recall of Ciudad Guayana buildings by movement has the effect of building contour partialed out. Movement is significantly associated with building recall controlling for the effects of contour on recall. Viewpoint significance did not show up in the Orange study as a significant predictor probably because it was highly correlated (r > 0.80) with two other variables already in the prediction equation, immediacy and viewpoint intensity. In Appleyard's study the correlations of viewpoint significance with immediacy and viewpoint intensity were considerably more modest.

Signage was relatively unimportant as a predictor of recall in Ciudad Guayana probably because a large proportion of the citizens sampled by Appleyard were illiterate. More than 30 percent of his sample had only primary school education or less, whereas more than 90 percent of the Orange sample had finished high school. While size was not a significant predictor in Appleyard's best regression equation as it is in this study's, both studies found a high correlation between building size and recall (see Table 1). Size was highly intercorrelated with several of the other significant predictor variables in Appleyard's data. As discussed above, this may have reduced its independent contribution to recall as measured by the stepwise regression technique. In the Orange study, building size was not as highly correlated with the other significant predictor variables.

This discussion has focused primarily on cross cultural, environmental, and statistical explanations of the few differences found between the two respective studies. It is important to re-emphasize here the notable stability found for most of Appleyard's building attributes in predicting recall. Clearly, most of Appleyard's conclusions about why buildings are known in Ciudad Guayana, Venezuela hold true for the Orange, California site.

This fact is important to urban planners and designers because some general principles are operative in linking building characteristics with urban knowledge. Urban designers can more confidently apply principles of urban legibility across different settings. Appleyard's findings are not site specific.

Overall the recall and building form data indicate
good stability and generalizability in Appleby's original sample. Buildings with large, sharp, and unique functions are more stable. Buildings with high aesthetic appeal are more noticeable and significant when evaluated. These characteristics were positively correlated with building recall in the Landscaping study, so they should be considered when studying the stability of the environment. On the other hand, other characteristics that were negatively correlated with recall were less significant. Complexity, for example, was negatively correlated with building recall.

Additional building characteristics that affect urban knowledge

In addition to examining the stability of Appleby's findings in Venezuela, this study extended his research in several directions. First, the authors examined what other characteristics of building structure might enhance adult's memory for buildings. Nine additional building features were included in the building ratings scheme in the Venezuelan study. These features were also rated by the three independent judges. Interrater reliability exceeded 90.

Five of these additional building characteristics were derived from research on environmental assessment by Stephen Kaplan (1973, 1975). Kaplan theorizes that physical features that enhance comprehension and make a place more interesting increase preference. For Kaplan, interesting means a balance between certainty and coherence. Enough structure and information must be provided to allow one to make sense of a setting, but too much regularity makes places boring.

The five physical variables from Kaplan's work that were examined were complexity, naturalness, mystery, coherence, and spaciousness. Complexity was rated as the amount of variety within a set of characteristics, color, and texture of the building exterior. Naturalness measured the extent of landscaping and greenery immediately surrounding the structure. Mystery was rated according to how much information one could ascertain about the building's function and appearance if one were to move from the front door to the side of the building and vice versa. A building to which the external facade of the structure had a pattern or organized image. Finally, spaciousness measured the relative scale of building area to lot area. Low spaciousness, for example, was recorded if buildings were closely spaced or nearly all of its lot.

These five physical features adapted from Kaplan's work on environmental assessment, as well as the existing variables, were significantly correlated with recall. Buildings that were more complex and had more surrounding naturalness were recalled more often. Complexity turned out to be significantly correlated with Appleby's ratings of shape, which explains why complexity was related to recall. Since both this study and Appleby's found that variety of building shape was correlated with memory for buildings, it is concluded that naturalness may be related to recall for two reasons. Landscaping surrounding a building increases attractiveness and may make buildings more noticeable. Furthermore, in some cases landscaping can provide distinctiveness, visually separating one structure from an otherwise homogenous set of facades.

These findings linking aesthetic variables to urban legibility are important because they provide further evidence for the basic proposition that aesthetic preference and cognitive clarity are linked together. Features of settings that make them more legible can also make them more aesthetically satisfying.

Several features from Kaplan's work on aesthetics did not relate to memory. Mystery did not vary much in this sample of buildings. Since reduced variance within a variable is a sign of reduced correlation, this research probably does not provide a fair test of this feature. Kaplan's work with mystery has occurred primarily in small towns and natural settings where greater variety in the landscape is found. There was sufficient variance in ratings of coherence and of spaciousness, so the preliminary conclusion is that these variables are not related to recall of buildings, even though these variables are related to aesthetic preference (Kaplan 1973, 1975).

Four additional environmental features, derived from the authors' own work and focusing on path/building relationships, were also examined. Transition (ρ = .20) and street context (ρ = .48) were significantly associated with building recall. Transition reflected the directness of access to the building from the street. Context measured the uniformity of building architectural style with other proximate buildings on the same street. Thus, a modern building among older modern buildings was rated low on street context; a modern building among Victorian houses was rated high on context. Buildings with more street access and with higher contrast in architectural style are recalled more often by urban residents.

Additional building features from the authors' work that were not related to recall included the proximity of buildings to freeway access and the amount of build-
Table 3. Building characteristics significantly related to recall in the elderly sample

<table>
<thead>
<tr>
<th>Movement*</th>
<th>Contour*</th>
<th>Shape*</th>
<th>Use intensity*</th>
<th>Use singularity</th>
<th>Significance*</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Significant building characteristics were Appendley.
2. Belfield in the City (Walsh, Krons, and Nagel).
3. Significant building characteristics in Orange study only using elderly data set.

The significant results suggest that frontage per se is not critical; instead, visibility is the key factor.

These nine additional building features (five derived from Kaplan's work, four from the authors' work) were also forced into a regression equation after all of Appendley's building variables were entered. This technique allows examination of whether any of these nine new physical variables are associated with recall after the variance explained by Appendley's building features is partialled out. Both naturalness (B = 6.30) and street context (B = 4.10) appear to be added significantly to the variance accounted for by the elderly particpants in Orange for at least one year. Overall, the pattern of the elderly in comparison to the young adult sample reveals two trends. First, many of the individual building characteristics found in Appendley to correlate with recall also hold for the elderly sample. Examination of Table 3 reveals this pattern. Furthermore, by comparing Table 1 and 3, the impressive visibility of Appendley's findings can be seen. It's found that buildings that are large, more complex in shape, and physically separated from adjacent structures are more readily recalled by urban residents. Similarly, buildings that are more frequently utilized and with kinetic activity surrounding them are better remembered. There is also good agreement on the additional variables examined from Kaplan's environmental assessments, demonstrating a high degree of replicability. Essentially, the same set of four environmental characteristics from Kaplan's and the authors' work that correlated with building recall among young residents also are effective for the elderly. This finding demonstrates the significance of these additional environmental characteristics in predicting building recall.

Where there is evidence for considerable overlap among the elderly sample and the young adult samples, there are also important differences that are shown in Table 4. As revealed in the upper portion of the spatial lag and regression analysis, the elderly have a much larger role for the elderly in building recall relative to the roles of form and visibility. This means that the elderly in comparison to young adults rely more on history and cultural significance of buildings. Note that the roles of form and visibility attributes remain relatively constant for the elderly and young adults. However, Appendley's young adults, young adults in Orange, and elderly adults in Orange.

For example, striking differences between young and elderly urban residents are shown in the best prediction regression equation found in the lower portion of Table 4. This equation is quite different from the two young adult models discussed in Table 2 for the Vancouver and Orange studies, respectively. The more prominent role of building significance for the elderly again emerges as in the multiple correlation findings. In addition, many of the common variables are not for the two young adult samples drop out of the elderly data set. These include movement, viewpoint, and immediacy. While relative building size and intensity of use are also important independent predictors of recall for the elderly, historical significance of buildings emerges for the first time as an independent predictor of building recall.

Furthermore, when examining which additional variables add to the prediction equation of recall for the elderly, one finds that building characterizations have been forced in this predictor, an important difference occurs in comparison to the results found with the Orange, young adult sample. As discussed above in the Orange young adult study, street context and naturalness added significant model chi-square improvements. By the elderly sample, increasing R by nearly 10 percent. For the elderly these two variables are important (naturalness, B = 2.1; street context, B = 1.7), but transition (B = 2.80) also emerges. The addition of these three variables to the Appendley equation increased R from 65 to 70 in the elderly recall sample. This increment in R is statistically significant.

Two building characteristics seem distinctly important for elderly residents' urban knowledge-building access to the street and the historical/cultural significance of the buildings. Even though the seniors in this study were healthy and relatively active, mobility seems to still play an important part for environmental cognition in the elderly. The important role of building access is shown by its significant predictive power for the elderly sample above and beyond the prediction offered by Appendley's full set of original building characteristics. Access to roadway, and mobility as a factor contributing to restricted cognitive maps among elderly citizens (Lawton 1970; Walsh, Kraus, and Regnier 1981). The results of this study are consistent with this hypothesis. Further research needs to clarify the role of individual activity patterns and geographic knowledge. This additional role of building significance for the elderly in building recall may be because of the buildings' ranked high on significance in Orange were historical preservations. The elderly population may have greater involvement and personal history with historical features of cities in comparison to younger populations. Historical buildings may have an important legibility function, in addition to its already recognized educational and cultural benefits. Historical landmarks may help between elderly and young residents. They contribute to legibility because they are familiar, and because they provide spatial continuity amidst environmental change.

The significant overlap and divergence among the building characteristics that elderly and young adult residents rely on for urban cognition. Buildings with high use, that are large, and have sharp, singular shapes are relatively easily by elderly citizens as was the case for young adults. Naturalness around buildings and uniqueness of building style also improve building recall among the elderly and young adult samples. Two additional aspects of buildings enhance recall for the elderly yet are relatively unimportant for young adults. Buildings with more direct street access and buildings that have important symbols, especially historical, significance are remembered more easily by elderly urban residents.

Building location memory

The final extension of Appendley's research on memory for buildings was to examine elderly residents' memory for building location and understand these differences concerned with the physical environment, planners care not only about individual knowledge of煞 buildings are in a city, but also about a person's knowledge of where the buildings are located. Basic research in cognitive psychology indicates that spatial and verbal memory are distinct processes. Variables that improve spatial memory for objects do not improve comprehension of the object's form (Pozdnek and Evans 1979). Environmental cognition research has not examined the interplay between location memory and verbal (semantic) memory. Most environmental cognition research has relied on either verbal reports of knowledge or hand drawn sketch maps. One cannot assess the accuracy of spatial knowledge of buildings using techniques. Because of problems related to scale and drawing ability which contaminate measurement of individual item location, accuracy of sketch maps can only be used as a qualitative or relative measure of precision. For more details on problems with sketch maps methodologies see Evans (1980).

After the building recall task was completed, researchers gave each a 13 by 13 matrix with a well-known landmark provided in the center block. Each block was 2 centimeters square. The landmark was a small square box park located in downtown Orange. Above the matrix were the names of thirteen highly familiar, downtown buildings. From pilot research the authors knew that over 90 percent of the
Table 5. Building characteristics significantly correlated with location memory

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Simple r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>.59</td>
</tr>
<tr>
<td>Material</td>
<td>.51</td>
</tr>
<tr>
<td>Spaciousness</td>
<td>.48</td>
</tr>
<tr>
<td>Transition</td>
<td>.45</td>
</tr>
<tr>
<td>Viewpoint intensity</td>
<td>.43</td>
</tr>
<tr>
<td>Movement intensity</td>
<td>.43</td>
</tr>
</tbody>
</table>

A sample could identify those thirteen buildings. Participants placed each building in one of the blocks so that the relative position of each building in space corresponded to the location of the building in real space. Geographical positions were selected in a way that people who lived in the area could be seated on the task and were encouraged to take as much time as they desired, rearranging the buildings until they were satisfied with the overall configuration.

Conclusions
Several conclusions can be drawn from this set of studies. First, the original characteristics of buildings proposed by Donald Appleyard to predict recall are stable and generalize well. Buildings features linked with recall are movement around buildings, sharp singular contours, large relative size, complex shape, and height. Second, additional building characteristics that may enhance recall include the presence of natural features around a building, ease of pedestrian access, overall building complexity, and uniqueness of architectural style.

Third, elderly urbanites rely on some of the same building features that young adults do for recalling the names of buildings. However, elderly depend more on pedestrian access to buildings and the symbolic (historical) significance of structures.

Finally, memory for the location of buildings depends on different factors than does memory for the names or descriptions of buildings. The most critical components for location memory are brightness of color, spatial prominence of the building, and use of high-quality materials.

Practical applications
At a general level the most important implication of these findings for planners and urban designers is the fact that the appearance and location of urban buildings have strong, documented implications for the adult's urban legibility. If user comprehension is included as one criterion of good urban design, then planners can utilize environmental cognition data to generate planning recommendations. Buildings can be designed and sited to enhance their identity and utility in urban cognition. Principles of urban legibility are not site specific; they generalize across settings and can be used with confidence.

Environmental cognition research provides planners and other policy makers with scientific data that can be used as evidence to substantiate land use and site planning regulations. Policy makers are increasingly being challenged to provide evidence for planning regulations related to land use, open space requirements, traffic planning, development restrictions, and the like. Setting can be made more legible by the careful placement of landmarks at major decision points in the road system. Careful consideration should be given to such requirements. Landmarks should be sited near intersections to maximize visibility. Structures that are easily visible and physically distinctive from their surroundings function as memorable landmarks. Distinctiveness can be enhanced by unique architectural style, height, and physical separation from adjacent structures. Note that these characteristics of distinctiveness are in relation to the field of surrounding structures. Thus the orienting function of a good landmark can be destroyed by alteration in its own form or the form of surrounding structures. Street local controls on color and architectural style which are currently in vogue in planned communities may contribute to poor legibility because they breed homogeneity.

Building function also contributes to legibility. Buildings of high use or those located at centers of pedestrian or vehicle activity are highly memorable. Planners can take advantage of this by combining form, siting, and function. Thus the location of certain buildings to create highly distinctive, visible, and well used buildings where a landmark is needed.

Furthermore as new circulation systems are built or expanded, they should be integrated with existing, highly legible landmarks. Intersections can be located proximate to important landmarks; major acres can begin and terminate at major landmarks, and primary roads can encircle the city. The traditional role of road district to reinforce edges (Appleyard 1976; Lynch 1960). Research in environmental cognition indicates that landmarks will be less needed where existing structures are largely homogeneous in form, where it is difficult to see distant landmarks, where the directional orientation of major roads cannot be seen, and where streets are not in a city block matrix (Evans 1980; Moore 1979).

Several strategies may be available to incorporate findings from the environmental cognition literature into the urban planning process. Building form and siting could be more tightly constrained in certain city areas where legibility is deemed important. Appleyard (1976), for example, suggests the creation of visibility zones where right form and visibility restrictions would be applied. Regulations could also be instituted to insure that structures which currently function well as landmarks are not altered. In addition, existing areas of confusion such as homogeneous areas could be made more distinctive by structural changes or with selective landscaping.

While the findings of this research demonstrate considerable stability in location memory for a memorable urban structure, two caveats are in order. First, even this study's best regression equation explains only about half the variance in urban resident's knowledge of landmarks. As Appleyard (1979) has recently noted, human cognition depends not only upon the physical components of the stimulus array, but also on important symbolic, contextual, and contextual factors from the urban field. The importance of historical features to elderly residents underscores this concern. Second, while the data from California generally replicated Appleyard's, this data also highlight the crucial importance of individual differences among subgroups within the urban center. In this case some interesting and important differences in elderly citizens' images of their city have been noted.

Pedestrian access to buildings is particularly important to elderly citizens' knowledge of buildings. This holds true even for those in good physical health with adequate mobility. Many people still walk in downtown areas. The fact that pedestrian access enhances urban knowledge provides another reason for respecting the pedestrian's share of the urban space.

Historical landmarks serve as important cognitive markers that enable elderly citizens, in particular, to maintain orientation in urban settings. The orienting function of landmarks, as shown in the environmental cognition literature (Evans 1980; Moore 1979), is particularly important for individuals with impoverished cognitive maps. Well-placed landmarks, for example, are critical for orientation of elderly as well as adult newcomers to an area. Landmarks, and in particular long-standing landmarks. provide an especially needed cognitive orientation for the elderly amidst the ever changing and expanding cityscape.
Further research should explore other physical and symbolic aspects of city form that may enhance urban legibility. In addition planners need to consider more carefully other urban subgroups who may have unique planning and design needs. Persons with restricted mobility, the developmentally disabled, and others with specialized needs warrant consideration in the urban planning process.

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**References**


