COMMUNICATION OF RESIDENTIAL SPACES BY ARCHITECTURAL GRAPHICS[1/]

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Abstract

Four sets of four bipolar adjectives were employed to index the aesthetic appeal, physical organization, phenomenological size, and physical size of three different living rooms as represented in floor plans, isometric drawings, and photographs of the rooms. Averaged across living rooms and sets of bipolar adjectives, responses to floor plans and photographs did not differ, although responses to isometrics were less positive. All graphic forms showed one living room to be of greater aesthetic appeal, of better physical organization, and of greater phenomenological size than the other two. Surprisingly, responses to physical size were least consistent across graphic forms; depending on form of graphic representation, responses to areas varying over 147 square feet did not differ reliably.

Background

Montgomery (1970) suggests that a sense of spatial identity is one of man's basic needs. Research investigating psychological responsiveness to architectural spaces has been primarily focused on the use of space in institutional settings (e.g., Hall, 1966; Maslow and Mintz, 1956; Sommer, 1965, 1969; Wells, 1965). Residential interiors, where the most significant experiences are lived, have received relatively little attention. The need for research on means for measuring and communicating space concepts of residential interiors is reflected in Zevi's (1957, p. 45) statement that "The problem of how to represent space, far from being solved, has not as yet been stated." Garling (1969, p. 250) has similarly noted that ". . . knowledge of architectural perception is badly needed."

Architects, interior designers, contractors, and real estate personnel all employ graphic forms as tools to convey spatial concepts. The graphic forms most typically employed are floor plans, elevations, isometric drawings, perspectives, and photographs. Addressing these various graphic representations of residential spaces, Zevi (1957) considered the floor plan, the most frequently used graphic form, ". . . an abstraction entirely removed from the real experience of a building" (p. 46). However, each of the graphic forms ". . . has its own contribution; the contribution of

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one may be compensated for by the others" (p. 59). Photographs, for example, faithfully reproduce ". . . the great number of two- and three-dimensional elements in architecture, everything, that is, but internal space" (p. 57).

The need to understand the means by which spatial concepts are communicated is not peculiar to the architect and the interior designer. Indeed, the beginning of psychology as an empirical discipline was Helmholtz's demonstration of the error in Hering's claim that each point on the retina carried three "local signs" for breadth, height, and depth in space. That the psychologist shares the need to better understand the perception of spatial parameters is documented by the number of theories proposing accounts of space perception (e.g., Brunswik, 1947; Gibson, 1950, 1966; Hochberg, 1957; Kilpatrick, 1961).

The present study utilized techniques similar to those previously employed in studies of responsiveness to institutional structures. Accordingly, subjects were asked to respond to prepared graphics (floor plans, isometric drawings, and photographs) of living rooms.

Method

The three living rooms selected for study met the following criteria. They were

1. Furnished and occupied by a single family,
2. Separated as a distinct room from other living areas of the home, and
3. Different in size.

The three graphic forms selected are all used to represent space in residential architecture. Although the floor plan represents, to a potential user, the dimensional constraints within which the space is to be furnished and used, it is limited in representing only the two dimensions of a frontal parallel plane. Isometric drawings are perhaps the least frequently employed representations of residential spaces even though they present all three of the physical dimensions of the represented space. Photographs are commonly claimed to duplicate interior spaces. The photograph presents at least one of the views of the space that the eye would see in the actual space, including the shadings and gradients that furniture and other room decorations present to the eye. Its particular disadvantages concern the angle from which the photograph is taken and the potential, depending on camera lenses and lighting, for distorting the view.

In the study reported here, photographs of the experimental rooms

were taken from a height of 5' with a 4" X 5" camera at the doorway through which the room is customarily entered. The floor plans and isometric drawings, including scaled drawings of all furnishings, were scaled to ¼" = 1'0", and the viewpoint for the isometrics was that offered by the view from which the photographs were taken. Each graphic was prepared as a 2" X 2" slide for presentation in the laboratory. Table 1 presents the dimensions and experimental designations of the stimulus materials, and Figure 1 presents reduced versions of the graphic forms.

TABLE 1. Designations of the living rooms and graphic forms.

Living Room	Dimensions	Square Feet	Graphic Form
LR_1	13'6" X 16'0"	216.00	F Floor Plan
LR_2	13'6" X 21'0"	283.50	I Isometric
LR_3	15'8" X 23'2"[a]	363.86	P Photograph

[a] Bay area not included in interior room measurements

Four of the psychological dimensions of responsiveness to architectural spaces identified by Kasmar's (1970) Environment Description Scale (EDS) were selected for study. Four pairs of bipolar adjectives with consistently high factor loadings on these four dimensions in the EDS were selected to index responsiveness to each dimension. The four psychological dimensions and the adjective pairs chosen to index them are presented in Table 2. Instead of the 11-point rating scale by Kasmar (1970), the instrument of the present study employed the 1-99 scale of the "certainty method" developed by Wolins and MacKinney (1965). The 1 response was associated with the left adjective of each pair, and the 99 response was associated with the right adjective of each pair. A 50 response indicated neutrality between the adjectives. For statistical evaluation of the data, a 50 response equaled zero; responses between 51 and 99 were given positive values, and responses between 49 and 1 were given negative values.

Procedure and Design

Female students (N = 105) enrolled in an introductory course in housing were randomly assigned to nine groups of approximately equal size. Order of presentation of the three (living rooms) X three (graphic forms) = nine stimulus configurations was counterbalanced across these nine groups. Each group met with the experimenter twice, once for description of the experiment and once for

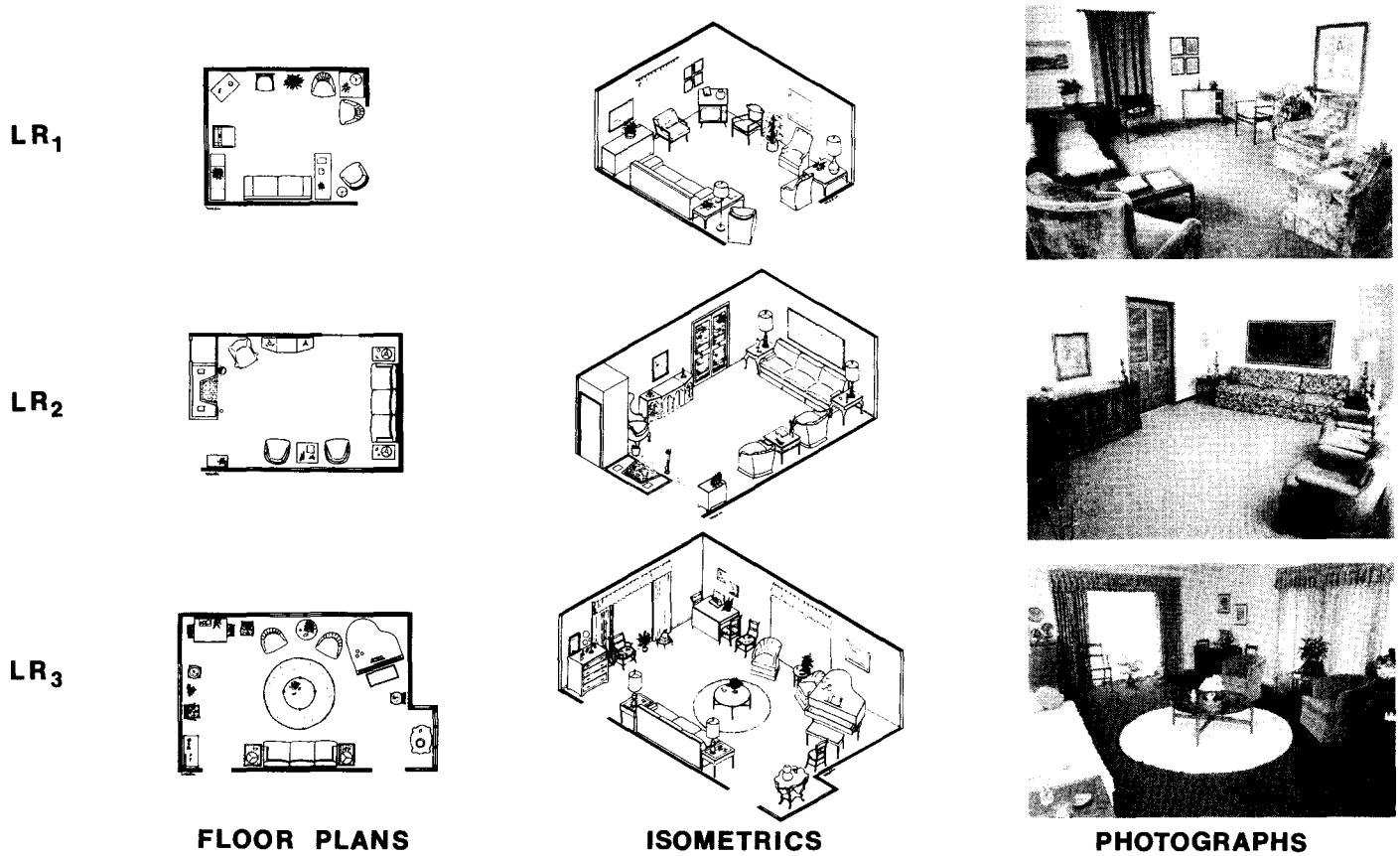

Figure 1. Graphic forms of living rooms.

rating the stimuli in terms of all pairs of adjectives for each psychological dimension.

Numerical responses were evaluated by four separate within-subjects three (rooms) X three (graphic forms) X four (adjective pairs) balanced analyses of variance, one for each psychological dimension. Scheffe's test was employed in tests among main effects and interactions.

TABLE 2. Bipolar adjectives employed to index responsiveness within the four psychological dimensions.

Dimension I. Aesthetic Appeal
Unappealing - Appealing
Repelling - Inviting
Unattractive - Attractive
Unstylish - Stylish
Dimension II. Physical Organization
Poorly Organized - Well Organized
Chaotic - Orderly
Inefficient - Efficient
Poorly Scaled - Well Scaled
Dimension III. Phenomenological Size
Crowded - Uncrowded
Cramped - Roomy
Restricted Space - Free Space
Uncomfortable - Comfortable
Dimension IV. Physical Size
Small - Large
Tiny - Huge
Narrow - Wide
Public - Private

Results and Discussion

The most informative findings appeared in the main effects of living rooms and graphic forms and the interaction between these two variables. In each of the four analyses of variance, these main effects, and their interaction, were highly significant ($P < 0.01$). Summaries of Scheffe's test, applied to the interaction between living rooms and graphic forms in each analysis, are presented in Table 3. Although the data summarized in Table 3 present a patterning among responses that may not be simplistically addressed, indications from the data are relatively clear.

TABLE 3. Scheffe test of AB interaction within the four psychological dimensions.

Factor AB	Aesthetic Appeal	Factor AB	Physical Organization	Factor AB	Phenomenological Size	Factor AB	Physical Size
LR_2P	24042.90	LR_2P	29591.94	LR_2F	32068.01	LR_2F	10916.98
LR_2I	17049.06	LR_2I	23816.10	LR_2P	30917.00	LR_3P	10119.06
LR_2F	10772.16	LR_2F	21989.94	LR_2I	16889.00	LR_2P	9539.00
LR_3P	5643.12	LR_3P	2070.98	LR_3P	13505.98	LR_3F	6370.98
LR_1F	2273.88	LR_1F	-934.00	LR_1F	2950.00	LR_2I	5309.01
LR_3F	-3234.84	LR_3F	-3341.02	LR_3F	-794.98	LR_3I	1675.00
LR_1P	-3326.82	LR_1P	-5677.98	LR_1P	-8980.99	LR_1F	998.97
LR_3I	-4942.14	LR_1I	-8733.06	LR_3I	-14278.99	LR_1P	-8255.98
LR_1I	-10691.10	LR_3I	-12498.99	LR_1I	-21590.02	LR_1I	-11026.01

Responses to the three rooms proved to be jointly determined by form of graphic representation and the psychological dimension addressed. As is evident in Table 3, when all nine combinations of graphic form and living room are considered, the resulting rankings were similar for the first three dimensions. For these dimensions, the medium-sized room consistently obtained the most favorable responses. For that room, the ranked graphic forms were alike on the first two dimensions, but the ranking changed for the third dimension; meanwhile, the various graphic representations of the other two rooms ranked similarly on all three dimensions. This indicates that responses to the other two rooms, along any of these dimensions, more strongly depended on form of graphic representation.

The last dimension, physical size, differs from the other three in having an objective referent, the actual dimensions of the depicted room. While the separations among judged physical sizes of the stimulus configurations were not unambiguously drawn by Scheffe's test, the responses strikingly demonstrated the extent to which judged physical size depends upon form of the displayed graphic. Although the smallest room ranked lowest in all forms of graphic presentation, the floor plan of the medium-sized room ranked highest in physical size, and the physical size represented in the floor plan of the 363.9-sq. ft. room was not judged to be significantly greater than any graphic representation of the 216.0-sq. ft. room. The observed influences of graphic form upon perceived physical size were consistent with the observation that the phenomenological size of the medium-sized room (283.5 sq. ft.) ranked higher, in each graphic form, than that of the largest room (363.9 sq. ft.) and, similarly, that isometric drawings of the smallest (216.0 sq. ft.) and the largest rooms did not differ reliably in phenomenological size.

Additional Considerations

Two additional considerations should be noted in conclusion. The first is that, in all four analyses of variance, the differences among subjects were significant. Thus, while individual differences in responsiveness to the various psychological dimensions were not great enough to override the influences of the major independent variables, the differences in individual responsiveness contributed to ambiguities in the separations among stimuli indicated by Scheffe's test.

The second consideration concerns the problem of selecting or devising sensitive, consistent measures of responsiveness to architectural spaces. In each of the analyses of our study, responses to the four pairs of bipolar adjectives addressing each psychological dimension differed reliably. This variability in

response to the four bipolar adjectives was particularly marked for the physical size dimension. This finding permits at least two possible interpretations. Given the identification of any one of the psychological dimensions indexed in the present study, the four bipolar adjectives employed to tap that dimension may not have all been tapping the same psychological dimension. Alternatively, for any one of the dimensions employed in this study, even though each pair of bipolar adjectives may have tapped the same psychological dimension, the sensitivity with which the dimension was tapped may have varied among the four pairs of adjectives. The data do not permit determination between these alternative possibilities; they point out to the architectural researcher the need for rigorous research into the problem of what instruments sensitively index what components of psychological responsiveness to architectural spaces.

References

Brunswik, E, 1947, Systematic and Representative Design of Psychological Experiments. (University of California Press) Berkeley.

Garling, T, 1969, Studies in visual perception of architectural spaces and rooms: I. Judgment scales of open and closed space. Scandinavian Journal of Psychology 10, 4 250-256.

Gibson, J J, 1950, The Perception of the Visual World. (Houghton Mifflin) Boston.

Gibson, J J, 1966, The Senses Considered as Perceptual Systems. (Houghton Mifflin) New York.

Hall, E T, 1966, The Hidden Dimension. (Doubleday) New York.

Hochberg, J E, 1957, Effects of the gestalt revolution: the Cornell symposium on perception. Psychological Review 64, 2 73-84.

Kasmar, J V, 1970, The development of a usable lexicon of environmental descriptors. Environment and Behavior 2, 2 153-169.

Kilpatrick, F P, 1961, The nature of perception: Some visual demonstrations. Chapter 2. In F P Kilpatrick (ed.) Explorations in Transitional Psychology. (New York University Press) New York.

Maslow, A H and Mintz, N L, 1956, Effects of esthetic surroundings. Journal of Psychology 41, 2 247-254.

Montgomery, J E, 1970, Impact of housing patterns on marital interaction. Family Coordinator 19, 3 267-274.

Sommer, R, 1965, The significance of space. American Institute of Architect Journal 43, 5 63-65.

Sommer, R, 1969, Personal Space. (Prentice-Hall) Englewood Cliffs.

Wells, W P, 1965, The psycho-social influence of building environment; Sociometric findings in large and small office spaces. Building Science 1, 153-164.

Wolins, L and MacKinney, A C, 1965, A theory-based scale for measurement of responses to the methathetic class of stimuli. Unpublished mimeographed proposal from the Departments of Psychology and Statistics, Iowa State University, Ames, submitted to National Science Foundation.

Zevi, B, 1957, Architecture as Space. (Horizon Press) New York.