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SPATIAL VERSUS DIMENSIONAL CHARACTERISTICS UNDERLYING ENVIRONMENTAL PERCEPTIONS

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Spatial Versus Dimensional Characteristics Underlying Environmental Perceptions *

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[1]Results of components analyses for these samples may be obtained from the authors.

Abstract

Environmental factors are generally assumed to be important determinants of individual behavior. Thus, considerable empirical effort has focused on discovering how individuals organize their perceptions of the environment. The present study analyzed individual perceptions of a variety of environmental spaces in an attempt to determine whether these perceptions were organized in terms of the types of spaces being rated or by content dimensions occurring across spaces. The findings supported a "mixed mode" approach whereby both spatial and dimensional factors appeared to be important concepts in the construction of cognitive representation of environmental settings.

Spatial Versus Dimensional Characteristics Underlying Environmental Perceptions

Although it has become almost a truism that psychologists must consider both individual characteristics and environmental settings if they are to understand human behavior, the nature of this person/environment interrelationship has not been clearly specified (cf. Bowers, 1973; Ekehammar, 1974; Endler & Hunt, 1968). At an empirical level, recent efforts have generally focused on the effects of the situation and have yielded growing evidence that situational and environmental measures account for as much as or more variance in attitudes and behavior than can be accounted for by individual difference measures (cf. Moos, 1969, 1973). At a conceptual level, the presumed influence of environmental factors upon individual behavior is evident in the work of such authors as Insel and Moos (1974) who characterized environments as having "personalities" that exert directional influences on behavior. Similarly, Ittelson, Proshansky, Rivlin, and Winkel (1974) stressed the "demand character" of the environment. These latter authors emphasized, however, that this demand character describes not only the immediate sensory stimuli of the situation but also encompasses social and symbolic meanings. Payne and Mansfield (1973) stated the issue more explicitly, emphasizing that concern is better directed toward understanding how situational attributes influence individuals and groups rather than simply describing the situation's physical or social attributes.

It is not surprising, therefore, that considerable attention has focused on determining the processes whereby individuals perceive and structure attributes of the external environment into an internal representation or cognitive map (Ittelson et al., 1974). Harrison and Sarre (1975) noted that understanding mental images of the environment is an essential first stage in developing a theory relating human behavior and the environment. In this as in many fields of scientific endeavor, however, interest has not necessarily meant clarity or resolution. As Lockman, Hazen, and Pick (Note 1) pointed out, "Although we know people are aware of their location in a familiar space, we know little about how these representations are constructed and organized or what developmental changes occur in the organization of the knowledge."

There does appear to be general agreement that the construction of cognitive representations of the environment (i.e., the formation of a map) incorporates an inherently inseparable combination of perceptual and cognitive processes as well as an active organizing and structuring of information (Beck & Wood, 1976; Insel & Moos, 1974; Ittelson et al., 1974). On the other hand, there is less agreement about the nature of this internal representation. Insel and Moos (1974) suggested that the representation is dimensional, where a limited number of dimensions can characterize a large and varied group of social environments. A second school of thought (cf. Beck & Wood, 1976) stated that individuals generally treat environments somewhat categorically and that cognitive maps are basically spatial in nature. Beck and Wood (1976) emphasized that mapping is to be taken in the concrete sense of the conventional map where individuals form cognitive sketches of the geographic structure of the environment. These authors further stressed that even though information was cognitively coordinated to provide a unified report about places, it remained relatively unsorted and uncategorized such that the raw knowledge could be recaptured. Gärling (1976) merged both schools of thought suggesting that individuals categorize environments on the basis of type and then establish preferences by weighing various factors within the area. Empirical evidence to test the relative validity of the above mentioned dimensional, spatial, or "mixed" models has generally been lacking, however. The present study explored relationships among perceptual ratings of a variety of environmental spaces in an attempt to determine whether such perceptions were organized primarily by the type of space or by the particular characteristics being rated.

Method

Sample

The sample consisted of 4,315 enlisted personnel aboard 20 U. S. Navy ships operating in the Atlantic and Pacific Oceans. These ships ranged from small destroyers with crews of approximately 250 men to aircraft carriers with crews of more than 4,000 men. At the beginning of each ship's overseas deployment period, each person completed a questionnaire describing the physical environment of the total ship and its major spaces. A subset of the sample (n = 1,821) also received an abbreviated version of the questionnaire toward the end of the six month deployment period. In addition to the shipboard sample 805 enlisted personnel from three Navy shore installations were tested (two within the U. S. and one remote, isolated facility).

Instruments

Ratings of the physical environment were obtained from 54 questionnaire items asking the individual to describe characteristics of his work space, sleeping facilities, toilet facilities, dining facilities, and the total ship or shore station. Each area was rated in terms of characteristics such as lighting, heat, ventilation, odor, crowding, and privacy. Ratings were provided in terms of a 5-point, bipolar adjective scale where a higher score indicated more favorable conditions. Additional items requested the individual to rate his satisfaction with each space. Satisfaction items were presented in a 5-point Likert format.

Results and Discussion

To explore the pattern of relationships underlying individual perceptions of the environment, a principal components analysis was conducted on the ratings of the various spaces. Analyses were performed separately for the pre- and post-deployment shipboard responses as well as the shore facility responses. A varimax rotation procedure was used to arrive at the optimum solution for each sample. The components analysis on the post-deployment sample yielded 12 components with eigenvalues $\geq$ 1.0, accounting for 60% of trace (see Table 1). Only the post-deployment results are reported in Table 1 because it has been suggested: (1) that there may be a time lag of several months before the situation has its greatest effect on perceptions (Hand, Richards, & Slocum, 1973; Likert, 1967), and (2) that longer term residents of environments construct better maps (Beck & Wood, 1976).

Insert Table 1 about here

As shown in Table 1, there was relatively little complexity in the component solution (only 14 of the 54 ratings had loadings $\geq |\pm.40|$ on more than one component). The resulting components appeared to support both the spatial and dimensional schools of thought; approximately half the components reflected underlying dimensions and half reflected general descriptions of spaces. For example, the first, fourth, ninth, and twelfth components were defined solely by ratings of toilet facilities, work spaces, eating facilities, and the total ship, respectively. On the other hand, the second, third, sixth, seventh, and tenth components described safety, temperature and ventilation, color, lighting, and privacy, respectively. This latter set of components generally described characteristics across various spaces.

Component solutions for the shore facilities and for the pre-deployment shipboard samples yielded results similar to the solution described above.[1] To further test the generalizability of the solutions, each sample was scored using component weights derived from its own solution as well as the solutions of the other two samples (i.e., each sample had three sets of component scores). A direct solution scoring method (Harman, 1967, p. 349) was used. All components were scored so that higher scores (M = 10.00, SD = 1.00) reflected more favorable conditions. Correlations among the resulting component scores were calculated. The median intercorrelation among similar components from the different sample solutions was .86 (e.g., pre-deployment shipboard lighting with post-deployment shipboard lighting with shore facility lighting), while the median correlation among dissimilar component scores was less than .30.

Such results suggested that the component structure presented in Table 1 was stable (at least over a six month period) and, more important, appeared generalizable across a broad range of environments. This apparent robustness of component structure was noteworthy given the differences in the types of ships and shipboard environments sampled but was even more remarkable when shore installations were included. Environmental settings at these latter installations ranged from modern barracks and classrooms located in pleasant surroundings in a moderate climate to wooden huts and metal quonset buildings on an isolated island in the tropics. Thus, there did appear to be some support for the suggestion that individual perceptions of the environment include both: (a) categorical representations of environmental spaces (that is, general profiles of the characteristics that occur together within certain types of spaces); and (b) sets of characteristics or dimensions that occur across situations and which may be used to describe environments of numerous types or to differentiate among environments of similar types.

This latter point was supported by the fact that while the underlying component structure appeared to apply across diverse environments, the resulting component scores discriminated among the different environments and, further, appeared to reflect actual conditions at the various locations. For example, a multiple discriminant analysis (MDA) using the 12 component scores showed significant differences among the three shore installations (see Table 2). Two discriminant functions were obtained; subsequent classification analyses based on the findings of the MDA resulted in the correct classification of 82% of the individuals in the shore station sample. That is, based on classification functions derived from the 12 environmental perception components, it was possible to predict the particular environment in which the individual served for 662 of the 805 persons assigned to the three shore stations.

Insert Table 2 about here

As noted in Table 2, there were significant differences among the three installations on all components except the one describing color. Such differences appeared to reflect actual differences in the environments of the various stations. For example, all stations shared standardized color schemes, thus no differences were expected. On the other hand, one station was described as hot, relatively unsafe, and having generally poor living living conditions, but offering privacy, relatively uncrowded work areas, and so forth. Such a description appeared appropriate for an installation situated on a tropical island where most men worked outdoors with heavy equipment and lived in minimally improved plywood or metal huts. A second installation was described as having relatively favorable berthing and toilet facilities, but somewhat crowded and unfavorable work area conditions, as well as relatively poor food preparation and service areas. This installation was, in fact, a training base which had older but spacious and comfortable living quarters whereas the classrooms, equipment, and training facilities were overcrowded and generally inadequate for the number of students.

While the apparently meaningful discrimination across different environments suggests construct validity for the various components, it is important to consider relationships with other perceptions and attitudes. Table 3 presents correlations between the component scores and attitudes (i.e., satisfaction) about the various environmental spaces at the three shore installations.

Insert Table 3 about here

In general, satisfaction ratings of a particular area or space tended to be most strongly related to components describing characteristics of that space. Both specific dimensions and characteristics of other spaces tended to be relatively unrelated to these satisfaction scores, although two exceptions were noted. First, berthing areas and toilet facilities tended to be located in proximity and showed similar patterns of correlation. Second, both the safety and crowding dimensions appeared to be important correlates of satisfaction with multiple spaces.

Conclusions

The findings of the present study tended to support Gärling's (1976) "mixed mode" approach to cognitive representations of the external environment. In other words, the results suggested that individuals do categorize areas on the basis of certain similarities with other areas but that preferences about a particular area are at least partly determined by specific conditions within the area. The major support for the category approach was evidenced by those components that were defined by characteristics of a single type of space (e.g., Food Service Area conditions). On the other hand, certain conditions or characteristics such as crowding appeared to reflect conditions across spaces and to be especially relevant to satisfaction with a variety of spaces, thus supporting the specific conditions approach.

Unfortunately the "mixed mode" model remains incomplete unless it contains a statement about how such categorical and dimensional representations relate to individual attitudes and behavior. Although the present study did not directly address either the processes or the sequence of events that lead to the formation of individual attitudes about particular environmental spaces, the results do seem to permit a postulated extension of the Gärling model in this regard. Such an extension might be that the formation of a cognitive map involves a multi-stage, dynamic process where: (1) spatial, configural, or category characteristics of a perceived environment are used in an initial orienting response which serves to identify the environment and assign it to a particular cognitive category or type; (2) the particular type of environment is then used to identify especially salient dimensions of the environment (cf. Leff, Gordon, & Ferguson, 1974) or to call forth an optimum profile of characteristics, a functional orientation, or some set of potential criteria by which the individual assesses or evaluates the environmental setting; and (3) satisfaction and other responses involve a comparison of the actual characteristics of the environmental setting (e.g., light, color, heat, crowding) with the optimal profile or functional orientation appropriate to that type of setting.

While findings of the present study appear conducive to such speculation, several points should be remembered. First, the study addressed a wide range of environmental settings but was conducted within a relatively homogeneous sample of individuals. Thus, although the results appeared to be generalizable across a variety of environmental settings, the question of generalizability across a range of individual characteristics lacked the same degree of empirical resolution. While the personnel participating in the study represented diverse abilities, backgrounds, and occupations (ranging from musicians, to construction workers, to electronics technicians), it was impossible to rule out a potential restriction of individual characteristics due to an all-military sample. Second, a principal components analysis was used to assess underlying dimensions. Although the resultant dimensions were stable across time, were consistent across environments, and yielded some evidence of construct validity, alternative methods such as multi-dimensional scaling procedures might be useful for further corroboration. Third, even though shipboard environments were assessed at two points in time, the study did not address the processes underlying the formation of cognitive maps of the environment in the dynamic way that appears to be required.

In spite of such cautions, the current study has several implications for the future. Principal among these is the suggestion that a relatively limited number of dimensions are applicable across a variety of environmental settings, provide useful descriptors of conditions within these settings, are sensitive to basic differences across diverse environments, and are linked to individual attitudes about various settings. Thus, given appropriate care that the dimensions are indeed salient to the particular environmental setting being investigated, a dimension or dimension profile approach seems an effective and parsimonious technique for future environment/behavior research. However, based on indications (albeit indirect) that individual perceptions of the environment are organized around both spatial and dimensional cues and that the perception/cognitive organization/evaluation/behavior process may involve a number of stages or linked strategies of conceptual functioning, it would seen crucial to ascertain the degree to which the stages or dimensions vary from setting to setting. Finally, insofar as individual difference characteristics such as intelligence, previous experience, or cognitive style are generally thought to be important factors in developing individual cognitive representations or subjective evaluations of conditions, it would appear imperative for future research to explore the degree to which various dimensions, weights, and even environmental setting categories differ across persons. Approaching such issues from a truly dynamic, process-oriented perspective would appear to be a major step in developing a meaningful understanding of the person/environment interface.

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Reference Note

1. Lockman, J. J., Hazen, N. L., Pick, Jr., H. L. Development of mental representations of spatial layouts. Paper presented at the meeting of the American Psychological Association, Washington, D. C., 1976.

Table 1

Principal Component Analysis of Post-Deployment Shipboard Environment Ratings[a]

Area	Variable	Component Loadings[b] 1	2	3	4	5	6	7	8	9	10	11	12	h^2
Food Service	Light							.75						.60
	Temp			.68										.51
	Vent			.48						.44				.56
	Clean									.58				.56
	Odor									.65				.62
	Size											.65		.64
	Crowding											.71		.64
	Color						.54			.46				.60
	Noise									.41	.51			.58
	Safety		.63											.58
Sleeping	Light							.73						.58
	Temp			.74										.63
	Vent			.50		.40								.58
	Clean					.71								.64
	Odor					.66								.62
	Size											.72		.68
	Crowding											.67		.63
	Color						.67							.63
	Privacy										.40	.51		.52
	Noise										.58			.57
	Safety		.70											.66
Work	Light				.45			.41						.41
	Temp				.73									.65
	Vent				.71									.59
	Clean				.46									.52
	Odor				.54									.52
	Size								.72					.64
	Crowding								.85					.76
	Color						.67							.60
	Privacy													.47
	Noise				.52						.46			.57
	Safety		.46											.56
Toilet	Light							.60						.57
	Temp			.56										.47
	Vent	.61												.59
	Clean	.64												.63
	Odor	.67												.65
	Size	.62										.44		.67
	Crowding	.62										.43		.63
	Color						.63							.64
	Privacy	.43										.42		.46
	Noise		.46											.53
	Safety		.67											.62
Total Ship	Light							.68						.64
	Temp			.64										.63
	Vent			.42									.42	.59
	Clean												.56	.60
	Odor												.56	.63
	Size											.44	.60	.68
	Crowding											.46	.58	.64
	Color						.66							.67
	Privacy										.50	.40		.61
	Noise										.61			.64
	Safety		.65											.64

Note. All variables are scored so that a higher score reflects a more favorable condition.

[a] *n* = 1,831

[b] Only loadings > |±.40| are reported.

Table 2

Mean Score Differences for Three Shore Installations

Compared Across Environmental Perception Components[a]

Component	Station 1 (n = 315)	Station 2 (n = 234)	Station 3 (n = 256)	Total	F
	Means[b]				
Dimensional Characteristics					
Safety	10.24	10.11	9.61	10.00	31.92*
Temperature/Ventilation	9.50	10.79	9.15	9.76	171.14*
Aesthetic Color	9.87	9.78	9.82	9.83	0.65
Lighting	9.86	9.47	9.83	9.74	13.63*
Privacy	10.24	10.36	10.62	10.39	11.45*
Crowding	11.22	11.12	10.04	10.81	118.75*
Spatial Characteristics					
Work Area Crowding	9.93	10.12	10.38	10.13	17.15*
Work Area Conditions	9.83	10.28	10.22	10.08	21.45*
Berthing Area Cleanliness	10.64	9.53	10.02	10.12	75.89*
Toilet Facility Conditions	11.36	10.82	9.54	10.62	245.14*
Food Service Area Conditions	9.12	10.13	9.76	9.62	69.50*
Total Facility Conditions	9.58	9.88	9.65	9.69	4.92*

[a] $n = 805$

[b] Higher scores reflect more favorable conditions.

*$p < .01$, df (2,802)

Table 3

Correlations Between Component Scores Representing

Perceived Environmental Conditions and Satisfaction with Environmental Spaces[a]

Component Scores	Satisfaction Ratings[b] Berthing Area Satisfaction	Toilet Facility Satisfaction	Food Service Area Satisfaction	Work Area Satisfaction	Total Installation Satisfaction
Dimensional Characteristics					
Safety	.31*	.30*			.23*
Temperature/Ventilation			.28*		
Aesthetic Color					
Lighting					
Privacy					
Crowding	.49*	.38*	.31*		.31*
Spatial Characteristics					
Work Area Crowding				.28*	
Work Area Conditions				.37*	
Berthing Area Cleanliness	.44*	.27*			
Toilet Facility Conditions	.39*	.64*			.28*
Food Service Area Conditions			.32*		
Total Installation Conditions					.20*

[a] $n = 805$

[b] Only correlations > $|\pm.20|$ are reported.

*$p < .01$

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Environmental factors are generally assumed to be important determinants of individual behavior. Thus, considerable empirical effort has focused on discovering how individuals organize their perceptions of the environment. The present study analyzed individual perceptions of a variety of environmental spaces in an attempt to determine whether these perceptions were organized in terms of the types of spaces being rated or by content dimensions occurring across spaces. The findings supported a "mixed mode" approach whereby both spatial and dimensional factors appeared to be important concepts in the construction of cognitive representation of environmental settings.

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