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AN EXPERIMENTAL STUDY OF EVALUATION IN BUILDING DESIGN

Şahap ÇAKIN

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INTRODUCTION AND BACKGROUND STUDIES

The study reported here is aimed at gaining an insight into the relationships between the quality of information presented to architects and non-architects on design alternatives, their professional training and the level of agreement in "choice" situations. Beginning with earlier studies on concepts such as judgement and evaluation in design, we shall dwell on background studies related to the quality of information, its complexity and the role of architectural training on preferences.

ARCHITECTURAL JUDGEMENT AND EVALUATION

As reported by Collins,[1] design decisions refer to those aspects of architectural judgement involved in the creation of an architectural environment, including laymen's judgements of the built environment or its representations, and juries' assessments of competitive designs. Among a number of researchers who have studied factors affecting people's judgements of the built environment, Craik[2] summarizes five major classes of factors:

- What kind of spaces are being judged,
- Who is the judge,
- What kinds of judgements are being asked of the judges,
- How the different stimuli or the elements of the built environment are represented, and
- Under which conditions judges view the representations.

Out of these five major classes, the second one is further emphasized in a study undertaken by Zube.[3] According to Zube, preferences are more likely to be conditioned by personal environmental dispositions, place of residence, occupation and personality characteristics.

Abercrombie[4] relates design to evaluation by considering design as a two-stage process consisting of :

- Receiving information: perception and
- Acting on the information received: construction.

An important part of design is learning to use a code of

1. P. COLLINS, *Architectural Judgement*, London: Faber and Faber, 1971, pp.107-119.

2. K. CRAIK, The comprehension of the everyday physical environment, *Journal of the American Institute of Planners*, v.34, n.1, 1968, pp.29-37.

3. E.H. ZUBE, Evaluation of Environment, of Change and of the Designer's Underlying Assumptions, *The 3rd International Design Activity Conference Preprints*, London, 1973, pp.3.1.1 - 3.1.7.

4. M.L.J. ABERCROMBIE, Perception and construction, *Design Methods in Architecture*, AA Paper No.4, London: Lund Humphries, 1969, pp.118-127.

which drawings, figures and three dimensional scale models are different forms. The evaluation of alternative design schemes is about the interpretations of this code. The idea of considering evaluation as an integral part of design is best expressed in Mannheim's words:

> ... individuals are unable to express consistent, operational, fully defined goals in the abstract, they do not know their goals, their values change over time, they clarify their goals by making choices. What individuals are able to do is to make explicit choices among discrete, well-defined alternatives.[5]

5. K. MANNHEIM, Reaching Decisions About Technological Projects with Social Concequences: a Normative Model, *Design Research Bag*, June 1972.

ROLE OF PROFESSIONAL TRAINING IN DESIGN EVALUATION

An experimental study undertaken by Mikellides shows that architects and non-architects used different aesthetic criteria in evaluating holiday chalets.[6] This experiment ascertains the fact that specialised education and training can make the architect different from the man in the street. A comperative study of interior spaces by Wools indicates that professional architects differ from non-architects in identifying the most important factor in relation to 'friendliness' scale.[7] Chambell's study ascertains the differences of beliefs between sub-groups in architectural profession; architects belonged to four occupationally distinct groups, i.e. public, private, research and teaching, demonstrated significant differences in their beliefs on rationalism and pragmatism scales.[8] The similar differences due to professional training are observed in real world situations, apart from the tests on simulations and experiments. Mr. Bailey, the managing director of a house building firm in Britain comments:

> ... we have found, to be frank, that many designs in our publications which have pleasing lines and good use of space, do not appeal to the majority of home buyers.[9]

6. B. MIKELLIDES, Evaluation of Holida, Chalets by Architects and Laymen, *Synthesis 2: Architectural Research Review*, Oxford Polytechnic, April 1973, pp. 5-7.

7. R.M. WOOLS, The Assessment of Room Friendliness, *Proceedings of the Architectural Psychology Conference*, Dalandhui, February 1969; London: RIBA Publications Limited, 1970, pp. 48-55.

8. S. CAMPBELL, Architectural Values as a Measure of Design Decision-Making, *Proceedings of the EDRA 3 Conference*, UCLA, Los Angelas, Calif. 1972, pp. 17.2.1 - 17.2.8.

9. J.M. BAILEY, Letter to the Editor, *The Architect's Journal*, 19 June 1974, p.1475.

Although the confidence in participatory design grows among the members of the design professions, i.e. a strong belief in that the social merits of mass-housing can best be assessed by the residents, they are less ready to accept that the merits of a theatre can best be assessed by theatre goers or that the merits of a court-room can best be assesed by judges and advocates.[10] Stringer explains differences in preferences by different personal construct systems of the layman and the designer.[11] According to the same belief, any plan or design produced by a professional designer constitutes part of a specialist construct system. The designer should rather be fitting his system to that of the layman.

10. P. COLLINS, *Architectural Judgement*, London: Faber and Faber, 1971, pp.154-170.

11. P. STRINGER, A Rationale for Participation, *Design Participation*, Proceedings of the DRS Conference, Manchester, September 1971; London: Academy Editions, 1972, pp. 26-29.

AMOUNT AND THE COMPLEXITY OF INFORMATION

Craun indicates that satisfaction with the perceived environment depends on the amount and organisation of the information presented to the observer.[12] A group of designers believe that the design participation can be achieved by legislative measures aimed at providing more information at the strategic design stages. For example, Coleman suggests the use of computers

12. R. CRAUN, Visual Determinants of Preference for Dwelling Environs, *Proceedings of the EDRA 1 Conference*, N.C. State Un., Raleigh, N.C., 1970, pp. 75-85.

in producing objective information to promote effective design decision-making.[13] This actually constitutes both of two basic concepts from which present research originates:

- Design-in-use is participatory. Those affected by design decisions at various levels, i.e. city, individual building, should participate in making these design decisions.[14]
- There are many factors to be considered and weighed against each other in evaluating design proposals. Considering the complex nature of the design decision-making, i.e. the large number of design attributes; people's level of agreement can be considered as a choice criterion itself, provided that the decision-maker is presented with the objective and accurate information on design proposals.

The complexity of design evaluation is emphasized by various authors: according to Fleming, design proposals always used to be assessed on their merits taking account of aesthetic and other intangible considerations;[15] Hormann shows the likelihood of making knowledgeable decisions, tangible and intangible factors and the direct involment of experts and users in exploring possible consequences and trade-offs;[16] the results of the study carried out by Sanoff on the evaluation of houses indicate at least ten different attributes of dwellings which were considered very important by a majority of respondents;[17] Craun mentions three important variables among others, in evaluating houses, namely the degree of visual complexity, the perceived cost of the dwelling and the amount of privacy offered by the dwelling environment.[18]

There are a few studies concentrating on the complexity in the built environment or in its representation, and the relationship between the complexity and preferences. Rapoport stresses the necessity of a common search for optimum complexity in the environment.[19] Gärling suggests "variation" as the common basis for aesthetic preferences.[20] Payne in his experiments finds a significant correlation between the architects' pupillary responses and the complexity of the stimuli, but no significant correlation between the non-architects' responses and complexity.[21]

Experiments carried out by Markman investigate the relationship between sensation-seeking, i.e. need for variation, optimal level of stimulation and complexity, and environmental preferences.[22] Results imply upper class design students to be higher on the sensation-seeking dimension than first, third and fourth year design students. Kaplan and Wendt experimentally tested the hypothesis that environmental preferences can be accounted for the complexity of the stimulus.[23] Results show that although complexity affects the decisions, it is neither the only variable, nor necessarily the most important variable in accounting for preferences.

According to Canter, research on the complexity as an information characteristic, describe it as a number of different things going on within the environment, the variety and intensity of information available from it.[24] Experimental studies indicate that other things being equal, more complex environments produce higher levels of physiological arousal in the users of those environments. Another important point is the fact that complexity is relative to the level of description and has no independent value. For example, a form may be conceptually complex but perceptually simple.

13. J.R. COLEMAN, A Computer Program Package for User Participation in Housing Design, *The 3rd International Design Activity Conference Preprints*, London, 1973, pp. 3.6.1 - 3.6.5.

14. T.W. MAVER, Design Paradigms, Design Aids and Design Decisions, *International Conference on Computers in Architecture, Preprints*, University of York, 1972, pp.39-47.

15. M.C. FLEMING, Building Decisions and Economic Appraisal Techiques in Practice, *Value in Building*, London: Applied Science, 1973, pp.61-81.

16. A. HORMANN, Machine-aided Evaluation of Alternative Designs, *Proceedings of the EDRA 3 Conference*, UCLA, Los Angeles, Calif., 1972, pp. 22.2.1 -22.2.11.

17. H. SANOFF and M. SAWHNEY, Residential Livability: A Study of User Attitudes Towards Their Residential Environment, *Proceedings of the EDRA 3 Conference*, UCLA, Los Angeles, Calif., 1972, pp. 13.8.1 - 13.8.10.

18. R. CRAUN, Visual Determinants of Preference for Dwelling Environs, *Proceedings of the EDRA 1 Conference*, N.C. State Un., Raleigh, N.C., 1970, pp. 75-85.

19. A. RAPOPORT, An Approach to the Study of Environmental Quality, *Proceedings of the EDRA 1 Conference*, N.C. State Un., Raleigh, N.C., 1970, pp. 1-13.

20. T. GÄRLING, Studies in Visual Perception of Architectural Spaces and Rooms; V. Aesthetic Preferences, *Scandinavian Journal of Psychology*, v.13, 1972, pp.222-227.

21. I. PAYNE, Pupillary Responses to Architectural Stimuli, *Proceedings of the Architectural Psychology Conference*, Dalandhui, February 1969; London: RIBA Publications Limited, 1970, pp. 35-39.

22. R. MARKMAN, Sensation-seeking and Environmental Preference, *Proceedings of the EDRA 2 Conference*, Carneige-Mellon Un., Pittsburgh, 1970.

23. S. KAPLAN and J.S. WENDT, Preference and the Visual Environment: Complexity and some Alternatives, *Proceedings of the EDRA 3 Conference*, UCLA, Los Angeles, Calif., 1972, pp. 6.8.1 - 6.8.5.

24. D. CANTER, The Place of Architectural Psychology, *Proceedings of the Architectural Psychology Conference*. ed. by B. Honikman, Kingston Polytechnic, September 1970; London: RIBA Publications Ltd., 1971, pp. 3-5.

DESIGN MEDIA AND LANGUAGE

Appleyard suggests that the most urgent priority for environmental psychology should be to integrate with design decision-making process.[25] He then proposes possible future strategies to achieve the integration of environmental research with design decision-making:

- Simulations and predictions, i.e. gaming, optimizations,
- Manuals and cook-books, i.e. Pattern Language,
- Experiments with the design media and language, i.e. experiments to validate modes of representation commonly used in design.

The effect of design media and language as written and pictorial material on design decision-making is emphasized by Rapoport.[26] Gärling in his experiment, compares the effect of two different forms of presentation, namely colour photos and drawings of urban street views on preferences in terms of pleasantness.[27] Results indicate that the stimuli, form of presentation and the interaction between those two have a significant effect on the preferences. Results of another experiment completed by Seaton show that colour photos appear to give good representation of reality, i.e. individual buildings relative to models and black and white photographs.[28] Lau notes similar findings related to the form of presentation.[29] Experiments carried out by Lau indicate that the assessment of scale model rooms were similar to the assessment of the full size rooms for pleasantness and gloom with respect to artificial lighting.

25. D. APPLEYARD, Professional Priorities for Environmental Psychology, *Architectural Psychology: Proceedings of the Lund Conference*, University of Lund, June 1973; Lund: Studentlitteratur ab, 1973, pp. 85-111.

26. A. RAPOPORT, An Approach to the Study of Environmental Quality, *Proceedings of the EDRA 1 Conference*, N.C. State Un., Raleigh, N.C., 1970, pp. 1-13.

27. T. GÄRLING, Studies in Visual Perception of Architectural Spaces and Rooms; V. Aesthetic Preferences, *Scandinavian Journal of Psychology*, v.13, 1972, pp.222-227.

28. R. W. SEATON, Validity and Reliability of Ratings of Simulated Buildings, *Proceedings of the EDRA 3 Conference*, UCLA, Los Angeles, Calif., 1972, pp. 6.10.1 . 6.10.12.

29. J.J.H. LAU, Differences Between Full-size and Scale-model Rooms in the Assessment of Lighting Quality , *Proceedings of the Architectural Psychology Conference*, Dalandhui, February 1969; London: RIBA Publications Ltd., 1970, pp.43-48.

EXPERIMENT

The hypothesis of the present research is that *the level of agreement on selection of design alternatives at the early design stages varies as a function of :*

- *the amount and quality of the information given to the judges;*
- *the professional training of the judges.*

To the knowledge of this author, there have been no experiments to test this hypothesis. In the present experiment, the hypothesis is tested by systematically manipulating the quality of information presented to the judges and the professional training. Hence the effect of these factors on the level of agreement within and between architects and non-architects is tested.

AIMS

Research aims were two-fold:

a. to develop a rational basis, e.g. agreement level for evaluating design alternatives;
b. to develop general information criteria in evaluating design proposals.

METHOD

The present experiment was conducted to investigate the effect of the quality of information presented to architects and non-architects on the evaluation of five holiday houses.

Independent variable : information quality, i.e. crude/ sophisticated

PARTICIPANTS:

Four groups of the University of Strathclyde students, each consisting of fifteen British individuals, participated in the experiments. (Total 60). Groups were formed of volunteer male subjects only. Participant age varied from 21 to 29, the overall mean age being 23.18.

MATERIALS:

Five sets of design drawings representing five holiday houses, each designed by a student of architecture for the same brief on the same site, were used. Participants were presented with a total of 25 A4 sheets. Each sheet was marked as Design A, B, C, D and E. Drawings consisted of site plans, floor plans, two sections, and two elevations.

Cost and performance values of the same holiday houses in numerical and profile form.

PROCEDURE:

The experiment was conducted in the Department of Architecture, University of Strathclyde. Each participant was given a form, and asked to read and to fill it out. He was then given five sets of drawings and asked to list five schemes in order of preference. To eliminate the order effect, the sequence of material was randomised and each participant was given a set with a different order.[30]

Participants in Group 3 and 4 vere presented with the cost and performance profiles of five design schemes, in addition to drawings. Subjects were asked to make individual judgements and not to discuss design schemes with each other before the completion of the experiment. Although no time limit on final decision-making was determined, time to reach the final decision was recorded for each participant. Considering some earlier experiments carried out by Mikellides[31] and Lau[32], three dimensional scale models were not included in the experiment. The rank ordering technique was preferred over paired comparison because of its ability to handle larger numbers, five design alternatives in this case. Results of this experiment support the findings of another test carried out by Abdelrahman[33] in which the paired comparison technique was employed. The experiment was discussed with participants informally after the completion of the experiment and their comments were recorded.

Considering Craik's factors which affect architectural judgement the rationale for designing the experiment can be summarized as follows:

Holiday houses were selected becuse they are small in size and many people are familiar with them as a common building type;
Architects and non-architects judged the schemes;
The judges were asked to evaluate schemes on a general like/dislike scale;
The different stimuli, i.e. five holiday house schemes, were presented in drawing and profile forms since architectural drawings are the most common forms of presentation used by designers during design;
Judges viewed the representations individually without any time constraints.

30. Notes taken of opinions expressed by Dr. T. Mayes of the Department of Psychology, Strathclyde, during an informal discussions, 1974.

31. B. MIKELLIDES, Evaluation of Holiday Chalets by Architects and Laymen, *Synthesis 2: Architectural Research Review*, Oxford Polytechnic, April 1973, pp. 5-7.

32. J.J.H. LAU, Differences Between Full-size and Scale-model Rooms in the Assessment of Lighting Quality, *Proceedings of the Architectural Psychology Conference*, Dalandhui, February 1969, London: RIBA Publications Limited, 1970, pp. 43-48.

33. S. ABDELRAHMAN, "An Experiment to compare the Response of Architects and Laymen to two Dimensional Architectural Drawings," Unpublished Report, Department of Architecture and Building Science, Strathclyde,, 1974.

RESULTS

The results were analysed in relation to the agreement within and between groups.

AGREEMENT WITHIN THE GROUPS

The results indicated that the highest intra-group agreement is found in Group 3: Architectural students presented with sophisticated information, (cf. Table 1 and Figure 1). This result ascertains the fact that architectural students can have a common basis for judging design schemes when they are given information in addition to design drawing. Group 2: non-architectural students with crude information exhibit the second highest agreement and Group 4: Non-architectural students with sophisticated information come third. The highest degree of agreement within Group 3 supports the results of the pilot experiments completed at the University of Strathclyde by Abdelrahman.[34]

34. S. ABDELRAHMAN, "An Experiment to Compare the Response of Architects and Laymen to Two Dimensional Architectural Drawings," Unpublished Report, Department of Architecture and Building Science, Strathclyde, 1974.

	GROUPS	W*= coefficient of concordance	F**	Results
Agreement Within Groups	1. Architectural Students with crude information	0.112	1.77	Not significant
	2. Non-architectural Students with crude information	0.302	6.05	Significant
	3. Architectural Students with sophisticated information	0.362	7.94	Significant
	4. Non-architectural Students with sophisticated information	2.273	5.25	Significant
Agreement Between Groups	Group 1 - Group 2	0.117	3.87	Significant
	Group 1 - Group 3	0.187	6.67	Significant
	Group 1 - Group 4	0.121	3.99	Significant
	Group 2 - Group 3	0.171	6.01	Significant
	Group 2 - Group 4	0.149	5.09	Significant
	Group 3 - Group 4	0.298	12.33	Significant

Table 1. Agreement Within and Between Groups.

* Kendall's Coefficient of Concordance: (W) varies from zero signifying complete agreement among the judges.

** Tabulated F = 3.68 at 0.01 level of significance, for agreement within groups.

Tabulated F = 3.50 at 0.01 level of significance, for agreement between groups.

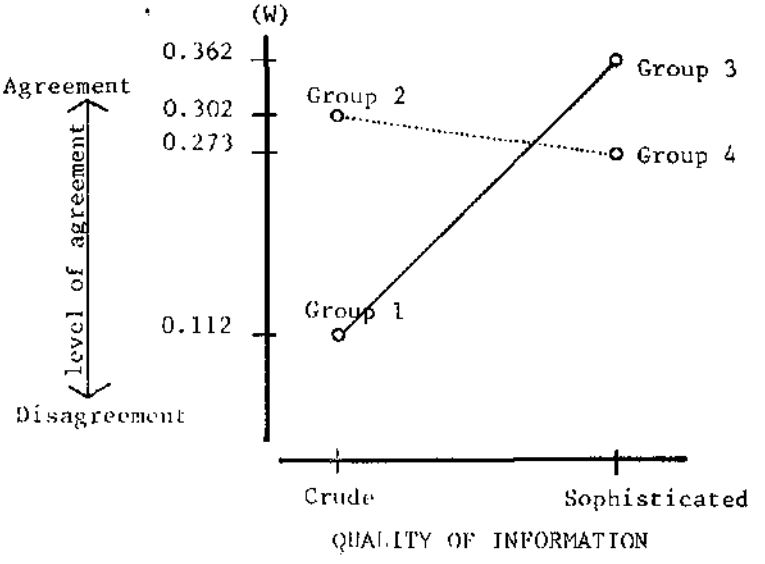


Fig. 1 Agreement Within Groups.

——— Denotes architects Groups 1 and 3

..... Denotes non-architects Groups 2 and 4

W = Coefficient of Concordance; the measure of agreement between the judges

An interesting part of the results is the fact that the members of Group 1 exhibit a very low level of agreement with each other when they are presented with drawings only (cf. Figure 1). Our informal discussions with the participants in Group 1 support the hypothesis that architectural students differ very much in their opinions on single aspects of the holiday houses, e.g. styles in elevations, in comparison to non-architectural students. In terms of the total and mean rankings, Groups 3 and 4 tend to converge more in their opinions of each design scheme, than Groups 2 and 1. (cf. Figures 2 and 3). This shows that the additional information was an important factor which can cause convergence in people's opinions.

Figure 3 illustrates that a change in the quality of information affects both architectural and non-architectural students' preferences of holiday houses. In the case of Design B, C and E, the changes in preferences are on the same direction for architectural and non-architectural students, whereas in Design A and D, changes occur at the opposite direction on the 'like-dislike' scale.

AGREEMENT BETWEEN GROUPS

As can be seen in Table I, the highest inter-group agreement was found between Group 3: architectural students presented with sophisticated information and Group 4: non-architectural students presented with sophisticated information. The combination of Groups 1 and 3 exhibits the second highest agreement and Group 2 and 3 combination comes third. Although the findings of this experiment are not conclusive, it can be noted that *the results support the hypothesis that an increase in the quality of information causes convergence in opinion of architectural and non-architectural students.* Architectural students' specialised training and education tend to be the second important factor determining the level of agreement. The lowest degree of agreement found between Group 1 and Group 2 is supported by the results of an experiment of Mikellides[35] in which non-architectural polytechnic students presented with crude information, similar to Group 2 in the present experiment, exhibited a higher degree of agreement with laymen than with architectural students with crude information, similar to Group 1 in the present experiment.

35. B. MIKELLIDES, Evaluation of Holiday Chalets by Architects and Laymen, *Synthesis 2: Architectural Research Review*, Oxford Polytechnic, April 1973, pp. 5-7.

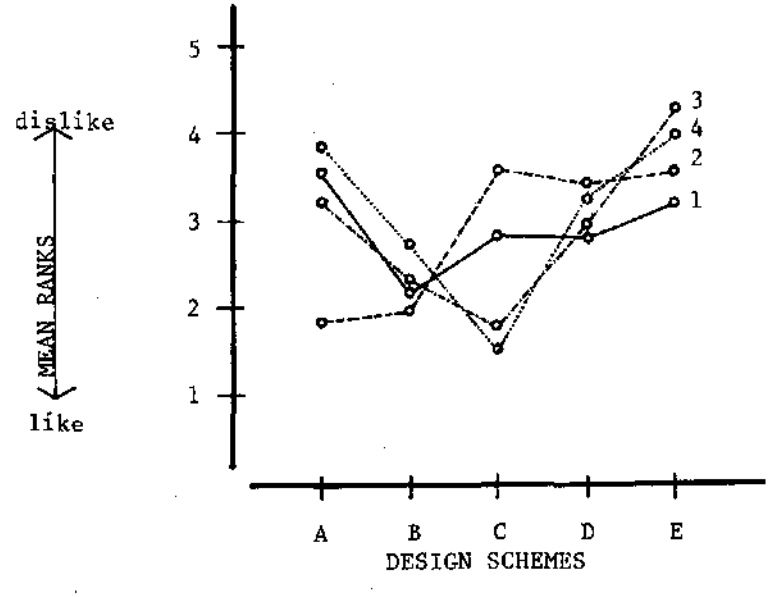


Fig. 2 Mean Ranks Versus Holiday Houses for Each Experimental Group.

—— Group 1= architectural students, *.crude information*

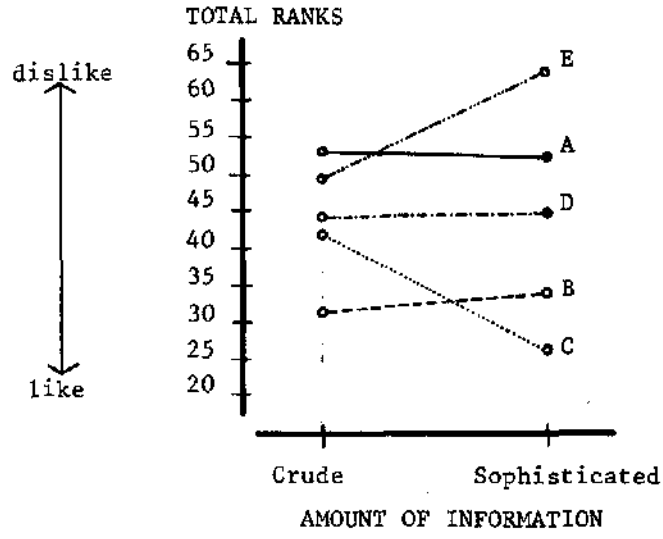
----- Group 2= non-architectural students, *.crude information*

-.-.-.- Group 3= architectural students, *.sophisticated information*

..... Group 4= non-architectural students, *.sophisticated information*

The results of this experiment partly support the findings of a pilot study in which participants of Group 1 and 3 also exhibit a significant degree of agreement in their preferences.[36]

a) Architects : GROUPS 1 and 3



b) Non-architects: GROUPS 2 and 4

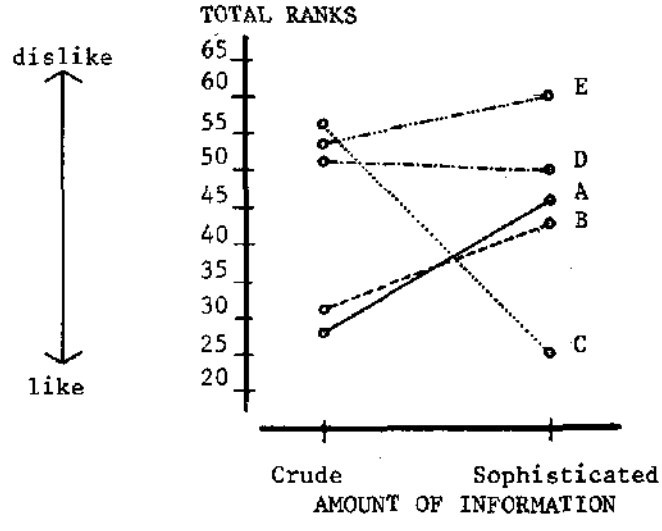


Fig. 3 Mean Ranks Versus Quality of Information for Five Holiday House Schemes.

——— Design A

– – – – Design B

..... Design C

—.—.— Design D

——.—— Design E

CONCLUSIONS

Although the present research continues, the following tentative conclusions can be drawn from the experiment results:

1. Given 'crude' information, non-architects achieve a higher level of agreement with each other than do architects.
2. Given 'sophisticated' information, non-architects reach the same conclusion as architects on the quality of alternative schemes.
3. Given 'sophisticated' information, non-architects can achieve almost as much group agreement as architects presented with the same information.

36. S. ABDELRAHMAN, "An Experiment to Compare the Response of Architects and Laymen to Two Dimensional Architectural Drawings," Unpublished Report, Department of Architecture and Building Science, Strathclyde, 1974.

4. Finally, agreement level is proposed as an evaluation criterion in building design.

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BİNA TASARIMINDA DEĞERLENDİRMEYE İLİŞKİN DENEYSEL BİR ÇALIŞMA

ÖZET

Bu yazıda mimar ve mimar olamayanların, mimarlık tasarımlarının değerlendirilmesindeki davranışları incelenmekte, karar verici grupların düşünce birliği düzeyleri, tasarıma ilişkin verilerin nitelik ve niceliği, ve karar vericilerin meslekleri arasındaki ikişkiler deneysel yolla araştırılmaktadır.

Bu amacla düzenlenen deneylerin ilkinde veri niceliğinin, tatil evlerinin seçimindeki rolü incelenmiş, istatistik analizlerle, aşağıdaki sonuçlara varılmıştır:

1. Mimar olmayanlar, kendilerine sadece tasarım çizimleri verildiğinde birbirleriyle mimarlara oranla daha çok düşünce birliğine varmakta,
2. Yine mimar olmayanlar, tatil evi çizimleri ve ek bilgi verildiğinde (örneğin, yapım ve işletme maliyetleri, alanları) hemen hemen mimarlarla aynı sonuçlara varmakta,
3. Mimar olmayan karar vericiler, kendilerine çizim ve ek bilgi verildiğinde en az mimarlar kadar düşünce birliğine varmaktadırlar.

Yine sonuç olarak, gelecekte düşünce birliği düzeyinin, tasarımların değerlendirilmesinde (örneğin, mimarlık yarışmaları) geçerli ölçüt olarak kabul edilmesi gereği savunulmaktadır.

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