PREDICTING USER RESPONSES TO BUILDINGS

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An approach is discussed whereby architects can learn to predict user responses to the buildings they design. An argument for the importance of prediction in architecture is presented, initial research efforts are discussed, specific scale and media development experiments are reported, and two professional applications of the resulting instrument are described.

Background. The recent history of architecture has been marked by an increasing involvement of architects with client-user groups with whom they previously have had little or no contact. Commissions are obtained by architects not only in their own communities, but throughout the country, and for some firms, throughout the world. They are obtained not only with clients from the same socio-economic class, or even the ruling elite as was the case in previous centuries, but with client groups having widely diverse socio-economic and ethnic backgrounds (Appleyard, 1969). Often the clients represent user groups with special age, health, or mobility problems (Carp, 1970). Occasionally user groups or potential user groups are so large or ill-defined as to be virtually unobservable in any primary way. And almost invariably, because of pressures brought on by rapidly increasing construction costs, the architect is expected to perform his services in the shortest conceivable period of time, "fast-tract" becoming the common-place rather than the exception.

From a technological view-point architects appear to be managing quite well under these circumstances. New buildings for all clients and users incorporate the finest of materials and systems to provide physical conveniences far beyond those offered in previous times. The buildings are sturdy, durable, and often quite attractive, at least from the architect's point of view. There is an increasing awareness that such buildings may be excessively consumptive of energy and resources, but there is now evidence even here that architects will be able to make the necessary adjustments (Balchen, 1974).

Where the system often seems to break down is in terms of user satisfaction (Michelson, 1967). Architects seem to have neither the time nor the ability to come to know and understand the pluralistic user groups for whom they are designing. In consequence they seem prone to design environments which compromise the aspirations of these groups and at worst are intolerable for them, as with the Pruitt-Igo Housing Development in St. Louis (Yancey, 1971).

The Problem is Prediction. When the architect and his client/user come from the same socio-economic strata or share the same environmental and architectural beliefs, the architect's intuition may serve him well. The architect may be able to predict how the client/user will respond to the specific design he proposes. On the other hand, when the architect and the client/user have very little in common, the problem of prediction becomes acute. If the architect attempts to empathize with such groups, he is likely to err. He is likely to attribute environmental values, needs, and interests to such groups which in fact they do not have. He is likely to make erroneous predictions about how such groups will comprehend and use the buildings he designs (Hershberger, 1974). The user may not even perceive the same design features as does the architect. He may have no knowledge of the referents which the architect intends, so may respond with uncertainty or even distaste to buildings which the architect feels would be ideally suited to his needs.

Many architects understandably feel caught in a bind. On the one hand, the architect is being pushed toward the role of social scientist, forced to develop his "clinical" skills and research abilities so that his design solutions might reflect the needs and preferences of diverse client/user groups. On the other hand, under the increasing constraints of design time and budget which characterize the profession, he finds himself hard pressed to do the job. He yearns for the social scientist who will step in and tell him the environmental needs and preferences of each client/user group, or hopes for quick and inexpensive approaches to discover what the social scientist is unwilling or unable to reveal. Unfortunately social scientists rarely have information on the specific user groups for whom the architect is designing and are understandably reluctant to make generalizations to groups they have not studied. Any quick and inexpensive research approaches which the architect can use and analyze himself during the design process to obtain reliable and valid results about user group needs and preferences are difficult to come by. If time and budget permit, the wise architect may turn for help to one of the new environmental analysis/programming firms. If the project is small, or time is of the essence, he more often must turn to his own resources: intuition, casual observation, and limited interviews followed by simple tabulation of results. Quite often this approach is satisfactory. Occasionally it is not, resulting in the need for extensive redesign and drawing in order to satisfy client/user demands, or worse, the project gets built and does not work.

Learning to Predict. This paper discusses the efforts of the authors to develop practical research and training procedures which the architectural designer can use to improve his ability to make correct and consistent predictions about how specific client/user groups will perceive and respond to the buildings he designs. Our efforts to date have focused on predictions of user comprehension (or meaning) of the designed environment rather than prediction of specific use. We have been concerned with such affective and evaluative judgements as perceived satisfaction, pleasantness, usefulness, safety, comfort, excitement, and beauty as well as with the physical attributes of the designed environment to which such judgements relate such as spaciousness, permanence, potency, complexity, temperature, and lighting.

We do not wish to de-emphasize the importance of actual use, but to recognize on the one hand that it is not possible to use a building in a physical sense during the design process because it does not yet exist, and on the other hand that the actual building cannot be used, except in the most primitive sense, in the absence of comprehension or meaning (Osgood, et. al. 1957; Hershberger, 1970); such comprehension or meaning having more direct expression in verbal than in overt physical behavior. And such verbal responses are important in their own right. From the day a child first learns to talk, verbal responses become one of the primary ways for children to manipulate their environment, to express satisfaction or distaste, and to cause others to manipulate the environment for them. This is true not just for children, but also for poor or otherwise powerless adults such as the aged or mentally handicapped who find themselves unable physically to influence the types of environment in which they are placed. Even for normal adults it should not be assumed that physical behavior is all that is important, or that a persons attitudes or beliefs can be inferred from physical behavior. Just because a person cheerfully eats breakfast every morning at a table in a dark, windowless room, it should not be assumed that he is satisfied with the arrangement. He may be a basically cheerful person who enjoys his wife's cooking and tolerates the arrangement, confident that he will someday be able to move into much more satisfactory accommodations...and will tell you so if you ask. It is important for the architect to learn to predict how people will respond to their physical environment. Learning to predict their verbal responses is an important first step.

Previous Research. The first solid research evidence to support the notion that architects view the world in a substantially different way than laymen was obtained in a doctoral dissertation at the University of Pennsylvania (Hershberger, 1969). In this study semantic differential scales and single color slide representations of familiar buildings were employed to obtain judgements from architects, pre-architects, and non-architects (1) to determine if representational, affective, and evaluative judgements by the three groups contained important differences and (2) to determine if the differences could be attributed to the professional education of the architect. Pronounced differences were found between the architect and non-architect groups, and because the pre-architect group was similar to the non-architect group in nearly all comparisons, it was evident that the judgement of the architects had been influenced by their professional education. The magnitude of the differences suggested to the authors that architectural education may actually decrease the ability of architects to predict user responses. Furthermore, because the groups compared at the University of Pennsylvania were very similar in nearly all other respects: age, race, intelligence, economic, geographical, etc., it was felt that difficulties of prediction might become very pronounced when the architect is different from the user in these other respects as well.

Developing the Research Instrument. Subsequent research efforts by the authors have been directed toward development of research instruments which can be used to attack the prediction issue directly (Hershberger, 1971). Our first effort was to establish a short set of semantic differential scales (See TABLE A) which would fully cover the presentational, affective, and evaluative areas of architectural meaning. A group of twenty scales was identified by reviewing a number of research efforts utilizing semantic scales (Vielhauer, 1965; Craik, 1966; Canter, 1968; Hershberger, 1969; Collins, 1970) and selecting lead scales for the factors which had previously appeared. This research was presented and reported at EDRA 3 (Hershberger, 1972). A further analysis of the proposed set of scales was completed in 1972 and presented in a workshop at EDRA 4 (Cass and Hershberger, 1973). In this study the twenty scales presented at EDRA 3 and ten additional scales of interest to the authors were used to obtain responses from students to twelve buildings selected from the campus at Arizona State University and the surrounding community. Factor analysis of the results and least squares comparisons revealed nine distinct factors or dimensions of meaning having eigenvalues over unity, as well as one superordinate evaluative factor. These ten factors are listed in TABLE A along with ten primary and ten alternate scales which in terms of high correlations and communalities seem best suited to represent them. The primary set of scales should be considered the absolute minimum essential for coverage of the range of independent meanings attributable to designed environments. The alternate set of scales can be used in whole or part in place of the primary scales for subject matter or respondent groups where their use would seem more appropriate. The alternate scales might also be used in addition to the primary scales to insure coverage of various nuances of meaning within each dimension, to permit more robust factor analytic comparisons, to further test the orthogonality of these ten semantic dimensions, and to create a larger data base to improve reliability of the measuring instrument.

There are also ten secondary scales and ten alternate secondary scales included in TABLE A. These secondary scales were not accounted for clearly in the factor analytic results. They either (a) did not load heavily on any of the identified dimensions, (b) loaded contrary to previous studies on one of the evaluative dimensions, or (c) behaved somewhat erratically across media. Where time and resources permit, it would be advisable to include one or both sets of alternate scales to insure more comprehensive coverage of the range of meaning attributable to buildings. We are currently engaged in two research studies in which these scales have been included in order to ascertain if their absence as separate dimensions was an artifact of the particular buildings used in the initial study or was in fact a result of their not having essentially different meaning from the ten identified factors.

Evaluating Representational Media. We have also been engaged in efforts to discover which, if any, media of representation might serve as an adequate substitute for actual environments. Specifically, the authors have sought to discover the degree to which responses to designed environments represented by various media might serve as useful indices of responses to the actual environments. This is an important question because of the time, expense, and control problems associated with transporting people to the environments one wishes to have evaluated. In the case of environmental design it is, of course, mandatory to simulate environments, because the ones being designed do not yet exist.

TABLE A

SEMANTIC SCALES TO MEASURE THE MEANING OF DESIGNED ENVIRONMENTS:

HERSHBERGER-CASS BASE SET

Factors	Primary Scales	Alternate Scales
1. General Evaluative	good-bad	pleasing-annoying
2. Utility Evaluative	useful-useless	friendly-hostile
3. Aesthetic Evaluative	unique-common	interesting-boring
4. Activity	active-passive	complex-simple
5. Space	cozy-roomy	private-public
6. Potency	rugged-delicate	rough-smooth
7. Tidiness	clean-dirty	tidy-messy
8. Organization	ordered-chaotic	formal-casual
9. Temperature	warm-cool	hot-cold
10. Lighting	light-dark	bright-dull

Secondary Scales	Alternate Secondary Scales
old-new	traditional-contemporary
expensive-inexpensive	frugal-generous
large-small	huge-tiny
exciting-calming	beautiful-ugly
clear-ambiguous	unified-diversified
colorful-colorless	vibrant-subdued
safe-dangerous	protected-exposed
quiet-noisy	distracting-facilitating
stuffy-drafty	musty-fresh
rigid-flexible	permanent-temporary

Review of the literature in simulation (Seaton and Collins, 1971; Woods, 1971; Howard et. al., 1972) indicates to the authors that photographic media would probably be the most satisfactory considering our interest in improving the architects ability to predict user responses during the early stages of design. The usual architect's sketches and line drawings as well as finished renderings appear to be the least promising because of the inability of most laymen to read them (Seaton and Collins, 1972). Architect's models also seem difficult to employ because of the time and expense involved in their preparation as well as with the difficulty in representing interiors (Woods, 1972). Furthermore our interest is to improve the architect's understanding, hence prediction, of the client/users' environmental perceptions and evaluations prior to heavy investment of time and energy by the architect. It is of little satisfaction to the architect to find that he has misread the client after he has expended his entire design budget. The architect really needs to have an understanding of the client/users' environmental perceptions and attitudes at the first stages of the design process. Our experimental efforts were directed, therefore, to finding an appropriate media to fulfill this need.

In our first experiment, views of twelve prototypical housing examples were judged on thirty semantic differential scales by 120 architectural students randomly assigned to six equally sized respondent groups. One respondent group was bused to the selected examples of housing in order to make judgements; each of the other five respondent groups based judgements on one of the following five representational media: (1) 35 mm single color slides, (2) 35 mm multiple color slides, (3) Super 8 mm color film, (4) Super 8 mm black and white film, (5) black and white video tape. Factor analysis, least-square factor comparisons, and analysis of variance were used to analyze the results.

Very similar factor structures were found for the real environments and each media type -- with closeness to the real as follows: color film, black and white film, video-tape, single color slides, and multiple color slides. The principal factors for each media and the real visits based on an eigenvalue of one (1.0) were Aesthetic (Eval.), Pleasantness (Eval.), Organization, Ruggedness, and Spaciousness. The single and multiple color slides varied from the real and other media in that the otherwise independent Space and Pleasantness dimensions collapsed into one dimension. On all other dimensions the single and multiple color slides were actually very similar to the real.

Multivariate analysis of variance indicated that there was a significant difference between judgements of the buildings on the six different media groups (including the real). Univariate one-way analysis of variance on each of the thirty scales revealed 10 significant differences. Dunnett's Test was employed to compare judgements based on real visits with judgements based on each of the representational media for these ten scales. Results of this analysis indicate that there were significant differences between real judgements and those on media for only five scales. As can be seen on FIGURE 1, there were no significant differences in mean judgements comparing real visits with color film, and only one with color slides. There were two each comparing real with multiple color slides and video tape and three with

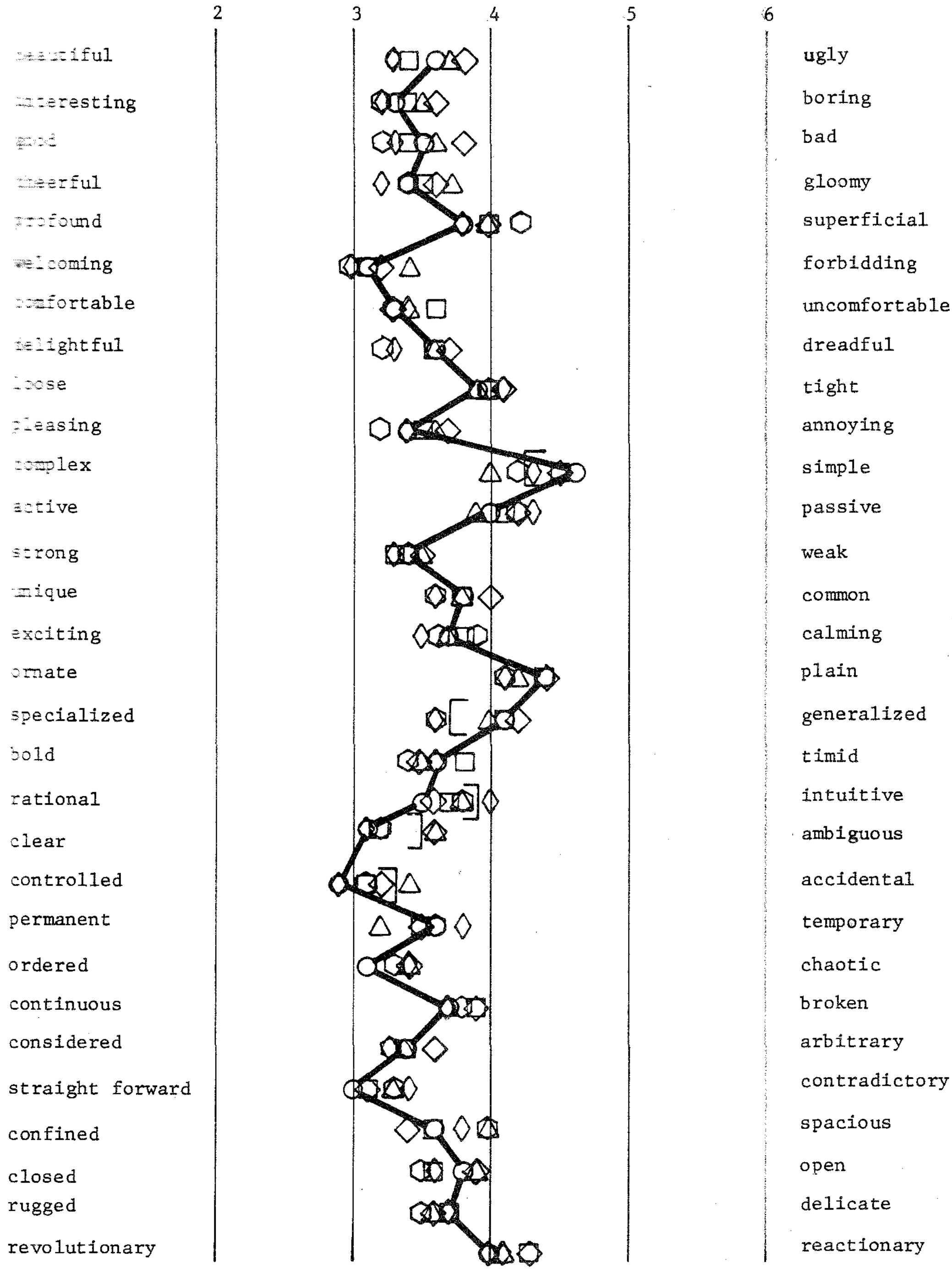

FIGURE 1. Experiment 1 Media Profile. The mean responses on each of thirty semantic scales are plotted for judgements made during real visits and with respect to each of five representational media for twelve prototypical housing examples. ○ Real visits, □ super 8 mm color film, △ super 8 mm black and white film ◇ 35 mm single color slides, ⬡ 35 mm multiple color slides, ◊ video tape.

black and white film. Interestingly all of the differences were found for scales loading on the organization or evaluative dimensions: simple-complex, ambiguous-clear, accidental-controlled, generalized-specialized, and rational-intuitive. In each case judgements based on real visits indicated a greater degree of organization than those based on the media. In only two cases were there significant differences in opposite directions, those for videotape and multicolor slides on the generalized-specialized scale.

Scale by scale correlations between judgements on the real and each of the media were often very high, going from .72 on the average for color film up to .79 on the average for multiple color slides. Most scales with primary loadings on factors were in the .85 to .95 range. This suggests that even where significant differences occur it may be possible with careful scale selection to use linear regression equations to predict judgements of real environments using judgements based on color film or color slides.

The second experiment was a replication of the first with three variations. The views of the twelve prototypical housing examples were replaced by views of twelve institutional and commercial buildings. The original thirty semantic scales were replaced by the thirty factor representative scales (Hershberger, 1972). Only the two most promising media representations, color slides and color film, were included in this investigation. Three randomly selected groups of pre-architecture students of 27 subjects each responded to all twelve buildings either by visits to the real building or by viewing super 8 mm color film or 35 mm single color slides.

A separate factor analysis of the thirty scales was performed for each respondent group. Eight factors with eigenvalues greater than 1.00 emerged for each of the groups. Comparison of the factor structures again revealed remarkable similarities and only minor differences. Major dimensions such as aesthetic, evaluation, activity, potency and space were very similar over all media. A warmth dimension emerged from the judgements made during visits to the real buildings which did not emerge in the judgements made during the media presentations. Conversely, a lighting dimension emerged from the judgements during real visits to the buildings. Most differences, like these, however, involved dimensions accounting for less than five percent of the trace variance: lighting, temperature, and tidiness. A synthesis of the factor structures forming a total of ten factors is shown at the top of TABLE A.

Results of a multivariate analysis of variance indicated that there were significant differences between the judgements of the three media groups. When mean judgements for each of the two media groups were compared with mean judgements for the real visit group, significant differences in judgement were found on twelve of the thirty scales (see FIGURE 2). The buildings viewed in person, were judged significantly more good, beautiful, pleasing, friendly and unique than when the buildings were judged on the basis of color slides or color film. All of these scales formed part of the two evaluative dimensions: Aesthetic and Pleasantness. In addition, the buildings were judged as more quiet and safe during real visits while the media seemed

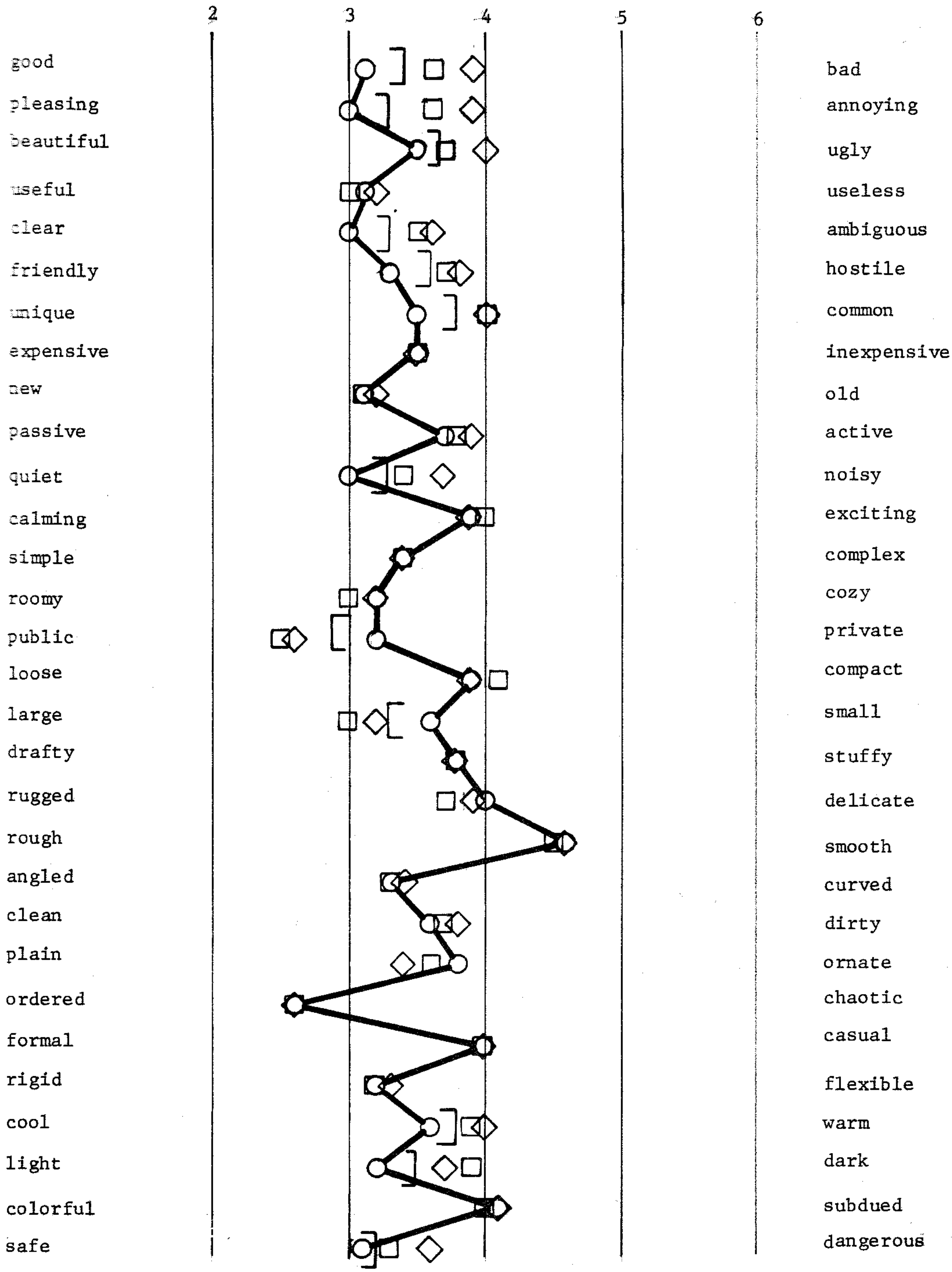

FIGURE 2. Experiment 2 Media Profile. The mean responses on each of thirty semantic scales are plotted for judgements made during real visits and with respect to each of two representational media for twelve institutional and commercial buildings. ○ Real visits, □ Super 8 mm colorfilm, ◇ 35 mm single color slides.

to enhance the size and publicness of the buildings. Not surprisingly, significant differences were found on the lighting and temperature scales, the media apparently not being able to represent these dimensions with any degree of accuracy.

Preliminary evaluation of the results of the two experiments reveals that media such as color film and color slides can be used to simulate actual designed environments. Evidence for this conclusion was provided by the factor analytic studies and least squares factor comparisons which indicated that very similar and easily identifiable dimensions were operating for both the real and the media representations even for dissimilar sets of scales and widely diverse building types. The very small number of significant differences found in the analysis of variance comparisons gives similar promise. The uniform suppressing tendency of the two representational media on evaluative judgements found in the second study again suggests that regression equations might be applied to allow closer prediction of evaluative judgements. The generally high scale by scale correlations between each of the media judgements and the real judgements further supports this possibility. Indeed, the fact that there were no significant differences in opposite directions for color film and color slides when compared to real visits for either study suggests that errors which occur in prediction based on these media should be only in degree rather than in direction of judgement; i.e. more or less complex, not simple vs. complex; or more or less good, not bad vs. good. This is an extremely important consideration when evaluating the adequacy of media to represent the real. Neither medium distorts the judgements enough to cause a reversal of meaning, hence use of either medium will tend to assure, over a group of judgements, that the qualitative aspects of bi-polar judgements will not be misrepresented.

Applications to Architectural Practice. We are currently utilizing the Hershberger-Cass Base Set of semantic differential scales in a post-construction evaluation study of Federal Aviation Administration regional office buildings in Los Angeles and Seattle. This Governmental Services Administration sponsored research is being conducted by the People Space Architecture Company of Spokane, Washington, Sam A. Sloan, principal; along with Robert Sommer, Ph.D., Social Psychologist; Walter Kleeman, Ergonomist; and Robert Hershberger, Ph.D., Architect as research consultants. The entire base set of semantic scales is being employed in this study as part of a larger questionnaire dealing with user satisfaction relative to the new office facilities. The semantic differential portion is used to elicit responses to (1) the employees' own FAA regional office building and (2) their own personal work station, as well as responses to three photographs each of (3) a standard GSA office arrangement, (4) a typical office arrangement at the other FAA regional office building, and (5) a typical office arrangement at their own regional office building. The thrust of this research is essentially comparative. The primary objective is to determine if the office arrangement in Seattle is more or less satisfactory to the users than the office arrangement in Los Angeles. The choice of semantic differential questions were made according to the following rationale. The first two questions, in which the respondents rate the actual offices in which they are located, are included to obtain basic information about user satisfaction as it relates to the representational, affective, and evaluative attributes of the offices. The three photographic displays of various office environments are used to obtain comparative attitudes or preferences relative to office arrangement. Taken together it will be possible to determine not only which office, Seattle or Los Angeles, is most satisfactory in terms of actual user evaluations, but also to determine which is considered more preferable by both user groups. It may also be possible to determine which physical attributes recognized by the users are most highly correlated with satisfaction. In uncovering these relationships we will, of course, be giving the architect information which will make it possible for him to predict more accurately how office workers will respond to their environment (Craik, 1968). By utilizing all forty scales on the Hershberger-Cass Base Set, we will also be able to employ factor analysis to further refine our understanding of the essential dimensions of architectural meaning, and possibly to reduce the number of scales required to elicit the information the architect requires for prediction.

Developing the Prediction Process. Having established in previous research that architect's representations and responses to the designed environment become increasingly different from the layman as a result of the architect's professional education (Hershberger, 1969), and noting that the architects ability to predict user responses becomes notably weaker as his distance from the user increases in terms of place, race, language, sex, age, etc. (Hershberger, 1971), we have become increasingly convinced that a research instrument is needed which architects can employ directly in practice to learn to predict how specific client/users will respond to the buildings they design. A set of semantic differential scales has been established and refined which appears to cover the architectural subject material with which most practicing architects are concerned (Hershberger, 1972; Cass and Hershberger, 1973). Other studies have been undertaken to determine which media of presentation are acceptable alternatives to direct experience of designed environments (Hershberger, 1971; Hershberger and Cass, 1973).

It now remains to utilize the scales and presentation media to develop a research instrument specifically geared to application: to helping the architect learn to predict user responses to his buildings before they are designed, and, if possible, even before initial design studies begin. This is being attempted at present by the authors with respect to a commission of Par 3 Planning, Architecture, and Research Studio to design a new facility for the First Southern Baptist Church of Tempe, Arizona.

The procedure we are testing is based on concept formation (Bourne, 1966; Bruner, Goodnow and Austin, 1956; Haygood, 1966) and traditional interrater reliability procedures developed in the social sciences. We first obtain from the user group, or a random sample of the user group, their assessments of a representative sample of buildings presented by color slides and using the Hershberger-Cass Base Set of semantic scales. The sample of buildings are selected by the architect to include (1) a variety of building types and styles which represent a range of approach to the solution of the particular design problem, as well as (2) a number of unrelated buildings which might reveal the extremities of judgement of the user group. It is felt at this time that a standardized set of buildings could not be selected that would adequately reflect the diversity of architectural commissions possible and, furthermore, to be most effective as a practical research tool the building selection ought to reflect the particular architect's preferences and non-preferences in order to convey the most useful information to him. In this regard it should be pointed out that individual architects might wish to add one or more bi-polar scale to the Hershberger-Cass Base Set in order to obtain ratings of particular interest to them. Factor analysis of the results will, of course, reveal if they are actually tapping new dimensions of meaning in so doing, or if the scales established in the previous studies actually represent these areas of meaning as well. A sample of the semantic differential response sheet utilizing the full set of forty scales used in this research is shown on TABLE B.

The mean and standard deviation of the user responses to each building for each scale are then calculated and plotted in the manner shown in FIGURE 3. For simplicity of illustration only the ten primary scales of the Hershberger-Cass Base Set are shown. The architect meanwhile (before the above analysis is revealed to him) responds to the set of buildings and scales in two ways, (1) he indicates what he personally feels about the buildings, and (2) he predicts the mean responses of the client/user group. His judgements are then plotted on the same diagram as for the user group so that the direction and magnitude of the differences between the architect, his prediction of the user, and the user responses are revealed. This is also shown in FIGURE 3.

At this point an associate in the office (not the design architect) carefully reviews the results giving particular attention to (1) differences in opposite directions between the user responses and architect's predictions, as can be seen for the useful-useless scale on FIGURE 3 and (2) very large differences in the same direction, as shown on the cozy-roomy scale. The associate then calculates the magnitude of the absolute distances between the mean user responses and the architect's predictions scale by scale over all of the buildings assessed, noting the total number of differences in opposite directions for each scale, and the total number of differences greater than one standard deviation. A hypothetical sample of the results of such a tabulation using 12 buildings and 10 scales is shown on TABLE C.

The design architect is then apprised of the calculated results, but not shown any of the profiles for specific buildings. If the architect's predictions are very close to those of the user group there is no reason to proceed further. The architect has essentially confirmed that his intuition about the user group is sufficient; that his ability to predict users' responses is probably quite adequate. We plan to confirm this by comparing the architect's predictions to actual user responses (1) to the architect's design presentations and (2) to the completed, occupied buildings.

If the architect's predictions about the user are quite different from the actual user responses, but his personal responses are quite similar, there is also no need to proceed further. In this case the architect will have seen that the user is really quite a lot like himself and that he need only let his own judgement be the guide. He can essentially design the building for himself.

TABLE B

cozy	___	___	___	___	___	___	___	roomy
common	___	___	___	___	___	___	___	unique
clean	___	___	___	___	___	___	___	dirty
dark	___	___	___	___	___	___	___	light
useful	___	___	___	___	___	___	___	useless
delicate	___	___	___	___	___	___	___	rugged
active	___	___	___	___	___	___	___	passive
bad	___	___	___	___	___	___	___	good
ordered	___	___	___	___	___	___	___	chaotic
cool	___	___	___	___	___	___	___	warm
old	___	___	___	___	___	___	___	new
colorless	___	___	___	___	___	___	___	colorful
stuffy	___	___	___	___	___	___	___	drafty
flexible	___	___	___	___	___	___	___	rigid
expensive	___	___	___	___	___	___	___	inexpensive
calming	___	___	___	___	___	___	___	exciting
clear	___	___	___	___	___	___	___	ambiguous
noisy	___	___	___	___	___	___	___	quiet
safe	___	___	___	___	___	___	___	dangerous
small	___	___	___	___	___	___	___	large
hot	___	___	___	___	___	___	___	cold
simple	___	___	___	___	___	___	___	complex
pleasing	___	___	___	___	___	___	___	annoying
smooth	___	___	___	___	___	___	___	rough
formal	___	___	___	___	___	___	___	casual
dull	___	___	___	___	___	___	___	bright
friendly	___	___	___	___	___	___	___	hostile
messy	___	___	___	___	___	___	___	tidy
private	___	___	___	___	___	___	___	public
boring	___	___	___	___	___	___	___	interesting
traditional	___	___	___	___	___	___	___	contemporary
generous	___	___	___	___	___	___	___	frugal
huge	___	___	___	___	___	___	___	tiny
beautiful	___	___	___	___	___	___	___	ugly
unified	___	___	___	___	___	___	___	diversified
subdued	___	___	___	___	___	___	___	vibrant
protected	___	___	___	___	___	___	___	exposed
facilitating	___	___	___	___	___	___	___	distracting
musty	___	___	___	___	___	___	___	fresh
temporary	___	___	___	___	___	___	___	permanent

FIGURE 3. Sample building prediction profile. This is an example of a hypothetical prediction problem in which the architect has personally evaluated a given building (□) and has predicted how a group of client/users would assess the building (△). The hypothetical mean judgement of the client/users is indicated by ○, and the standard deviation of the judgements is indicated by the shaded area.

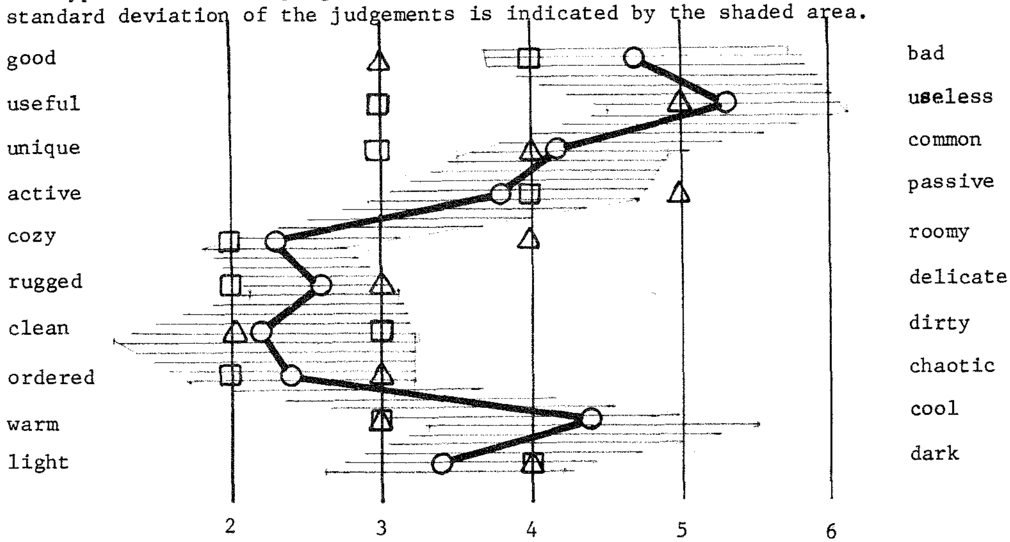

TABLE C

Architect Prediction Summary Table

SCALE	1 SUM OF ABSOLUTE DISTANCES	2 MEAN ABSOLUTE DISTANCE	3 OPPOSITE JUDGEMENTS	4 STANDARD DEVIATION DIFFERENCES
good-bad	25.3	2.1	6	6
useful-useless	10.8	.9	0	2
unique-common	9.6	.8	2	3
active-passive	16.8	1.4	3	1
cozy-roomy	8.4	.7	3	0
rugged-delicate	15.6	1.3	7	5
clean-dirty	4.8	.4	0	0
ordered-chaotic	7.2	.6	3	1
warm-cool	9.6	.8	0	1
light-dark	4.8	.4	2	0

This table presents a hypothetical problem in which errors made by the architect in predicting the client/user responses are calculated. Absolute distances between the architect's prediction and the client/user responses are summed across all buildings assessed and entered in column 1. These distances are divided by the number of buildings assessed, in this example the number is 12, and entered in column 2. The number of predictions made by the architect which are opposite of the client/user responses are entered in column 3. The number of predictions which differ from the client/user responses by more than one standard deviation are entered in column 4.

If the architect's predictions about the user are quite different from the actual user responses for some or all of the buildings, then a systematic prediction/learning process is in order. Otherwise, the architect is likely to design the building with erroneous ideas about how the user will respond to it.

At least three approaches to the prediction/learning process are possible. The first, most obvious, approach is to show the architect the results of each building comparison so that he can observe the magnitude and direction of the differences between his predictions and the mean user responses. In this way he can gain a better understanding of the user group, himself, and his ability to predict. If some differences are particularly disturbing to the architect, he can make contact with representatives of the client/user group to begin an interactive educational process to discover why the differences occur, to try to establish a mutual understanding of the differences, and to try to determine if they are important enough to cause problems.

The second approach is more of a behavior modification process. In this case the architect actually trains himself to assess buildings in the same way as do his client/users. The authors are utilizing the following procedure for this commission. The architect will first be shown the prediction-user profile for the building in which the overall magnitude of differences were greatest. After studying the results he will be asked to re-evaluate his predictions for one of the other buildings. The re-evaluated predictions will then be charted over the earlier user responses and architect predictions, and shown to the architect. He will again study the results, noting on which scales he has come closer to the client/user mean and those on which he has gone further away. The same procedure is continued through the remainder of the buildings, or until the architect learns to predict the user responses with considerable consistency and accuracy. Upon completion of this procedure it is, of course, possible to contact representatives of the client/user group, as in the first procedure, in order to establish a mutual understanding of the differences.

A third approach to learning how to predict user responses, more closely related to concept formation theory as previously cited, which we hope to explore in a subsequent commission, would be conducted somewhat as follows. An associate of the design architect would analyze the results of the several building/scale predictions and develop a dimension by dimension learning experience. The architect would be presented with slide representations of two buildings which were assessed by the client/users as differing widely on one factor analytic dimension (i.e. potency) while being more similar on all other dimensions. The architect would assess the two buildings on the scales most representative of that dimension (i.e. rugged-delicate) and be given immediate feedback on the user's responses to that scale. The procedure would be continued on the same dimension for various scales until the architect is successful in making sufficiently fine, consistent, and accurate discriminations amongst the buildings. After the criteria of successful prediction (i.e. within one-half of a standard deviation from the user mean) have been achieved on one dimension, the process would be repeated for the remaining dimensions until the architect performs satisfactorily on each. Having obtained success with unidimensional discriminations the architect would be asked to assess each building on all of the scales with an expected large degree of success. The criteria of successful prediction will, of course, depend on the architect's determination and those traditional limitations of architect-client interaction: time and money. Again with the third procedure, either one or both of the previously described procedures could be applied to further refine the architect's ability to predict correctly and accurately. And comparisons of user responses could be made with the architect's predictions of user responses to his design solution and to the building itself in order to confirm his understanding of the client/user.

Conclusion. We believe that this predictive/learning approach will afford substantial benefits to the architect and client/user with a minimum of investment on the part of the architect. It does not eliminate the need for careful architectural programming to make certain that the functional and physical needs of the client/user will be properly accommodated. It does eliminate the need to generalize the results of other research on presumed similar client/user groups to the current commission, and quite possibly will allow the architect to avoid extensive clinical or experimental work with the client/user group, trying to determine their specific environmental preferences. The architect is not, of course, bound to design a building which will be immediately satisfactory to the client or user along all or any of the dimensions covered in the set of semantic scales. If he chooses to produce a design which will not be immediately satisfactory on some dimension, because he believes it will be more satisfactory in the long run or for whatever other reason he might have, including aesthetic preference, he will at least be able to do so with a full understanding of the likely response of the client/user. He will also have the opportunity from the very early stages of design to "educate" the client/user to appreciate the type of architecture which he values, with full knowledge of where the client/user's values do not correspond to his own. Most importantly, the architect will be able to design a satisfactory building for the client/user while avoiding some of the pitfalls of time and expense inherent in the slower, traditional design exchange.

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