THE PERCEPTION AND ASSESSMENT OF ARCHITECTURAL ENVIRONMENTS: MODE OF REPRESENTATION AND DISCRIMINANT/DIVERGENT VALIDITY

by

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ABSTRACT

The perception and evaluation of architectural spaces is an important concern of environmental psychology. The frequent use of alternate modes of representation such as photographs and scale models in environmental perception and assessment research is based on a largely untested notion that responses to real and represented environments are the same. In addition, it has been suggested that the rating scales used in this type of research lack discriminant, or divergent, validity because they do not successfully discriminate between diverse environments.

The present study determined the extent to which projected photographs serve as a valid substitute for full-scale interior environments, and assessed the discriminant/divergent validity of a set of 20 five-point unipolar semantic scales. Three groups of 50 male and 50 female introductory psychology students rated either two full-scale interiors, photographs of those same interiors, or rated conceptualized settings. A repeated measures multivariate analysis of variance revealed that there were significant differences in the ratings as a function of the mode of representation, the sex of the rater, and the type of room being rated. In addition, there were three significant two-way interaction effects; (i.e., mode by sex, mode by room, and sex by room). Discriminant analyses demonstrated that the differences in

ratings primarily separated the group rating conceptualized interiors from the groups rating either the actual interiors or the photographic representations. Hence, the measures employed exhibited discriminant/divergent validity. A moderate enhancement of the perceived size of an interior viewed and assessed photographically was evident; however, the ratings on the majority of scales for the full-scale and the photographically represented interiors were largely congruent.

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INTRODUCTION

Environmental psychology is often described as the study of man/environment interactions. One area of concern in environmental psychology is the question of how individuals perceive and evaluate man-made and natural environments. Basically, there are two ways of presenting an environment for evaluation. First, a real space can be used. In this situation, subjects would make on-site observations of pre-existing environments such as a room, building, recreation-site or natural landscape. Second, some form of indirect representation of the environment could be used. Using this method, subjects would be presented with a photograph, perspective drawing, or perhaps a scale model of the environment under investigation.

For a variety of reasons, the use of actual spaces is often impractical and even impossible in this type of research. For example, it would be prohibitively expensive to actually construct an experimental house, office building, or recreational setting. This is a particularly salient point if one is interested in comparing responses to different designs. Similarly, it is very often the case that a designer wants an assessment of a planned or projected environment, and it is unlikely that a setting would be constructed solely for this purpose. Further, even if appropriate settings are available, they clearly cannot be brought to the subjects, rather, the subjects must be transported to them (Seaton, 1971). This can be an expensive and/or logistically difficult proposition. Finally, perhaps the greatest difficulty with using real spaces becomes evident when considering the magnitude and complexity of the system under study. The complex of variables which are inherent to a real setting defies the use of sound methodology and experimental design in this type of research (Winkel and Sasanoff, 1970). At best, it is difficult to control or hold constant the multitude of components which contribute to a real setting while manipulating single components or variables of interest. At worst, it is quite impossible to do so. If significant differences in perception and evaluation do emerge it would be difficult to determine their sources.

Because of these difficulties, it is not surprising that the majority of the research in this area has employed some form of indirect representation of the actual settings being investigated. Most pervasive in the literature has been the use of colour transparencies or colour photographs in order to assess people's perceptions and evaluations of natural landscapes (e.g., Calvin, Dearinger, and Curtin, 1972; Linton, 1968; Sonnenfeld, 1966; Wenger and Videback, 1969; Zube, 1974). In addition, slides and colour photographs have been used to assess outdoor recreation environments (Carls, 1974), architectural styles (Oostendorp and Berlyne, Note 1), urban and rural environments (Sorte, 1973), and interiors (Acking, 1971; Kuller, 1972; Wedin, Avant, and Wolins, 1973). Black and white photographs have been used as well but to a lesser extent, (e.g., Canter, 1969; Kaplan, Kaplan and Deardorff, 1974; Peterson and Neumann, 1969; Seaton and Collins, 1972; Shafer, Hamilton, and Schimdt, 1969). Other modes of representing environments include; perspective drawings, (Brodin, 1973; Garling, 1973; Hayward, Scott, and Franklin, 1974), scale models, (Kaplan, Kaplan, and Deardorff, 1974; Lau, 1972), floorplans and blueprints, (Cunningham, 1977; Wedin, Avant, and Wolins, 1973), simulation booths (Winkel and Sasanoff, 1970), cinematographic presentation (Clamp, 1976) and computer graphic simulation (Greenberg, 1974).

Representations are not foreign to the applied professions either. Architects, interior designers, landscape planners, and city planners have long used simulations of prospective projects to convince clients that their design solutions are effective ones. Three-dimensional scale models, photographs, drawings, and drafted plans are frequently used.

With such widespread use of the various modes of representing environments, it is surprising that the question of their validity has been so infrequently addressed. That is, in the transition from the real environment to a representation of it, are researchers or designers potentially losing important elements of the environment which contribute to the manner in which it is perceived and evaluated? Specifically, studies and projects in academe and the design professions, given the inherent differences between the real and the simulated, are of questionable value until the validity of using representational techniques in environmental research is established.

Are scale models, photographs, drawings, and the like, valid substitutes for real spaces? Are responses to representations of planned environments predictive of those to the finished product? Which representations are best suited for the research or design questions being asked? In general, do representations elicit the same responses as real or "full-cue" situations? If not, in what manner do they differ? Given that they differ, are the representations at least comparable and therefore useful for research purposes? Such questions have not gone unnoticed. For example, Seaton (1971, p.1) writes "if architecture - defined as the design of environments at human scale - survives as a profession, it will be because it has access to a body of empirical knowledge... established by controlled experimentation." He continues, and states "if the profession of architecture is to become knowledge-based, architectural variables as stimuli must be amenable to simulation which is cheap, flexible, transportable, reduced in size and - above all - valid in terms of responses elicited by real constructions." Similar sentiments regarding representational techniques have been expressed by researchers investigating other diverse environments; notably, Shafer and Richards (1974) on landscapes and Hershberger (1972), Danford and Willems (1975), and Stokols (1978) on environmental assessment research in general. Indeed, Craik (1968) has suggested that establishing the effects which different modes of representing environments have on a person's comprehension of that environment must take priority over other questions in environmental assessment research. The validity of these techniques must be established prior to their use.

The literature reviewed and research presented below will deal with the question of whether or not, or to what extent, a representation is a valid substitute for a real environment.

Literature Review

Research on the validity of simulation techniques in the perception and evaluation of environments has been both limited, and has produced equivocal results. There appear to be several reasons for this. First, the number of ways in which environmental stimuli can be presented is quite large, thus, the number of possible comparisons is appreciable. To date, only a small number of these comparisons have been made. In addition, a variety of dependent measures have been used therefore many studies are not directly comparable. Further, it may be the case that two modes of representation may be equivalent for one judgemental measure but not another. For example, if one is rating houses, photographs and line drawings may be appropriate for "preference" judgements but not for those of "status." In a similar vein, the environments rated have ranged from landscapes through buildings to interiors. It is not necessarily the case that a given mode of representation is adequate for all environmental settings. Finally, many studies appear to be methodologically inadequate and/or lack significance testing. With these points in mind, a review of the relevant literature can be pursued.

In an early work on the validity of simulations, Winkel and Sasanoff (1970) investigated the feasability of using simulation "booths" to ascertain the behaviour of visitors in a museum setting. The simulation involved the presentation of a series of colour transparencies depicting a "walk" through the museum by the subject. Subjects viewed an initial set of transparencies picturing the overall view of the museum interior as seen from the entrance to the museum. They then chose to "walk" to the right or left of the scene. Subsequent sets of slides depicted the scene which they would have encountered had they proceeded in the direction which they had chosen. In this manner the subjects were "walked" through the museum. The results, when compared to the behavior of actual visitors to the museum were comparable in some ways, however, quite different in others. A post-experimental questionnaire revealed that many of the respondents who underwent the simulation were unable to accurately state where they had been in the museum during their "walk." On the other hand, visitors who had actually walked through the museum were quite accurate in this regard. It should be noted as well that the study is merely descriptive and does not utilize dependent measures which adequately test for comparability between the actual tour and the simulated version.

Using a semantic differential approach, Canter (1969) investigated the cognitive framework people utilize in the perception of buildings as a function of two distinctly different simulations. Using architectural floorplans Canter looked at the connotative dimensions of architecture as expressed in ratings made by students of architecture. In addition, he used perspective line drawings of room interiors using as subjects undergraduates who were not architecture students. Factor analysis yielded similar connotative dimensions with both modes of representations. Unfortunately, these ratings were not compared to those made in actual enviroments. In addition, the use of factor analysis alone, as in this study, does not adequately address questions concerning the comparability of the two modes of representation. It could be the case that the mean ratings of two modes are significantly different even though the factor structures are very similar. Conversely, the factor structures could be very different even when the mean ratings are not significantly different. Factor analysis should be treated as an aid in determining where differences or similarities lie, rather than a test of the comparability or adequacy of the representations.

In an investigation to study the effects of architectural features on the perceived happiness, coherence, and activity of interiors, Wools (1970) varied the type of window, ceilings, and furniture arrangement of a number interiors. Factor analytically derived sets of bi-polar scales effectively distinguished rooms with different characteristics both in simulation (line drawings) and in actuality on the happiness and coherence factors. The comparability of the real and the simulated in this study is questionable however, in that none of the drawings were modeled after the actual rooms used.

This methodological shortcoming is evident as well in a study by Acking and Kuller (1972). The authors looked at the perception of interiors as a function of their colour. Using both colour drawings and colour slides of interiors, responses (semantic descriptions) were compared to the semantic profiles of three differently coloured hospital interiors rated *in situ*. Ratings proved to be similar on a number of dimensions however, once again, the simulated interiors were not representations of the actual interiors used. In addition, different semantic descriptors were used for rating the simulations and the hospital interiors. This would suggest that the similarities which the authors note are an artifactual finding; due primarily to insensitive dependent measures. In effect, the high degree of congruence found by the authors may be due more to the generality of the descriptors than to similarities in the underlying connotative frameworks within which the environments are perceived.

This difficulty is evident in another study conducted by Acking and Kuller (1973). Bipolar semantic scales were used to generate factor structures that would be descriptive of interior environments viewed in actuality and simulated through the use of colour slides. The authors found similar factor configurations for both modes of representation. The same scales were then used to rate respondent's perceptions of a housing project. Factor analysis of this data yielded eight connotative dimensions, very similar to those derived from the room study. The fact that the same set of descriptors characterized both interiors and the exterior architecture of the housing project suggests that the dependent measures used are not tapping important differences in these inherently diverse environments. Once again, the generality of the descriptors appears to be the problem.

The authors then used the highest loading variables for each of the principal dimensions (labelled as unity, complexity, social status, enclosedness, and pleasantness) to rate two other housing projects. Both projects were rated on-site and through a number of simulations; i.e., illustrational plans, monochromatic schematic models, coloured naturalistic models, black and white perspective drawings, colour slides of the naturalistic models. All of the ratings for the simulations were compared to those for the on-site condition. The plans, monochromatic models, and perspective drawings proved to be the poorest methods for capturing the unity, complexity, enclosedness, and pleasantness of the real housing projects. The movies did not correctly represent the social status as rated in actuality and the naturalistic model failed to reflect the unity of the actual housing projects. However, the colour slides showed a moderate degree of congruence on all of the factors when compared to on-site ratings. This is a rather curious and perhaps fortuitous finding given that the colour slides were photographs of the naturalistic models, hence a second-order representation of reality.

A study in 1971 by Wood, (cited in Collins, Note 2) investigated the perceived differences between three modes of representing a stamp purchasing experience as recorded in five different post offices. This research compared the actual experience with a videotape representation and black-white and colour films of that same experience. Subjects assessed each of the representations on five bipolar semantic scales and twelve other dependent measures which assessed, among other things, the subjects perceptions of the quality of the service provided and the subject's willingness to experience minor inconveniences in order to use the facilities. With the exception of assessed interbuilding distances, the responses to reality were not significantly discriminable from those in the three simulation conditions. The differences which did exist however suggested that the responses to the videotape was most like reality and colour film and black and white film least like the responses to the actual experience. An interesting finding in this study is that subjects had no greater difficulty responding to metathetic than prothetic dependent measures. Scales designed to tap subject's perceptions of discrete physical variables such as "size" or "distance" (prothetic) were responded to with the same ease as the metathetic variables measuring more abstract perceptions (i.e., pleasantness, functional clarity). Other studies, notably Kasmar (1970), have suggested that subjects have difficulty rating environments on metathetic scales.

Peterson, Woodman, and Eaton (1970) had five groups rate a building (a theater) on four different criteria. One group saw colour slides of the building taken at various times during the day. A second group saw slides of the building taken during a scheduled performance. The third group viewed both sets of these slides. The fourth group rated the theater in actuality after attending a performance and a fifth group rated the building prior to a performance. The building was rated by all groups according to it's perceived space, scale, detail, and architecture. Using architectual students as subjects, the ratings of the actual building and those of the slides were not significantly different. No explanation is given as to why the authors chose to have one group rate the building after attending a performance and another rate it prior to a performance. Choosing to do this destroys a good deal of the comparability of the real versus the simulated. If significant differences had been found between the ratings in actuality and the ratings for the slides it would be difficult to decide whether these differences were due to the mode of representation used or to the fact that the groups had experienced the building in two completely different ways (i.e., as participators in the activity offered by the building or as naive viewers of the building). The fact that significant differences were not found is not surprising however. It is often the case that mean differences in ratings are on the order of one scale point. Given that the total number of raters in each group ranged from eight in the real presentation to a high of ten in the combined slide group the power of the test chosen to detect any differences between the groups appears to have been inordinately low.

Garling (1970) has suggested that with respect to the perceived depth and size of street scenes, perspective drawings and photographs are rated similarly to those same scenes judged in situ. This marked similarity between judgements was demonstrated in an earlier work by Garling (1969) when investigating the perceived depth and size of interiors using the same three modes of presentation. These findings are contrary to the results of a study conducted by Wedin, Avant, and Wolins (1973). In this study four sets of bipolar adjectives were employed to assess the aesthetic appeal, physical organization, phenomenological size, and physical size of three different living rooms as represented by floor plans, isometric drawings, and photographs. Although the ratings of the aesthetic appeal, physical organization and phenomenological size of the room were similar and consistent for all of the modes of representation employed, the responses to the physical size were inconsistent across the three graphic forms. Subjects rated the smallest room lowest in physical size, however they also consistently, for all modes of representation, rated the medium sized room as much larger than the truly largest room. It is difficult to assess precisely why the physical size of interiors should be adequately portrayed by surrogate modes of representation in Garling's (1969) study and yet prove inadequate in the Wedin et. al. (1973) investigation. One notable area of difference between the studies is the dependent measures used by each to assess the subject's perceptions. Whereas Garling (1969) had subjects assign numbers proportional to the perceived size and depth of the rooms, Wedin et. al. (1973) used semantic bipolar scales, (e.g., small/large, narrow/wide), to assess physical size. It may well be the case that the choice of dependent measure is a critical factor when attempting to assess people's perceptions of environments. (This proposition will be elaborated upon later in this review). Another important difference between these studies which could account for their contradictory findings lies in their choice of subjects. Garling's (1969) study employed male raters exclusively whereas Wedin et. al. (1973) used female raters exclusively. Perhaps the differences in the results of the two studies are accounted for by the sex variable. Indeed, Hudgens and Billingsley (1978) have shown that of 59 articles surveyed in the journals, Human Factors and Ergonomics, 73% showed significant differences for the sex variable. Future environmental assessment research should include both sexes whenever possible, and further, statistical tests for sex differences in the ratings should be performed.

A number of studies have investigated the validity of using simulations for assessing the lighting quality of interiors. Lau (1972) had subjects rate the illuminant quality of full size rooms as compared to scale models of those same rooms. Responses to the scale models were similar to those of the full-size rooms, however, the author notes that generally the scale models were assessed more positively than were the full-scale interiors. In a similar study, Corth (1980) also assessed the validity of scale models as depictors of lighting quality. He too noted that the scale models were consistently rated as more "desirable," hence their qualities were enhanced. Whereas, Lau (1972) hypothesized that this enhancement effect was due to some intrinsic characteristic of miniaturization, Corth (1980) suggests that the bias is due to the differences in luminance intensity between the models and the full-size rooms. When the level of illuminance was halved in the scale model relative to the real room, responses to the simulation were comparable to those for the real space (Corth, 1980). Appropriate scaling of the illuminance level as well as room size resulted in the disappearance of the positive bias for the scale models.

However, this enhancement effect is noted in other studies which do not employ scale models. While varying the lighting arrangement of an interior, Hendrick, Martyniuk, Spencer and Flynn (1977) compared subject's perceptions of photographs of those arrangements with scores for the real room. Generally, the projected transparencies were rated as more clear, distinct, radiant, and bright when compared to the real space. Given that slides were used as a stimulus mode rather than scale models, it is difficult to see how luminance intensity could account for the enhancement effect.

Indeed, enhancement effects for alternate modes of representation are evident in other studies investigating their validity. Anderson (1972) noted that the representation of exterior architecture using colour film was rated more positively than the real exterior. Research conducted by Lane, Byrd, and Brantley (1975) compared preferences for outdoor recreation environments with panoramic colour slides of these environments and found large discrepancies in preferences between the real and the photographic representation. The colour slides tended to over-glamourize the sites, enhancing them to the extent that they yielded significantly different perceptions when compared to the actual sites.

Other studies have investigated the validity of representations of buildings, apartment complexes, and housing design. For example, Seaton and Collins (1972) had subjects evaluate scale models, colour photographs, and black and white photographs of campus buildings and compared them to evaluations of the real buildings. Using five 7-point semantic scales (i.e., 1. peaceful/quiet, 2. strong/bold, 3. dynamic/exciting, 4. orderly/tidy, 5. pleasing/appealing), the authors note that the buildings rated high on some scales and low on others and that the different modes of representation did not affect the average ratings pooled across buildings. However, what the different modes did significantly affect were the relative mean values between the buildings. Specifically, the relative pleasantness or appealingness of the buildings depended on how it was represented. The study found a significant building by simulation interaction effect, $F(9,888) = 3.13$, $p < .01$. Of the three modes, colour photographs were noted as being the best representers of reality, especially when appraising the strength/boldness and dynamism/excitingness dimension. Black and white photographs proved to be the least veridical mode, exhibiting a low correlation with ratings for the real buildings on all of the scales used. Generally, however, none of the modes employed represented reality as efficiently as was hypothesized. The photographs and models were "not typically a psychological surrogate for the real facades" (Seaton and Collins, 1972, p.6-10-1).

Kaplan, Kaplan, and Deardorff (1974) have suggested that people respond similarly to three-dimensional models of apartment buildings as compared to photographs of the actual complexes. Interestingly, in this study a second-order representation of reality was used. Rather than present the models for evaluation, photographs of the models were rated and then compared to the responses for photographs of the real space. Unfortunately the study as reported is merely descriptive in nature and does not allow the reader to assess the degree of similarity between the judgements for the two modes. In addition, the authors did not investigate subject's perceptions of the real space, hence, any conclusions regarding the validity of the different modes of representation are questionable.

Hershberger and Cass (1974) and Sorte (1975) independently investigated simulations of housing. The two studies yielded conflicting results. Whereas Hershberger and Cass (1974) concluded that colour slides and colour movies represented the real environment well, Sorte (1975), using the same modes of representation as well as others (i.e., illustration plans, three-dimensional models, and perspective drawings), found large differences between the factor structures of the real and the simulated versions. It should be noted however that Sorte (1975) does not provide for significance testing of the mean response scores. The study merely reports mean-profile comparisons in graphic form. Although differences in the means across the modes of representation used are evident, this is a qualitative judgement; it is difficult to decide whether or not these reflect a real difference in perception without the appropriate statistical tests. On the other hand, Hershberger and Cass (1974) report that, in addition to having very similar mean-profiles and factor configurations, a multivariate analysis of variance revealed that there were no significant differences in mean judgements between the real and the colour film mode on the scales used. The results also suggest that colour slides adequately depicted reality, although they were not as comparable with reality as were colour movies.

Conflicting results are evident in the investigation of simulations of other environments as well. In particular, studies looking at the validity of simulations as representers of natural and urban landscapes have argued both in favour of and against their use. Boster and Daniel (1972) investigated scenic quality and concluded that the scenic values assigned to the landscapes used, as estimated by on-site and photographic representation, were essentially the same. This is a qualitative judgement however; no significance tests were performed. Shafer and Richards (1974) recorded viewer's reactions to outdoor scenes and compared them to the responses to colour photographs of those same scenes. The authors conclude that colour slides and colour photographs adequately depict most natural and man-made environments when the bulk of the variability present in these environments is tapped by the response instrument. However, when only a portion of the stimulus variability is allowed for, responses to the simulated presentations are significantly different from the on-site responses. This would suggest that simulations are capable of capturing only the grosser aspects of a given landscape, and in so doing, leave out important, more subtle differences.

In a study by Zube, Pitt, and Anderson (1974), on-site evaluations of natural landscapes were compared to evaluations of the same landscapes represented by single and multiple frame panoramic colour photographs. The responses to the photographs were highly correlated with on-site evaluations (i.e., Pearson $\underline{r}$ ranged from a low of $\underline{r} = .68$, to a high of $\underline{r} = .99$, with values of $\underline{r} = .97$ or higher for six of the eight settings evaluated). Clamp (1975) also examined the validity of simulating landscapes by comparing responses to colour slide presentations with on-site evaluations. As in the study by Zube et. al. (1974), responses to the simulations and the real were highly correlated (i.e., $\underline{r} = .87$). However, the findings of Lane et. al. (1975), a study discussed earlier in this review, found that evaluations of colour slides of outdoor environments were significantly different from the scores for the real environment.

Why contradictory findings are evident for studies which investigate the same "type" of environment and employ similar methodology using the same modes of representation is not clear. One source of variation which may account for the contradictions is the subject population which the studies employ in their investigation. For example, whereas Shafer and Richards used photography students as raters, Lane et. al. used forestry students as judges. Presumably, these two group's preferences may differ when rating outdoor environments _in situ_ and photographs of those same environments; (if it is acknowledged that enrollment in a course reflects an interest in the subject matter taught in the course). Indeed, choice of subject population is a well documented and potent source of variation in environmental assessment research. Canter (1969) has shown that architecture students judge floorplans and drawings of buildings differently than do non-architects or "laymen." Further, Canter and Wools (1970) have documented differences in responses between groups familiar with the environment being rated and those unfamiliar with the environment. Craik (1970, 1972) has argued that environmental decision-makers, that is, experts, often differ from the naive or non-expert population in their perception, interpretation, and evaluation of the physical environment. This hypothesis is empirically supported in studies by Peterson (1974a, 1974b) and by a study by Clark (1971) which reports that outdoor recreation park managers' perceptions of a park users' views are a reflection of his own feelings, hence, are often at variance with the user's true sentiments. Ratings of the area by the park manager and the park users were quite different even when the expert role-played the part of a user.

In perhaps the most provocative study on simulation techniques, Danford and Willems (1975) have revealed some disturbing findings which raise questions concerning the validity of all research investigating the use of surrogate modes of representation in environmental assessment research. The study examined the adequacy of using colour transparencies to represent full-scale architectural settings. Unique to the study was the employment of two control groups used to test the degree of shared response variance between groups exposed to representations which "should" elicit ratings similar to those elicited by the real space as opposed to those groups which "should not" elicit similar ratings when compared to responses to the real setting. As the authors suggest, it is important to test the degree of congruence between the real environment and a "good" simulated version of it. Moreover, it is equally important to test the comparability of responses between the real environment and a "poor" simulated version of it. If the responses to the real setting are comparable with the simulation then convergent validity has been attained. The simulation can then justifiably be used for research or assessment purposes. If the responses to the real environment differs significantly from the responses to a representation which should differ, (i.e., a representation which is obviously a poor surrogate for the real setting), then discriminant validity has been established. In effect, it has been demonstrated that the response instrument measures what it purports to measure; in this case, the degree of congruence or incongruence between responses to the simulations employed and the real environment.

The distinction between convergent and discriminant validity was introduced by Campbell and Fiske (1959). Discriminant validity is said to have been demonstrated when a test is not redundant with other better established or more parsimonious tests (Campbell, 1960). This is an entirely different notion of discriminant validity than the one presented by Danford and Willems. Whereas Campbell and Fiske (1959) are concerned with the redundancy and parsimony of a test, Danford and Willems are concerned with the ability of a test to show differences where differences logistically should be. In this sense, perhaps a more appropriate label for the Danford and Willems' version of discriminant validity is "divergent validity." Indeed, Danford and Willems do inexplicably interchange these terms throughout their paper without differentiating between the two. However, their misinterpretation does not deny the importance of testing for discriminant/ divergent validity as they define it.

To test for both convergent and discriminant/divergent validity, the authors, using 36 unipolar semantic scales, elicited responses from four groups. One group rated the real setting; (a campus law building). A second group rated a photographic representation of the building and were informed of the building's function. A third group responded to their concept of what a law building should be like; (imagery of a campus law building was elicited by verbal instruction). A fourth group rated the photographs of the building without being informed of the building's function. The first two groups were included to test for convergent validity, hence, address the question concerning the adequacy of the photographic representation of reality. The inclusion of the latter two groups provides for a test of the discriminant/divergent validity of the response instrument employed. Results indicated that there were virtually no differences among the four groups in terms of average scale values, overall response profiles, and factor structures. As the authors suggest, the similarities might be expected for groups 1 and 2. However, the fact that the subjects who did not view the setting but only responded to the concept of a law building and those who viewed unlabelled photographs responded "in a fashion that was essentially indistinguishable" from the first two groups is disturbing. As a result of the overall similarity in ratings Danford and Willems concluded that techniques using subjective rating scales may result in response patterns determined solely by an invalid response instrument rather than the environmental stimuli employed.

At this point in time, only one researcher has attempted to address the criticisms of environmental assessment research raised by Danford and Willems. Gifford (Note 1) had subjects rate four buildings on three bipolar semantic scales which represented the following dimensions: aesthetics, usefulness, and moderness. As in the Danford and Willems study, four groups were employed. Group 1 rated the actual buildings; group 2 rated colour photographs and were told what function the buildings served; group 3 were given a verbal label of the buildings' functions; and finally, group 4 viewed the photographs uninformed as to the function of the buildings. For the buildings in this study significant differences in responses between those who viewed the buildings in actuality and those given the verbal label describing function were noted. Specifically, 8 of 15 comparisons made between groups 1 and 3 were significantly different. It is unfortunate that the author does not report comparisons between the other groups. No mention is made of the degree of congruence between responses by groups 1 and 2. Comparison of these groups is essential in order to establish the convergent validity of the simulations employed. In short, it would determine if the photographs were valid representations of the real environment.

Although not conclusive, Gifford's study suggests that Danford and Willems' criticisms concerning the use of subjective assessment methods may be unwarranted. It is important that future research establish whether or not this problem with subjective assessment methods is evident when investigating other types of environments (e.g., landscapes, interiors, etc.). It should also be demonstrated that Danford and Willems' study provides for an adequate test of discriminant/divergent validity. Several points can be raised to suggest that it does not. The study does not elaborate on the characteristics of the law building which they employed or the detail inside the building which the subjects viewed. For example, if the building which they used in their study resembled the popular image of a law building then coincidence alone would result in similar ratings. In addition, if entrance signs, interior signs, and special purpose rooms (e.g., courtroom) are eliminated from the presentation then presumably there would be little that identifies a building as a "law" building. Further, there is little beyond such cues that would make a law building discriminably different from another faculty building on many of today's university campuses. The connotative meaning of a particular building may change very little if the label "law" is attached to it. These points could account for the lack of differences in judgements between the group which rated the label alone and those which rated the photographs. It is equally possible that differences would emerge as a function of different labels. To elaborate, there may be no difference between an unlabelled building and one labelled "law," However, differences might emerge if a particular building is identified as a "law" building in one condition, and as a "fine arts" building in another. This would be a legitimate and methodologically superior way to test for discriminant/divergent validity as Danford and Willems define the concept. In short, it remains to be demonstrated whether or not Danford and Willems' results are an artifact of the particular label chosen and the building which they employed rather than being due to an invalid response instrument as they suggest.

One final point which applies not only to the Danford and Willems study, but to all of the studies reviewed which employed factor analyses in their investigations. Without exception these studies have violated important assumptions underlying this statistical technique. Comrey (1973) and Gorsuch (1974) have suggested that when the subject to variable ratio is less than 5 to 1 analyses may yield results which are due to chance alone. In addition, it is suggested that at no time should the total number of subjects employed be less than 100 when using factor analyses as this also introduces unacceptable levels of chance results. Mode of representation studies have routinely failed to meet one or both of these criteria (e.g., Acking and Kuller, 1972; Hendrick et. al, 1977; Hershberger and Cass, 1974; Seaton and Collins, 1972). Indeed, in the study by Danford and Willems there were 40 subjects per group. Thus, sample size was inadequate. In addition, with the 36 scales which they employed, a 5 to 1 subject to variable ratio would require a total of 180 subjects per group. With only 40 subjects per group the ratio was an unacceptably low 1.1 to 1.

This study determines the extent to which projected photographs serve as a substitute for full-scale interior settings. In includes controls for establishing the discriminant/divergent validity of the unipolar semantic response scales employed. The methodological problems of earlier studies are eliminated by the use of two environmental settings, a sufficiently large sample size and an appropriate subject to variable ratio.

Chapter 2

METHOD

<u>Subjects</u> A total of 300 introductory psychology students (150 males, 150 females) were used as subjects. Students participating in research as subjects are awarded credits for their participation; (a percentage of their final grade in introductory psychology can be earned by participating in research activity).

<u>Response Format</u> A list of 20 adjectives was compiled and presented as unipolar scales with a five-point response range. A response of "1" indicated that the adjective was "not at all" descriptive of the stimulus being rated. A response of "5" indicated that the adjective was "very much" descriptive of the interior being rated.

Unipolar, rather than bipolar, scales were chosen because of problems that can occur with bipolar scales. Sivik (1974) has pointed out that it is extremely difficult to choose words which are truly antonymous in meaning. The use of bipolar adjectives forces subjects to accept the supposedly antonymous words selected by the experimenter when in fact they may not be valid opposites in the context of environmental perception or assessment. For example, "beautiful" often exhibits a stronger connotative contrast with words such as "poor" and "rough" rather than its commonly chosen antonym, "ugly." In addition, researchers often choose bipolar adjectives which logistically and/ or intuitively appear to order the subject's responses along invalid dimensions (e.g., elegant - unadorned; from Kasmar, 1970). It is not necessarily the case that an environment which is perceived as lacking elegance is then necessarily an environment which is "unadorned."

To ensure that the scales employed were sensitive measures, that is, applicable to interior environments, adjectives appearing in the factor structures of two or more previous studies on the perception of interiors were chosen. Using this criterion, 12 adjectives in all were gleaned from the literature. Eight other adjectives were chosen from Kasmar's (1970) lexicon of "appropriate" environmental descriptors. It should be noted that all of these adjectives also appear in the factor structures of previous research, however, they were not included in more than one study. A list of the adjectives chosen is shown below.

1.	Exciting	11.	Large
2.	Spacious	12.	Cheerful
3.	Comfortable	*13.	Ordered
4.	Colourful	*14.	Wide
5.	Beautiful	*15.	Unusual
*6.	Efficient	16.	Friendly
7.	Interesting	17.	Roomy
8.	Unique	*18.	Unorganized
9.	Unattractive	*19.	Pleasant
*10.	Modern	*20.	Complex

* Indicates that these adjectives did not appear in the factor structures of "two or more" previous studies.

Stimulus Material and Method of Presentation A group of subjects were asked to come to a local department store where they viewed and responded to two interior displays in the store. These displays were full-scale rooms. Specifically, they were a living room and bedroom display set up by interior designers employed by the department store in order to display the furniture and wares available for consumer purchase. These rooms are on display for approximately three months at a time and were not changed in any way during the course of this study. The physical dimensions of the living room were 16 feet by 15 feet with a ceiling height of 10 feet. The bedroom display was 15 feet by 12 feet with a ceiling height of 10 feet. Both rooms had three walls with one wall space left open for viewing purposes. Both rooms contained the amenities of "typical" living rooms and bedrooms, (e.g., ash-trays, magazines, articles of clothing, telephones, paintings, etc.). Every effort was made by the designers to present "real" rooms to the consumers for their evaluation. Subjects viewing these rooms were designated as participators in the "full-cue experimental condition."

A second group of subjects viewed, and responded to, colour transparencies of the same interior displays used in the full-cue condition. The transparencies were projected on a screen in a campus classroom. Projection distance was 40 feet resulting in an image size of 8 feet by 12 feet. This session was experimentally designated as the photographic representation condition.

In order to provide for an adequate test of the discriminant/divergent validity of the 20 variables chosen a third group of subjects was included. In this group, (designated as the concept rating condition), subjects responded to the imagery of a living room and bedroom. The imagery was elicited by verbal instructions from the experimenter. For control purposes, the words living room and bedroom were separately copied on transparency material and projected on a screen while the subjects were responding to the imagery. Subjects in this group responded in the same campus classroom as in the previous condition.

Experimental Procedure Subjects were randomly recruited into three groups with 100 subjects (50 males and 50 females) per condition. This yielded an appropriate subject to variable ratio (5 to 1) for the subsequent factor analyses performed on the data (Comrey, 1973; Gorsuch, 1974).

Group 1 rated the actual living room and bedroom on display at the department store. Presentation of the two rooms was counterbalanced such that half of the subjects viewed the living room first and half viewed the bedroom first. Order of presentation was counterbalanced across subject gender as well. There were 10 subjects responding in each session resulting in 10 sessions in all.

Photographs were taken of both the living room and bedroom viewed by group 1 from the same viewing angle and viewing distance as in the full-cue condition. A second group of subjects viewed and responded to these photographs projected on a screen. As in the previous condition, order of presentation of the two rooms was counterbalanced across subjects and subject gender. There were a total of two experimental sessions with 50 subjects responding in each session.

A third group of subjects were asked to form a picture in their mind of a living room and subsequently a bedroom (or vice-versa to counterbalance for order effects). Their task was to respond to the resulting imagery. Verbal instructions were worded such that the respondents were free to imagine any "type" of living room or bedroom that they wished (see Appendix A for a copy of the instructions for all experimental conditions). This was to ensure that the experimenter, when eliciting the imagery, did not induce a specific set in the subjects with regard to the qualities of the interiors which they were to imagine. There was a total of two experimental sessions with 50 subjects responding in each session.

All groups used the same aforementioned 20 item response instrument regardless of the mode of representation which they viewed. In addition, each item was presented on a separate page to maximize the degree of independence between responses. The adjective list was purposely ordered to ensure that the word previous to each subsequent word did not have a similar connotative meaning.

Data Analysis A 3 X 2 X 2 repeated measures multivariate analysis of variance (MANOVA) was performed on the data obtained to determine if significant differences existed between the ratings as a function of mode of representation, gender of the rater, and the room being rated. (See Appendix B for a graphic representation of experimental design.)

When groups are compared in terms of many variables, as in this study, it is of interest not only to see if they differ significantly from one another but, if they do differ, also to understand the nature of the differences. One approach to this problem is to simply list the variables on which a specific group had significantly higher means than another group, and also the variables on which the reverse was true. Unfortunately, this simple method of describing differences by listing the variables often renders invalid descriptions, distorting the true nature of the differences. This distortion is apparent when variables or scales measure the same constructs. That is, as the correlations among the variables increases so does the danger of distorting the nature of the differences found. Since many of the variables in this study are intuitively highly correlated (i.e., spacious, large, wide, roomy) discriminant analyses were employed to determine the nature of the differences between groups as evidenced by the MANOVA. Discriminant analysis overcomes the aforementioned difficulty by constructing linear combinations of the set of variables that best differentiate between groups. Each linear combination forms a discriminant function independent (uncorrelated) with any other discriminant function found. This yields a much clearer, valid, and more parsimonious picture of the manner in which the groups differ.

In addition to the MANOVA and the discriminant analyses, factor analyses were employed to better understand the "dimensionality" of the variables employed. Although these analyses do not address the major questions of the study, (namely: do photographs adequately represent reality in environmental assessment research?; and, are subjective assessment scales a valid means of measuring cognitive impressions of environments?) they do serve to assist the reader in understanding what the variables are measuring. Given that they are merely supplemental analyses they are included as an appendix (See Appendix C).

Both the MANOVA and the major discriminant analyses were performed using Finn's (1977) Multivariance: version VI statistical manual and computer program. Subsequent discriminant analyses on the scores for the living room alone and bedroom alone, as well as the factor analyses, were performed using the Nie, Hull, Jenkins, Steinbrenner, and Brent (1975) Statistical Package for the Social Sciences; (S.P.S.S.) manual and computer programs.

Chapter 3

RESULTS

Overview

This overview is included to introduce the major findings of the multivariate analysis of variance in summary form (see Table 1). This will assist the reader when interpreting later, more detailed, sections. Subsequent to the overview each significant main and interaction effect will be discussed in detail in the order presented in this overview. Tabular presentations of the univariate analysis of variance performed on each scale for each effect are included along with a discussion of the magnitude and direction of the differences as evidenced by further analyses. These are followed by independent presentations of the effects on the ratings for each interior. The section concludes with the results of paired comparisons between the overall ratings for the three modes of representation.

A multivariate analysis of variance with repeated measures (MANOVA) demonstrated a highly significant main effect of mode of representation on the ratings for both rooms, $F(40,550) = 10.96$, $p < .0001$. In addition there were significant overall differences in the ratings as

TABLE 1

Multivariate Analysis of Variance with Repeated Measures

Source	df	F	p	ω^2*
Mode	40	10.96	.0001	.69
Error	550			
Sex	20	2.72	.002	.16
Error	275			
Room	20	24.46	.0001	.64
Error	275			
Mode X Sex	40	1.62	.02	.14
Error	550			
Mode X Room	40	5.39	.0001	.47
Error	550			
Sex X Room	20	2.25	.002	.12
Error	275			
Mode X Sex X Room	40	1.40	.064	.07
Error	550			

* The calculation of ω^2 (omega squared) is based on a multivariate formula discussed by Tatsuoka (1970). It is not to be interpreted in the same manner as ω^2's derived from a univariate formula. Whereas the univariate formula provides an estimation of the percentage of the total variability attributable to a factor, the multivariate formula is based on the findings of the discriminant analyses and estimates the percentage of the variability of the derived discriminant functions which is attributable to group differences. That is, the multivariate ω^2 estimates the percentage of the variability in the discriminant space which is relevant to group differentiation. For a more comprehensive discussion of the interpretation of multivariate ω^2's the reader is referred to Tatsuoka (1970, pp. 48-49).

a function of the sex of the rater, $F(20,275) = 2.72$ $p < .0001$, and the room being rated, $F(20,275) = 24.46$, $p < .0001$. The three modes of representation were rated relatively differently by males and females and across the two rooms, (i.e., there was a significant mode by sex interaction effect, $F(40,550) = 1.62$, $p < .02$, and a significant mode by room interaction effect, $F(40,550) = 5.39$, $p < .0001$). Further, the living room and bedroom were rated relatively differently by males and females (i.e., a significant sex by room interaction effect was evident, $F(20,275) = 2.25$, $p < .002$). The three-way interaction, mode by sex by room, was not significant at $\alpha < .05$.

Mode of Representation: Main Effect

An examination of the differences in ratings between the three modes of representation as determined by univariate analyses of variance reveals that the living room and bedroom were rated significantly differently on 13 of the 20 scales (see Table 2). Mean response profile comparisons graphically depict the magnitude and direction of these differences (see Figure 1).

Discriminant analysis of the scores on the 20 scales yielded two significant linear combinations of variables (discriminant functions) which best explain where the differences between the ratings for the three modes of

TABLE 2

Univariate Analyses of Variance: Mode Main Effect

Variable	MS	F	p
Exciting	.49	.19	.829
Spacious	274.09	116.07	.0001
Comfortable	53.41	31.86	.0001
Colourful	47.59	21.28	.0001
Beautiful	46.36	18.36	.0001
Efficient	4.96	1.99	.139
Interesting	1.86	0.87	.421
Unique	2.62	0.99	.371
Unattractive	36.93	16.90	.0001
Modern	15.96	6.14	.0025
Large	282.43	109.83	.0001
Cheerful	137.11	64.83	.0001
Ordered	9.52	3.97	.0199
Wide	130.57	49.97	.0001
Unusual	1.37	0.42	.654
Friendly	24.69	12.91	.0001
Roomy	187.61	78.11	.0001
Unorganized	1.08	0.50	.608
Pleasant	33.48	17.74	.0001
Complex	8.02	2.75	.065

df for Hypotheses = 2
df for Error = 294

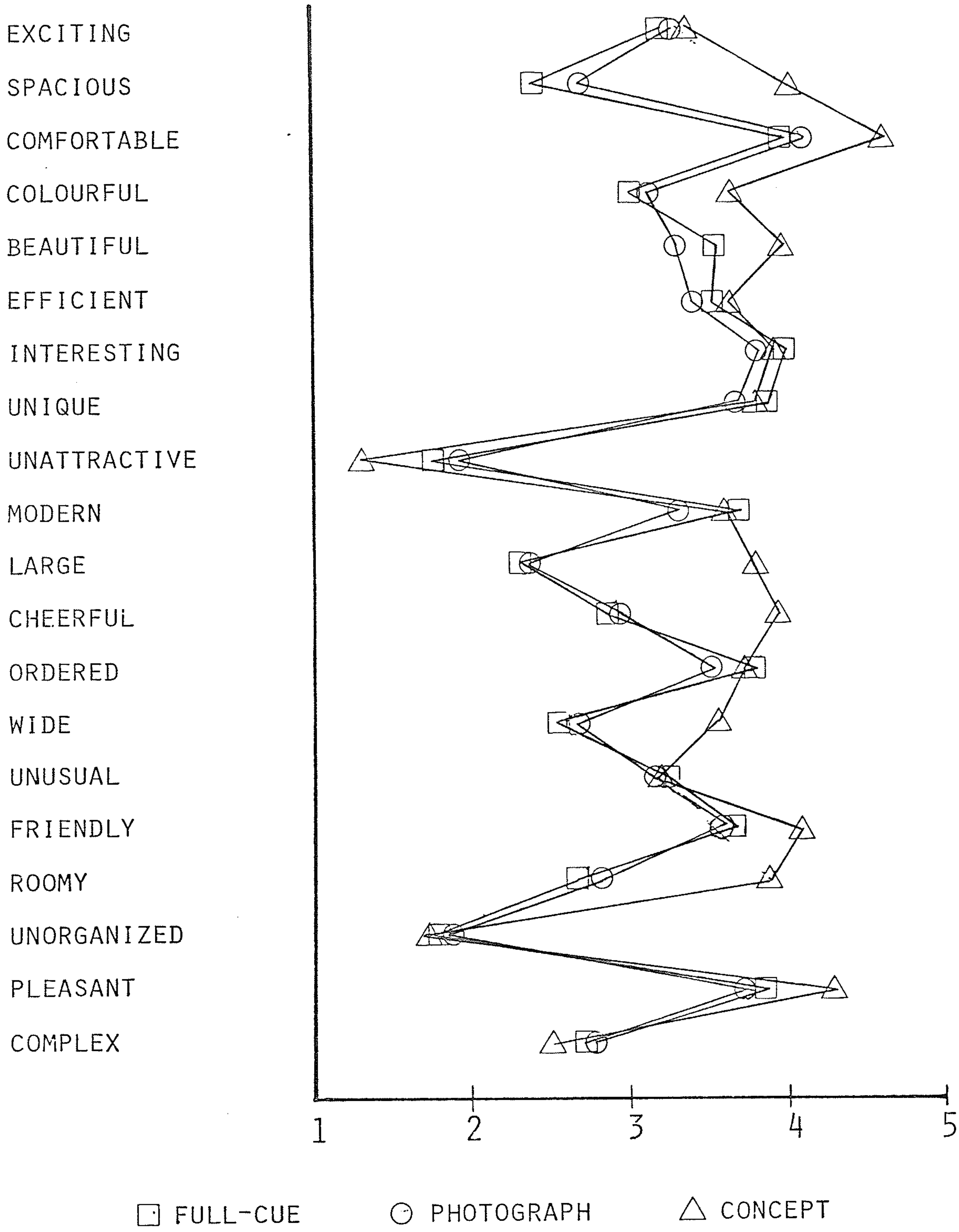

FIGURE 1

MEAN RESPONSE PROFILE COMPARISON:
MODE MAIN EFFECT

representation lie. The first and most powerful discriminant function, $\underline{\chi}^2(40) = 336.63$, $\underline{p} < .0001$, is comprised of the variables, spacious and cheerful. Table 3 indicates that both of these variables had high positive standardized discriminant weights (i.e., .606 and .587 respectively) relative to the rest of the variables.

Structure coefficients were then calculated to determine which of the original variables correlate highly with the discriminant combination; (the derived discriminant combination is essentially a new, transformed variable). A high correlation between the derived discriminant combination and one of the original variables indicates that the latter is also a good discriminator. In short, calculation of the corresponding structure coefficients for each variable often yields a more informative description of the dimension along which the groups differ. Hereafter, the interpretation of the results of the discriminant analyses will involve appraisal of the structure coefficient weights (correlations) rather than the standardized discriminant function coefficients. However, the latter are included in all tables and the reader is encouraged to note the relationship between the two.

It can be seen in Table 3 that the variables, spacious, large, roomy, wide, cheerful, and comfortable have high positive structure coefficients and therefore combine to form the first discriminant dimension. This dimension

TABLE 3

Discriminant Analysis of
Living room and Bedroom Scores Combined, (Mode Main Effect);
Standardized Discriminant Weights and Structure Coefficients

Variable	Mode Main Effect			
	Function 1[a]		Function 2[a]	
	DFC[b]	SC[c]	DFC[b]	SC[c]
Exciting	-.322	.067	.154	.003
Spacious	.606	.832	.587	.020
Comfortable	.100	.527	.184	-.114
Colourful	.164	.454	.264	.023
Beautiful	-.101	.363	-.638	-.491
Efficient	-.039	.090	.028	-.236
Interesting	-.453	.024	-.060	-.211
Unique	.016	.023	.062	-.227
Unattractive	-.359	-.369	.154	.376
Modern	-.309	-.125	-.449	-.505
Large	.192	.804	-.815	.301
Cheerful	.587	.686	.045	-.208
Ordered	-.119	.041	-.505	-.437
Wide	-.021	.618	.126	-.139
Unusual	.217	.035	-.184	-.132
Friendly	-.033	.357	.087	-.176
Roomy	.148	.735	.092	-.145
Unorganized	.235	-.017	-.374	.161
Pleasant	-.080	.393	.014	-.306
Complex	-.117	-.156	.129	.063

[a] Discriminant Function

[b] Standardized Discriminant Function Coefficient

[c] Structure Coefficient

accounts for 92.3% of the total discriminating power of the 20 scales. A plot of the centroids for each group in Figure 2 clearly shows that the first discriminant dimension, (DF1), separates the concept rating group from the full-cue and photograph rating groups. (Note: The centroid coordinates for all discriminant analyses are given in Appendix D). The second significant discriminant function, (DF2), $\underline{x}^2(19) = 40.34$, $\underline{p} < .003$, is comprised of the variables modern, beautiful, and ordered. These variables all have high negative structure coefficients (see Table 3) and together account for 7.7% of the total discriminating power that is apportioned to the two discriminant functions. Figure 2 indicates that this combination of variables separates the three modes of representation equally well, although minimally; ranking them from low to high in the order (1) photograph, (2) concept, (3) full-cue.

Bearing this configuration in mind, (see Figure 2), it can be seen that those subjects rating the conceptualized rooms saw them as significantly more spacious, large, roomy, and wide than did those rating the actual rooms or the photographs of those same rooms. In addition, they were viewed as significantly more comfortable and more cheerful environments than in either of the other two experimental conditions. The photographs were rated slightly higher on this dimension than were the actual rooms. On the second discriminant dimension, represented

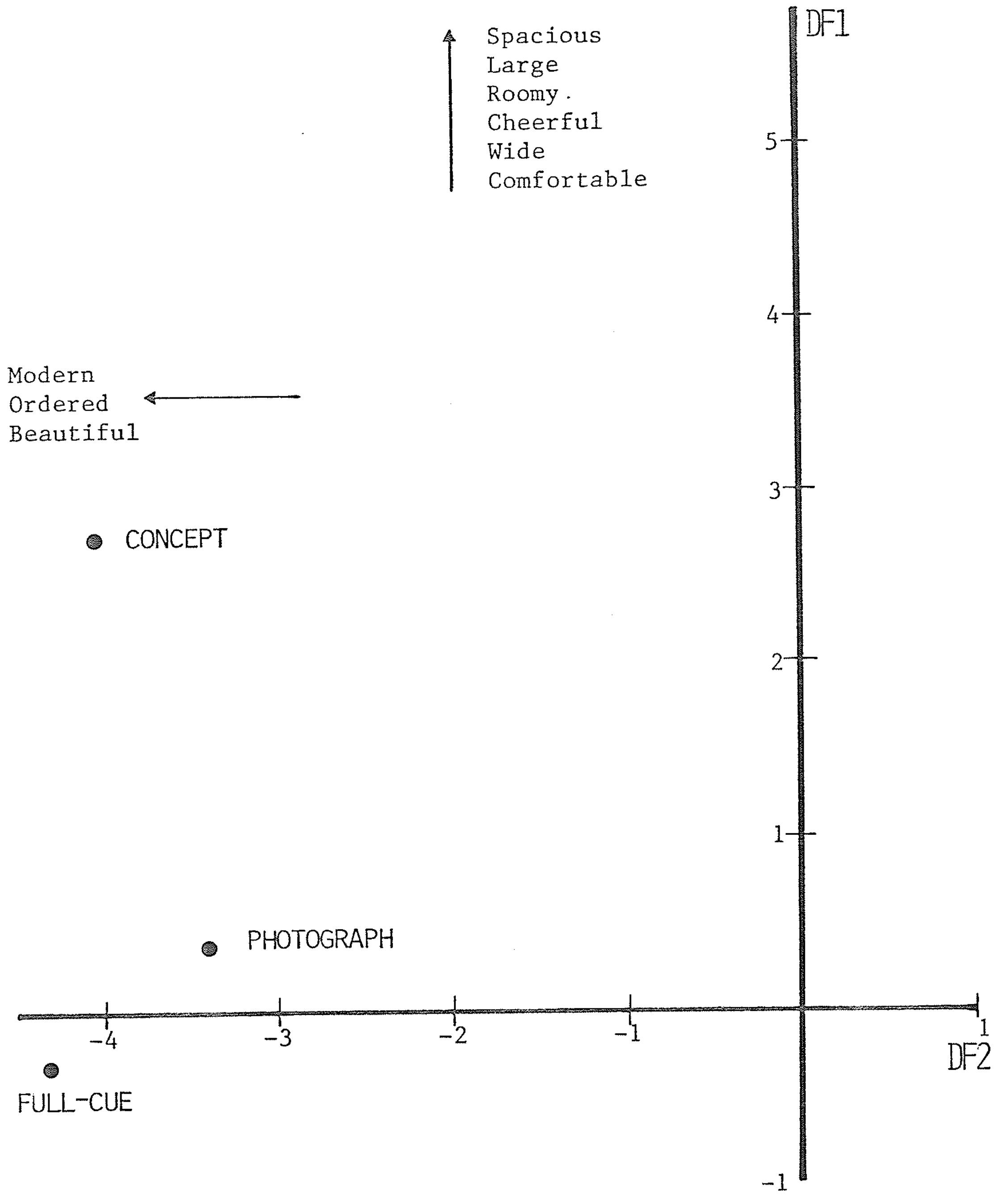

FIGURE 2

CENTROID PLOT: MODE MAIN EFFECT

by the scales modern, beautiful, and ordered, the differences between the three groups are slight. It should be reiterated that although the differences are statistically significant, the second discriminant function accounted for 7.7% of the power of the scales whereas the first discriminant function accounted for 92.3% of the power apportioned to the functions. Hence, further interpretation may not be particularly meaningful given the low magnitude of difference across this dimension.

Sex: Main Effect

Univariate analyses of variance show that males and females rated the two rooms significantly differently on 6 of the 20 scales (see Table 4). Figure 3 graphically portrays the magnitude and direction of these differences.

Discriminant analysis of the ratings for both interiors revealed that the differences in perception and assessment between males and females were greatest on the combination of variables; unique, colourful, interesting, and unorganized (see Table 5). These variables comprised the first and only significant discriminant function for the sex main effect, $\underline{\chi}^2(20) = 51.38$, $\underline{p} < .002$. Whereas the variables unique and interesting have high negative structure coefficients, the variables, colourful and unorganized have high positive structure coefficients (see Table 5). A

TABLE 4

Univariate Analyses of Variance: Sex Main Effect

Variable	MS	F	p
Exciting	0.56	0.21	.644
Spacious	4.32	1.83	.177
Comfortable	1.47	0.88	.350
Colourful	9.72	4.35	.038
Beautiful	0.65	0.26	.611
Efficient	3.85	1.54	.215
Interesting	13.23	6.15	.013
Unique	30.72	11.63	.0008
Unattractive	3.20	1.47	.227
Modern	4.81	1.85	.175
Large	0.21	0.08	.774
Cheerful	2.80	1.33	.251
Ordered	1.61	0.67	.413
Wide	4.56	1.75	.187
Unusual	12.81	3.96	.047
Friendly	0.16	0.09	.770
Roomy	1.61	0.67	.413
Unorganized	10.45	4.82	.029
Pleasant	7.68	4.07	.045
Complex	0.48	0.16	.685

df for Hypotheses = 1
df for Error = 294

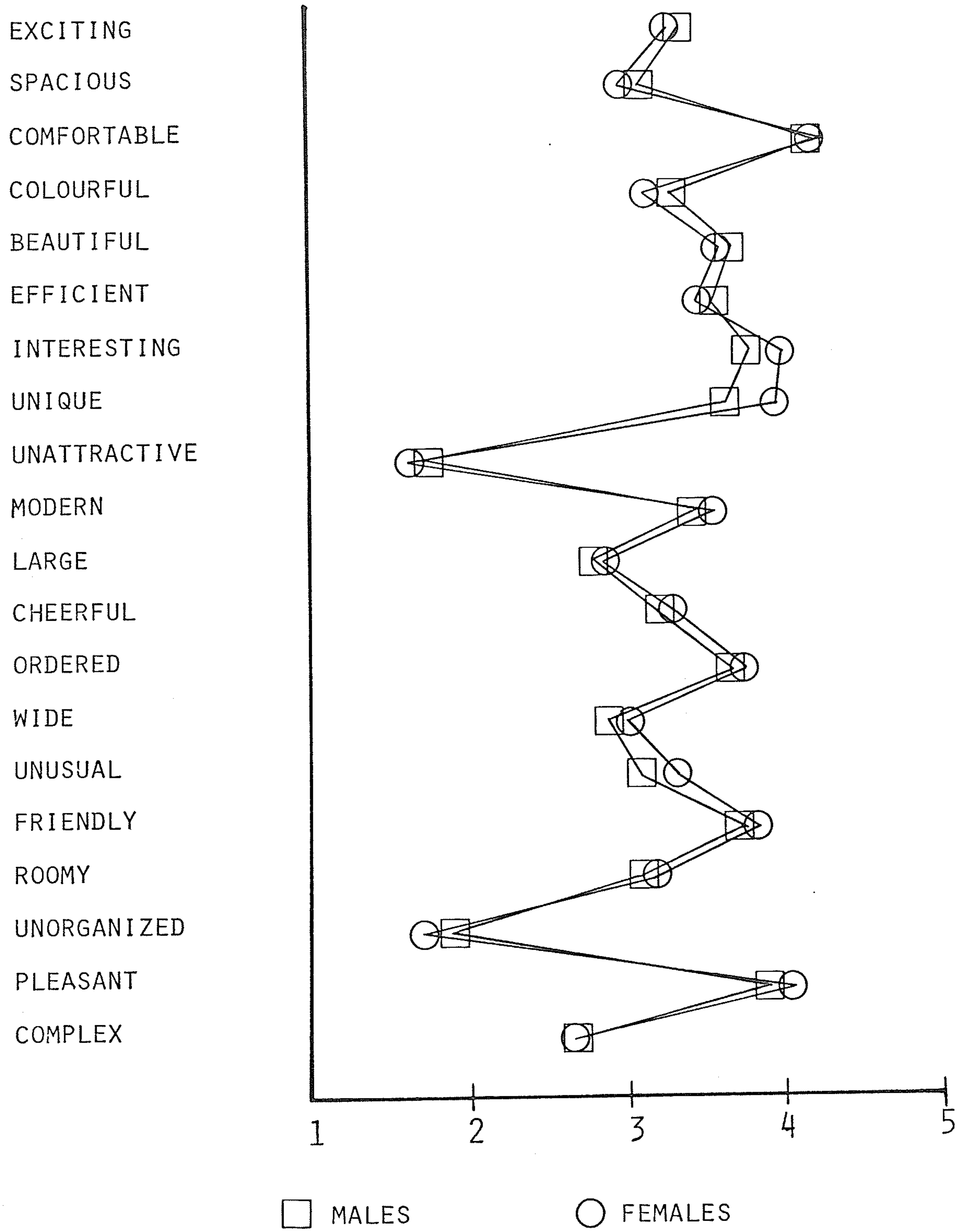

FIGURE 3

MEAN RESPONSE PROFILE COMPARISON:
SEX MAIN EFFECT

TABLE 5

Discriminant Analysis of Living Room and Bedroom Scores Combined (Sex Main Effect); Standardized Discriminant Weights and Structure Coefficients

Variable	Sex Main Effect Function 1[a] DFC[b]	SC[c]
Exciting	.058	.081
Spacious	.497	.287
Comfortable	-.207	-.026
Colourful	.359	.350
Beautiful	.486	.121
Efficient	.400	.177
Interesting	-.284	-.336
Unique	-.477	-.462
Unattractive	-.041	.099
Modern	-.186	-.220
Large	.046	.104
Cheerful	-.143	-.014
Ordered	-.060	-.118
Wide	-.310	-.055
Unusual	-.084	-.280
Friendly	.377	.022
Roomy	-.133	.037
Unorganized	.315	.304
Pleasant	-.584	-.195
Complex	.211	.034

[a] Discriminant Function

[b] Standardized Discriminant Function Coefficient

[c] Structure Coefficient

plot of the centroids for males and females (see Figure 4) indicates that males viewed the rooms as significantly more colourful and unorganized than did females. Further, females saw the rooms as being significantly more unique and interesting than did males. However, these differences, although significant, are quite small given that the multivariate ω^2 indicated that they account for only 16% of the variance in the discriminant space (see Table 1). An examination of the mean response profile comparisons of male and female responses provides further evidence supporting the notion that these differences are small (see Figure 3). The mean difference between males and females was never greater than one-half of a scale point on any of the variables. In most cases it proved to be much smaller than this.

Room: Main Effect

Univariate analyses of variance demonstrated that the living room and bedroom were assessed significantly differently on 15 of the 20 scales (see Table 6). Relatively large differences between the ratings for the rooms on a number of the scales are evident when examining the mean differences in profile (see Figure 5).

Discriminant analysis of the ratings for the two rooms across the three modes of representation yielded one

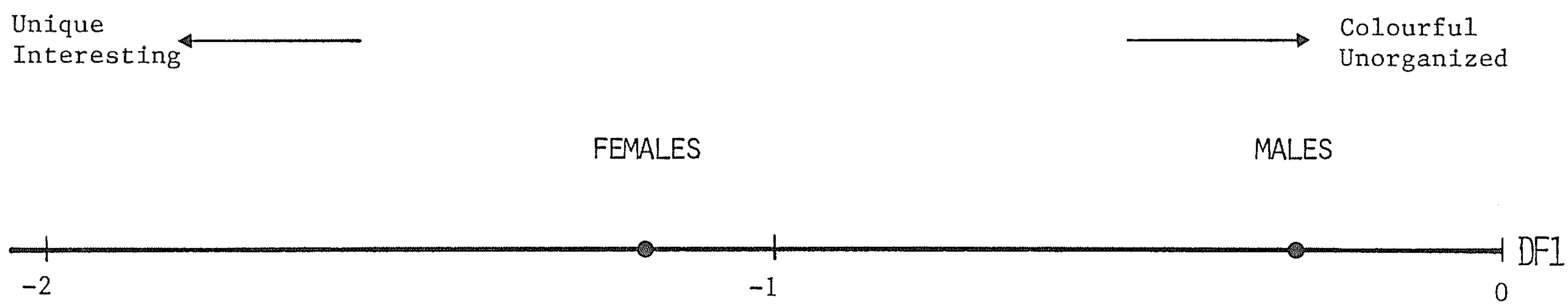

FIGURE 4

CENTROID PLOT: SEX MAIN EFFECT

TABLE 6

Univariate Analyses of Variance: Room Main Effect

Variable	MS	F	p
Exciting	104.43	53.65	.0001
Spacious	147.00	86.24	.0001
Comfortable	47.20	33.20	.0001
Colourful	8.33	4.81	.029
Beautiful	29.45	17.65	.0001
Efficient	13.65	7.59	.006
Interesting	22.96	14.37	.0002
Unique	89.65	47.49	.0001
Unattractive	0.16	0.11	.742
Modern	228.81	117.32	.0001
Large	105.61	64.29	.0001
Cheerful	0.08	0.06	.806
Ordered	108.00	69.09	.0001
Wide	121.60	80.82	.0001
Unusual	128.05	71.38	.0001
Friendly	0.16	0.11	.743
Roomy	85.33	44.96	.0001
Unorganized	58.08	34.97	.0001
Pleasant	0.85	0.67	.414
Complex	0.01	0.01	.932

df for Hypotheses = 1
df for Error = 294

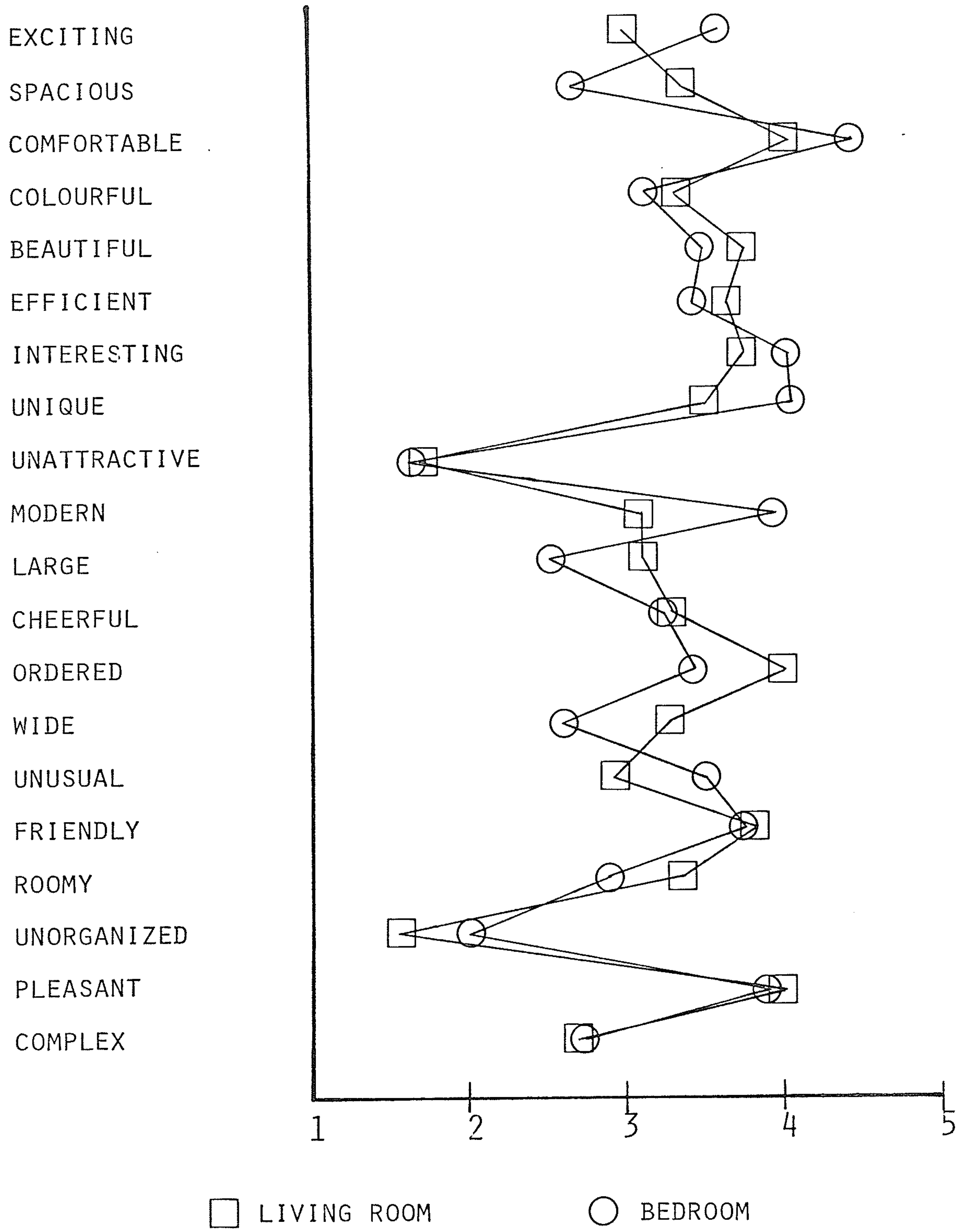

FIGURE 5

MEAN RESPONSE PROFILE COMPARISON:
ROOM MAIN EFFECT

significant discriminant function, $\chi^2(20) = 290.27$, $p < .0001$, which best discriminated between the scores for the living room and bedroom. It is comprised of the variables; modern, unusual, spacious, wide, and unique. The variables modern, unusual, and unique have high positive structure coefficients whereas the variables, spacious and wide have high negative structure coefficients (see Table 7). This information combined with an examination of the graphic representation of the centroids (see Figure 6) reveals that the living room was rated as significantly more spacious and wide than the bedroom. Not surprisingly, factor analysis shows that these two variables as well as the variables, roomy and large, tap a subject's impressions of the physical size of interiors (see Table 16, Appendix C). Indeed, the living room was viewed as significantly more roomy and larger than the bedroom under all three modes of representation. On the other hand, the bedroom was rated as the more modern, unusual, and unique of the two rooms across all three modes of representation. Neither room was viewed as significantly more colourful, attractive, cheerful, friendly, pleasant, or complex than the other.

Mode by Sex: Interaction Effect

The two interiors were rated relatively differently by males and females across the three modes of representation.

TABLE 7

Discriminant Analysis of Living Room
and Bedroom Scores Combined (Room Main Effect);
Standardized Discriminant Weights and Structure Coefficients

Variable	Room Main Effect Function 1[a] DFC[b]	SC[c]
Exciting	.410	.339
Spacious	-.320	-.433
Comfortable	.397	.293
Colourful	-.253	-.082
Beautiful	-.272	-.145
Efficient	-.119	-.188
Interesting	-.016	.275
Unique	.103	.404
Unattractive	-.006	-.033
Modern	.384	.575
Large	-.089	-.351
Cheerful	.074	-.018
Ordered	-.220	-.385
Wide	-.341	-.412
Unusual	.296	.483
Friendly	-.038	.029
Roomy	.075	-.307
Unorganized	.007	.253
Pleasant	-.165	-.033
Complex	-.077	.109

[a] Discriminant Function
[b] Standardized Discriminant Function Coefficient
[c] Structure Coefficient

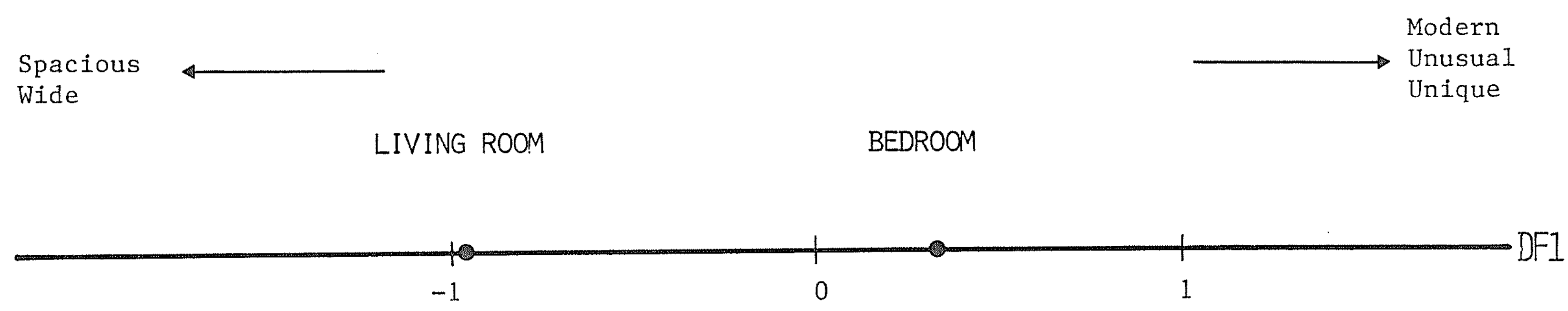

FIGURE 6

CENTROID PLOT: ROOM MAIN EFFECT

Specifically, univariate analyses of variance performed on the 20 scales showed that a significant mode by sex interaction effect was evident for 8 of the variables in all (see Table 8).

Discriminant analysis yielded one significant discriminant function, $\underline{\chi}^2(40) = 63.52$, $\underline{p} < .05$, which best accounts for these differences. The variables; spacious, roomy, cheerful, and large all had high negative structure coefficients hence combine to form this dimension (see Table 9). Figure 7 depicts the nature of these interactions. Females rated the conceptualized rooms as more spacious, roomy, cheerful, and large than did males. On the other hand, males viewed the rooms as more spacious, roomy, cheerful, and large than did females when rating the actual rooms and the photographs of the rooms.

Mode by Room: Interaction Effect

An examination of mean differences using univariate analyses of variance indicates that a significant mode by room interaction effect occurs on 13 of the 20 scales (see Table 10). Discriminant analysis reveals that of these 13 variables, 6 combine to form two discriminant dimensions which best predict the direction and magnitude of group differences. The first significant discriminant function, $\underline{\chi}^2(40) = 188.35$, $\underline{p} < .0001$, is comprised of

TABLE 8

Univariate Analyses of Variance:
Mode X Sex Interaction Effect

Variable	MS	F	p
Exciting	7.04	2.68	.070
Spacious	12.28	5.20	.006
Comfortable	2.79	1.66	.191
Colourful	3.25	1.45	.236
Beautiful	9.44	3.74	.025
Efficient	2.57	1.03	.358
Interesting	1.93	0.90	.409
Unique	0.67	0.25	.776
Unattractive	5.20	2.38	.094
Modern	10.09	3.88	.022
Large	8.00	3.11	.046
Cheerful	10.10	4.78	.009
Ordered	1.80	0.75	.472
Wide	4.41	1.69	.187
Unusual	1.97	0.61	.544
Friendly	6.17	3.23	.041
Roomy	13.77	5.73	.004
Unorganized	0.17	0.08	.923
Pleasant	9.72	5.15	.006
Complex	2.08	0.71	.714

df for Hypotheses = 2
df for Error = 294

TABLE 9

Discriminant Analysis of Living Room and Bedroom Scores Combined (Mode X Sex Interaction Effect); Standardized Discriminant Weights and Structure Coefficients

Variable	Mode X Sex Interaction Effect Function 1[a] DFC[b]	 SC[c]
Exciting	-.158	-.285
Spacious	-.363	-.687
Comfortable	.187	-.449
Colourful	-.046	-.408
Beautiful	-.088	-.462
Efficient	.219	.000
Interesting	.345	-.126
Unique	-.043	-.075
Unattractive	.280	.409
Modern	.704	.347
Large	-.066	-.616
Cheerful	-.458	-.620
Ordered	-.056	-.054
Wide	.468	-.418
Unusual	-.117	-.031
Friendly	.048	-.422
Roomy	-.459	-.671
Unorganized	-.170	-.001
Pleasant	-.250	-.497
Complex	-.192	.004

[a] Discriminant Function

[b] Standardized Discriminant Function Coefficient

[c] Structure Coefficient

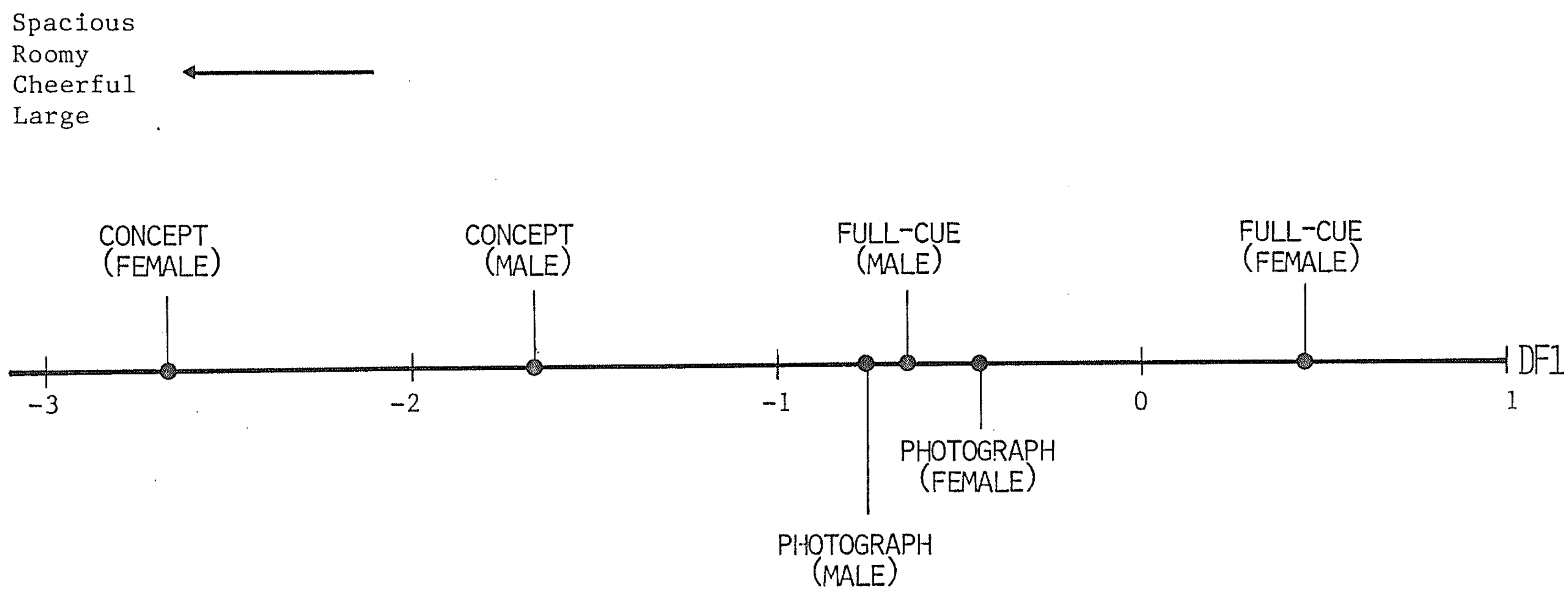

FIGURE 7

CENTROID PLOT: MODE BY SEX INTERACTION

TABLE 10

Univariate Analyses of Variance:
Mode X Room Interaction Effect

Variable	MS	F	p
Exciting	6.13	3.15	.044
Spacious	14.56	8.54	.0003
Comfortable	19.08	13.42	.0001
Colourful	8.46	4.88	.0082
Beautiful	0.42	0.25	.776
Efficient	9.61	5.34	.0053
Interesting	24.06	15.06	.0001
Unique	24.56	13.01	.0001
Unattractive	3.58	2.38	.095
Modern	66.81	34.26	.0001
Large	4.20	2.56	.079
Cheerful	0.60	0.44	.646
Ordered	10.87	6.95	.0012
Wide	3.69	2.45	.088
Unusual	44.89	25.02	.0001
Friendly	0.89	0.59	.555
Roomy	7.05	3.72	.026
Unorganized	9.48	5.71	.0038
Pleasant	2.01	1.58	.208
Complex	24.65	13.45	.0001

df for Hypotheses = 2
df for Error = 294

the variables; modern, unusual, interesting, unique, and complex. This dimension accounts for 72.6% of the power of the two discriminant functions. The second significant discriminant function, $\chi^2(19) = 56.90$, $p < .0001$, is comprised of only one variable; comfortable, and accounts for 27.4% of the power. In both discriminant functions, all of the discriminating variables have high positive structure coefficients (see Table 11). A plot of the centroids shown in Figure 8 graphically depicts the nature of the interaction. When rating the moderness, unusualness, interestingness, uniqueness, and complexity of the rooms, subjects viewing the actual rooms and the photographic representations of the rooms gave them widely discrepant ratings on this dimension relative to those viewing the conceptualized rooms. Specifically, the bedroom was seen as the more modern, unusual, interesting, unique and complex room. On the other hand, subjects rating the conceptualized rooms, saw both the bedroom and living room as being equally modern, unusual, interesting, unique, and complex. On the second dimension, the living room and bedroom were rated as equally comfortable in both the photographic and concept rating conditions. However, when viewed full-cue the bedroom was assessed as significantly more comfortable than the living room.

Sex by Room: Interaction Effect

Univariate analyses of variance indicates that a

TABLE 11

Discriminant Analysis of Living Room
and Bedroom Scores Combined (Mode X Room Interaction Effect);
Standardized Discriminant Weights and Structure Coefficients

Variable	Mode X Room Interaction Effect			
	Function 1[a]		Function 2[a]	
	DFC[b]	SC[c]	DFC[b]	SC[c]
Exciting	.008	.228	-.003	.080
Spacious	-.159	-.342	.190	.252
Comfortable	.169	.154	.772	.651
Colourful	-.082	.107	-.448	-.395
Beautiful	.084	.036	-.246	.058
Efficient	-.327	-.285	-.216	-.145
Interesting	.242	.494	-.038	-.068
Unique	-.041	.460	.101	.170
Unattractive	.108	-.034	-.094	-.270
Modern	.612	.706	.086	.105
Large	.013	-.188	.116	.165
Cheerful	-.134	-.022	.139	.100
Ordered	-.185	-.308	.136	.227
Wide	.097	-.219	-.291	-.047
Unusual	.416	.628	.108	-.021
Friendly	.253	.108	-.374	.033
Roomy	-.162	-.223	-.004	.193
Unorganized	-.143	.203	-.236	-.339
Pleasant	-.258	-.050	.135	.211
Complex	.219	.405	-.301	-.346

[a]Discriminant Function

[b]Standardized Discriminant Function Coefficient

[c]Structure Coefficient

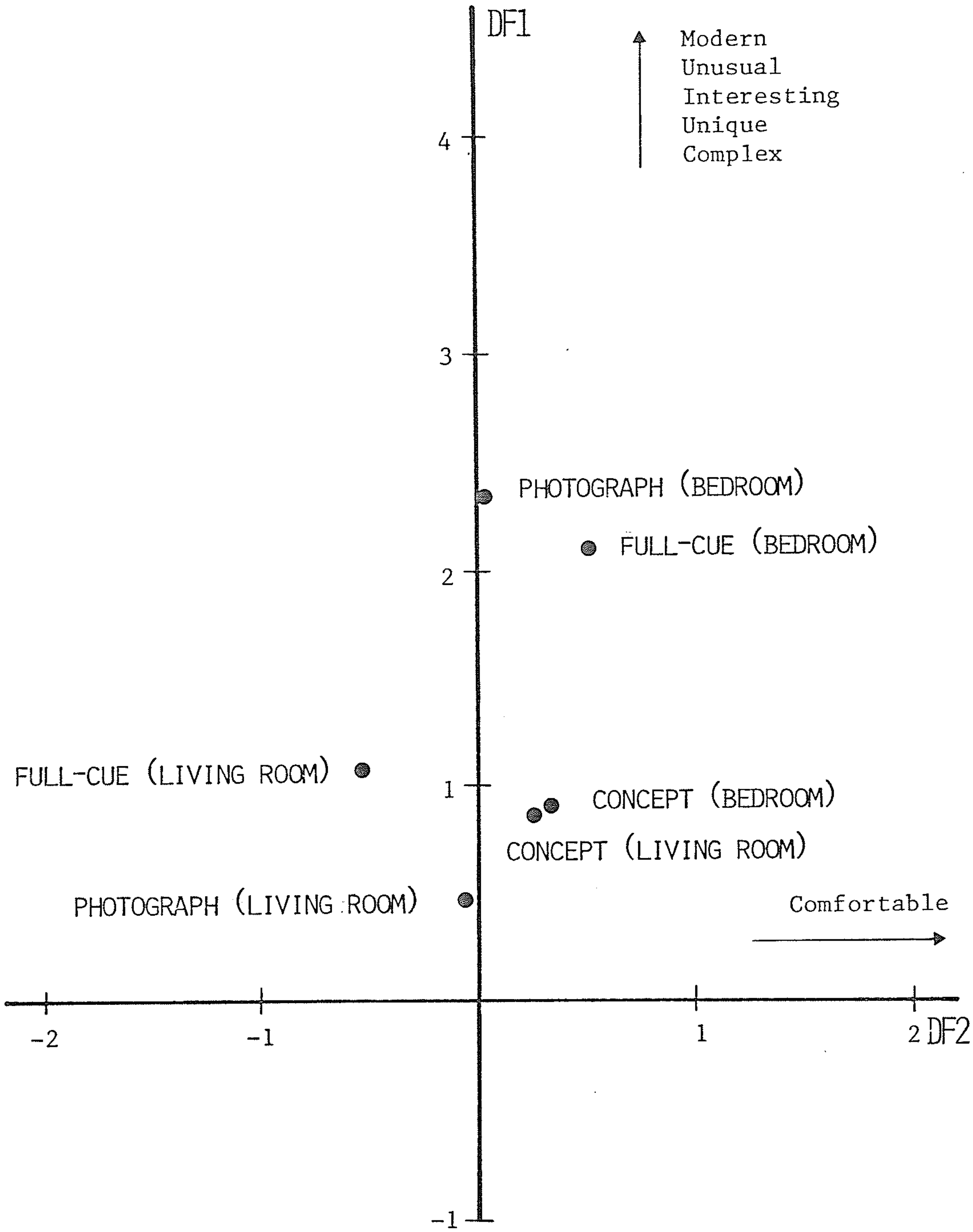

FIGURE 8

CENTROID PLOT: MODE BY ROOM INTERACTION

significant sex by room interaction effect occurred on 8 of the 20 scales (see Table 12) Discriminant analysis yielded one significant discriminant function, $\underline{\chi}^2(20) = 42.98$, $\underline{p} < .002$, consisting of the highly negative weighted variables; beautiful, pleasant, exciting, interesting, cheerful, and friendly and one highly positive weighted variable; unattractive (see Table 13). A plot of the group centroids for the sex by room interaction effect (see Figure 9) indicates that males, when rating the bedroom, assessed it as significantly more beautiful, pleasant, exciting, interesting, cheerful, friendly, and attractive than the living room. In contrast, females rated the living room higher than the bedroom on this dimension. Notably, although males viewed the living room as the more unattractive room, and females assessed the bedroom as the more unattractive room, neither room was rated negatively on this scale. Both rooms had low mean ratings on this scale (see Figures 10 and 13) and therefore were generally assessed as "not at all" unattractive.

Analysis of Living Room Scores

An examination of the mean response profile comparison depicted in Figure 10 suggests that the ratings for the living room vary as a function of how it is represented. More specifically the profile shows that the conceptualized

TABLE 12

Univariate Analyses of Variance:
Sex X Room Interaction Effect

Variable	MS	F	p
Exciting	22.96	11.80	.0007
Spacious	0.48	0.28	.596
Comfortable	0.003	0.002	.962
Colourful	4.81	2.78	.097
Beautiful	21.33	12.79	.0005
Efficient	3.41	1.90	.170
Interesting	14.96	9.93	.0025
Unique	5.88	3.11	.079
Unattractive	14.96	9.93	.0018
Modern	1.33	0.68	.409
Large	0.12	0.07	.787
Cheerful	12.40	9.01	.003
Ordered	3.00	1.92	.167
Wide	5.60	3.72	.055
Unusual	9.01	5.02	.026
Friendly	13.23	8.75	.003
Roomy	0.01	0.007	.933
Unorganized	2.25	1.36	.245
Pleasant	16.33	12.82	.0005
Complex	0.33	0.18	.670

df for Hypotheses = 1
df for Error = 294

TABLE 13

Discriminant Analysis of Living Room
and Bedroom Scores Combined (Sex X Room Interaction Effect);
Standardized Discriminant Weights and Structure Coefficients

Variable	Sex X Room Interaction Effect Function 1[a] DFC[b]	SC[c]
Exciting	-.405	-.531
Spacious	.254	.096
Comfortable	.520	.002
Colourful	.019	-.275
Beautiful	-.201	-.548
Efficient	-.143	-.192
Interesting	-.095	-.480
Unique	-.033	.277
Unattractive	.189	.479
Modern	.111	-.159
Large	-.134	.051
Cheerful	-.085	-.462
Ordered	-.111	-.189
Wide	.428	.293
Unusual	-.370	-.352
Friendly	-.197	-.454
Roomy	-.067	.002
Unorganized	-.052	.156
Pleasant	-.299	-.535
Complex	.262	.038

[a] Discriminant Function

[b] Standardized Discriminant Function Coefficient

[c] Structure Coefficient

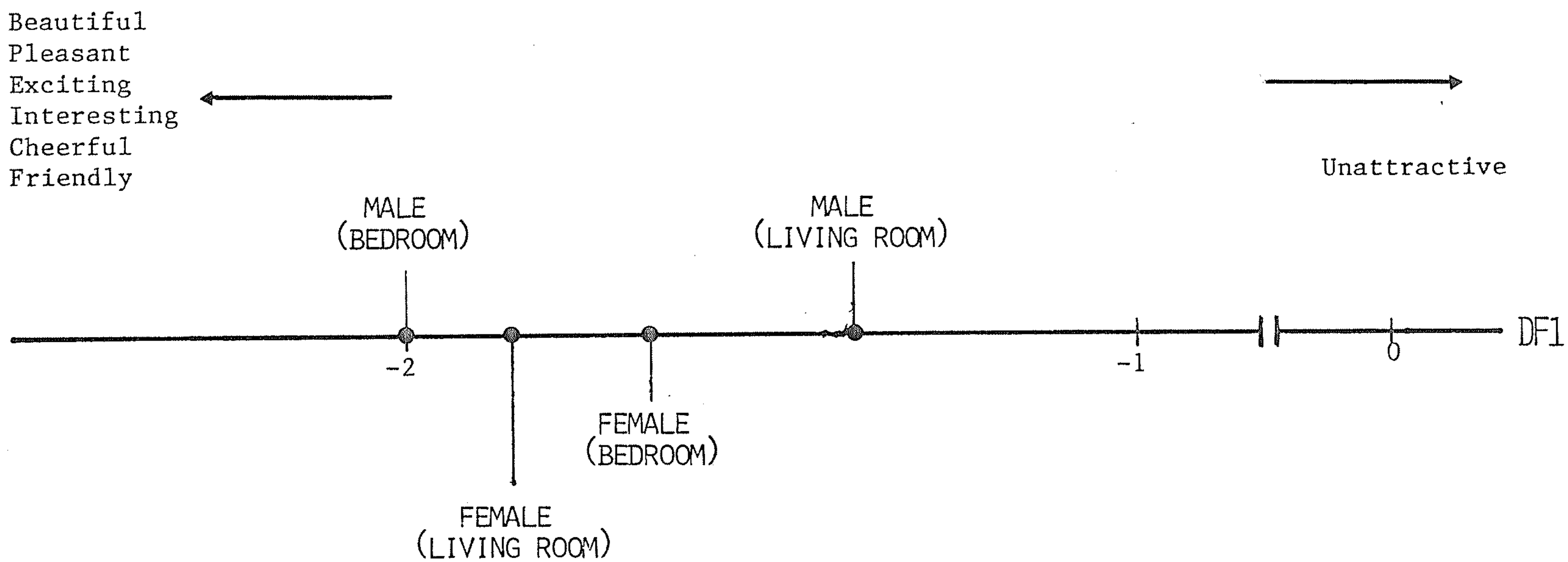

FIGURE 9

CENTROID PLOT: SEX BY ROOM INTERACTION

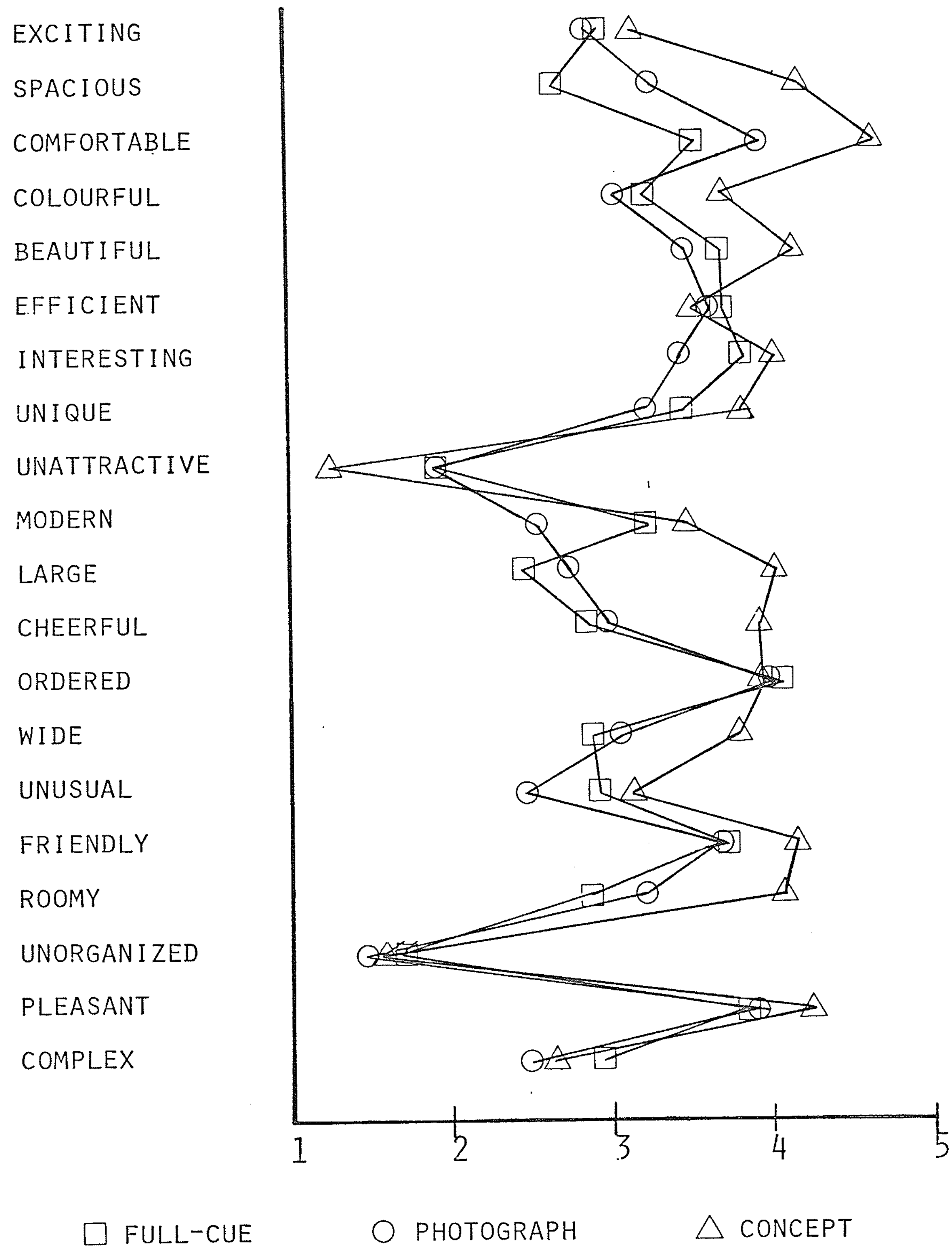

FIGURE 10

MEAN RESPONSE PROFILE COMPARISON:
LIVING ROOM MEAN RATINGS BY MODE OF REPRESENTATION

living room was, on a majority of scales, rated quite differently than either the actual living room or the photographic representation of it. Further, it is apparent that the ratings for the living room presented in actuality differ from those for the photograph, although these differences are not of the same magnitude nor are they as frequent as those evident for the concept rating group. In addition, a mean response profile comparison of the ratings by males and females for the living room suggests that small differences exist on a few of the scales as a function of the sex of the rater (see Figure 11).

A discriminant analysis of the living room scores, independent of those for the bedroom, was performed to determine if these "qualitative" judgements have empirical support. The analysis yielded three significant discriminant functions. The first significant function, $\chi^2(100) = 349.76$, $p < .0001$, is composed of the variables, large, spacious, roomy, comfortable, and cheerful. All of these variables have high negative structure coefficients (see Table 14). This dimension accounts for 61.2% of the total discriminating power that is apportioned to the three discriminant functions, hence, is the most powerful discriminating combination. The second significant discriminant set, $\chi^2(76) = 156.98$, $p < .0001$, consists of the variables, modern, interesting, and unusual. These three variables have high positive structure coefficients (see Table 14) and together account

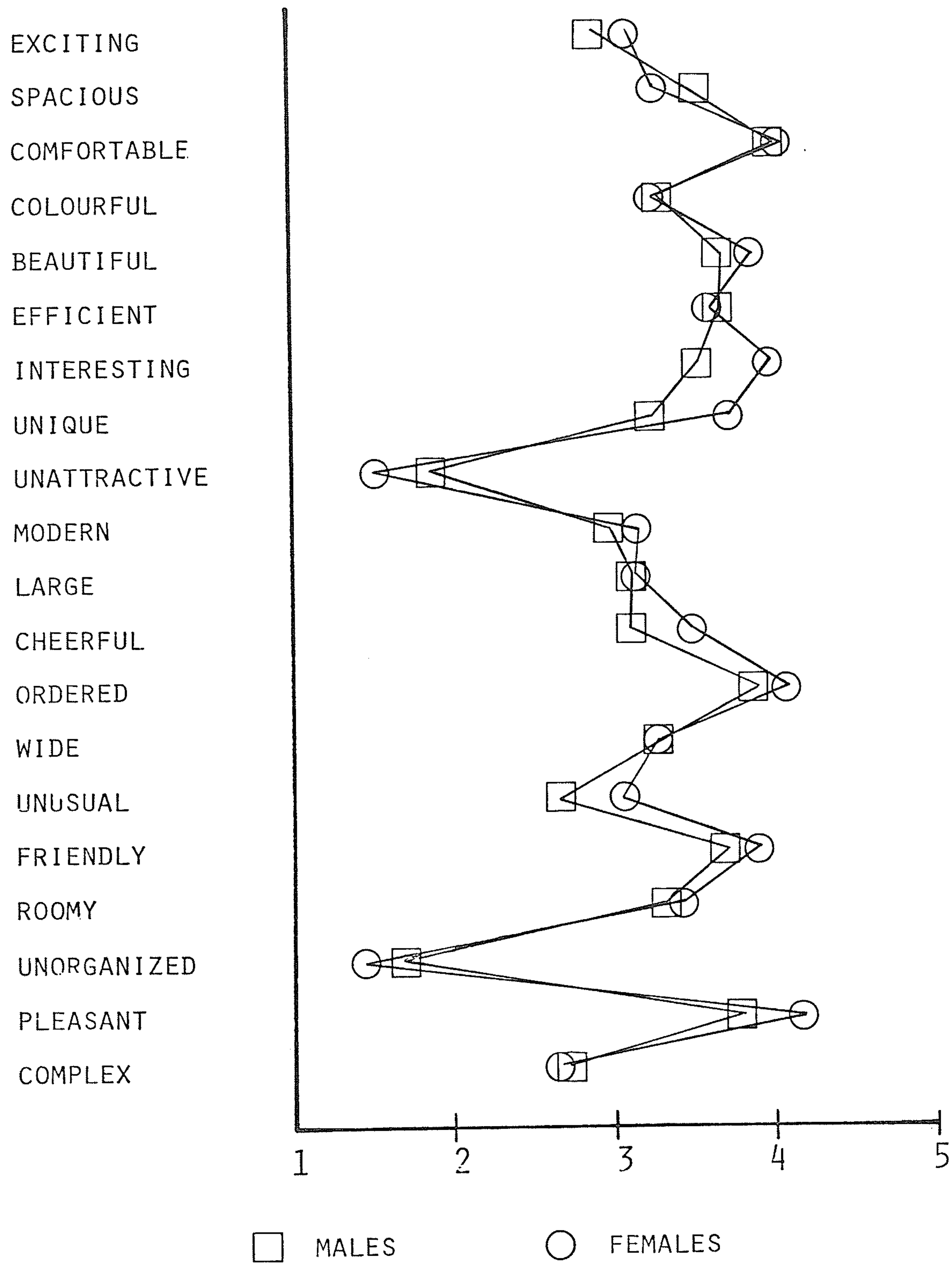

FIGURE 11

MEAN RESPONSE PROFILE COMPARISON
LIVING ROOM MEAN RATINGS BY SEX

TABLE 14

Discriminant Analysis of
Living Room Scores (Mode & Sex);
Standardized Discriminant Weights and Structure Coefficients

Variable	Mode & Sex					
	Function 1[a]		Function 2[a]		Function 3[a]	
	DFC[b]	SC[c]	DFC[b]	SC[c]	DFC[b]	SC[c]
Exciting	.244	-.122	-.097	.131	.359	.243
Spacious	-.541	-.636	-.646	-.197	-.328	-.107
Comfortable	-.367	-.521	-.271	-.045	-.081	.155
Colourful	.077	-.256	.009	.217	-.417	-.196
Beautiful	.173	-.258	.296	.343	-.145	.125
Efficient	.255	.081	-.111	.027	-.136	-.018
Interesting	.223	-.143	.408	.485	.160	.313
Unique	.035	-.175	-.226	.341	.267	.387
Unattractive	.385	.290	.042	-.239	.075	-.295
Modern	-.049	-.147	.633	.607	-.419	-.247
Large	-.281	-.644	.445	.153	-.040	-.071
Cheerful	-.468	-.517	-.043	.240	.215	.270
Ordered	.190	.032	.135	.061	.023	.196
Wide	.119	-.371	.063	.065	-.169	-.069
Unusual	-.242	-.156	.424	.444	.202	.239
Friendly	.018	-.244	.186	.181	-.340	.261
Roomy	-.099	-.565	.009	.002	.274	.124
Unorganized	-.170	.021	.183	.057	-.453	-.416
Pleasant	.092	-.274	-.076	.198	.726	.466
Complex	.010	.045	-.051	.202	-.254	-.131
Eigenvalue	0.962		0.321		0.179	
% of Variance	61.25		20.43		11.37	

[a] Discriminant Function
[b] Standardized Discriminant Function Coefficient
[c] Structure Coefficient

for 20.4% of the total discriminating power. A third significant discriminant function obtained, $\chi^2(54) = 77.38$, $p < .02$, accounts for 11.4% of the discriminating power and is composed of the variables, pleasant, unorganized, and unique. Both pleasant and unique have high positive structure coefficients whereas unorganized has a high negative structure coefficient (see Table 14).

A plot of the centroids of the three modes of representation broken down by sex is shown in Figure 12. The configuration of centroids clearly shows that the first discriminant function separates the concept rating group from both the full-cue rating group and the group rating the living room represented photographically. The conceptualized living room was assessed as significantly larger, more spacious, roomier, more cheerful, and more comfortable than the actual living room and the photographic representation of the living room. The first dimension also indicates that there was a moderate difference between the room rated full-cue and it's photographic counterpart. When this separation is viewed in conjunction with the corresponding mean ratings on these scales depicted in Figure 10 it can be seen that the photograph of the living room did not adequately capture the "size" of the room relative to it's ratings in actuality. That is, the photograph of the living room was rated slightly higher on the scales; spacious, large, and roomy.

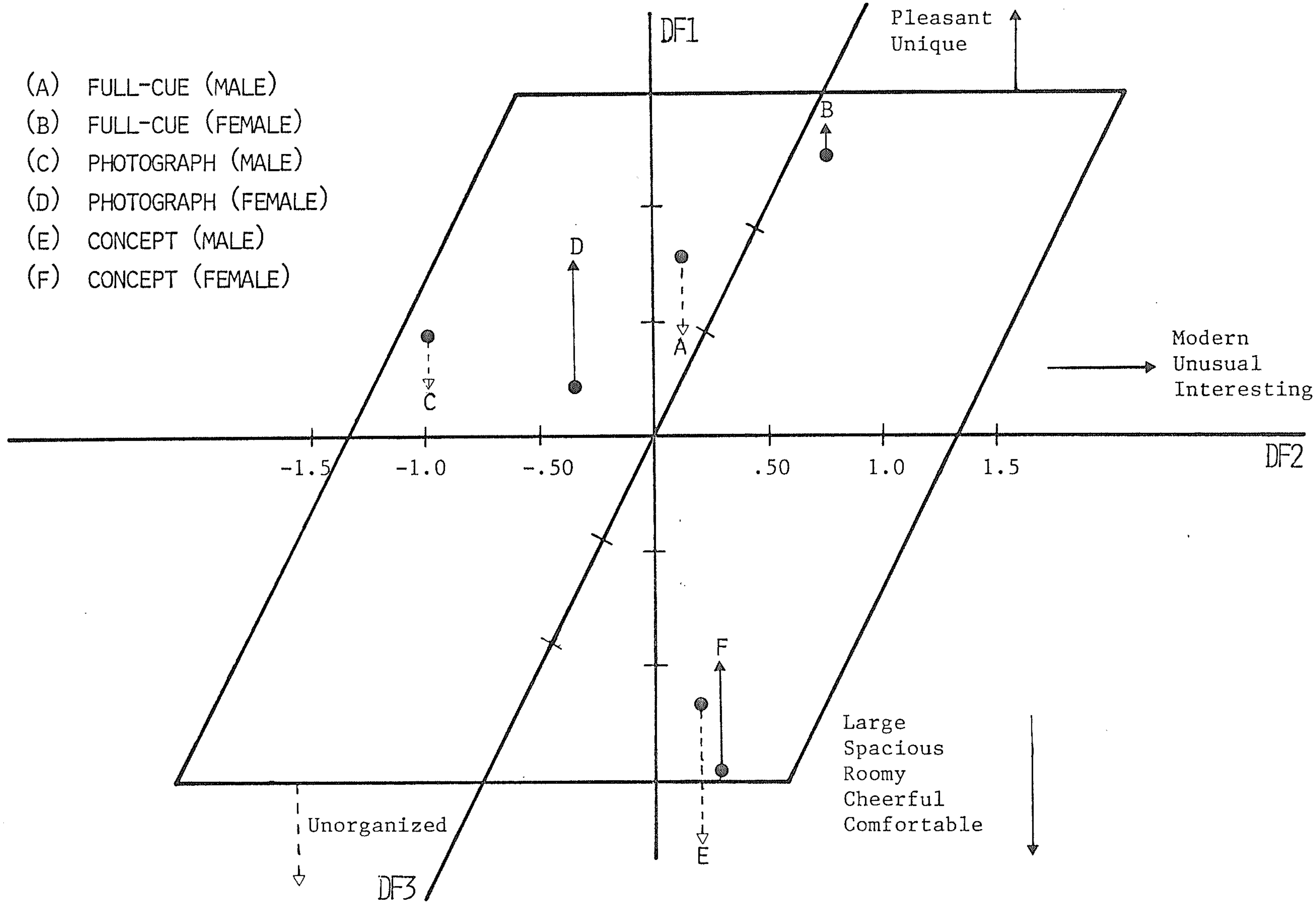

FIGURE 12

CENTROID PLOT: LIVING ROOM RATINGS (MODE AND SEX)

An examination of the spatial separation between the centroids on the second discriminant function (see Figure 12) indicates that the photographic representation of the living room was rated as the least modern, unusual, and interesting room relative to the living room rated full-cue or the ratings for the conceptualized room. Differences between the full-cue rating condition and the concept rating condition were negligible along this dimension.

The separation evident along the third discriminant dimension is primarily between the ratings by males and females regardless of the mode of representation. Whereas the centroids of males for all three modes of representation lie in negative space on this dimension, the centroids for females across all modes are on the positive side (see Figure 12). The reader will recall that this dimension is represented by the positively weighted variables, pleasant and unique, and the negatively weighted variable, unorganized. It can be seen then that females viewed the living room as more pleasant and unique than did the males, and further, as less unorganized relative to the ratings made by males.

Analysis of Bedroom Scores

As was the case for the ratings of the living room, the mean ratings for the bedroom broken down by mode of representation differ considerably (see Figure 13). Once

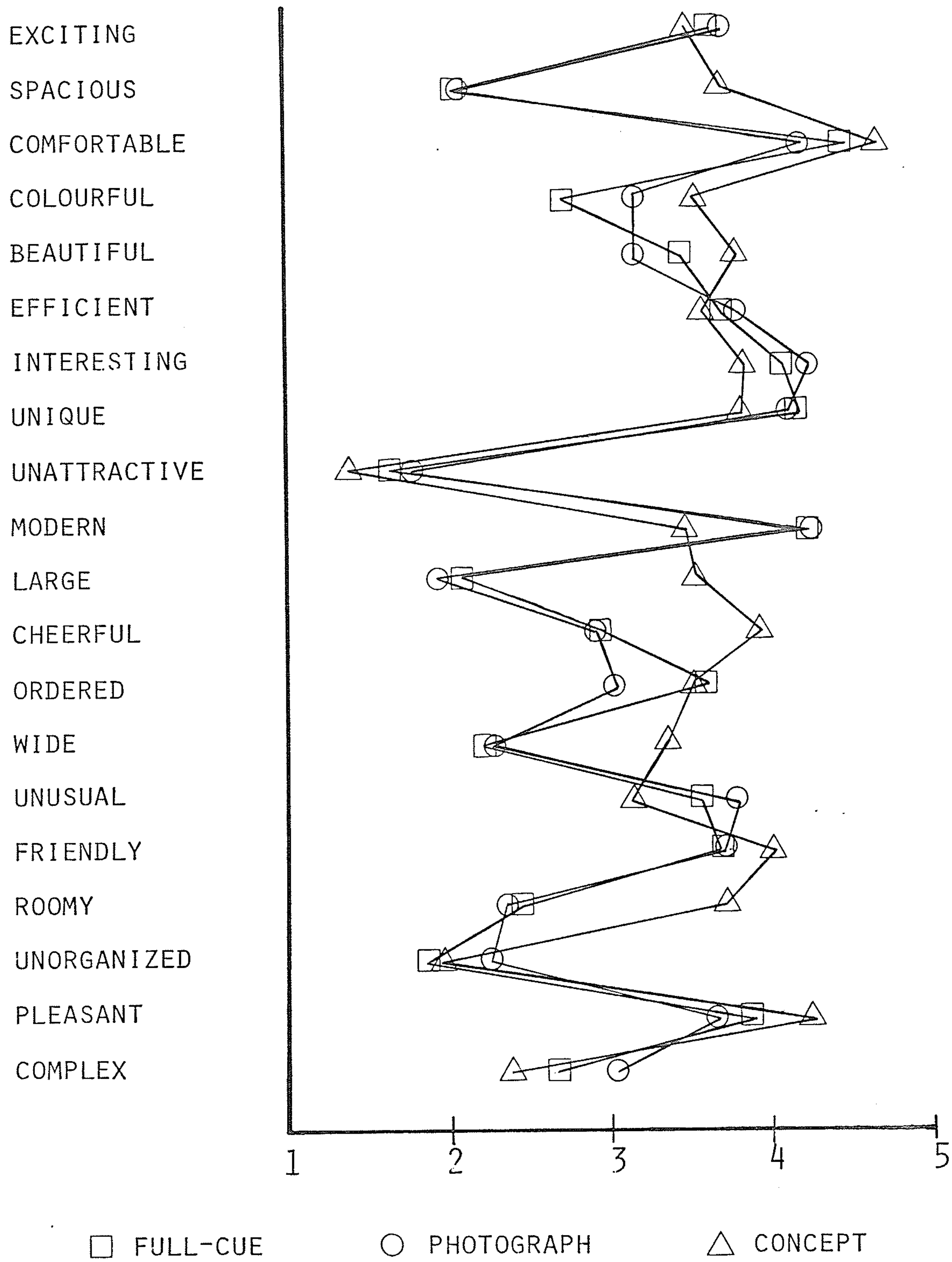

FIGURE 13

MEAN RESPONSE PROFILE COMPARISON:
BEDROOM MEAN RATINGS BY MODE OF REPRESENTATION

again, the largest discrepancies in ratings are between the conceptualized room and the bedroom rated full-cue and depicted photographically. However, unlike the ratings for the living room, the mean ratings for the bedroom examined in profile reveal that there are very few differences between the room rated in actuality and the ratings for the photographs of that same room. Further, the differences that are evident are relatively small (i.e., typically much less than one-half of a scale point, see Figure 13). In addition, the ratings for the bedroom broken down by the sex of the rater and examined in profile (see Figure 14) suggest that males and females rated the bedroom similarly on the majority of the scales.

A discriminant analysis of the bedroom scores yielded two significant discriminant functions: ($\chi^2(100) = 397.71$, $p < .0001$: and $\chi^2(76) = 127.02$, $p < .0002$). The first function accounted for 76.59% of the discriminating power of the two functions and is represented dimensionally by the variables, spacious, large, roomy, wide, and cheerful. All of these variables had high negative structure coefficients (see Table 15). The second function accounted for 11.75% of the discriminating power and is comprised of the variables, colourful and exciting, both of which have high negative structure coefficients (see Table 15).

A plot of the centroids of the three modes of representation boken down by sex (see Figure 15) indicates that

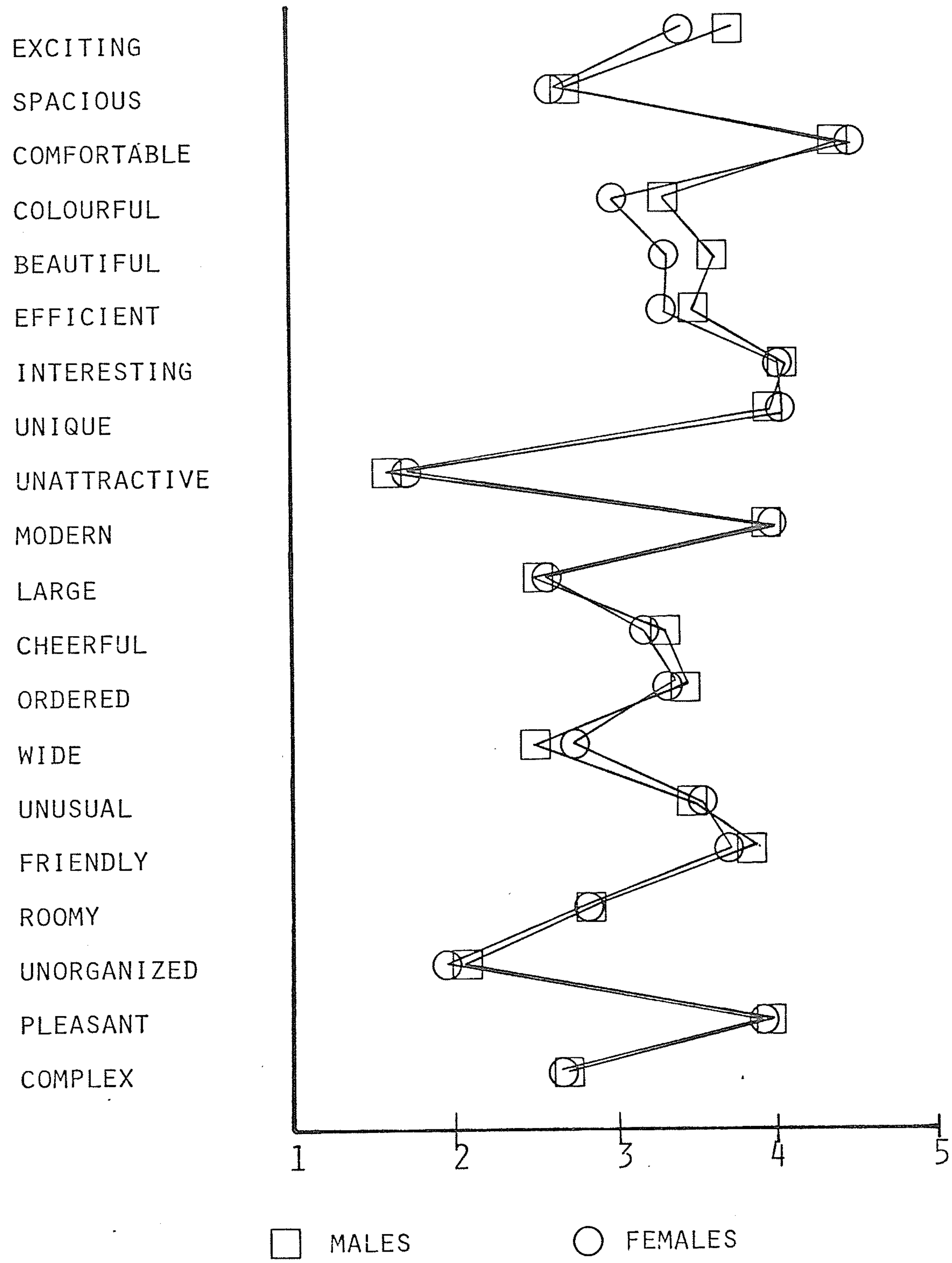

FIGURE 14

MEAN RESPONSE PROFILE COMPARISON:
BEDROOM MEAN RATINGS BY SEX

TABLE 15

Discriminant Analysis of
Bedroom Scores (Mode & Sex);
Standardized Discriminant Weights and Structure Coefficients

Variable	Mode and Sex			
	Function 1[a]		Function 2[a]	
	DFC[b]	SC[c]	DFC[b]	SC[c]
Exciting	.269	.018	-.454	-.452
Spacious	-.467	-.625	-.370	-.008
Comfortable	.058	-.155	.717	.225
Colourful	-.300	-.272	.337	-.452
Beautiful	.125	-.216	.420	-.252
Efficient	-.162	-.138	-.009	-.011
Interesting	.269	.105	-.005	-.230
Unique	.042	.145	.224	.079
Unattractive	.172	.195	.194	.070
Modern	.463	.298	.107	.069
Large	-.192	-.591	.255	.207
Cheerful	-.434	-.448	.036	-.122
Ordered	-.064	-.102	-.035	.181
Wide	-.102	-.456	.379	.284
Unusual	-.047	.179	-.074	-.152
Friendly	.034	-.174	-.278	-.207
Roomy	-.080	-.469	.043	.127
Unorganized	-.284	.030	-.330	-.230
Pleasant	-.129	-.246	.118	-.039
Complex	.136	.157	-.241	-.224
Eigenvalue	1.577		0.242	
% of Variance	76.59		11.75	

[a] Discriminant Function
[b] Standardized Discriminant Function Coefficient
[c] Structure Coefficient

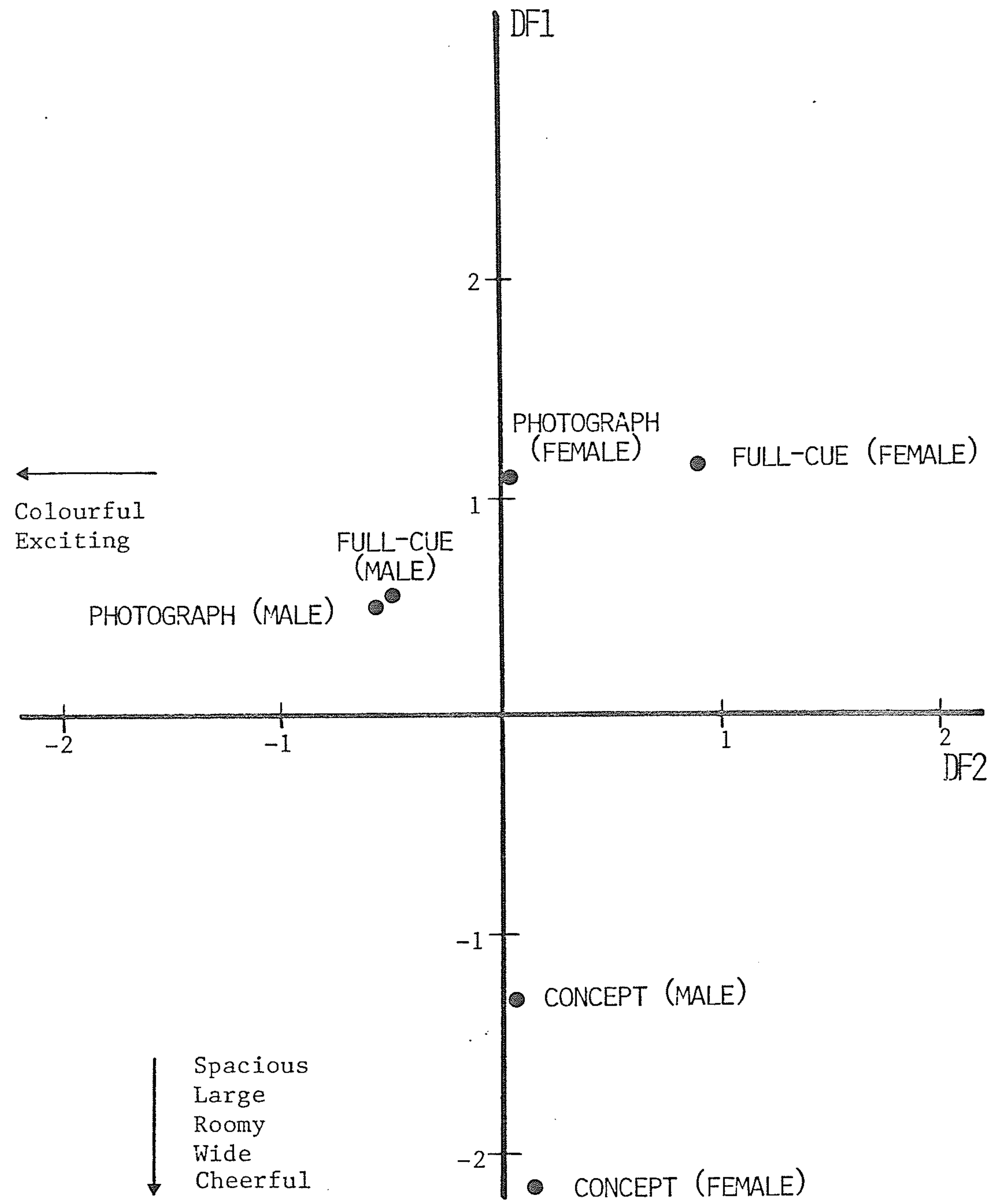

FIGURE 15

CENTROID PLOT: BEDROOM RATINGS (MODE AND SEX) the largest separation on the first discriminant dimension serves to differentiate the concept rating group from both the full-cue and photograph rating groups. Specifically, Figure 15 indicates that the conceptualized bedroom was rated as a more spacious, larger, roomier, wider, and more cheerful room than either the bedroom represented photographically or the bedroom rated *in situ*. Importantly, there is little discriminable difference on this dimension between the ratings for the bedroom rated in actuality and the photographic representation of the bedroom.

The second dimension primarily separates the ratings made by females in both the full-cue rating condition and the photograph rating condition from the ratings made by males in these same conditions (see Figure 15). Specifically, males rating the photograph of the bedroom and the actual bedroom assessed them as more colourful and exciting relative to the ratings made by females. There is little discriminable difference between male and female assessments of the conceptualized bedrooms on this dimension. In addition, differences between the three modes of representation on the second dimension are slight. The bedroom, regardless of the mode of representation, was assessed as equally colourful and exciting.

Paired Comparisons

Discriminant analyses have consistently shown that the assessments of the conceptualized interiors were widely discrepant from the ratings for the existing interiors rated from photographs or rated in situ. In addition, they have indicated that only moderate to negligible differences exist between the ratings for the interiors assessed full-cue and from photographs. Paired comparison procedures were employed to provide further empirical evidence concerning the differences across mode of representation.

Results indicate that the assessments of the living room and bedroom rated full-cue were highly significantly different from the ratings of the conceptualized rooms, $F(2,294) = 23.87$, $p < .0001$. In addition, the ratings for the photographic representations were significantly different from those for the conceptualized rooms, $F(2,294) = 14.94$, $p < .0001$. These findings are in agreement with the results of the discriminant analyses. However, contrary to the findings of the discriminant analyses, the ratings of the living room and bedroom viewed in actuality and the ratings of the same two interiors represented photographically were also significantly different, $F(2,294) = 2.95$, $p < .0001$. This apparent contradiction between analyses is resolved when univariate ω^2's are calculated to determine the percentage of total variance in the data which each of these significant effects accounts for. Whereas, the first two contrasts (full-cue vs.

concept and photograph vs. concept) account for 14.3% and 9.6% of the total variance respectively, the latter contrast (full-cue vs. photograph) accounts for only 1.2% of the total variability in the data. Although the differences in assessment between the full-cue rating condition and the photographic rating condition are statistically significant, they are not, as a group, of sufficient magnitude to be meaningful with regard to the overall cognitive impression of the interiors as measured by the 20 scales. However, the variations between these two groups on a single scale, or on a discriminating group of scales as demonstrated by discriminant analyses, remain meaningful and subsequently validly interpretable as reflections of true differences in perception and assessment.

Chapter 4

DISCUSSION

The present study has experimentally addressed two major questions in environmental perception and assessment research. First, are projected photographs valid substitutes for real spaces when assessing cognitive impressions of interior environments? That is, do photographs elicit comparable responses to those elicited by full-cue interior environments thereby validating their use for assessment purposes in lieu of presenting the actual space? Second, are rating scales capable of discriminating between environments which are intuitively very different? More specifically, do such scales have what has been termed discriminant or divergent validity? Both questions are important, given the widespread use of photographic modes of representation and semantic response formats in environmental perception and assessment research.

A number of the methodological problems evident in previous research in this area have been eliminated in this study. Typically, previous research failed to provide for a test of the discriminant/divergent validity of their response instrument. Moreover, the analyses employed in previous studies were often inappropriate for the questions being asked (e.g., the use of factor analyses alone when attempting to determine the degree of congruence in responses between surrogate modes of representation and reality). Additionally, all of the previous research employing factor analyses violated important assumptions of the technique. Many of the previous studies were merely descriptive in nature and did not do significance testing to provide empirical support for their conclusions. Further, a number of studies employed inappropriately small numbers of subjects. It would appear in these studies that the failure to detect significant differences between responses to reality and alternate modes of representation was due primarily to a lack of statistical power rather than being due to a true lack of differences. Finally, a number of the studies investigating the validity of representational techniques did not compare them to the actual environments which they depicted. Rather, they were compared to other, "similar," full-cue environments. This represents at best, a test of the discriminant/divergent validity of their response instrument rather then a test of the convergent validity of an alternate mode of representation.

It was hypothesized that the ratings for the photographic representations would be comparable to the ratings for the full-cue interiors. In addition, it was further hypothesized that the unipolar semantic scales employed would have discriminant/divergent validity. That is, the ratings for the conceptualized rooms would be significantly different from the ratings for either the interiors presented full-cue or represented photographically. In general, the results supported the hypotheses as predicted, however, notable exceptions on a number of scales were evident.

The differences in assessment between the full-cue rating group and the photograph rating group were statistically significant. On that basis it is tempting to conclude that the photographs did not adequately portray the full-scale settings and therefore are not useful for research purposes. However, an examination of the absolute magnitude of these differences reveals that, on the majority of scales, they did not exceed one-quarter of a scale point. In addition, the differences between the full-cue and photograph rating groups accounted for only 1.2% of the total variability in the data. On that basis, the photographs did adequately portray the actual rooms; at least from the point of view of a researcher attempting to assess people's perceptions of interior environments. Although the differences were statistically significant, they were not, as a group, of sufficient magnitude to negate the usefulness of photographic modes of representation in this type of research. In short, the ratings of the photographs were, on the majority of scales, functionally comparable to the ratings of the actual rooms. However, the differences between these two groups on a few of the scales were greater than one-quarter of a scale point. Discriminant analyses indicated that these scales reflect meaningful differences in perception and assessment. Specifically, a moderate enhancement of the perceived size of the rooms viewed and assessed photographically was evident. Independent discriminant analyses of the effects of mode of representation on each room indicated that the enhancement occurs primarily in the ratings for the living room. Whereas the living room represented photographically was assessed as a larger, roomier, and more spacious environment relative to the ratings for the actual living room, the ratings for the photograph of the bedroom and the bedroom presented _in situ_ were essentially the same on these scales.

The enhancement of environmental features when represented photographically has been noted in other studies investigating the validity of using surrogate modes of representation (e.g., Anderson, 1972; Hendrick et. al., 1977; Lane et. al. 1975). In addition, other researchers using scale models have noted that such representations were rated more positively than the real environment (e.g., Corth, 1980; Lau, 1972). It is apparent then, that enhancement effects of other modes of representation are well documented by previous research. However, less apparent are the reasons why the enhancement occurs. In the case of landscapes it has been suggested that the enhancement is due to pre-exposure to "distracting" features of other environments prior to rating the actual environment being studied (Lane et. al., 1975).

In the case of scale models, differences in the luminance intensity across modes (Corth, 1980), and some intrinsic characteristic of miniaturization (Lau, 1972), have been offered as explanations of the enhancement effect. None of these explanations can reasonably account for the enhancement effect found in this study. Both the living room and the bedroom were assessed using identical experimental procedures and yet the enhancement was evident in the ratings of only one of the two interiors investigated.

Given that the enhancement of perceived size was evident only in the case of the living room, and not the bedroom, an explanation of the effect can be deduced by considering the different "properties" of the two rooms. One notable difference between the rooms was their actual size compared to an intuitive judgement of the size of an average or typical living room and bedroom encountered in a North American home. Whereas the bedroom utilized in this study was comparable in size to a typical bedroom, the living room used was smaller than the norm. It seems plausible that the subjects's ratings of the photographic representation of the living room were influenced by what might be termed a "cognitive set" or alternately an "expectation" of viewing a more typically sized living room. This would account for the moderately inflated ratings of the size of the living room rated from a photograph as compared to the ratings of the interior assessed full-cue. That is, when assessing the size of the living room from a photograph, subjects were unable to fully perceive the deviation in size from an expected norm and their ratings were influenced accordingly. On the other hand, they were capable of making appropriate judgements with regard to the size of the room when it was assessed *in situ*.

It is interesting to note that the assessments of the photograph of the living room deviate significantly from the assessments of the room viewed full-cue primarily on scales which have an objective referent. The objective referent referred to is the actual physical dimensions of the room. Dependent measures which have an objective referent; those which assess perceptions of discrete physical variables of environments, have been termed "prothetic" measures. Scales which do not have an objective physical correlate have been termed "metathetic" measures (Stevens, 1968). Whereas Kasmar (1970) has suggested that people have difficulty responding accurately on metathetic scales and Collins (Note 2) has stated that prothetic and metathetic measures are responded to with the same ease and accuracy; this study has determined that the discrepancy in ratings across mode of representation were greatest on prothetic measures. However, although the ratings were discrepant, they were not necessarily wholly inaccurate. In both the full-cue condition and the photographic condition mean ratings on those scales measuring perceived size indicated that the interiors were generally scored on the lower end of the scales. That is, both rooms were rated as being moderately to "not at all" spacious, large, roomy, or wide. These judgements are in keeping with the actual physical dimensions of the rooms. Hence, the use of photographs when assessing cognitive impressions of the size of interiors may not be unwarranted if appropriate precautions in interpretation are taken.

Holahan and Holahan (1977;1979) have suggested that environmental schematization by females is relatively more personal and social than that of males. In the present study, females viewed the interiors as more unique and interesting than did males. Further, males viewed the interiors as more colourful and unorganized relative to the ratings made by females. None of these scales can reasonably be interpreted as addressing the personal or social schema of the interiors, nor were they designed to do so. However, they do differ in terms of their relative subjectivity and/or objectivity. That is, although all are metathetic scales as Stevens' (1968) defines the term, the variables colourful and unorganized do have related physical correlates in an interior whereas the variables unique and interesting, relatively speaking, do not. Specifically, the perceived colourfulness of an interior is likely to be a function of the actual hue and the degree of colour saturation of the walls and furniture in the interior. The perceived organization of a room is intuitively related to the position of the furniture in the interior, the amount of furniture in the interior, and the corresponding complexity of the furniture arrangement. On the other hand, objectifying the perceived interestingness and uniqueness of an interior environment is a more difficult task.

The fact that males scored the interiors higher on the more readily objectified variables and that females rated the rooms higher on relatively more subjective scales lends support to another, related, suggestion by Holahan and Holahan (1979). Namely; males tend to view environments in objective terms whereas a female's schematization of the environment is relatively more subjective. The support is tenuous however, given that the actual mean differences in ratings on these scales, although statistically significant, were quite small.

Few studies on the validity of alternate modes of representation have employed both male and female raters. Typically, male subjects have been used exclusively in this type of research (e.g., Garling, 1969; Seaton and Collins, 1972; Zube, 1974). In a number of studies researchers did not specify the sex of their subjects (e.g., Acking and Kuller, 1972; Hendrick et. al., 1977). Of those which have included both sexes (e.g., Corth, 1980; Danford and Willems, 1975) none have employed significance testing to determine if relative differences exist between the ratings across modes of representation as a function of the sex of the rater. Hence, the presence of a significant mode by sex interaction effect in this study is apparently a unique finding. Results indicated that females rated the conceptualized rooms as more spacious, roomy, cheerful, and large than did males. Conversely, males rated the rooms higher on these scales than did females when assessing the actual rooms and the photographic representations of the rooms.

To date, research on sex differences in environmental schematization (cf., Holahan and Holahan, 1977; 1979) has not provided any empirical evidence to suggest why this interaction effect might occur. Its occurrence defies intuitive explanation as well. Future research in environmental perception and assessment; particularly research which investigates environmental displays identified only by name or verbal description as opposed to actual presentation or representation, should take note of the effect. In addition, the design professions often give verbal descriptions of prospective projects to potential clients prior to the construction or design of an actual environment. They too should be aware that the opinion and assessment of a project may vary differentially as a function of the sex of the client when the project is represented in a different manner at a later date.

Less surprising and more readily explained is the presence of a significant sex by room interaction effect in this study. Males, when rating the bedroom, assessed it much more positively on a number of scales than did females. In contrast, females rated the living room slightly higher on these scales. This was particularly true for the assessments of the rooms rated in situ and represented photographically. Male and female judgements of the rooms were essentially equivalent on these scales in the concept rating condition.

The bedroom chosen for assessment in this study was characteristic of a single male's bedroom relative to what one might expect in a stereotypic female equivalent or in a couple's bedroom. That is, the bedroom contained some of the "trappings" of what might be expected in a bachelor's room (e.g., a strategically placed stereo set and fur rugs). Admittedly this is an intuitive judgement; however, if the subjects were attending to these features of the bedroom a feasible explanation of the interaction effect is readily apparent. Males assessed the bedroom more positively simply because it was characteristically a male's bedroom. On the other hand, females assessed it less positively for precisely the same reason. The relatively equivalent positive assessments of the two rooms in the concept rating condition suggest that the subjects were imagining rooms, particularly bedrooms, either with characteristics in keeping with their gender or perhaps relatively "androgynous" interiors.

It is unfortunate that these findings were not anticipated prior to beginning this study. A post-experimental questionnaire could have provided empirical support for a number of the explanations offered concerning the findings of this study. For instance, it would have been useful to determine if subjects did indeed perceive the bedroom as being characteristic of a male's bedroom. This could easily be determined with an open-ended question addressing this issue after the subjects had completed their ratings. Additionally, it would have been useful to determine the characteristics of the rooms which the subjects were imagining in the concept rating situation. That is, were they imagining pre-existing interiors which they had lived in or were currently living in, or were they forming a picture of an "ideal" room based on a selective composite of other interiors which they had experienced? It would appear from the predominantly highly positive ratings given to the conceptualized rooms that the majority of the subjects were indeed imagining their "ideal" interior. However, this is again an intuitive judgement. Future research in environmental perception and assessment could benefit by eliminating the now obvious methodological shortcoming and oversight which this study contains.

Results also indicated that the living room and bedroom were rated relatively differently across the three modes of representation. The presence of a significant mode by room interaction effect suggests that the relative differences in assessment between the interiors depends in part on the mode of representation employed when presenting the interior for assessment. This finding is in keeping with the results of a study by Seaton and Collins (1972) which found that the relative pleasantness or appealingness of a building depends on how it is represented.

Surprisingly, in the present study, the fact that there was a significant mode by room interaction effect was due primarily to the nature of the ratings assigned to the conceptualized rooms relative to the ratings of the other two experimental groups. The ratings for the pre-existing interiors, presented full-cue and represented photographically, exhibited relative differences in ratings on only one scale. Specifically, the living room and bedroom were rated as being equally comfortable when assessed in the photographic and concept rating condition. However, when viewed full-cue the bedroom was assessed as significantly more comfortable than the living room. A very simple, yet plausible, explanation for the interaction effect on the variable "comfortable" can be derived by considering the fact that subjects in the full-cue condition were viewing a real bed. On the other hand, subjects in the photographic condition were viewing a two-dimensional representation of a bed projected on a screen and subjects in the concept rating condition were assessing an imaginary bed. It is not surprising then that the perceived comfort of the interior would be affected relatively differently by the three different modes of representation. In the full-cue situation the real bed is conceptually, if not literally, a useable item (i.e., it can be lain upon, and can literally be comfortable). However, in the other two assessment situations the bed being viewed is not a useable item. The suggestion is that since the use of the bed in the full-cue situation is potentially a more viable behaviour it is correspondingly rated as the more comfortable interior.

As suggested, the mode by room interaction effect demonstrated on other scales can be attributed to the presence of the group rating the conceptualized interiors. When rating the moderness, unusualness, interestingness, uniqueness, and complexity of the rooms, subjects viewing the actual rooms and the photographic representations rated the rooms differently on these scales. Although the ratings were different, they were consistent and in the same direction across the two viewing conditions. In contrast, subjects assessing the conceptualized rooms gave them essentially equivalent ratings on these scales. This is the first effect discussed which addresses the question of the discriminant/divergent validity of the scales employed in the study. It would appear that these scales were capable of discriminating between the pre-existing interiors assessed in actuality and from photographs. However, they did not discriminate between the conceptualized living room and bedroom.

The reader will recall that the discriminant/divergent validity of a dependent measure is demonstrated when ratings on that measure differ significantly between groups which are intuitively and/or logistically expected to show differences. In this study, it was hypothesized that the ratings for the conceptualized rooms would differ significantly from the ratings for the pre-existing interiors viewed full-cue and photographically. In short, the concept rating group was included specifically to provide for a test of the discriminant/divergent validity of the scales employed. One would also expect that if the semantic scales employed were discriminantly/divergently valid, then the ratings for the living room and bedroom would be significantly different as well. Indeed, results indicated that there was a significant room main effect. A multivariate analysis of variance demonstrated that the ratings for the living room and bedroom were significantly different. What is disturbing, however, is that the mode by room interaction effect indicated that the ratings for the two rooms were only incongruent in the full-cue and photographic assessment conditions. As stated earlier, the ratings for the conceptualized living room were essentially the same as the ratings for the conceptualized bedroom on the majority of scales. This would suggest that semantic scales do not have discriminant/divergent validity when the stimuli being assessed are identified only by name or elicited by verbal description. However, this finding may not generalize to other types of imagined interiors. That is, assessments may prove to be incongruent if the ratings of other types of settings are compared. For instance, semantic response formats may discriminate between a conceptualized kitchen and bedroom setting, even though they do not discriminate between the conceptualized living rooms and bedrooms in this study. A number of researchers have investigated the perception and assessment of environments using a conceptual mode of presentation (e.g., Craik, 1971; Mehrabian and Russell, 1974; Pace and Stern, 1958), however, they did not provide for a test of the discriminant/divergent validity of their dependent measures. Future research employing this mode in conjuction with semantic measures should be aware that their response format potentially lacks discriminant/divergent validity.

An examination of the results of the combined analysis on both rooms and the independent analyses of each room indicated that only 4 of the 20 scales failed to discriminate the conceptualized rooms from the rooms represented photographically and presented in actuality. Specifically, each room was rated as being an equally efficient, interesting, unorganized, and ordered interior across the three modes of representation. Moreover, although these scales failed to discriminate across the three modes of representation, the ratings on the variables, efficient, interesting, and unorganized did diverge significantly as a function of the type of room being rated. Hence, only the variable, ordered, completely lacked discriminant/divergent validity.

It is not surprising that the ratings for the rooms would fail to diverge as a function of diverse modes of representation on a few of the scales. Coincidentally "similar" conceptualized interiors could account for the lack of divergence. That is, perhaps the relative efficiency, interestingness, organization, and orderedness of the interiors being imagined was indeed similar to the efficiency, interestingness, organization, and orderedness of the pre-existing interiors assessed in this study. It may also be the case that one or more of the four scales which failed to exhibit divergence were not particularly good "assessors" in the context of interior environments. That is, they may not be sensitive or relevant measures when attempting to assess people's cognitive impressions of architectural environments. Although they did not have discriminant/divergent validity in this study, assessments on these scales of other types of environments such as landscapes may well result in divergent ratings. Perhaps the discriminant/divergent validity of a semantic scale is situation specific. It would be unreasonable to expect that all semantic scales would be equally applicable and relevant to all types of environments. Thus, researchers utilizing these types of dependent measures when investigating people's perceptions of environments must choose their scales carefully, with an eye towards applicability and relevance, if they are to obtain valid results.

However, the results also demonstrated that the majority of the carefully chosen unipolar semantic scales employed in this study were capable of discriminating between the conceptualized rooms and the pre-existing interiors assessed *in situ* and rated from photographs. Discriminant analyses consistently showed that the largest differences in the ratings can be attributed to the presence of the group which rated conceptualized living rooms and bedrooms. The scores on the majority of the scales utilized in this study did diverge where they were logistically expected to diverge. They did discriminate between environments which were inherently diverse, and therefore, by definition, proved to be discriminantly/divergently valid measures. In addition to being capable of discriminating between diverse environments, previous research has shown that semantic scales also appear to be sensitive to discrete manipulations of the features within environments (e.g., Baird, Cassidy and Kurr, 1978; Tognoli, 1973; Kaye and Murray, Note 4). Hence, Danford and Willems' (1975) conclusion concerning the general lack of discriminant/divergent validity of semantic scales when used to assess pre-existing environmental stimuli appears to be unwarranted.

What remains to be empirically demonstrated is whether or not semantic measurement techniques have construct and/or predictive validity. If, for instance, as in this study, results indicate that one interior scores significantly higher on the semantic scale "comfortable," relative to a score on the same scale for another interior, does it then follow that the former is truly a more comfortable interior than the latter? Does assessed semantic comfort have relevance when a person experiences a real setting? If it is determined through semantic measurement that an environment is perceived as being comfortable can we then predict that people experiencing the environment will be comfortable in it? A study by Lowenthal and Riel (1972) found striking differences between the responses of subjects walking through an environment and the responses of subjects who knew the environment but responded only to their images of it: "what we think we like or should like (or dislike) about certain kinds of environments is often not what we do like (or dislike) when we actually experience them" (p. 205). In light of such results, future research in environmental perception and assessment should address these questions. Prior to generalizing from cognitive impressions of an environment, to behaviour within that same environment, it must be determined whether or not knowing one, allows prediction of the other.

Additionally, although the present study has shown that photographic modes of representation are valid substitutes for actual interior environments in perception and assessment research, future research should continue to investigate the validity of other modes for representing other types of environments. Different types of environments may well require different modes of representation to validly communicate their real characteristics. For instance, a waterfall landscape is a relatively dynamic environment when compared to an interior. Inherent in this type of landscape are sounds and motion which could influence the manner in which it is perceived and assessed. A static, photographic rendition of this type of environment would result in a relatively impoverished representation and thus, may not be a valid means of representing the environment for assessment. It is not necessarily the case then, that all modes would prove to be valid representers of all types of environments.

In conclusion, this study has served to demonstrate that photographs do yield comparable ratings to actual environments and are therefore a useful means of representation in this type of research. Moreover, the study provides a resolution to the question of whether or not subjective rating scales are capable of discriminating between diverse environmental settings. That is, the study has shown that semantic scales do have discriminant/divergent validity when they are carefully chosen and are used for the assessment of pre-existing architectural environments. There has been a tendency in environmental perception and assessment research to generalize findings far beyond the limited domain of the environments sampled and responses measured.

To the extent that there has been a limited sample of the types of environments which are of interest in environmental assessment research, and further, a limited sample of the various modes of representation which could be used to represent these environment, the present study has limited generalizability. What is evident after conducting this research however, is that environmental perception and assessment researchers cannot continue to ignore questions concerning the validity of the techniques which they employ. It is imperative that the validity of the alternate modes of representation and the response formats in common use in this field be established prior to conducting any further research.

REFERENCE NOTES

1. Oostendorp, A., & Berlyne, D.E. Dimensions in the perception of architecture. Paper presented at the meeting of the Canadian Psychological Association, Toronto, 1976.

2. Collins, J.B. Scales for evaluating the architectural environment. Paper presented at the meeting of the American Psychological Association, Washington, D.C., 1971.

3. Gifford, R. On the discriminant validity of subjective ratings of the environment. Manuscript submitted for publication, 1979.

4. Kaye, S.M., & Murray, M.A. Evaluations of an architectural space as a function of variations in furniture arrangement, furniture density, and windows. Unpublished manuscript, 1980.

REFERENCES

Acking, C-A. Factorial analysis of the perception of an interior. In B. Honikman (Ed.), AP70: Proceedings of the Architectural Psychology Conference at Kingston Polytechnic, London: RIBA Publications, 1971, 46-48.

Acking, C-A., & Kuller, R. The perception of an interior as a function of its colour. Ergonomics, 1972, 15, 645-654.

Acking, C-A., & Kuller, R. Presentation and judgement of planned environments and the hypothesis of arousal. In W.F.E. Preiser (Ed.), Environmental design research: Vol 1, Selected papers. Proceedings of the 4th International Environmental Design Research Association Conference, 1973, 72-83.

Anderson, J.M. Simulating architecture. The Architect's Journal, 1972, 6, 1325-1329.

Baird, J.C., Cassidy, B., & Kurr, J. Room preference as a function of architectural features and user activities. Journal of Applied Psychology, 1978, 63, 719-727.

Boster, R.S., & Daniel, T.C. Measuring public responses to vegetative management. In Proceedings of the 16th Annual Arizona Watershed Symposium, Arizona Water Commission, Phoenix, 1972.

Brodin, C. A study of preferences for simulated outdoor environments with different intensities of feelings of enclosed space. In R. Kuller (Ed.), Architectural Psychology, printed in Sweden, Studentlitteratur, 1973.

Calvin, J.S., Dearinger, J.A., & Curtin, M.E. An attempt at assessing preferences for natural landscapes. Environment and Behaviour, 1972, 4 (4), 447-470.

Campbell, D.T. Recommendations for APA test standards regarding construct, trait, or discriminant validity. American Psychologist, 1960, 15, 546-553.

Campbell, D.T., & Fiske, D.W. Convergent and discriminant validation by the multitrait - multimethod matrix. Psychological Bulletin, 1959, 56, 81-105

Canter, D. An intergroup comparison of connotative dimensions in architecture. Environment and Behaviour, 1969, 1 (2), 37-48.

Canter, D., & Wools, R. A technique for the subjective appraisal of buildings. Building Science, 1970, 5, 187-198.

Carls, E.G. The effects of people and man-induced conditions on preferences for outdoor recreation landscapes. Journal of Leisure Research, 1974, 6, 113-124.

Clamp, P. Evaluating English landscapes - some recent developments. Environment and Planning, 1976, 8, 79-92.

Clark, T. Values, behaviour, and conflict in modern camping culture. Journal of Leisure Research, 1971, 3, 141-159.

Comrey, A.L. A first course in factor analysis. New York: Academic Press, 1973.

Corth, R. Can models predict the real world? Lighting Design and Application, 1980, 10, 28-34.

Craik, K.H. The comprehension of the everyday physical environment. Journal of the American Institute of Planners, 1968, 34, 29-37.

Criak, K.H. The environmental dispositions of environmental decision makers. Annals, 1970, 389, 87-94.

Craik, K.H. The assessment of places. In P. McReynolds, (Ed.), Advances in Psychological Assessment, 1971, Science and Behaviour Books, Palo Alto, 40-62.

Craik, K.H. Psychological factors in landscape appraisal. Environment and Behaviour, 1972, 4 (3), 255-265.

Cunningham, M.R. Notes on the psychological basis of environmental design: The right-left dimension in apartment floor plans. Environment and Behaviour, 1977, 9, 125-135.

Danford, S., & Willems, E.P. Subjective responses to architectural displays: A question of validity. Environment and Behaviour, 1975, 7 (4), 486-516.

Finn, J.D. Multivariance: Univariate and multivariate analysis of variance, covariance, regression and repeated measures; Users guide, Version VI. Chicago, Illinois: National Educational Resources Inc., 1977.

Garling, T. Studies in visual perception of architectural spaces and rooms. Scandanavian Journal of Psychology, 1970, 2, 133-145.

Garling, T. Some applications of multidimensional scaling methods to the structural analysis of environmental perception and cognition. In R. Kuller (Ed.), Architectual Psychology, printed in Sweden, Studentlitteratur, 1973.

Gorsuch, R.L. Factor Analysis. Philadelphia: W.B. Saunders Company, 1974.

Greenberg, D.P. Computer graphics in architecture. Scientific American, 1974, 230, 98-106.

Hayward, S., & Franklin, S. Perceived openness - enclosure of architectural space. Environment and Behaviour, 1974, 6, 37-52.

Hendrick, C., Martyniuk, O., Spencer, T., & Flynn, J. Procedures for investigating the effect of light on impression: Simulation of a real space by slides. Environment and Behaviour, 1977, 9 (4), 491-510.

Hershberger, R.G. Toward a set of semantic scales to measure the meaning of architectural environments. In W.J. Mitchell (Ed.), Environmental Design: Research and Practice, Los Angeles: University of California Press, 1972, 6-4-1 to 6-4-10.

Hershberger, R., & Cass, R. Predicting user responses to buildings. In D.H. Carson (Ed.), Man-Environment Interactions: Evaluations and Applications, Environmental Design Research Association, 1974.

Holahan, C.J., & Holahan, C.K. Sex-related differences in the schematization of the behavioural environment. Personality and Social Psychology Bulletin, 1977, 3, 123-126.

Holahan, C.K., & Holahan, C.J. The relationship of psychological masculinity and femininity and gender to personalization and social emphasis in environmental schematization. Personality and Social Psychology Bulletin, 1979 5 (2), 231-235.

Hudgens, G.A., & Billingsley, P.A. Sex: The missing variable in human factors research. Human Factors, 1978, 20, 245-250.

Kaplan, R., Kaplan, S., & Deardorff, H.L. The perception and evaluation of a simulated environment. Man-Environment Systems, 1974, 4, 191-192.

Kasmar, J. The development of a usable lexicon of environmental descriptors. Environment and Behaviour, 1970. 2 (3), 153-169.

Kuller, R. Beyond semantic measurement. In R. Kuller (Ed.), Architectural Psychology, printed in Sweden, Studentlitteratur, 1973.

Lane, C.L., Byrd, W., & Brantley, H. Evaluation of recreational sites. Journal of Leisure Research, 1975, 7 (4), 296-300.

Lau, J. Use of scale models as a stimulus mode. In J. Archea & C. Eastman (Eds.), EDRA 2, Proceedings of the 2nd Annual Environmental Design Research Association Conference, 1970.

Linton, D.L. The assessment of scenery as a natural resource. Scottish Geographical Magazine, 1968, 84, 218-238.

Lowenthal, D., & Riel, M. The nature of perceived and imagined environments. Environment and Behaviour, 1972, 4 (2), 189-207.

Mehrabian, A., & Russell, J.A. An Approach to Environmental Psychology, Cambridge, Mass., M.I.T. Press, 1974.

Nie, N.H., Hull, C.H., Jenkins, J.G., Steinbrenner, K., & Brent, D.H. SPSS, statistical package for the social sciences. New York: McGraw-Hill Inc., 1975.

Pace, C.R., & Stern, G.C. An approach to the measurement of psychological characteristics of college environments. Journal of Educational Psychology, 1958, 49, 269-277.

Peterson, G.L., & Neumann, E.S. Modelling and predicting human response to the visual recreation environment. Journal of Leisure Research, 1969, 2, 219-237.

Peterson, G.L. Evaluating the quality of the wilderness environment: Congruence between perception and aspiration. Environment and Behaviour, 1974a, 6 (2), 169-193.

Peterson, G.L. A comparison of the sentiments and perceptions of canoeists and wilderness managers in the Boundary Waters Canoe Area. Journal of Leisure Research, 1974b, 6, 13-24.

Peterson, J., Woodman, D., & Eaton, R. Slides versus buildings: Critical judgement of architecture. The Journal on Human Ecology, June, 1970, 4-7.

Seaton, R.W. Architectural simulation: A mini-bib. Council of Planning Librarians, Exchange Bibliography No. 200, July, 1971.

Seaton, R.W., & Collins, J.B. Validity and reliability of ratings of simulated buildings. In W.J. Mitchell (Ed.), Environmental Design: Research and Practice, Los Angeles: University of California Press, 1972, 6-10-1 to 6-10-12.

Shafer, E.L., Hamilton, M., & Schimdt, O. Natural landscape preferences: A predictive model. Journal of Leisure Research, 1969, 1, 1-20.

Shafer, E.L., & Richards, T.A. A comparison of viewer reactions to outdoor scenes and photographs of those scenes. In D. Canter & T. Lee (Eds.), Psychology and the Built Environment, Tonbridge: Kent Architectural Press, 1974.

Sivik, L. Measuring the meaning of colour: Problems of semantic bipolarity. Goteborg Psychological Reports, 1974, 4, No. 13.

Sonnenfeld, J. Variable values in space and landscape: An inquiry into the nature of environmental necessity. Journal of Social Issues, 1966, 12 (4), 71-82.

Sorte, G.J. Significance of components in environmental settings. In R. Kuller (Ed.), Architectural Psychology, printed in Sweden, Studentlitteratur, 1973.

Sorte, G.J. Methods for presenting planned environments. Man-Environment Systems, 1975, 5, 148-154.

Stevens, S.S. Ratio scales of opinion. In D.K. Whitlaw (Ed.), Handbook of Measurement and Assessment in Behavioural Sciences. Reading, Mass: Adison-Wesley, 1968, 176-199.

Stokols, D. Environmental Psychology. Annual Review of Psychology, 1978, 29, 253-295.

Tatsuoka, M. Selected Topics in Advanced Statistics, No. 6, Discriminant Analysis: The study of group differences. Institute for Personality and Ability Testing, Illinois, 1970.

Tognoli, J. The effects of windowless rooms and unembellished surroundings on attitudes and retention. Environment and Behaviour, 1973, 5 (2), 191-201.

Wedin, C.S., Avant, L.L., & Wolins, L. Communication of residential spaces by architectural graphics. In R. Kuller (Ed.), Architectural Psychology, printed in Sweden, Studentlitteratur, 1973.

Wenger, W.D., & Videback, O. Eye pupillary measurement of aesthetic response of forest scenes. Journal of Leisure Research, 1969, 2, 149-162.

Winkel, G.H., & Sasanoff, R. An approach to an objective analysis of behaviour in architectural space. In H.M. Proshansky, W.H. Ittelson, & L.G. Rivlin (Eds.), Environmental Psychology. New York: Holt, Rinehart, & Winston, 1970, 619-631.

Wools, R.M. The assessment of room friendliness. In D.V. Canter (Ed.), Architectural Psychology. London: RIBA Publications, 1970.

Zube, E.H. Cross-disciplinary and intermode agreement on the description and evaluation of landscape resources. Environment and Behaviour, 1974, 5 (1), 69-89.

Zube, E.H., Pitt, D., & Anderson, T. Environmental simulation, landscape values and resource. Man-Environment Systems, 1974, 4, 245-246.

APPENDIX A

Transcript of Instructions Presented Verbally to Subjects

Instructions Full-cue Condition

"This is a study in an area of psychology known as environmental psychology. You may have already discussed this area in your introductory psychology class. If you have, then you probably know that one of the interests in this area concerns how people perceive and assess environments. This study represents an attempt to determine the manner in which people perceive and assess architectural environments. Specifically your task will involve rating two interior environments using the booklets I have handed out to each of you."

At this point the subjects were shown an example variable ("lively") graphically presented on a card in the same format as the variables in the booklets. The rating system was then explained in detail.

"Does everyone understand what they are to do?"

If questions were asked the rating system was re-explained until all the subjects indicated that they understood the task.

"Prior to rating please print on the front of both booklets a capital "M" if you are a male and a capital "F" if you are a female. Be sure that you make your ratings in the order in which they are presented in the booklet. Do not go back and change a rating once it has been made. Do not consult with anyone else while making the ratings; your ratings are to be a reflection of your impressions alone. After you have completed all of the ratings please count all of the pages in the booklet and be sure that you have an "X" on every page. There are 20 pages in each booklet. Please come with me and I will show you the first room to be rated."

Subjects then rated the "full-cue" interiors.

Instructions: Photographic Condition

"This is a study in an area of psychology known as environmental psychology. You may have already discussed this area in your introductory psychology class. If you have, then you probably know that one of the interests in this area concerns how people perceive and assess environments. This study represents an attempt to determine the manner in which people perceive and assess architectural environments. Specifically your task will involve rating two interior environments using the booklets I have handed out to each of you."

At this point the subjects were shown an example variable ("lively") presented in the same format as the variables in the booklets. The "sample" variable was copied on transparency material and projected on a screen. The rating system was then explained in detail.

"Does everyone understand what they are to do?"

If questions were asked the rating system was re-explained until all the subjects indicated that they understood the task.

"Prior to rating please print on the front of both booklets a capital "M" if you are a male and a capital "F" if you are a female. Be sure that you make your ratings in the order in which they are presented in the booklet. Do not go back and change a rating once it has been made. Do not consult with anyone else while making the ratings; your ratings are to be a reflection of your impressions alone. After you have completed all of the ratings please count all of the pages in the booklet and be sure that you have an "X" on every page. There are 20 pages in each booklet. I will now present the first room to be rated."

The rooms lights were dimmed and the slide of the first interior was projected on a screen. In this manner, subjects rated the photographic representations of both interiors.

<u>Instructions: Concept Rating Condition</u>

"This is a study in an area of psychology known as environmental psychology. You may have already discussed this area in your introductory psychology class. If you have, then you probably know that one of the interests in this area concerns how people perceive and assess environments. This study represents an attempt to determine the manner in which people perceive and assess architectural environments. Specifically your task will involve rating two interior environments using the booklets I have handed out to each of you."

At this point the subjects were shown an example variable ("lively") presented in the same format as the variables in the booklets. The "sample" variable was copied on transparency material and projected on a screen. The rating system was then explained in detail.

"Does everyone understand what they are to do?"

If questions were asked the rating system was re-explained until all the subjects indicated that they understood the task.

"Prior to rating please print on the front of both booklets a capital "M" if you are a male and a capital "F" if you are a female. Be sure that you make your ratings in the order in which they are presented in the booklet. Do not go back and change a rating once it has been made. Do not consult with anyone else while making the ratings; your ratings are to be a reflection of your impressions alone. After you have completed all of the ratings please count all of the pages in the booklet and be sure that you have an "X" on every page. There are 20 pages in each booklet. To begin, I would like you to form a picture in your mind of a living room (bedroom), any living room (bedroom) which you choose to imagine. ...PAUSE... Does everyone have a picture in their mind of a living room (bedroom) now?"

The experimenter waited until everyone had responded affirmatively.

"Okay, please rate that room using the booklet as I have explained. While you are rating I will project the word living room (bedroom) on the screen to remind you of which type of room you are imagining."

The lights were dimmed to the same intensity as in the photographic condition and the word living room (bedroom) projected on a screen. In this manner, subjects rated their image of a living room and a bedroom.

APPENDIX B

Graphic Representation of Experimental Design

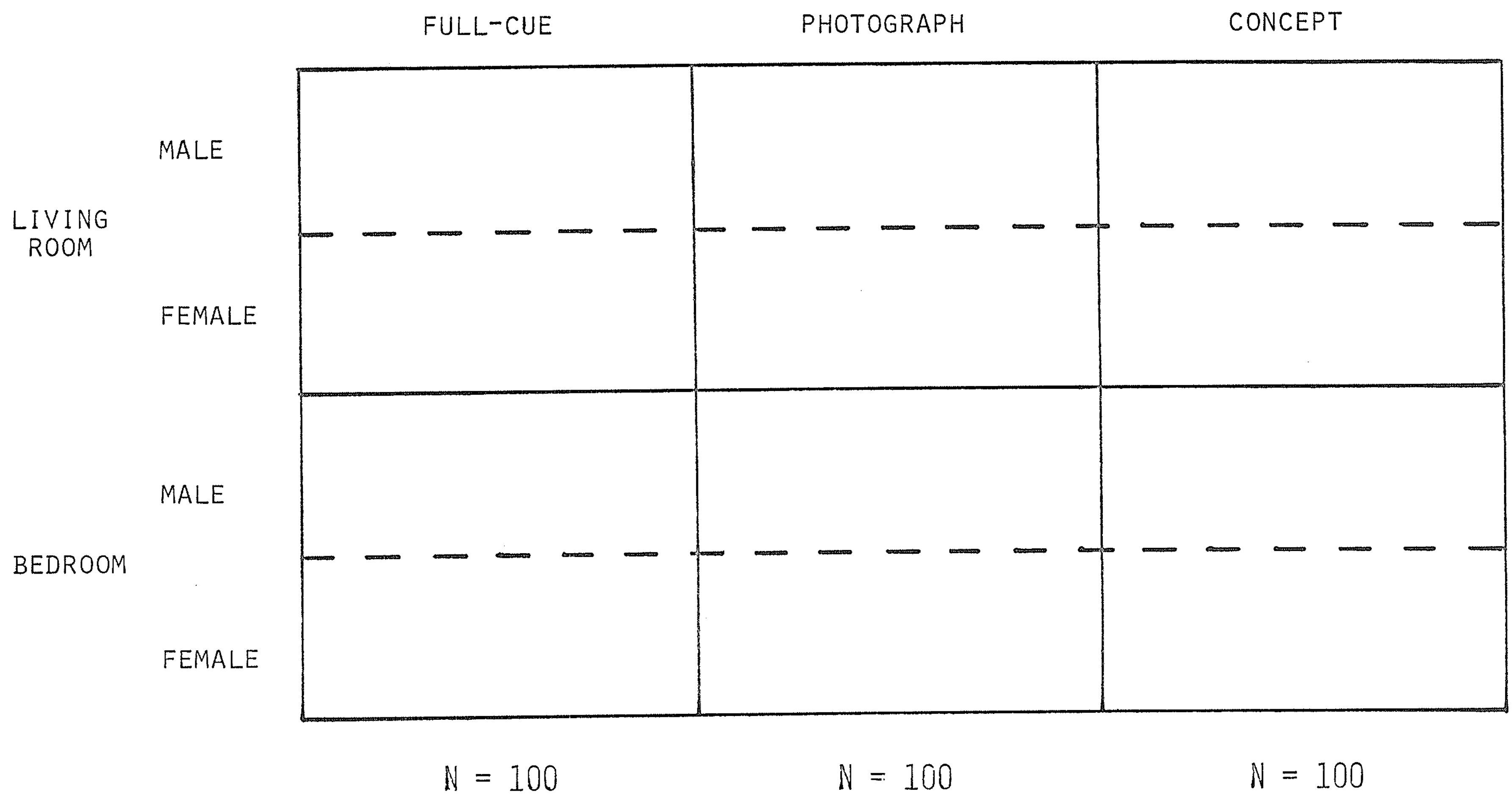

FIGURE 16

GRAPHIC REPRESENTATION OF EXPERIMENTAL DESIGN

APPENDIX C

Factor Analyses with Varimax Rotation; All Groups

TABLE 16

Varimax Rotated Factor Matrix
of all Data

Variable	Factor 1	Factor 2	Factor 3	Factor 4	h^2
Exciting	.436	.061	.303	-.012	.29
Spacious	.219	.835	-.075	.102	.76
Comfortable	.651	.159	.106	.053	.46
Colourful	.470	.213	.098	-.065	.28
Beautiful	.650	.250	.131	.254	.57
Efficent	.236	.052	.005	.380	.20
Interesting	.422	.022	.610	.072	.56
Unique	.186	.002	.768	.035	.63
Unattractive	-.660	-.109	-.108	-.316	.56
Modern	.284	-.119	.335	.015	.21
Large	.187	.911	-.014	.066	.87
Cheerful	.681	.273	.022	.119	.55
Ordered	.078	.128	-.168	.772	.65
Wide	.126	.762	-.008	.118	.61
Unusual	-.030	-.043	.717	-.164	.54
Friendly	.662	.061	.015	.186	.48
Roomy	.212	.798	-.023	.130	.70
Unorganized	-.153	-.124	.103	-.673	.50
Pleasant	.775	.117	.023	.254	.68
Complex	-.026	-.001	.386	-.106	.16
Eigenvalue	5.404	2.485	1.594	0.767	
% of Variance	52.7	24.2	15.6	7.5	

TABLE 17

Varimax Rotated Factor Matrix
of Ratings for the Living Room;
Full-cue Condition

Variable	Factor 1	Factor 2	Factor 3	h^2
Exciting	.279	.112	.661	.53
Spacious	.747	-.047	.154	.64
Comfortable	.288	.638	.087	.53
Colourful	-.073	.138	.566	.39
Beautiful	.187	.367	.605	.61
Efficent	.029	.214	.141	.27
Interesting	-.017	.168	.437	.64
Unique	.073	.059	.231	.61
Unattractive	-.031	-.445	-.450	.67
Modern	.052	.015	.402	.20
Large	.867	.113	.115	.80
Cheerful	.094	.430	.414	.41
Ordered	-.010	.175	-.059	.33
Wide	.671	-.002	.050	.47
Unusual	-.083	-.090	-.110	.55
Friendly	.014	.721	.143	.70
Roomy	.718	.357	-.042	.66
Unorganized	-.144	-.089	-.104	.49
Pleasant	-.006	.683	.382	.71
Complex	.056	-.091	.049	.15
Eigenvalue	4.85	2.22	1.72	
% of Variance	46.8	21.4	16.6	

TABLE 18

Varimax Rotated Factor Matrix
of Ratings for the Living Room;
Photographic Condition

Variable	Factor 1	Factor 2	Factor 3	h^2
Exciting	.490	.181	.209	.32
Spacious	.158	.782	.035	.65
Comfortable	.687	.045	.196	.58
Colourful	.647	.196	.138	.50
Beautiful	.840	.168	.137	.76
Efficent	.283	.007	.232	.20
Interesting	.552	.115	.702	.83
Unique	.315	-.046	.668	.57
Unattractive	-.800	-.058	-.061	.65
Modern	.555	.126	.047	.36
Large	.112	.869	-.183	.80
Cheerful	.730	.107	.117	.64
Ordered	.168	.301	-.150	.38
Wide	-.010	.750	.038	.57
Unusual	-.051	.010	.696	.49
Friendly	.656	-.090	.113	.61
Roomy	.167	.751	.069	.65
Unorganized	-.230	-.269	.014	.36
Pleasant	.795	.045	.128	.73
Complex	.308	-.124	.409	.31
Eigenvalue	6.35	2.69	1.30	
% of Variance	57.8	24.5	11.8	

TABLE 19

Varimax Rotated Factor Matrix
of Ratings for the Living Room;
Concept Condition

Variable	Factor 1	Factor 2	Factor 3	Factor 4	h^2
Exciting	.192	.296	.172	.026	.34
Spacious	.837	.232	.025	.073	.77
Comfortable	.112	.257	.551	.193	.43
Colourful	.092	.158	.145	-.095	.20
Beautiful	.214	.400	.209	.414	.42
Efficent	.180	-.038	.134	.265	.80
Interesting	.139	.646	.270	.139	.56
Unique	.121	.838	.213	.060	.78
Unattractive	.013	-.167	-.358	-.649	.64
Modern	.011	-.009	-.002	.265	.62
Large	.864	.143	.063	.098	.79
Cheerful	.083	.116	.667	-.112	.62
Ordered	.133	-.017	.076	.639	.50
Wide	.645	.084	.067	.013	.45
Unusual	.162	.740	.000	-.195	.64
Friendly	.085	.039	.737	.234	.63
Roomy	.844	.089	.149	.062	.78
Unorganized	-.020	.105	-.120	-.847	.80
Pleasant	.147	.094	.678	.335	.62
Complex	.148	.500	-.450	.044	.50
Eigenvalue	4.90	2.40	1.68	1.32	
% of Variance	41.3	20.2	14.2	11.1	

TABLE 20

Varimax Rotated Factor Matrix
of Ratings for the Bedroom;
Full-cue Condition

Variable	Factor 1	Factor 2	Factor 3	h^2
Exciting	**.563**	.193	.095	.58
Spacious	.212	**.741**	-.151	.66
Comfortable	**.694**	.030	.038	.49
Colourful	**.550**	.320	-.111	.59
Beautiful	**.724**	.186	.126	.64
Efficent	.089	.216	.086	.10
Interesting	.449	.075	.386	.79
Unique	.108	.115	**.703**	.53
Unattractive	**-.745**	-.226	-.035	.71
Modern	.224	.014	.314	.17
Large	.106	**.903**	-.083	.86
Cheerful	**.649**	.178	.026	.58
Ordered	.085	.022	-.056	.46
Wide	.136	**.607**	.094	.43
Unusual	.016	-.114	**.756**	.63
Friendly	**.622**	.141	.178	.59
Roomy	.159	**.630**	.107	.50
Unorganized	-.252	-.222	.235	.43
Pleasant	**.682**	.165	.233	.57
Complex	.052	-.027	.190	.40
Eigenvalue	5.50	2.13	1.31	
% of Variance	51.3	19.8	12.2	

TABLE 21

Varimax Rotated Factor Matrix
of Ratings for the Bedroom;
Photographic Condition

Variable	Factor 1	2	3	4	h^2
Exciting	.617	.123	.129	.016	.42
Spacious	.309	.180	.628	.063	.53
Comfortable	.648	.158	.147	.088	.66
Colourful	.505	-.093	.079	-.037	.31
Beautiful	.775	.320	.206	.072	.76
Efficent	.377	.420	.045	-.071	.40
Interesting	.405	.042	.166	.577	.53
Unique	-.009	.090	-.005	.818	.73
Unattractive	-.507	-.467	-.131	-.065	.50
Modern	.397	-.017	.073	.077	.29
Large	.219	.095	.833	.030	.76
Cheerful	.602	.217	.241	-.011	.47
Ordered	.152	.781	.096	-.058	.65
Wide	.095	.275	.559	-.140	.50
Unusual	-.131	-.350	-.132	.426	.35
Friendly	.572	.114	.084	.035	.35
Roomy	.083	-.049	.738	.037	.56
Unorganized	-.168	-.837	-.104	-.090	.76
Pleasant	.706	.346	.103	-.001	.64
Complex	-.045	-.075	.059	.175	.21
Eigenvalue	5.68	1.55	1.46	1.08	
% of Variance	54.7	14.9	14.1	10.4	

TABLE 22

Varimax Rotated Factor Matrix
of Ratings for the Bedroom;
Concept Condition

Variable	Factor 1	Factor 2	Factor 3	Factor 4	h^2
Exciting	.195	.134	.335	.000	.21
Spacious	.813	.121	.101	-.030	.69
Comfortable	.226	.621	.102	-.030	.45
Colourful	-.030	.202	.344	-.294	.36
Beautiful	.218	.587	.256	.080	.51
Efficent	-.219	.115	.000	.608	.49
Interesting	.134	.333	.500	-.078	.39
Unique	.100	.033	.845	.018	.73
Unattractive	-.100	-.595	-.109	-.188	.43
Modern	.070	.022	.201	.260	.28
Large	.932	.030	.211	-.061	.92
Cheerful	.074	.672	-.053	.093	.60
Ordered	.095	.151	-.160	.896	.87
Wide	.839	.155	.138	.043	.76
Unusual	.114	-.049	.715	-.053	.54
Friendly	-.061	.581	-.007	.028	.35
Roomy	.929	.113	.072	.079	.89
Unorganized	-.095	-.164	.023	-.685	.56
Pleasant	.047	.723	-.023	-.170	.56
Complex	.097	-.271	.387	-.193	.42
Eigenvalue	4.37	2.74	1.88	1.32	
% of Variance	39.8	24.9	17.1	12.0	

APPENDIX D

Centroid Coordinates for all Discriminant Analyses Centroid Plots

TABLE 23

Centroid Coordinates for Figure 2:
Mode Main Effect

Group	DF1 Coordinates	DF2 Coordinates
Full-cue	- .35	-4.38
Photograph	.28	-3.46
Concept	2.73	-4.08

TABLE 24

Centroid Coordinates for Figure 4:
Sex Main Effect

Group	DF1 Coordinates
Males	- .29
Females	-1.18

TABLE 25

Centroid Coordinates for Figure 6:
Room Main Effect

Group	DF1 Coordinates
Living Room	- .98
Bedroom	.33

TABLE 26

Centroid Coordinates for Figure 7:
Mode by Sex Interaction Effect

Group	DF1 Coordinates
Full-cue (Males)	- .65
Full-cue (Females)	.44
Photograph (Males)	- .77
Photograph (Females)	- .45
Concept (Males)	-1.69
Concept (Females)	-2.66

TABLE 27

Centroid Coordinates for Figure 8:
Mode by Room Interaction Effect

Group	DF1 Coordinates	DF2 Coordinates
Full-cue (Living Room)	1.12	- .56
Full-cue (Bedroom)	2.10	.51
Photograph (Living Room)	.46	- .08
Photograph (Bedroom)	2.33	.01
Concept (Living Room)	.90	.24
Concept (Bedroom)	.92	.33

TABLE 28

Centroid Coordinates for Figure 9:
Sex by Room Interaction Effect

Group	DF1 Coordinates
Male (Living Room)	-1.39
Male (Bedroom)	-2.00
Female (Living Room)	-1.86
Female (Bedroom)	-1.67

TABLE 29

Centroid Coordinates for Figure 12:
Living Room Ratings (Mode and Sex)

Group	DF1	DF2	DF3
Full-cue (Male)	.71	.18	- .36
Full-cue (Female)	1.23	.77	.16
Photograph (Male)	.41	-1.00	- .11
Photograph (Female)	.24	- .39	.46
Concept (Male)	-1.20	.20	- .65
Concept (Female)	-1.47	.24	.50

TABLE 30

Centroid Coordinates for Figure 15:
Bedroom Ratings (Mode and Sex)

Group	DF1 Coordinates	DF2 Coordinates
Full-cue (Male)	.56	- .51
Full-cue (Female)	1.18	.89
Photograph (Male)	.54	- .59
Photograph (Female)	1.11	.01
Concept (Male)	-1.31	.03
Concept (Female)	-2.08	.19