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THE ADEQUACY OF SIMULATIONS FOR REPRESENTING
INTERIOR ENVIRONMENTS

by

JAMES D. WYNNE

A dissertation submitted to the Graduate Faculty
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Abstract

THE ADEQUACY OF SIMULATIONS FOR REPRESENTING INTERIOR ENVIRONMENTS

by

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This study investigated the adequacy of simulation methods for representing architectural environments. Movies, slides, photos, perspective drawings, and floorplans with verbal descriptions were compared in terms of their relative adequacy for representing six reconstructed, period rooms in the American Wing of the Metropolitan Museum of Art.

Several response measures served as criteria for determining the relative adequacy of these simulation methods:

1. Recognition of the rooms when viewed in situ on the basis of having viewed them in simulation.
2. Preference choices made in response to the actual rooms compared to those made in response to their simulations.
3. Descriptive ratings of the actual rooms (using a semantic differential, environmental description scale) compared to those made in response to the simulations of the rooms.

Several characteristics of the environments were also considered; i.e., their relative recognizability, preferability, and visual complexity, and their descriptive profiles as derived from factor analysis of the semantic differential ratings.

The subjects for the experiment were 60 self-selected students in introductory level courses in psychology. Each subject viewed and evaluated the six rooms depicted by means of one of the simulation methods. About two or three weeks later each subject was taken through the actual rooms, asked to make the same evaluations and questioned about recognition of the rooms. The subjects were not told that these were the same rooms that had been seen in simulation until after the experiment had been completed.

Projected photographic simulations of the rooms, i.e., slides and movies, were found to be superior to enlarged color photos and tinted architectural perspective drawings for mediating room recognition. They were not superior to floorplans with verbal descriptions, however, which may have mediated recognition through verbal memory of decorative details. The methods did not differ in terms of their relative adequacy for facilitating preference judgments. All the methods facilitated descriptive evaluations similar to those made of the actual rooms. For these judgments, the photographic methods; slides, movies, and photos, were all superior to the perspective drawings, but not to the floorplans accompanied by verbal descriptions.

The six room environments were found to differ significantly in terms of recognizability, preferability, and judged visual complexity. Preferability was found to correlate very highly, and positively, with complexity when the rooms were evaluated in situ, but not in simulation. Room complexity was measured by both semantic differential and magnitude estimation procedures, the two methods producing very similar results. Magnitude estimation however seemed to provide subtler and more stable measurements than semantic differentiation did. Room recognizability was not related to either preferability or visual complexity.

Factor analysis of the semantic differential data for the rooms yielded factor structures similar to those found in a previous study by another investigator who developed the scale used in the present experiment. Ratings by a different group of students, using this scale to describe an imaginary "conceptual living room," also yielded a similar factor structure. The contribution of semantic sets and other verbal linkages to the factor analytically derived descriptions of environments was discussed, as well as other problems pertaining to the use of semantic differentials and factor analysis for environmental description.

Suggestions were made for improving research in architectural simulation. The implications of the present study for the use of simulations by the design professions were also discussed.

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Mr. Phil Farrell, Instructor in Interior Design at Pratt Institute, and his student, Peter Constable prepared the perspective renderings utilized as one of the simulations. Mr. Ronald Ferina, Educational Technician at York College, C.U.N.Y. prepared the color movies. Mr. George Tamaro, Chief Engineer for the ICOS Corp. of America rendered technical assistance in planning the study and photographing the rooms. Mr. Roger Carroll, Supervising Architect for the Port

Authority advised on the uses and limitations of architectural simulations.

Dr. Rosamond Gianutsos, of the Department of Psychology, at Adelphi University and Mr. John Melchione, Computer Technician at York College, C.U.N.Y. programmed the many statistical analyses that the data required.

A major portion of the costs involved in producing the simulations and key-punching the data were underwritten by the Environmental Psychology Program of the Graduate Center, C.U.N.Y. Most of the computer time was provided by York College, C.U.N.Y., where the author is employed.

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CHAPTER I

INTRODUCTION

The present investigation bears upon the issue of the adequacy of visual simulation methods for communicating useful information about architectural environments. Such methods typically include; three dimensional representations of an environment, for example, scale models or two-dimensional pictorial or diagrammatic representations such as drawings and floorplans. Despite a long tradition of use within the design professions not much is known about the communication effectiveness of the methods commonly employed. A small but growing body of research into the usefulness of simulations has been accumulating during the past ten years in a somewhat haphazard fashion. Studies tend to be either narrowly restricted in their sampling of available simulation techniques or similarly limited in their selection of measures used to evaluate the relative effectiveness of the methods compared; or both.

The present effort attempts to avoid these shortcomings by utilizing a reasonably wide variety of simulation techniques and by using a range of dependent measures to evaluate them. The ensuing discussion considers in turn; background research in environmental cognition, relevant

studies in environmental simulation, a general statement of the areas of focus of the present investigation, research methods, results, and conclusions.

Background Research

Research into the individual's comprehension of his everyday, man-made environments is admittedly at a rudimentary level of development. It is however receiving increasing attention from many quarters. Bachelard (1964) has sketched a phenomenological description of space and Norberg-Schulz (1971) has extended this description to large-scale architectural spaces. Hesselgren (1967, 1971) has begun a detailed, programmatic study of the perceptual psychology of architecture and Winkel (1969) has surveyed a broad range of current research efforts into the perception of large-scale environments. Seminal contributions to a cognitive psychology of space have emanated from transactional functionalism (Ittelson, 1960) and structuralism (Piaget & Inhelder, 1967). Ittelson (1973) has recently intensified the transactional analysis of the environment and Moore (1972) has similarly extended the structural approach. Urban planners have become increasingly interested in urban perception (Appleyard, Lynch & Myer, 1964; Carr & Schissler, 1969; Rapoport & Hawkes, 1970) and in the imageability of buildings and cityscapes (Appleyard, 1970; Lynch, 1960). Similarly, geographers such as Downs and Stea (1973) have begun investigating the cognitive mapping of cities and

others are exploring environmental perceptions and concepts (Lowenthal, 1967; Lowenthal & Riel, 1972; Tuan, 1972).

Whether descriptive or experimental, investigations in this area must deal with complex, multi-variate relationships between man and his environment. These man-environment relations are best understood through the molar, dynamic, self-reflexive, systems explanations first suggested by the transactional movement in psychology two decades ago (Ittelson & Cantril, 1954). The transactional approach seems uniquely suited to dealing with the complexity and ambiguity of the environmental stimulus display; the dynamic contribution of the perceiver as he expects, selects, attends to, interprets, and invests aspects of that array with meaning; and the resultant changes in the perceiver and the perceived display as the relationship process continues (Ittelson, 1973; Proshansky, Ittelson & Rivlin, 1970; Wapner, Kaplan & Cohen, 1973).

A Rationale for Simulations

Though environment-behavior systems are too complex to be explainable in terms of the simplistic, linear relations frequently arrived at in behavioral research; it may be useful to delimit such systems, where possible, as a heuristic first step in understanding their structures. The use of simulations of environments is one way of circumscribing such systems while retaining critical aspects and relations for further scrutiny. From a technical standpoint,

the simulation of a man-environment system refers to any method of substituting an analogous system for the actual one. In the present study, for example, the simulation methods attempt to substitute two dimensional representations for three dimensional physical environments, and to utilize visual scanning and vicarious loco-motor exploration of such representations in lieu of perceptually guided involvement with actual spaces.

The need for simulation is primarily a practical one. It would be enormously difficult, time-consuming, and expensive to construct the systematically varied and controllable environments necessary for an adequate investigation of environmental perception and cognition. Similarly, it is extremely difficult to monitor and control what the perceiver is attending to and how he is responding in the actual environment due to its perceptual richness and because of the opportunities it offers for many different behaviors. This is why it is often difficult in field studies of environmental perception to determine just what the independent variables are and how they are varying.

Despite their widespread usage, the effectiveness of various simulation techniques has not been evaluated. Because the traditional users of environmental simulations, design practitioners, have accepted and utilized them on an intuitive basis, they have little to tell us about how such methods succeed or fail in communicating about actual physical spaces.

Selected Related Studies

Research into the nature and usefulness of simulations is underway, however, both within the design professions and in the behavioral sciences. A useful overview for an understanding of simulation methods has been gleaned by Winkel and Sasanoff (1966) from the systems research and engineering literature. A continuum of simulations is described varying from the virtual duplication of an actual environment at one end through various levels of abstraction or transformation to completely symbolized representations at the other. Abstraction may be along a visual continuum, for example, photos of an interior versus architectural plans, a functional dimension, such as, viewing controlled by the observer compared to passive viewing; or both, i.e., operating a driving simulator as opposed to passively viewing a black and white movie of an automobile trip. Transformation may be analogical, substituting one set of system properties for another, e.g., in flow-charting; or symbolic, in which the system components and their relations are expressed in logical or mathematical terms and operations.

Craik (1970) has outlined a paradigm for research into the comprehension of environmental displays that considers some of the advantages and disadvantages of various modes of representation ranging from the direct presentation of the environment to drawings, models, photography, video, etc. He suggests that simulations be evaluated in terms of their behavioral equivalence, that is, the degree to which

the behavior displayed in their presence agrees with that which occurs in the actual environments. The present study samples some of the simulation methods suggested by Craik and relies heavily on the notion of behavioral equivalence for evaluating responses to the simulations.

There have been a number of descriptive studies of the problems involved in the comprehension of pictorial simulations of the built environment (Arnheim, 1954; Fieandt, 1966; Gregory, 1966). Some experimental attempts have also been made at studying the perception of photographically represented environments (Brunswik, 1956; Hudson, 1960). Hall (1966), in particular, has tried to point out cultural differences in the manner in which the visual world is represented in the paintings of the Byzantine culture and medieval Europe, as contrasted to its rendering in the works of the Italian Renaissance and the modern period. Most of these studies, however, have dealt with the artistic productions of great western painters in which the faithful representation of an actual environment is not usually required or even relevant. Perhaps it has been the widespread use of photography that has stimulated interesting questions about the fidelity of pictorial representation, its peculiar assets and limitations. Cineramic and stereoscopic photography and most recently holography are, of course, attempts to expand the limits of conventional photography by depicting three dimensions.

In the practical realm, however, architects, interior designers and other members of the design professions have long assumed that visual simulations of varying degrees of abstraction communicate valid and useful information about buildings and their interiors prior to their construction. This intuition must be basically correct or we would not recognize simulations as such (Canter, 1972). The exploration of various simulation techniques on a comprehensive scale is currently underway, initiated by a number of investigators attuned to the interrelation of human behavior and environmental design. Three of the most ambitious programs originate in architectural and urban planning settings. Several other research programs are being conducted by investigators from the newly evolving fields of environmental and architectural psychology. All of these efforts are interdisciplinary in nature and have the evaluation of present approaches to simulation as one of their stated aims. The investigators are especially aware of the indispensable role simulations play in developing and communicating design concepts and the economy they represent in comparison to working with real environments. To date, most of these research efforts emanate from Sweden, the British Isles, Canada, and the United States.

Hesselgren and his associates have begun assessing a variety of simulation techniques in a series of investigations of the perceptual dimensions of architecture at the National Swedish Institute for Building Research at Stockholm

(Hesselgren, 1971). In preliminary studies for developing rating instruments, Sörensen and Floderus attained similar descriptive judgments on 95 semantic differential scales¹ in response to color slides and black and white detailed perspectives of various townscapes and urban settings in Sweden and the U.S.A. Both techniques worked well as media for eliciting categorized judgments about restricted architectural spaces (i.e., in terms of bi-polar descriptors such as openness/closedness, shallow/deep, verdant/non-verdant, etc.). These investigators did not attempt to compare responses to simulations to those made in situ to the actual environments (Sörensen & Floderus, 1971). Such comparisons were made by Hesselgren's assistant, however. Gärling (1971a) found good agreement between in situ judgments and those made while viewing simulations of restricted spaces in the exterior architecture of the little town of Sigtuna, Sweden. He used both categorical ratings and magnitude estimates to compare color slides with actual architectural spaces along the perceptual dimension of openness/closedness. Using the technique of magnitude estimation developed by Stevens (1958) for the measurement of the perceived depth of an architectural space, Gärling found that subjects were able to estimate depth just as well, using either color

¹Semantic differential scales, developed by Osgood, Suci and Tannenbaum (1957) are sets of bi-polar, category rating scales, which can be used to describe the connotative meaning of just about anything: concepts, attitudes, personalities, environments, etc.

slides, or detailed perspectives, or simple line drawings, as they could in situ. He feels that this finding and those of another study (Gärling, 1971b) demonstrate that accurate judgments can be made about the openness/closedness of an architectural space by using its "parts" as depicted in the separate views provided by slides, perspectives or line drawings in place of the phenomenological "wholeness" of the in situ viewing experience.

A comprehensive series of simulation studies launched in the late 1960s by Carl-Axel Acking and his associates at Lund Institute of Technology in Sweden has led to the construction of an elaborate environmental simulator (Acking & Küller, 1973). Semantic differential scales were used to generate factor structures that would be descriptive of interior environments viewed in actuality and through the use of slides. Essentially similar factor configurations were attained for both conditions. The same 78 semantic differential scales were then used to rate the siting arrangements and exterior architectural aspects of a housing project. Factor analysis of these data yielded eight main connotative dimensions, very similar to those derived from the ratings of the room interiors. The fact that the same set of descriptors was found to characterize both room interiors and exterior architecture and siting arrangements is surprising and somewhat suspicious. It may be due more to the generality of the descriptors employed by Acking and Küller than to the supposed similarities in the underlying

connotative frameworks within which such differing environments are perceived.

The highest loading scales for each of the five principal dimensions; i.e., pleasantness, complexity, enclosedness, unity, and social status were then used as dependent variables for rating two other housing projects. Both were rated in actuality and through a variety of visual simulations; illustrational plans, white schematic models, colored naturalistic models, black and white perspective drawings, eye-level color slides of the naturalistic models, and eye-level color movies of the naturalistic models. The differences in the ratings of the two projects on each of the five dimensions were calculated for all of the conditions. Each simulation condition was then compared to the in situ condition in terms of the directions and the magnitudes of these differences. The plans, white models, and perspective drawings were poorer than the other methods in correctly communicating such critical factors as pleasantness, complexity, unity, and enclosedness of the actual housing sites. The naturalistic model did not reflect the unity of the sites accurately and the movies failed to adequately represent the factor of social status (a measure of social and economic quality). Only the color slides yielded similar relationships on all eight factors; that is, the differences between ratings of the two housing projects on each of the dimensions were in the same direction as those obtained in the in situ condition. The color movies,

however, yielded the smallest overall difference in the rating magnitudes compared to the in situ ratings.

An even more elaborate simulation laboratory is currently under development by Appleyard and Craik at the University of California, Berkeley. Drawing upon his extensive experience in studying the imageability of urban architecture and environments, Appleyard plans to use the simulator for a variety of interdisciplinary impact studies in urban planning and for research into the perception and cognition of urban environments (Appleyard, Craik, Klapp & Kreimer, 1973). Basically, the simulator will be a three dimensional scale model of an urban environment that the viewer can "move through" with the assistance of a computer-guided, traveling video camera that views the setting from eye level. Color video-taping or color movie filming will be possible with projection viewing on either a small screen or in a cineramic format. It will even be possible, Appleyard says, to couple viewing with the motoric aspects of moving through space by means of treadmills, cycling mills, and driving and flying simulation devices.

The Berkeley Simulator is described by Appleyard as being similar to those used by the airlines and N.A.S.A. for pilot and astronaut training and to one used for automobile driver training at the University of California at Los Angeles. He considers it to be a prototype or laboratory instrument, which may prove to be sufficiently realistic, economical, and useful so that similar devices may become an

integral part of the urban planning procedure in decision making, designing, and educational settings. Though no data are yet available from this operation, its programmatic potential is extremely exciting.

A number of psychologists are now working in the area of simulation studies, most of them considering themselves to be environmental or architectural psychologists. Perhaps the most notable among them is David Canter. Proceeding in much the same way as the Swedish researchers mentioned above, Canter (1969) also used the semantic differential approach for describing environments. In search of the underlying cognitive framework people utilize in the perception of buildings, Canter tested a suggestion made by Sommer (1966) that buildings were cognized within the familiar semantic framework of "evaluation, potency, and activity" (Osgood, Suci & Tannenbaum, 1957). He was also interested in possible differences in the way buildings are perceived by architects as compared to non-architects and whether the mode of presentation would affect the underlying pattern of cognitive dimensions as well.

Using typical architectural floorplans and elevations Canter explored the connotative dimensions of architecture as expressed in ratings made by third and fourth year students of architecture at the University of Strathclyde in Glasgow, Scotland. He also employed simplified perspective line drawings of room interiors for a similar study using as subjects undergraduates who were not architecture or fine

arts students. Factor analysis of these data yielded a number of similar dimensions for the evaluation of the architecture under both simulation conditions. Unfortunately, he did not compare ratings made with simulations to those made in actual environments (Canter, 1969).

In a subsequent study his associate, Roger Wools (1970), used similar line drawings to study the effects of several architectural features on the judged happiness, coherence, and activity of a room. Wools systematically varied the type of window, ceiling treatment, and furniture arrangement in the drawings and had subjects evaluate them using factor-analytically derived sets of bi-polar scales. He found these scales effective in distinguishing between rooms with different characteristics both in simulation and in actuality, at least as far as the happiness and coherence factors are concerned. Unfortunately, none of the drawings were representations of the two actual rooms used. Wools also compared color photos, black and white photos, and line drawings of small scale models (all presented as projected slides) finding them essentially equivalent for connotative type evaluations.

Another of Canter's students, J. J. H. Lau, compared judgments of light levels across full scale rooms and three dimensional models of them: finding them comparable (Lau, 1970). Peterson compared color slides of buildings with the actual buildings and found that connotative judgments agreed closely (Peterson, 1969). Collins and Wood have used

videotaping, color movies, and black and white movies to compare the interiors of post offices in Vancouver, B. C. They had undergraduates evaluate the offices on a number of dimensions ranging from aesthetic to practical considerations, via simulation and in situ. They found that the buildings were not significantly more discriminable in situ than in simulation and that the videotape gave the best simulation of a "walk-through" experience of the buildings, followed by color movies and black and white movies in that order (Collins, 1971).

A more recent attempt to simulate a "walk-through" experience involved the use of a photomontage model of an urban streetscape (Cunningham, Carter, Reese & Webb, 1973). A scale model of a section of a street was simulated by photographing each building facade and mounting the enlarged photos on panels next to a paper street and sidewalks. These were then video taped in black and white at eye-level by a camera mounted on a dolly pulled slowly up the street to approximate moving through the street. This simulation "twice removed" was compared to color movies and black and white video tapes of the actual street itself. Visual excitement or interest in the building facades was measured by means of a short semantic differential scale, and more importantly, by a non-verbal response technique. Subjects pushed a toggle-switch to the right or left to indicate the relative interest value of what they saw on one side of the street or the other. The switch was connected to a marking

pen and paper tape recorder which charted the locus of each point of interest. Cunningham compared interest profiles across simulations, finding the video tape interest profile of the model to be non-significantly different from that of the video tape of the actual street. The color movies led to more interest responses than either of the video tapes. Another noteworthy aspect of this study was the use of the semantic differential as a cross-check of the behavioral results, essentially corroborating them.

Using a cinerama type slide projection of photos of a museum gallery, Winkel and Sasanoff found a basic similarity in the way the observer moved around in the simulated space as compared to movement within the actual museum gallery (Winkel & Sasanoff, 1966). Canter summarized much of the work mentioned above in early 1972 by saying that "The research which has been carried out all indicates that, with present methods of measuring responses, simulations are closely related to each other and to actual buildings" (Canter, 1972). The present study attempts to evaluate this position further by several variations in method and measurement.

Methodological Problems, Input Variables

A number of methodological problems occur frequently in the simulation research cited above. One overriding concern is whether laboratory simulation studies as such will advance our understanding of actual environment-behavior

relations; or instead, lead to fruitless accumulations of findings about fragmented and irrelevant artifactual variables (Proshansky, 1972). To help safeguard against the latter possibility simulational systems should be checked for behavioral equivalence against the environmental systems they purportedly represent (Craik, 1970; Lowenthal, 1972). Though this suggestion seems obvious, about half of the studies mentioned earlier did not make such comparisons. Consequently, inferences about environmental cognition derived from these simulational investigations are difficult to evaluate. For example, it may be reasonable to assume that the connotative framework used by subjects in cognizing a drawing of an interior is essentially similar to one they would use in the actual environment represented; but there would undoubtedly be differences between the two sets of dimensions perhaps in terms of unique factors or the composition of group factors. These differences may be just as important as any commonalities for our understanding of environmental cognition.

A similar problem in some of these studies involves mixing simulation techniques and environments and then attempting to make cross-comparisons. If, for instance, photos of interiors are compared to line drawings of exterior architectural spaces in terms of their respective connotative dimensions, commonalities may be interpretable but what are differences attributable to; characteristics of the simulation techniques, different environmental aspects, or

measurement problems? In addition, it is quite likely that different modes of cognizing are involved in the perception of three dimensional representations of an environment as opposed to those abstracted to two. In their search for the common dimensions of a cognitive framework for experiencing environments, investigators tend to ignore these differences or downgrade their importance.

The above criticisms are related to a more general inadequacy shared by all the simulation studies that have come to the author's attention (including the present one). They are all limited in terms of the range of the independent variables explored or scheduled for future exploration. Practical considerations are no doubt partly to blame for these limitations; but inadequate conceptualization of the research problem is probably involved as well. A really comprehensive investigation of simulational methods would have to study a representative sample of architectural environments. Each environment would have to be depicted with a representative sample of the available methods which range from imaginative representation through the various conventional techniques to holographs, computer graphics, and elaborate simulations that afford sensory-motor feedback and decision-making experiences. (A listing of simulation techniques, both those under investigation and those not yet studied, is included as Appendix A.)

Some simulations, such as architectural drawings and models, depend heavily on the personal viewpoint, editorial

tendencies, and technical skills of their creators. It may also be necessary then to study the effects of such individual differences on the effectiveness of simulations. Similarly, since cognition of the simulated environment is a critical element of a communication process, receiver characteristics must also be taken into account. A small number of investigations have compared individuals with different backgrounds in terms of their cognition of environments through the use of semantic differential scales. These studies are summarized below in the discussion of response variables.

This consideration of input variables, though brief, must make some mention of several frequently recurring procedural inadequacies in the simulation research literature. Some of these devolve from the attempt to expose larger numbers of subjects simultaneously to a simulation stimulus. This results in presenting certain simulation formats in ways that are atypical of their use, e.g., slides of models or of drawings. Though the latter may be useful types of simulation (for others see Appendix A) some caution is necessary when generalizing from their effects to those of the more typical mode of presentation, that is, the presentation of the actual models or drawings to individuals or small groups.

Perhaps, a more serious problem is involved in using projectuals with large groups. Slide or movie film grain becomes bothersome for those up front when image size is

large, causing loss of detail and mottled image quality. If image size is not large, those viewing from the back of the group cannot discern detail and experience considerable loss of image brightness. Subjects in the first few rows and those on side-aisle seats of a lecture hall or auditorium experience considerable angular distortion and the resulting compaction of the image could cause distorted depth perception. In short, subjects at various locations in the seating arrangement of a typical lecture hall or auditorium are reacting to very different stimulus arrays. This may be tolerable in the usual movie film or slide sequence; but it is unacceptable where subjects are being asked to make evaluative judgments of environmental aspects in terms of their sizes, shapes, colors, textures, brightnesses, etc.

It may be possible to overcome these visual distortions with high quality photography and projection, by using a well designed movie theatre facility, and situating all the subjects centrally. For most purposes, however, it is necessary to work with one or a very few subjects at a time in simulation experiments so that the stimulus array can be viewed adequately.

When large groups of subjects are exposed to the simulation at the same time, the experimenter also sacrifices the benefits that accrue from varying and counterbalancing the sequences of stimuli. The use of only one sequence can cause serious problems when stimuli are viewed for dimensional scaling, preference rankings, and the like. Series effects

and adaptation level phenomena can disturb the judgment procedure obscuring the sought-after pattern or spuriously enhancing it (Bier, Ocutt & Leaman, 1963). This is especially likely when abstract dimensions such as visual complexity are being scaled or evaluated. If the first stimulus seen is the most complex of the series, the remaining items are likely to be underrated in terms of complexity in comparison to it (Wools & Canter, 1970).

Finally, auditory and other cues picked up from one another probably affect the way subjects attend to and evaluate particular stimuli (Cunningham, et al., 1973). Untrained subjects often find semantic differential ratings and magnitude scaling tasks difficult, especially when the items or dimensions are not typical of the way they think about environments. They tend to be unsure in their judgments and self-consciously slow in making them. Thus perceived tendencies of the group may influence them to respond quickly and in a particular way, for example, comments or expressions of surprise, delight, derision, impatience, and so on.

Methodological Problems, Output Variables

The sampling of response measures that characterizes the simulation literature is even more inadequate than that of the input variables. Though it may be a truism to say that human responses to environments are likely to be numerous and complicated, the research studies show little evidence of this recognition. Only three of the

investigations reviewed above explored as many as two types of responses to actual or simulated environments (Cunningham, et al., 1973; Gärling, 1971a; Wools, 1970). There are undoubtedly several reasons for this restricted range of dependent variables studied: the traditional psychophysical approach of studying one type of response at a time; an optimistic trust in one kind of response measure, e.g., semantic differential rating scales as the key to describing environmental cognition; or perhaps, an unawareness of the desirability of employing a variety of responses so that they can be used to explicate and validate each other.

Whatever the case may be, most of these investigations have used only semantic differential rating scales as the dependent variables and factor analysis as the chief means of analyzing and organizing the obtained data. These methods have usually been employed in an attempt to "empirically" derive a multi-dimensional, connotative meaning-space that could then serve as a framework for describing architectural structures and environments. The assumption, tacit or otherwise, is that once such a framework is available, an important advance will have been made toward understanding the kinds of strategies people use in cognizing buildings and environments. Though the verbal mediation of such perceptual experiences is undoubtedly important and worthy of study, there seems little reason to believe, at this time, that the establishment of semantic bearings constitutes the primary response to an architectural space experienced by

most people. There are probably more immediate and fundamental responses that are primarily emotional, motoric, and non-verbal in nature which require other more appropriate measuring techniques than semantic differentiation (Ittelson, 1973).

Semantic Differential Studies

The construction and utilization of the semantic scales in the simulation literature also raise serious questions about their usefulness. Each investigator (or group) generates a set of differential scales, assuming apparently that previous scales are inadequate. These sets are all very similar but different enough to make the derived factor structures difficult to compare. Some scales include items that seem more appropriate for design professionals than for laypersons though the scales are used to compare response patterns for both groups. Even with the help of explanations it is difficult for the untrained person to evaluate a built environment on scale items such as: coherent/incoherent, active/passive, well scaled/poorly scaled, high integrity/low integrity, and the like. These scales simply may not represent ways in which the non-designer thinks about spaces. The fact that such esoteric scale items hang together statistically may simply reflect equally uncertain ratings on similarly incomprehensible descriptors. Unquestionably, such scale items are meaningful for the aesthetician or designer who has been trained to categorize buildings in these terms.

At least one investigator (Blasdel, 1972) feels that even the less technical scale items may not be used in the same way by different subjects. It is easy to see that scales such as, spacious/constricted or cluttered/uncluttered, allow wide ranges of individual interpretation and would be particularly difficult to use accurately except in response to extreme (and unusual) environmental conditions. One person may interpret spaciousness as pertaining to the physical dimensions of a room; another may think of it in terms of the usable areas in the room unoccupied by furniture items; while the number of differentiated or compartmentalized spaces may define it for someone else. The writer encountered difficulties with subjects' questions about the meaning and/or appropriateness of some of the scale items used in the present study from its very outset and wonders why others have not reported this problem.

The semantic scales involve interval estimations which require a more or less commonly shared frame of reference if the scale items are to have really comparable meanings for different individuals. Typically, a subject in an environmental study is asked to evaluate each stimulus array as an individual entity and the range of possible arrays is not provided for him so that he can formulate the relevant frame of reference. The assumption apparently made is that subjects possess implicit and very comparable frames of reference for the various scale items. Once again, except for extreme and very atypical environmental situations,

scales such as large/small may not have similar anchoring points for different individuals. There is little evidence at this point to indicate that they do (Stevens, 1968).

Stability coefficients are rarely mentioned for the scales derived and one suspects that, in general, their reliability has not been ascertained. Some scales are very long, seventy-eight items, for example, and others as short as ten! There seems to be little recognition of the relationship between the length of a scale and its measurement reliability (Cronbach, 1970).

Factor Analysis Problems

A majority of the studies using semantic differential scales rely exclusively on factor analysis to prepare the data for interpretation. Blasdel (1972) has questioned this procedure pointing to the potential for spurious correlations in the input matrix due to: phrasing similarities in scale items, inability of some subjects to distinguish more than gross differences, and descriptive scales so broad and marginally relevant to environments that they permit ratings to be made on only the most general basis. Pointing to the condensation effect which lies at the heart of factor analysis, Blasdel also suggests that the technique further eliminates the distinctions scale items can make about environments by extracting their common variance and lumping them together.

The output stage of the factor analytic process, the factor patterns or structures, demonstrates the effects of these inadequacies. Lowenthal and Riel (1972) have shown that the descriptive adjectives typical of environmental, semantic differential scales tend to be grouped by their ratings into clusters organized around similarity of meaning, linguistic conventions, and past associations. They had subjects rate each scale item of a set of twenty-five environmental descriptors on every other item: for example, the item, spacious, would be rated on all the other scales; that is, good/bad, open/closed, pleasant/unpleasant, etc. These ratings, when correlated and analyzed, yielded coherent clusters of descriptive ratings that were virtually the same as half of those derived from ratings of actual environments. Lowenthal and Riel conclude that much of the connotative structure sketched in by the use of semantic scales may reflect what subjects believe environments to be like because of culturally conditioned ways of thinking about them. Such structures, then, are not likely to be simply descriptive of the actual environments as perceived. None of the studies that have used semantic differential ratings to compare simulation techniques has taken into account this source of response bias.

Factor structures have also been found to vary with individuals of differing backgrounds. Only a few investigations have made such comparisons and they have attributed the varying factor structures to differences in the ways in

which individuals perceive and cognize buildings and environments. It is safer to avoid the inferential step from verbal description to the nature of cognition and treat these findings under the heading of response variables.

In an investigation mentioned earlier, Canter (1969) found that student architects and non-architectural undergraduates used similar connotative frameworks to describe built environments. The architecture students viewing groundplans and elevations of building exteriors emphasized "character" or design integrity in their description. Non-architects, however, tended to describe simplified black and white line drawings of sitting rooms primarily in terms of their "friendliness" a quality that seems to be related to their receptivity to people. Although cognitive set factors are probably at work here, differences were found; they are difficult to interpret, however, because of the mix of environments, simulation techniques, and kinds of subjects.

Hershberger (1968) attained comparable results with large groups of students; non-architects, pre-architects, and architects, who viewed slides of buildings and rated them on a similar set of semantic differential scales. The factor structures obtained conformed essentially to Osgood's semantic space dimensions; evaluation, activity, and potency. All groups described the buildings primarily in terms of the evaluative factor and secondarily in terms of their organization dimension. The third factor, potency, tended to differentiate the groups however. The non-architects

described the buildings in terms relating almost exclusively to the potency dimension; e.g., temporary/permanent, strong/weak, bold/timid, etc. Pre-architects described them with an admixture of potency and novelty terms, introducing such descriptors as interesting, exciting, and unique. The student architects shifted this tendency even further, extending the potency factor broadly to include novelty and aesthetic evaluation aspects as well as the basic activity descriptors.

In a related study that used semantic differential scales derived through factor analysis, Wools (1970) found differences in the way in which practicing architects, beginning students of architecture, psychology students, and housewives evaluated simplified, black and white line drawings of rooms. The professional architects were the only group strongly influenced by window sizes and placement in their evaluation of the rooms on a factor scale characterized as "friendliness." The other three groups, the non-professionals, based their evaluations of the friendly character of the room primarily on the seating arrangements. The latter finding had been anticipated by Wools because of the work Sommer (1969) had done linking social interaction with furniture placement. The important point, obviously, is that the designers of such rooms, in this case, had a markedly different aesthetic framework than the potential client-users of them.

Other Response Measures

The three studies mentioned earlier, that employed more than a single type of response measure, attempted to use the second measure to corroborate and augment category scale ratings. Cunningham et al. (1973) found good agreement between non-verbal indications of the relative visual interest of buildings on a simulated street and semantic differential ratings of the interest value of such buildings. Gärling (1971a) used magnitude estimation as well as category scaling to evaluate a number of exterior environments on the dimensions of openness and closedness. Using different subjects for each measuring technique he found essentially equivalent ratings for both methods. This represents a valuable corroboration of the scaling approach employed in semantic differential scaling, even though Gärling used unipolar scales and eleven category intervals instead of the traditional bi-polar, seven point scale format of the semantic differential.

Preference choice represents another type of response measure relatively widely used in simulation research. Michelson (1966) had subjects rank order photos of buildings and neighborhoods in terms of their preferences for urban living environments and demanded "valuative rationales" for each choice. He was thus able to interpret the preference choices in terms of their motivational basis as well as descriptively. Similar studies using photos of the exteriors of housing and/or residential neighborhoods as independent

variable and preference choices as the dependent variable have been carried out by Peterson (1967), Flachsbart and Peterson (1973), and Sanoff (1970, 1973). Using photos and graphic representations of environments all presented in slide form, Kaplan (1973) studied differences in preference ratings between designers and clients. She found that architects preferred building complexes as environments, while college students ("clients") preferred nature scenes. This not unexpected finding was further explained, however, in terms of differences in the amount of "coherence and mystery" perceived in the environmental displays. The designers responded more to the coherence in a scene, the unifying effect of similar and repeated shapes and elements; while clients were more impressed by a display's mystery, the suggestion that more and more information about the scene will become apparent with further observation.

A number of non-verbal, behavioristic measures have also been utilized in simulation studies. As mentioned earlier, Winkel and Sasanoff (1966) compared the vicarious paths subjects took through a visual simulation of a museum exhibit with paths obtained by tracking visitors in the museum itself. Presumably the simulation devices under construction at Berkeley (Appleyard, et al., 1973); and at Lund (Acking & Küller, 1973) will permit such comparisons of movements within the large-scale urban setting. Viewing time has been used by Wohlwill (1968) as a measure of the visual complexity of slides of the geographic environment.

The present study attempts to use this measure both with respect to actual environments and with their simulations. Eye movements (actually fixations) of subjects viewing films of roadside views have been studied by Carr and Kurilko (1969), and Young (1967) to relate perceptual aspects with imageability of the freeway trip. Carr and Schissler (1969) subsequently corroborated hypotheses derived from these studies with data from the eye movements of actual freeway trip passengers. The measurement of eye movements has been used in a similar fashion by Pyron (1971, 1972) to study a walk-through experience in an actual housing development and in black and white movies of massing models of a number of housing site plans. Pupillary responses to slides of architectural interiors and exteriors were investigated by Payne (1970), who found greater dilation for architects than non-architects. He also found that architects; but not non-architects, showed more dilation for complex scenes than for simple ones. Payne's study was one of the few attempts to use a second response measure, namely, a set of semantic differential scales. He found significant correlations between pupil dilation and the factor analytically derived dimensions; femininity, intensity, and happiness. To some extent then, Payne's work seems to indicate that pupillometrics may provide a way of cross-validating evaluative responses made to architecture by means of category scales and semantic differential factors.

Theoretical Inadequacies

Current research in architectural simulation is also deficient in another conspicuous way. There is almost no explanation of how simulations work, how they compare to the richness of the represented environment, and how they resemble one another or differ from each other. Either the research to date is vacuously empirical or the reasons behind the choice of simulations for investigation and comparison are remaining on the level of implicit assumptions. In either case, a perusal of these studies leaves one with the impression of disorganization, duplication of effort, and little accumulating insight into the nature of simulation as a representational process.

Distinctive Features and Hypotheses

The present investigation has several features that characterize its direction and distinguish it from previous research of a similar nature. First of all, it is one of a mere handful of investigations that have attempted to compare a fairly wide variety of simulation methods. It had been expected that the several types of simulation utilized would differ in terms of their equivalence to the actual environments for eliciting a variety of responses. It was further expected that the movies would be the most equivalent simulation followed in order of decreasing equivalence by slides, photos, drawings, and floorplans accompanied by verbal descriptions. The results of such a comparison might have

some practical significance for the design professions, especially architecture and interior design, which rely heavily upon simulation methods for both conceptualization and communication purposes. It could do so by contributing to the assessment of the relative adequacy of the various methods for communicating about different types of environments.

A second emphasis of the present study involves a systematic attempt to increase the number of response measures used to evaluate the environments and the simulations of them. Human responses to environments are complex and usually occur on several levels; ranging from immediate emotional reactions and spatial orientation to cognitive awareness of the character and structure of the environment and active involvement with its aspects (Ittelson, 1973). Unlike previous simulation studies, the present effort attempts to deal with a complex response to the environment that includes emotional as well as cognitive components; for example, preferences, recognition judgments, and descriptive evaluations. The several response measures are also used to validate and explain one another.

Moreover, the present study is unique in that it examines recognition responses. It would seem that the most fundamental indicator of the effectiveness of a simulation effort, for the designer at any rate, is whether or not the client recognizes the actual environment when he views it in situ, on the basis of his experience with its representation.

Apparently, previous investigators have assumed that such recognition occurs; or that its occurrence or non-occurrence is inconsequential. In a similar fashion, preference choices made on the basis of simulations of environments have not been checked against choices made in response to the actual environments themselves; although this too seems fundamentally important to the evaluation of the effectiveness of any method of representation.

It had been expected that any rendering would be helpful for the room recognition task and that the simulation methods used in the present study could be expected to be more or less familiar to the lay person. It was anticipated that the several methods would differ in terms of their adequacy for this purpose and that an order of decreasing adequacy would pertain, ranging from movies as the most adequate down through slides, photos, and drawings to floorplans as least adequate.

Analogous hypotheses were entertained for the other response measures as well. It had been expected that all of the simulation methods would be useful for facilitating judgments similar to those made in response to the actual environments in situ, whether they be preference responses, descriptive evaluations or viewing times. Similarly, it had been expected that the methods would differ with respect to their relative adequacy for facilitating these responses and that the same order of decreasing equivalence would pertain as mentioned above.

A third emphasis of the present investigation was on the utilization of interior environments. Not enough attention has been paid in environmental research to the study of the comprehension of the interior environments in which people spend most of their time. Typically, exterior architecture and site arrangements have been studied (Appleyard, 1969, 1970; Hesselgren, 1971; Lynch, 1960; Sanoff, 1970, 1973; etc.). Such stimulus configurations may be more akin to those provided by sculpture than to the perceptual aspects presented by the enclosing environment of a room or rooms (Ittelson, 1973). It seems reasonable to expect the latter to have more urgent and determining effects on behavior than the former.

Although it had been expected that all of the rooms would be more or less recognizable in all of the simulations, some were expected to be more recognizable than others. The two largest, most ornate rooms, and the two smallest and plainest rooms were expected to be somewhat more recognizable due to particular features; such as, an elegant crystal chandelier and golden oriental wallpaper in the Powel room, large oil paintings and crimson draperies in the Almodington room, primitive furnishings and a very low ceiling in the Hart room, and the clutter of oversized furniture in the dreary and diminutive Newington room. The two remaining environments, the Bowler and Wentworth rooms, were expected to be less interesting and memorable.

Since the rooms were ranked with respect to one another on the dimension of preference, differences in preferability were expected. It had further been expected that obtained preference orderings would be related to perceived visual complexity; defined in terms of ornateness of decor, the number of interesting furniture items in the room, the varieties of colors and textures, and so on. The six rooms used for the study had been selected to represent several different levels of visual complexity and it had been expected that they would differ on this dimension. It was further expected that the more complex environments would be preferred to those less complex.

CHAPTER II

PROCEDURES AND METHODS

Self-selected undergraduate students served as subjects for this investigation. Each subject viewed and evaluated six interior environments displayed by means of one of the five simulation methods studied. After an interval of about two weeks, each subject viewed and evaluated the same six environments in situ, thus serving as his own control. It was not possible to control for intersubjective differences by exposing each subject to all of the simulation (treatment) methods. Such a procedure would have proven to be unduly long and confusing for the subjects. The experimental design compared the simulation methods in terms of their behavioral equivalence on several response measures, that is, the correspondence between responses made in situ to those made in the presence of the simulation.

Two ancillary studies, using two other simulation techniques and different subjects, were performed to help explain and validate some of the response measures used. Their procedures and outcomes will be described in the following chapters after the results they are intended to clarify.

The Environments Chosen

The environments chosen for simulation were six reconstructed rooms in the American collection of the Metropolitan Museum of Art in New York City. They were all "sitting rooms" from either seventeenth- or eighteenth-century American homes. All of these rooms were familiar enough to be readily recognized as to form and function, yet somewhat removed in style so that they were not likely to resemble the actual living environments of the subjects of the experiment. They ranged from a starkly simple all-purpose room from seventeenth-century New England to an elegant and elaborate sitting-room from the home of a wealthy and sophisticated eighteenth-century Philadelphia merchant. The rooms also varied in dimensions and lighting; from a small room with a low ceiling to one that was spacious and a lofty thirteen feet in height; from dark and cozy to well-lit and public in character. They displayed the modest differences in wall treatment, window and door placement, furnishings, and decoration that characterize the relatively homogeneous tradition of early American domestic, interior architecture and design. (Cf. Appendix B for detailed descriptions of these rooms.)

Though the visual appearances of the smallest and the largest rooms were very dissimilar, the differences between any other pair of rooms were not dramatic. This overall similarity within the series of environments chosen was intended to resemble the range of choices presented by the

architect or interior designer to the client in the design decision-making situation. Previous investigations of connotative or other kinds of judgments about environments have typically compared public interior spaces that were vastly different in character: for example, comparing a library room, a public dining room, and a lecture hall (Kasmar, 1970); or abstracted architectural interiors that appeared as simplified, "experimental rooms" (Dalkvist & Gärling, 1971). Though such studies are intrinsically interesting it is difficult to generalize from them to ordinary environments wherein choices must be made between complex and meaningful spaces that differ subtly within narrow ranges of several design dimensions. The similarity between the rooms used in the present study placed considerable demands upon the discriminating capability of the subject. It also tested the differentiating sensitivity of the several evaluative measures utilized.

The Simulations Investigated

The several simulation methods represented instances of the independent variable under manipulation in this investigation. This simulation method variable was, in reality, a complex of variables and not a single psychophysical entity. It was the mode of presentation of the environmental display ranging from the actual rooms themselves, the concrete reality, through various hypothesized degrees of abstraction to the most schematized level, the

floorplans. The modes of presentation were as follows:

1. Floorplans with verbal descriptions.
2. Tinted architectural perspectives.
3. Enlarged color photos.
4. Color slides.
5. Color movies.
6. Actual rooms.

The five simulation methods listed above were chosen for several reasons. To begin with, a reasonably wide but practically manageable sampling of the simulation methods was desired. Perspective drawings, floorplans, and verbal descriptions are the chief simulational formats in current use by designers for working with interiors. Elevations are sometimes used but usually only to detail a particularly important wall treatment or other noteworthy vertical element. They are not typically employed to depict environments of the scale involved here; except in construction plans for craftsmen. Enlarged photos ("glossies" in professional parlance), especially in color, are frequently used by designers to communicate concepts of interest to the client or to illustrate interiors similar to those to be designed. A similar use is made of color slides and, to a much lesser extent, movies as well.

The photos, slides, and movies were also chosen for other reasons which have more to do with manipulating the simulation variable than with surveying design practices. The photos were color enlargements of the slides, including

the same angle of view, detail, and color balance characteristics. In a sense, then, it was possible to vary some characteristics of simulation format, e.g., image size, and salience of the surround; while holding other pertinent aspects constant. As mentioned earlier, movies were selected in order to provide an anchor point at the maximal end of the realism continuum for two dimensional visual formats. A discussion of the rationale of this continuum and details concerning the production and utilization of the simulations appear below. Unfortunately, several other simulation modes, originally planned for this investigation, had to be eliminated because of cost and time limitations. These included: detailed, tinted scale models viewed conventionally from above; color slides taken through a viewscope (periscope device) at eye-level from within each model; and color movies filmed in the same way as the slides. In addition, several combinations of simulations were also contemplated; these were not run because of time limitations.

The Simulation Continuum

The simulation methods chosen are commonly used in the design professions for developing and communicating design concepts and solutions. From a research point of view it made sense to conceptualize these as organized roughly along a continuum from least equivalent to most equivalent. The full panoply of cues available to the subject when moving around within an actual environment was

assumed to be the basis upon which its simulation could be judged with respect to equivalence. That is, the more adequately a simulation represented these cues, the more equivalent it was considered to be to the original environment.

The color movies were considered to be the most equivalent simulation because of their rich array of movement-produced cues; large scale images; and myriad views, both wide angle vistas and close-ups. Slides seemed next most equivalent. They did not provide much by way of movement related cues, but image size was large and the wide angle views were comprehensive. The enlarged photos (made from the slides) provided the same wide angle views; but the image size was, of course, greatly reduced. Much less visual-motor feedback is available from "looking around" at a photo than from doing so with a projected image. The drawings were simplified and highly edited displays that omitted at least one wall and about thirty percent of the room altogether. Image size was small and much detail was eliminated, that is, lines, colors, and textures. Floorplans with verbal descriptions seemed the least equivalent in terms of providing displays similar to the original environments. The floorplans were highly schematic, communicating only gross sizes and relative positions. The verbal descriptions communicated much of the detail and character of each space; but the information was verbally coded and

not available for visual and visual-motor involvement, except indirectly through imagination.

Simulation Method I,
Color Movies

Super 8 color movies were filmed during bright daylight hours with supplementary lighting from two Colortran 1000 watt portable TV floodlights. Filming was done with a Nikon 8X Super Zoom movie camera with an f/1.8, 7.5-60 mm Nikkor, wide angle, zoom lens. The camera was mounted on a heavy duty Linhof tripod and the film used was Kodak High Speed Ektachrome 160 movie film, a fairly well-balanced movie film with an ASA rating of 160. Each room was filmed by moving into it from the door which subjects would later enter. The filming proceeded by panning slowly around in a clockwise direction from several locations inside the room. The camera was swept up and down the walls to bring the entire room into view and occasionally "zoomed-in" to get close-ups of interesting objects. The films were subsequently mounted in mobius loop cartridges for continuous projection in a Technicolor Projector, Model 810, with an f/3.5 lens and a 150 watt lamp. The projected image measured 4 ft. by 6 ft. in an almost totally darkened room. The subject was seated 10 feet from the screen at a small table 29 inches high, with the Technicolor Projector in front of him. A small amount of light, emitted from the rear of the projector, was sufficient illumination for the check type rating sheets which the subject had to complete. The only

other light came from a narrow window in a door at the far end of the room from the projection screen, about 16 feet away. The subject viewed each room as depicted on its own individual film loop, shown continuously, until he had finished his evaluations of it.

Simulation Method II,
Color Slides

Color slides were made of each room during bright sunlight hours supplemented by daylight flashbulb illumination. A Pentax Spotmatic 35 mm single lens reflex camera was used, equipped with an f/2.8, 28 mm Super Takumar wide angle lens, that had a 75° angle of acceptance. The camera was mounted on a heavy duty Spiratone tripod and the views photographed from eye level (5'6" from the center of the film plane to the floor). Kodak High Speed Ektachrome daylight type film was used with an ASA of 160. The available daylight was supplemented by wide angle flash illumination from the camera plane. Sylvania daylight type 2B flashbulbs were used with a guide number of 260 at a shutter speed of 1/50 second. Four corner views were taken, each from the corner opposite it, so that the entire area of the room was photographed with a good deal of overlap from slide to slide. (See Appendix B for black and white photos made from the slides of the rooms.) The slides were projected in sequential order so that the viewer seemed to be inside the room and looking about, first in a clockwise direction and then back around again in a counterclockwise fashion. The

image was projected on a screen about 6 feet from the subject in a semi-darkened room to create an image approximately 4'x6'. A Carousel 850 H slide projector was used, equipped with a wide angle, 3 inch f/3.5 lens, automatic focus, and a 500 watt lamp. The subject viewed the four slides continuously until he had completed the evaluation of each room.

Simulation Method III, Color Photos

The slides described above were used to make color prints of the four corner views of each room. Semi-matte finish, 8"x10" enlargements were made by Kodak Laboratories with reasonably good color fidelity. (See Appendix B for black and white photos similar to the enlargements.) Unlike the slides, the four prints of each room were viewed simultaneously. They were mounted on heavy posterboard 20"x26" so that viewing from the top left corner of the display around in clockwise fashion would be analogous to looking at the room from the left as one enters it around to the right, full-circle. The mounted photos were placed on a table-top easel for viewing by the subject at a distance of about 30". The plane of the photo display was tilted about 15 degrees from the vertical for comfortable viewing. Overhead lighting was provided by two fixtures each containing four "cool white" 40 watt fluorescent tubes with diffusing baffles at a height of 9'8" from the floor (about 6'6" from the display). Light levels were average for office work and color balance, though reasonably good, was a little weak at the red end of

the spectrum. Each subject viewed the photos as long as necessary for making his evaluations.

Simulation Method IV, Tinted
Architectural Drawings

A professional quality architectural rendering was prepared for each room in either one or two-point perspective. It attempted to represent the basic characteristics of the room in terms of construction, furniture, fenestration, proportions, and colors. The drawings were rendered with felt-tipped marking pens, a new medium widely used at the present time in the interior design field. This technique is capable of representing detail more readily than watercolors permit, while avoiding the fussiness of the pencil drawing. It also permits bolder and more vigorous lines than the watercolor rendering does, as well as brighter highlighting. Each drawing was floated on heavy bristol board, light tan in color, which provided a border of 2-1/2 to 3 inches wide around the perimeter. The drawings were placed on a table-top easel at a comfortable angle for viewing (about 15° from the vertical) which in turn rested on a small table of standard height (29"). The plane of the drawing was about 30" from the subject's eyes. Lighting conditions were identical to those mentioned above for the photos simulation condition. The subject viewed each drawing as long as necessary for making the various evaluations.

Simulation Method V, Floorplans
with Verbal Descriptions

A floorplan typical of those used in interior designing was devised for each room, accompanied by a verbal description of about 300 words. They were prepared by the experimenter in consultation with an architect. (See Appendix B for photo-copies of the floorplans, and the verbal descriptions.) The floorplan appeared on the inside left leaf of an 8-1/2"x14" manilla folder with the verbal description opposite it on the right. The floorplans were simplified top views, adjusted to the relative sizes of the rooms and rendered in black ink on white paper. The verbal descriptions provided a more or less detailed description of the room interiors including architectural features, major dimensions, furniture, and decorations. An attempt was made to limit the description so as not to overwhelm with detail, while still communicating an adequate picture of the room. A concerted effort was made to limit the use of the general descriptors which form the adjective end-points of the rating scales used to evaluate the rooms. This, of course, was not always possible since the primary task was to give a verbal description of the room that would be characteristic of the way a designer or architect might describe it. The subject, seated at a table, first read the verbal description of a particular room while consulting the floorplan; then made the required ratings. The table, easel, and lighting arrangements were the same as for the viewing of the drawings

and photos mentioned earlier. The subject was permitted to refer to the floorplan and description while making the ratings, and was allowed as much time as necessary for his evaluations.

Response Measures Selected

The response measures used to evaluate the simulation methods were:

1. Recognition scores, i.e., the number of rooms recognized in the actual condition after viewing them in simulation.
2. Preference rankings of the six rooms established by rank ordering, in the simulation and the in situ conditions.
3. Rating difficulty rankings of the six rooms established by rank ordering in both the simulation and the in situ conditions.
4. Viewing-rating time for each subject for each room in both conditions.
5. Semantic differential scale ratings on a shortened version of Kasmar's Environmental Description Scale (referred to hereafter as the EDS). Each room was rated with this scale in both the simulation and the in situ conditions.

Recognition Scores

As mentioned earlier, recognition of a represented environment would seem to be a fundamentally important index of the effectiveness of a simulation technique. The

recognition judgment obviously involves cognitive processes such as visual image memory and the ability to compare this memorial imagery with the perceived characteristics of the environment when viewed in situ.

Preference Rankings

Preference judgments are similarly important for the use of simulation techniques. They have been used in many studies of exterior environments (Kaplan, 1973; Michelson, 1966; Peterson, 1967; Sanoff, 1970, 1973; Sonnenfeld, 1969). None of these studies, however, compared preferences made in response to simulations to those made in response to the actual environment on an in situ basis.

Rating Difficulty Rankings

This response measure attempts to gauge the relative certainty and uncertainty subjects felt when evaluating each of the six rooms on the EDS (Environmental Description Scale). It was anticipated that felt certainty/uncertainty about the descriptive rating process for a room would be related to its perceived complexity, that is, the rooms perceived as relatively simple in the visual dimension would be easier to rate than those seen as relatively complex. The EDS items are included as Appendix C.

Viewing-rating Time

The time required for each subject to view and to make the EDS ratings for each room was recorded. This was

done for both the simulation and the in situ conditions. Viewing time has often been used as a measure of the complexity of a visual display (Berlyne, 1963; Leckart & Bakan, 1965; Wohlwill, 1968). It was anticipated that viewing time, rating difficulty rankings, and ratings on the EDS scale of simplicity/complexity would all be positively correlated and could be used to corroborate one another. It also seemed reasonable to expect visual complexity to be related to the recognizability of a room and its preferability. There is a growing body of literature linking stimulus complexity with: attention responses (Dember & Earl, 1957; Fantz, 1961), exploratory behavior (Berlyne, 1960), preferences for simple visual patterns (Munsinger & Kessen, 1964; Terwilliger, 1963; Vitz, 1966a), preferences for sequences of letters and words (Munsinger & Kessen, 1964), and even patterns of tones (Vitz, 1966b). Wohlwill's (1968) demonstration that preferences for slides of non-representational paintings and slides of geographic environments, both natural as well as architectural, are related to perceived stimulus complexity is most important because of his use of environments.

Semantic Differential Scale Ratings

Kasmar's (1970) Environmental Description Scale, a semantic differential instrument, was chosen to measure a number of perceived dimensions of the environmental displays. The decision to use such a scale was based on two

considerations. First, it seemed appropriate to elicit categorical judgments on a number of different perceptual aspects of the environmental displays to enable comparison across the two viewing conditions; i.e., simulation and in situ. The assumption made here, of course, is that the correlation between corresponding ratings for a display would provide an index of the adequacy of the simulation as a substitute stimulus array for the actual environment.

A second reason for using the EDS was the opportunity afforded by the present study to subject this excellently constructed instrument to independent scrutiny and perhaps to extend the generality of its usefulness. Kasmar obtained high internal consistency reliability coefficients (from .81 to .95) for a large number of the scale items of the EDS. Similarly, the edited full scale version of 66 items displayed considerable test-retest stability ($\underline{r} = .68$) after a three-week interval. Kasmar also reported that the full scale validly discriminated between three different environments irrespective of the subject sample rating the rooms. Moreover, ratings of the same room by either different subject samples or the same sample at different times did not differ significantly; thus demonstrating that the EDS was, in fact, discriminating between environments rather than subjects.

Several other semantic differential, environmental description instruments were available at the inception of this study (Canter, 1969; Sanoff, 1969; Sörensen & Floderus,

1971). Kasmar's scale, however, appeared to be the most carefully constructed instrument in terms of the breadth and representativeness of the original item pool, empirical selection procedures for the scale items, attention to internal consistency considerations, and criterion validation. The full scale was shortened from 66 to 56 items by eliminating the bi-polarities referring to sounds, temperature, and ventilation conditions since these items would create rating problems when viewing visual simulations.

Overall Procedure

The experiment was conducted at two settings. The simulations were viewed in a classroom at York College in Jamaica and the actual rooms viewed, of course, on location at the Metropolitan Museum of Art in Manhattan. During the first session the subjects were informed of the purposes of the study, filled out a form to receive their course credits for participating in the experiment, and made their evaluations of the six rooms while viewing one type of simulation. The subjects were assigned to one of the five simulation conditions according to a pre-established sequence arrived at by random assignment.

Preliminary practice with the rating form was carried out to insure that the subject was familiar with the semantic differential rating technique and the meaning of all the adjective endpoints to be used. Each subject was asked to rate the experimental room using the EDS scale items. The

experimenter explained the few more or less technical words in the scale, invited and answered questions about the appropriateness of any of the other items and checked to see if the subject was utilizing the rating intervals properly.

Subjects were told that they would first rate each of six rooms on the scales they had just used. The rooms were presented for viewing according to a pre-established random sequence. Each room was rated and the total viewing and rating time recorded for each subject. Next, the subject was asked to rank the six rooms in order of preference from most preferred to least. Next he was asked to rank them as to relative rating difficulty, from the hardest of the six to rate to the one that was easiest. The subject was permitted to view the simulations briefly once again in order to make these judgments. This session took about one hour.

After an interval of between two and three weeks, the second session was conducted, i.e., the evaluations of the actual rooms in situ at the Metropolitan Museum of Art. Here the subject viewed the rooms in the same sequence in which the simulations were presented. Once again EDS ratings, and viewing and rating times were recorded. The subject was then taken to a nearby lounge in the museum and questioned as to recognition of the rooms previously seen in simulation. To begin with, the subject was simply asked, "What do you think of the rooms?" If no recognition statement occurred, he was then asked "Have you ever seen any of these rooms before?" If no recognition statement was again forthcoming,

the subject was asked "Do you think you saw any of these rooms during the first session of the experiment at the school?"

The experimenter attempted to keep this line of questioning casual in manner to prevent biasing subjects toward making recognition responses. The decision was made to test recognition with only the six rooms seen in simulation, and therefore, no "catch trial" rooms were rated on the EDS. Though such trials would have added methodological rigor they would also have lengthened an already long and potentially boring procedure. Additional rooms would also have precluded comparisons between the simulation and in situ conditions with respect to preference and rating difficulty rank orderings.

To perform the recognition task correctly, therefore, subjects had to rely on their memory for recognition recall of visual scenes, which recent evidence (Haber, 1970) has shown to be remarkably good. They were not permitted to look at the rooms again in order to make their recognition responses for fear that this procedure might have put a premium on positive responses where in fact little or no recognition had occurred.

Finally, subjects were again asked to rank order the rooms in terms of preference and in terms of rating difficulty, just as they had done during the simulation session. They were permitted to glance into the rooms, if necessary, in order to make these judgments.

They were then asked if they had any other comments to make about the experiment. Any interesting or informative remarks were recorded. As mentioned above, this session required about an hour and a quarter to an hour and a half to complete, including debriefing. Travel to and from the Museum consumed two or two and one-half hours for each subject.

The Subjects

The subjects for the main study were undergraduate students who volunteered for the study in order to receive extra credit toward their grades in introductory level courses in general psychology or statistics. They agreed to participate in both sessions of the experiment; simulation evaluations, and in situ evaluations, for a total time commitment of between five and six hours. This heavy expenditure of time seemed to guarantee a rather responsible group of subjects. Only three out of a total of sixty-eight subjects had to be discarded for not completing this demanding schedule.

Subjects for the ancillary studies were also undergraduate students in psychology. They will be described within the context of each study.

CHAPTER III

THE SIMULATION METHODS COMPARED

The results of the present study though straightforward in conception are somewhat numerous. They have been grouped for convenience into the following chapters: the Simulation Methods Compared, Room Comparisons, and Environmental Description Scale Findings. The Environmental Description Scale findings are derived from replications of certain aspects of research reported by Vielhauer [Kasmar] (1965), and Lowenthal and Riel (1972).

Differences Between the Simulations

The several simulation methods were compared in terms of their relative adequacy for making recognition judgments, preference rankings, rating difficulty rankings, and EDS ratings. They were also compared on the basis of relative viewing times required for the EDS ratings. These comparisons appear below in the order given.

Recognition Judgments

Recognition scores were expected to decrease as simulation became more abstract; ranging from the most life-like, the movies, to the slides, photos, perspective drawings, and the schematized floorplans with verbal descriptions, in that order. This hypothesized hierarchy of the methods as to

effectiveness was confirmed only in a very general way with several reversals.

To test the differences between the simulation methods an analysis of variance was performed using the number of recognition responses for each subject as the data. The methods differed significantly ($F = 5.86$, $p < .001$, $df = 4,55$). Slides afforded the most recognitions followed by movies, floorplans, photos, and drawings in that order. Each of these distributions is described in Table 1.

TABLE 1
MEAN ROOM RECOGNITIONS ACROSS SIMULATION GROUPS

Movies	Slides	Photos	Drawings	Floorplans
$\bar{x} = 4.33$	$\bar{x} = 5.08$	$\bar{x} = 2.75$	$\bar{x} = 1.92$	$\bar{x} = 4.00$
$\Sigma x = 52$	$\Sigma x = 61$	$\Sigma x = 33$	$\Sigma x = 23$	$\Sigma x = 48$
$s = 1.55$	$s = 1.76$	$s = 2.32$	$s = 1.60$	$s = 2.30$
$s^2 = 2.42$	$s^2 = 3.09$	$s^2 = 5.39$	$s^2 = 2.55$	$s^2 = 5.27$

Pairwise comparisons between the methods were made by a multiple-range test (Duncan, 1955). The slides, movies and floorplans did not differ significantly from each other in the number of recognitions they afforded; but all were significantly better ($p < .01$, two tailed, $df = 55$) than the drawings. Slides and movies were also significantly better than the photos ($p < .05$, two tailed, $df = 55$). Table 2 displays the analysis of variance summary (A) and the pair-wise comparisons (B).

TABLE 2

ROOM RECOGNITIONS--ANOVA SUMMARY AND PAIRWISE COMPARISONS OF MEANS

A. Source of Variance	<u>df</u>	<u>ss</u>	<u>ms</u>	<u>F</u>	<u>p</u>
Treatments	4	74.10	18.53	5.86	.001
Within Groups	55	173.83	3.16	--	--
Total	60	247.93	--	--	--
B. Source of Difference ^a	Differences				<u>p</u>
Slides vs. Drawings	3.16				.005
Slides vs. Photos	2.33				.01
Movies vs. Drawings	2.41				.01
Movies vs. Photos	1.58				.05
Floorplans vs. Drawings	2.08				.01 ^b

^aThe Duncan Multiple-Range Test was used for these comparisons.

^bAll other differences between group means were insignificant.

In summary then, the hypothesized effect on the recognition response variable of the continuum of simulations was confirmed only in the grossest terms. Slides and movies were better than the other methods as expected but the floorplans were better than the photos and drawings. This superiority was not expected and will be commented upon later.

Preference Judgments

The hypothesis for the preference judgments was analogous to that made for the recognition responses. It was expected that the simulation continuum would result in decreasing effectiveness for this purpose as the methods became more abstract. This hypothesis approached partial confirmation. The overall differences between the methods, though not significant, were in the expected direction.

The preference rankings for the rooms in simulation and in situ were correlated for each subject. These correlations are listed in Table 3, grouped according to simulation method. The median correlation for each simulation method appears at the bottom of each column. The median correlation for all subjects across all simulations was moderate (Mdn. = .572). Slides provided the highest median, followed by movies, photos, floorplans, and drawings, in that order. Since these are merely averages of ordinal statistics there is no acceptable way of comparing them or assessing their significance levels.

TABLE 3

PREFERENCE ORDER CORRELATIONS (r_s) FOR ALL SUBJECTS BY GROUP

Simulation Method	Movies	Slides	Photos	Drawings	Floorplans	Total
	.943	1.000	1.000	.886	1.000	
Scores (correlations) for each subject have been arranged in the order of decreasing magnitude	.886	.943	.943	.829	.886	
	.886	.886	.943	.771	.771	
	.829	.829	.886	.543	.714	
	.829	.771	.829	.371	.600	a
	.771	.714	.771	.371	.543	
	.600	.714	.543	.257	.486	
	.486	.657	.371	.143	.486	
	.486	.600	.371	-.029	.371	
	.200	.543	.086	.086	.086	
	.143	.200	-.371	-.314	.029	
	.086	.029	-.771	-.371	-.086	
Median Correlation	.686	.721	.657	.314	.510	.572 ^b

^aMedian (.572) dichotomizes distributions at dotted line.^bOverall median for all subjects, $N = 60$.

An overall comparison of the simulation methods was performed by means of a median test. Dichotomization of the data in Table 3 was performed around the median ($Mdn. = 572$), producing expected cell frequencies high enough for Pearson chi square comparison. Differences between the groups approached significance ($\chi^2 = 7.33$, $p = .12$, $df = 4$).¹ The ordering of the methods in terms of relative effectiveness was as follows: slides were best, followed by movies, photos, floorplans, and drawings, in that order.

The Fisher test was subsequently applied to each of the ten possible pairs of simulations. Only the difference between slides and drawings was significant ($p = .05$, two tails), the slides being the better of the two. Though these values are low by conventional standards, they are worth considering since the direction of the differences is very similar to that of the recognition judgments. In both cases slides were best, movies second best, and drawings poorest. Photos and floorplans exchanged rankings in the two comparisons.

Some of the variability in the data was probably due to the difficulty most subjects experienced when assigning rooms to the intermediate rankings between the "one liked best" and "the one liked least." Subjects typically

¹The Kruskal-Wallis procedure, though more powerful than the median test, was not appropriate for this data, since it compares distributions as to average rankings (Siegel, 1956). A perusal of the data in Table 3 reveals that the several distributions compared differ more with respect to shape than to central tendency.

expressed a good deal of uncertainty about choices they did assign to the second through fifth rankings and many would not have persisted at all with the ranking task except for the insistence of the experimenter. It seemed reasonable then to look at the first and sixth ranking choices separate from the rest of the data since they could be expected to be more reliable responses. The number of correspondences between first and sixth ranking choices within the two viewing conditions was calculated for each subject. The data were then dichotomized around the median (.96 correspondences) and a median test performed. The overall differences between the simulation methods appeared to be significant ($\chi^2 = 10.26$, $p = .04$, $df = 4$). This can only be considered a rough estimate of the chi square value, however, since the expected frequencies of half the cells were very small; less than five (Ferguson, 1966). A more conservative estimate was attained through the use of the likelihood ratio method which yields superior approximations of chi square for small to moderate size samples (Hays, 1973). The simulation methods differed once again; but the differences only approached significance ($\chi^2 = 8.76$, $p = .07$, $df = 4$). All ten possible pairs of simulations were then compared by the Fisher test (Siegel, 1956) using the same dichotomies as above. Only the slides versus drawings difference reached significance ($p = .05$, two tails). The direction of the differences between methods was almost exactly the same as it was when using all the data, that is; slides were most effective and

drawings least. Floorplans remained in next to last place as to effectiveness, and movies and photos exchanged places in the two comparisons.

Rating Difficulty Judgments

This response measure was expected to reflect the complexity of the environments. The assumption was made that the relatively more complex environments would be harder to rate on the EDS than those that were visually simpler. It was further anticipated that the rooms could be rank-ordered by the subjects on this dimension, and that the correlations between the rank orderings in the simulation and the in situ conditions could serve as data for comparing the simulation methods.

None of these expectations was confirmed. Subjects found the task difficult to understand and to carry out. Their comments when making the judgments were instructive; many said the rooms they liked most and least were easy to rate, while the ones they were ambivalent about were more difficult to rate on the EDS. Some subjects expressed difficulty with rating some of the rooms they disliked; and others found it harder to rate a room they liked than those they didn't like. Only a few subjects seemed to make this judgment on grounds other than preferences. In any case, the response called for was ambiguous and the resulting data probably reflects the differing bases subjects used for making these judgments.

The rating difficulty rankings of the rooms in simulation and in situ were correlated for each subject. These correlations appear in Table 4, grouped according to simulation method. The median correlation appears at the bottom of each column. The overall median correlation for all subjects across all simulations was very low (Mdn. = .200). Floorplans provided the highest median correlation (+.229) and the drawings the lowest (-.114). Since all the median correlations are quite low any other differences are probably negligible. Because they are based on ordinal statistics there is no acceptable way of comparing them or assessing their significance levels.

The simulation methods were compared by utilizing the data in Table 4 for a median test. Dichotomization was performed around the median (r = +.200) and the resulting cell frequencies subjected to chi square comparison. There were no differences between the simulation groups ($\chi^2 = 3.176$, p = .468, df = 4). The rating difficulty response measure, in short, adds nothing to the comparison of the simulation methods. Though the results do not contradict the findings based on recognition and preference responses, they are too meager and the underlying data is too ambiguous to be of any use.

It seems clear, in retrospect, that the rating difficulty response measure was poorly conceived. At least two kinds of information were being sought in a confused manner; one, concerning the certainty/uncertainty of the EDS ratings,

TABLE 4
RATING DIFFICULTY CORRELATIONS (r_s) FOR ALL SUBJECTS BY GROUP

Simulation Method	Movies	Slides	Photos	Drawings	Floorplans	Total
	.886	.886	.657	.886	.886	
Scores (correlations) have been arranged in the order of decreasing magnitude	.829	.771	.619	.771	.886	
	.771	.600	.600	.714	.886	
	.714	.600	.600	.429	.657	
	.257	.371	.600	-.029	.543	
	.257	.200	.429	-.086	.257	
	-.029	.143	.257	-.143	.200	a
	-.029	.086	.257	-.143	.086	
	-.171	-.086	.086	-.314	-.429	
	-.543	-.262	.086	-.371	-.429	
	-.600	-.600	.029	-.600	-.714	
	-.829	-.657	-.314	-.857	-.771	
Median Correlation	+.143	+.172	+.191	-.114	+.229	+.200 ^b

^aMedian (.200) dichotomizes distributions at dotted lines.

^bOverall median for all subjects, $N = 60$.

and the other, concerning the perceived visual complexity of the environment. It would have been better to separate these and ask for each response in a more appropriate way. The subject's feeling of certainty or uncertainty about the EDS ratings should have been sought after each room was evaluated, probably in the form of a rating scale item as well. After all six of the rooms were evaluated and rated as to the certainty or uncertainty of the EDS ratings, then perhaps, the original rating difficulty ranking task could have been carried out reliably.

Instead of attempting to infer simplicity/complexity from the rating difficulty rankings, a more direct measure of this dimension should have been used. A comparison of the rooms in terms of judged simplicity/complexity after they had all been rated on the EDS would have been simpler for the subject than the rating difficulty ranking task; and more informative. A separate, ancillary study using magnitude estimation of visual complexity of the six rooms was performed, utilizing the slides and the drawings simulations. The results support this suggestion and are reported in detail in the room comparison findings that appear in a later chapter.

Environmental Description Scale Ratings

The shortened form of Kasmar's EDS used in the present study calls for interval ratings on 56 bi-polar scales descriptive of interior environments. It seemed reasonable

to expect the ratings of an environment in simulation and in situ to be similar for each subject. Differences in the two ratings could then be attributed mainly to the stability of the EDS as a measuring instrument and to the adequacy of the simulation as a surrogate for the actual environment.

Consequently, it was hypothesized that the relative adequacy of the simulation methods for making similar EDS ratings would decrease as the simulations became more abstract. This hypothesis was confirmed. The slides were most effective followed by movies, photos, floorplans, and drawings in that order.

Each subject rated each of the six rooms on the entire 56 item EDS under both in situ and simulation conditions. For each subject, the correlations between these two sets of ratings were very similar across all of the six rooms. Accordingly, the ratings for the six rooms were pooled, providing a total of 336 pairs of mathematically independent evaluations for correlation (Hays, 1973). These correlation coefficients are listed for each subject, grouped by simulation method, in Table 5. The mean correlation for each group appears at the bottom of each column, and the average correlation for all subjects across all the simulation groups appears in the Total column. Although the correlations are generally low to moderate, they are about as high as can be expected given the stability characteristics of individual semantic differential scale items (Heise, 1969).

TABLE 5

EDS CORRELATIONS ($\underline{r}$) FOR ALL SUBJECTS BY GROUPS

Simulation Method	Movies	Slides	Photos	Drawings	Floorplans	Total
	.689	.836	.700	.589	.622	
Scores (correlations) have been arranged in the order of decreasing magnitude	.633	.697	.597	.516	.571	
	.574	.685	.591	.500	.548	
	.572	.680	.589	.404	.546	
	.538	.619	.555	.348	.504	
	.502	.536	.546	.304	.496	
	.480	.499	.538	.296	.430	
	.472	.494	.535	.258	.302	
	.465	.474	.456	.193	.266	
	.392	.431	.391	.140	.213	
	.361	.178	.359	.069 ^a	.176	
	.306	.129	.077 ^a	.050 ^a	.174	
Mean Correlation ($\underline{r}$)	.518	.553	.493	.316	.415	.501

Note: Significant $\underline{r} = .108$, at .05 level, two tails, $\underline{df} = 334$.

^aNon-significant correlations.

The simulation methods were compared with each other by subjecting the data in Table 5 to analysis of variance. The methods differed significantly ($F = 3.413$, $p < .025$, $df = 4,55$). Slides produced the highest correlations between ratings made in simulation and in situ, followed by movies, photos, floorplans, and drawings in that order. Pairwise comparisons between the methods were carried out by means of a multiple-range test (Duncan, 1955). Slides, movies and photos did not differ among themselves; but were all better than the drawings ($p < .05$, two tails, $df = 55$). No other differences reached significance. Table 6 displays the analysis of variance summary (A) and the pairwise comparisons (B).

The original hypothesis, then, was borne out; namely, that as simulations become more abstract, their adequacy for making the EDS ratings decreases. There were two reversals, in the expected order of relative effectiveness of the methods; i.e., the slides were better than the movies, and the floorplans better than the drawings. The obtained order of effectiveness was exactly the same as that obtained from the comparisons based on the preference ranking correlations and almost the same as the order derived from the room recognitions.

Viewing Times

The amount of time required by each subject for viewing each room and rating it on the EDS was recorded for

TABLE 6

EDS RATINGS--ANOVA SUMMARY AND PAIRWISE COMPARISONS OF MEANS

A. Source of Variance	<u>df</u>	<u>ss</u>	<u>ms</u>	<u>F</u>	<u>p</u>
Treatments	4	.668	.167	3.408	.025
Within-groups	55	2.692	.049	--	--
Total	60	3.360	--	--	--
B. Source of Differences ^a	Differences				<u>p</u>
Slides vs. Drawings	.267				.01
Movies vs. Drawings	.246				.05
Photos vs. Drawings	.214				.05 ^b

^aThe Duncan Multiple-Range Test was used for these comparisons.

^bAll other differences between group means were insignificant.

both the simulation and in situ conditions. As mentioned earlier, it was assumed that these viewing times would be indices of the relative complexity of the several rooms; that is, the more complex rooms would require more viewing time to complete the EDS ratings than would the simpler rooms.

The hypotheses for this response measure were analogous to those posed for the other variables. First it was expected that all of the simulation methods would produce hierarchies of rooms based on differing viewing times similar to the order obtained when viewing the actual rooms in situ. Second, it was expected that the correlation between the sequences obtained in simulation and in situ would decrease as the simulation methods became more abstract; ranging from the relatively concrete movies to the schematic and abstract floorplans. Neither of these hypotheses were substantiated in any way.

Unfortunately, the differences in viewing times for the rooms were due almost completely to an unintended practice effect with respect to the EDS ratings. For almost every subject the amount of viewing time for each room decreased with its serial position; that is, the subjects simply became more efficient at making the EDS ratings with each successive room. Since the viewing sequence for each subject was the same in simulation and in situ, correlations between the sequences were typically perfect or near perfect. Every simulation method was, therefore, spuriously adequate for this response measure and there were, of course, no differences between the methods.

CHAPTER IV

ROOM COMPARISONS

Several of the response measures utilized to compare simulation methods were also used for comparisons between rooms. These comparisons were then used to establish relationships between such environmental characteristics as recognizability, preferability and visual complexity. These results will now be considered in detail.

Recognizability

For all simulation methods except the floorplans, there were some significant differences in the recognizability of the six interior environments. Further, in the four exclusively visual simulations, the same room proved to be least recognizable. For the floorplans (accompanied by verbal descriptions) overall room recognition was good; but there were no significant differences in the relative recognizability of the rooms. Recognition was probably mediated here primarily by verbal memory which seemed to be about equally good for each environment.

The recognizability of each room was determined by summing the number of recognitions and non-recognitions of it across all of the simulation groups. Goodness-of-fit chi square probabilities were calculated for each room

distribution based on expected frequencies for the dichotomous recognition judgment. These sums and probabilities appear in Table 7. Three of the rooms were recognizable ($p < .05$); while the other three did not exceed chance level in terms of recognizability. The most recognizable was the Powel room, a large, high, ornately decorated and lavishly furnished room. A close second was the Hart room, a small room with a heavily beamed low ceiling. The third most recognizable room was the Wentworth room, the largest of all the interiors, dimly lit, filled with furniture, and featuring one entire wall covered with wood panelling painted a dark red. Least recognizable was the Newington room, the smallest and most dimly lit of all the rooms. (See Appendix B for a fuller description and photos of the six interior environments.)

The relative recognizability of the rooms was determined by subjecting all the recognition data to an analysis of variance for repeated measures. Overall differences between the recognizability of the rooms were highly significant ($F = 5.4$, $p < .001$, $df = 5, 295$). The Powel room was once again most recognizable, followed by the Hart, Wentworth, Bowler, Almodington, and Newington rooms, in that order. The three most recognizable rooms, Powel, Hart, and Wentworth, were not significantly different from one another. They were, however, all significantly more recognizable than the Almodington and Newington rooms, the two least recognizable rooms. (All differences $p < .05$, $df = 295$, Duncan

TABLE 7

ROOM RECOGNIZABILITY--ALL SIMULATIONS COMBINED

Room	No. of Recognitions	No. of Non-Recognitions	χ^2	p
Powel	44	16	12.15	.001
Hart	42	18	8.82	.005
Wentworth	39	21	4.82	.04
Bowler	34	26	.82	.39
Almodington	31	29	.02	.88
Newington	27	33	.42	.52 ^a

^aApproximately chance level; but moving in the opposite direction to the other differences.

Multiple-Range Test). The Newington room was the least recognizable of all, significantly different than three of the other rooms. (All differences, $p < .05$, $df = 295$, Duncan Multiple-Range Test.) The analysis of variance and pairwise comparisons of means and their associated probabilities appear in Table 8.

TABLE 8
RELATIVE RECOGNIZABILITY OF THE ROOMS
FOR THE COMBINED GROUPS

A. <u>Anova</u> Summary					
Source of Variance	<u>df</u>	<u>ss</u>	<u>ms</u>	<u>F</u>	<u>p</u>
Treatments (rooms)	5	3.422	.684	5.445	<.001
Subjects	59	45.489	.771	6.134	<.001
Error	295	37.078	.126	--	--
Total	359	85.989	--	--	--
B. Comparisons of Means ^a					
Source of Differences	differences			<u>p</u>	
Powel vs. Almodington	.217			<.005	
Powel vs. Newington	.283			<.005	
Hart vs. Almodington	.183			<.01	
Hart vs. Newington	.250			<.005	
Wentworth vs. Almodington	.113			<.05	
Wentworth vs. Newington	.200			<.005	

^aThe Duncan Multiple-Range Test was used for these comparisons. All other differences between group means (rooms) were insignificant.

Recognition responses for each simulation condition were also subjected to analysis of variance. The movies, slides, photos, and drawings yielded differences in the relative recognizability of at least some of the rooms. (For all conditions, F ratios, $p < .05$, $df = 5,55$). Within three of these conditions the Newington room was the least recognizable room and for the fourth, it was tied with the Almodington room as least recognizable. For the floorplans method, however, there were no significant differences in the relative recognizability of the rooms. ($F = .540$, $p = \text{non-sign.}$, $df = 5,55$.) These results are listed in Table 9.

There was somewhat less agreement across the simulation methods about the relative recognizability of the entire set of rooms. To determine this, the rooms were rank-ordered within each group according to frequency of recognition and the rankings compared. Kendall's coefficient of concordance was calculated and found to be modest but significant ($W = .49$, $p < .05$, two tails, $df = 5$). Accordingly, the order of the rooms in terms of their recognizability as it appears in Table 9 can be considered a standard order or an empirically derived best estimate of their "true" rank ordering on the recognizability dimension (Siegel, 1956). For convenience, that sequence is repeated here; the Powel room is most recognizable, followed in order of decreasing recognizability by the Hart, Wentworth, Bowler, Almodington, and Newington rooms.

TABLE 9

RELATIVE RECOGNIZABILITY OF THE ROOMS FOR EACH SIMULATION GROUP

Simulation Method	Recognizability Order ^a	<u>F</u> Ratio	<u>p</u>
Movies	P = H > B > W = A > N	2.958	<.025
Slides	P = W = H = A > B > N	2.625	<.04
Photos	P = H > W > B > A = N	4.736	<.005
Drawings	W > P > H = A = B > N	3.019	<.025
Floorplans	W = B > P = N > H = A	0.540	Non-significant
All methods combined	P > H > W > B > A > N	5.445	<.001

^aIn order of decreasing recognizability, from left to right.

The differences in the relative recognizability of the rooms across the different simulation methods, displayed in Table 9, were subjected to further analysis by means of the F test for interaction. The overall interaction effects were highly significant ($\underline{F} = 16.285$, $\underline{p} < .001$, $\underline{df} = 20,275$). Simple interaction effects were examined next. All possible pairs of simulations, except slides vs. drawings, differed significantly with respect to the relative recognizability of the rooms (all differences, $\underline{p} < .05$, F test for simple effects, $\underline{df} = 5,275$).

Although the relative recognizability of the rooms within each simulation method was affected by the overall effectiveness of the method, a few generalizations are possible about the rooms-by-simulations interaction. The rooms were, relatively speaking, uniformly well recognized by subjects who had viewed the slides; and by contrast, uniformly poorly recognized by those who had seen the drawings. The photos group showed the most variability in their recognitions of the various rooms; the floorplans group, the least. As mentioned earlier, among the purely visual simulation methods (i.e., excluding the floorplans accompanied by verbal descriptions) the Newington room was the least recognizable environment. This, it will be recalled, was the smallest of the rooms, rather dreary and poorly lit, with unremarkable furniture and decor. The Powel room was the most recognizable room among the purely visual simulation methods. Its brightness, ornateness,

unusual wallpaper, and chandelier probably rendered it quite memorable. Next most recognizable was the Hart room with its very low ceiling, beds, and other relatively primitive furniture and decor.

Preferability

There were significant differences in the degree of preferability of the rooms in both the simulation and the actual viewing conditions for all groups except the one viewing the floorplans. In the in situ viewing condition the Newington room was ranked as least preferable by all the five experimental groups. For the simulation viewing condition, there was considerably less consistency among subjects with respect to the least preferred room. The Newington room again proved to be least preferable, however, when the preference rankings of all the subjects in all of the simulation conditions were combined. Overall agreement as to the relative preferability of all the rooms was low for both viewing conditions.

In order to establish a base line preference order for the six interiors, each subject's preference rankings of the actual rooms were correlated to every other subject's by means of Kendall's coefficient of concordance (Siegel, 1956). The five simulation groups were combined for this correlation. Overall agreement between the subjects as to preference order was low, but significant ($W = .20$, $p < .001$, $df = 5$). Hence the order represented by the sums

of ranks can be considered as the best estimate of the "true preference ranking" of the rooms. The Powel room was most preferred, followed, in order of decreasing preference, by the Wentworth, Almodington, Bowler, Hart, and Newington rooms.

The sums of ranks for each group were then compared by means of the Friedman test, a non-parametric analogue of the repeated measures analysis of variance procedure (Siegel, 1956). The rooms differed in terms of overall relative preferability ($\chi^2 = 59.85$, $p < .001$, $df = 5$). Pairwise comparisons between the rooms were performed using the Wilcoxon matched pairs, signed ranks test (Siegel, 1956). The Newington room was significantly less preferred than all of the other rooms ($p < .05$, $N = 6$). The Hart room was significantly less preferred than the Almodington, Powel, and Wentworth rooms (all differences, $p < .05$, $N = 6$). All other differences did not reach significance.

The preference rankings for the rooms as viewed in simulation were then intercorrelated for each subject, once again by the Kendall procedure. Overall agreement for all the simulation groups combined was slight, but highly significant ($W = .13$, $p < .001$, $df = 5$), and somewhat less than the agreement between subjects in the in situ condition, as indicated above. The best estimate of the "true preference ranking" of the rooms in simulation then was as follows: the Almodington room was most preferred, followed by the Powel, Wentworth, Bowler, Hart, and Newington rooms, in

order of decreasing preferability. There were significant differences between the preferability rankings of the rooms in simulation just as there were in the in situ viewing condition. Once again the Friedman non-parametric analysis of variance was used ($\chi^2 = 37.59$, $p < .001$, $df = 5$). Pair-wise comparisons between the rooms were again carried out by means of the Wilcoxon test. Both the Newington and Hart rooms were less preferred than all the other rooms, except each other. The Almodington room was preferred over all the rooms except the Powel room. All these differences exceeded the five percent level of significance. Other differences between the rooms did not reach significance.

It is apparent that the preference order for the rooms in simulation is quite similar to that derived from viewing them in situ. The three least preferred rooms were ranked in precisely the same way; and the precedence order for two of the most preferred rooms is the same for both the actual and simulation sequences. These two preference orders are listed in Figure 1 for comparison. The Spearman correlation between them was moderately high and significant ($r_s = .829$, $p < .05$, one tail test, $N = 6$).

Preference ranking agreements were also estimated for each simulation group under both conditions. In general, inter-rater agreement was less for the simulation condition than for the in situ condition; but the differences were small (see Table 10).

Viewing Condition	Sequence--From Left to Right--In Order of Decreasing Preferability					
Simulation	Almodington	Powel	Wentworth	Bowler	Hart	Newington
In Situ	Powel	Wentworth	Almodington	Bowler	Hart	Newington

Fig. 1. Room preference orders--combined groups--both viewing conditions

TABLE 10

INTER-RATER AGREEMENT--ROOM PREFERENCES---INDIVIDUAL GROUPS

Simulation Condition			In Situ Condition		
Group (<u>N</u> = 12)	Concordance (<u>W</u>)	<u>p</u>	Group (<u>N</u> = 12)	Concordance (<u>W</u>)	<u>p</u>
Movies	.36	<.01	Movies	.51	<.01
Slides	.14	Non-sign.	Slides	.37	<.01
Photos	.12	Non-sign.	Photos	.22	<.02
Drawings	.24	<.02	Drawings	.24	<.05
Floorplans	.09	Non-sign.	Floorplans	.08	Non-sign.
Combined (<u>N</u> = 60)	.13	<.01	Combined (<u>N</u> = 60)	.20	<.01

These results, then, generally confirm the earlier findings that the simulations are reasonably useful for preference judgments of actual interiors. On a group basis the agreement between the in situ and simulation preference orders was moderately high ($r_s = +.829$) while on the individual subjects level the degree of correspondence between preference orders of the rooms in the two conditions was considerably more modest (Median Spearman corr. = $+.572$). If the architectural drawings group is omitted, because as mentioned earlier these simulations tend to misinform and mislead subjects, then the resulting median correlation is somewhat higher ($Mdn. = +.667$) and more closely approaches the correlation between the averaged preference rankings (i.e., $r_s = +.829$).

Recognizability and Preferability

It was expected that the most preferred and the least preferred rooms would prove to be more recognizable than those to which subjects were relatively indifferent. This expectation was not confirmed. The overall preference rank orderings of the rooms under both viewing conditions were compared to the rank ordering of the rooms in terms of recognizability. The correlation between recognizability and preferability for the simulation condition was positive, but very low and insignificant ($r_s = +.257$, $p < .7$, $N = 6$). For the in situ viewing condition the correlation was positive, moderate; but also insignificant ($r_s = +.600$, $p < .3$, $N = 6$).

Since the five percent critical value for the Spearman correlation is very high in this instance (.886), it seemed worthwhile investigating this relationship further. Accordingly, each subject's preference choices were scored for recognition or non-recognition and the resulting data subjected to analysis of variance. Once again, for the simulation viewing condition there were no significant differences between more preferred and less preferred rooms with respect to the number of recognition responses they elicited ($F = 1.214$, $p > .20$, $df = 5, 295$). For the in situ viewing condition the differences in recognizability between preference choices was also non-significant ($F = 1.41$, $p > .20$, $df = 5, 295$). Furthermore, the correlation ratios for the simulation condition ($r_n = +.142$) and the in situ condition ($r_n = +.153$) are negligibly low and also indicate that there is virtually no relationship between the recognition and preference variables (Friedman, 1972).

Complexity

The two response measures that had been expected to be sensitive to the relative visual complexity of the rooms were not at all effective. As mentioned earlier, the rating difficulty response measure was beset by misinterpretation, and viewing times were confounded by practice effects. Consequently, two additional procedures were utilized in order to provide usable information about the important dimension of visual complexity. First, the ratings of the

rooms on the EDS scale item "complexity/simplicity" were extracted from the data for each subject in both the in situ and the simulation conditions. These were then used to evaluate the rooms as to relative visual complexity. Second, an ancillary procedure was carried out using two simulation techniques, different subjects, and a different rating task; i.e., the rank ordering of the six rooms on the dimension of visual complexity. These substitute response measures are described in turn as follows.

EDS Complexity Ratings

Every subject had rated each of the six rooms in both viewing conditions on the EDS scale item "complexity/simplicity." Thus each subject contributed two sets of semantic-differential ratings (ranging from one to seven); one set for the in situ situation, and the other for the simulation viewing condition to which he had been assigned. For each condition, these sets of ratings were rank-ordered, averaged across all 60 subjects, and correlated by means of Kendall's coefficient of concordance. Overall agreement on the complexity ratings was low, but significant, for both the actual and the simulation viewing conditions. The rooms, then, could be rank-ordered with respect to one another on the complexity/simplicity dimension, using the sums of the ranks as the basis of the best estimate of their "true rank-ordering." The overall correlation coefficients and

the orderings of the rooms as to relative complexity, for both viewing conditions, appear in Table 11.

The Powel, Wentworth, Almodington, and Bowler rooms received the same complexity rankings in both simulation and in situ viewing. The Powel room was judged as most complex followed in order of decreasing complexity by the Wentworth, Almodington and Bowler rooms. The Hart room and the Newington room were judged as the two simplest rooms (i.e., least complex) in both viewing conditions though not in the same order. Analysis of the data by means of the Friedman test (Siegel, 1956) indicated that there were overall differences between the rooms in terms of visual complexity in the simulation condition ($\chi^2 = 79.2$, $p < .001$, $df = 5$), and in situ ($\chi^2 = 73.8$, $p < .001$, $df = 5$). Pairwise comparisons with the Wilcoxon procedure yielded the following differences for the actual viewing conditions: the Powel and Wentworth rooms, though not differing in themselves, were rated significantly more complex than each of the other rooms (each difference $p < .01$, $N = 60$); and the Hart and Newington rooms were rated significantly less complex than each of the other rooms (each difference, $p < .01$, $N = 60$); though they did not differ from each other. All other differences were not significant.

Pairwise comparisons of the rooms in the simulation condition yielded similar results (all differences $p < .01$,

TABLE 11

RELATIVE ROOM COMPLEXITY--SEMANTIC DIFFERENTIAL RATINGS

Simulation Method	Simulation Condition		In Situ Condition		Correlation Between Orders ($\underline{r}_s$) ^b
	Complexity Order	Concordance ($\underline{W}$) ^a	Complexity Order	Concordance ($\underline{W}$) ^a	
Movies	P>W>A>B>N>H	.330 ($\underline{p} < .005$)	P>A>W>B>N>H	.317 ($\underline{p} < .005$)	.943 ($\underline{p} = .01$)
Slides	P>W>B=A>N>H	.297 ($\underline{p} < .005$)	P>W>A>B>H>N	.311 ($\underline{p} < .005$)	.929 ($\underline{p} = .02$)
Photos	P>A>B>W>N>H	.488 ($\underline{p} < .001$)	P>W>A>B>N>H	.202 ($\underline{p} < .04$)	.829 ($\underline{p} = .05$)
Drawings	P=W>B>A>N>H	.255 ($\underline{p} < .01$)	W>P>B>A>H>N	.219 ($\underline{p} < .025$)	.929 ($\underline{p} = .02$)
Floorplans	"No objective order"	.144 (non-sign.)	B>P>W>A>H>N	.375 ($\underline{p} < .001$)	--
Total	P>W>A>B>N>H	.264 ($\underline{p} = <.001$)	P>W>A>B>H>N	.246 ($\underline{p} < .001$)	.943 ($\underline{p} = .01$)

^aInter-subject agreement was measured by Kendall's Coefficient of Concordance ($\underline{W}$), probabilities are two-tailed values.

^bAgreement between complexity orders was measured by Spearman's Rank Order Correlation ($\underline{r}_s$). All probabilities are one-tailed values.

$\underline{N} = 60$). The Hart room was rated least complex, significantly less than any of the other rooms. The Newington room was rated significantly less complex than any of the other rooms except the Hart room. This is the reverse of the sequence found in the actual viewing condition; but the difference is relatively unimportant. What matters is that the two rooms rated as least complex in actuality were also rated least complex in simulation. The Powel room was rated significantly more complex than any other room except the Wentworth. It, in turn, was rated as more complex than the Newington and Hart rooms only. The overall rank-orderings for the two conditions were almost identical and, when correlated, yielded a Spearman coefficient of $+0.943$ ($p < .01$, $\underline{N} = 6$). The sequence of rooms derived from the judgments made in the in situ viewing condition is considered the "objective order" of the rooms in terms of visual complexity; the Powel was ranked as most complex followed by the Wentworth, Almodington, Bowler, Hart, and Newington rooms, in order of decreasing complexity.

These relationships pertained for most of the simulation groups on an individual basis as well. For all groups except the floorplan viewing condition, there was significant agreement between subjects as to the judged relative complexity of the rooms. It is worthwhile noting that there

was virtually no agreement among subjects who rated the complexity of the rooms on the basis of floorplans and verbal descriptions. Apparently this simulation mode did not provide the visual information subjects required for judgments of complexity. Some suggestions concerning the nature of the information needed might include: the number of objects in the stimulus array, the frequency of contours (especially sharply angled turns), the diversity of contrasting colors, and the like.

The correlations between relative complexity orders in simulation and in situ were also high and statistically significant for all the simulation methods except the floorplans. (For this group, complexity orders were very similar, but agreement did not reach significance in the simulation viewing condition. Hence, the obtained order cannot be considered reliable enough for further comparisons.) The concordance coefficients and the correlations between room orders for the individual simulation methods appear in Table 11.

Rationale

A second procedure for exploring the complexity dimension was provided by an ancillary study using a variant of Stevens' magnitude estimation technique (Stevens, 1968). By using a different sample of subjects and a ratio scaling procedure, it was possible to both check and extend the findings derived from the semantic differential rating scales.

Seventy-two subjects were tested; 30 with color slides of the rooms, 30 with color slides of the perspective drawings of the rooms, and 12 in situ at the Metropolitan Museum of Art. The slides and drawings were chosen on the basis of the earlier findings in the study, which indicated that these two media represented the best and the poorest simulation methods respectively.

Slides of the drawings were made in order to permit large scale projection for the testing of small groups of subjects. It also made the format of the drawings equivalent in scale to that of the slides. Subjects were, once again, students in introductory level courses in psychology, participating voluntarily for extra course credits. The simulation subjects were run in small groups averaging about six subjects per group with the slide projection set-up described earlier. The in situ subjects, of course, were taken individually through the actual rooms. The stimuli were presented in several different orders to each group, but in every case the rooms that had proven to be the most and least complex in the semantic differential data were presented in the middle of the series to prevent sequential biasing effects (Bier, et al., 1963). Subjects were permitted to view the rooms over and over again to make and revise their ratings until they were satisfied with them. The rating procedure itself will now be described.

Magnitude Estimation Scaling

The scaling method used was patterned after the free-modulus variation of the method of magnitude estimation (Engen, 1971). This procedure is basically the same as Stevens' original magnitude estimation method (Stevens, 1968) in that the subjects assign numbers to instances of the psychological quality they are measuring, in an attempt to represent differences in magnitudes on the phenomenal dimension with numerical values, usually ratios. Unlike the original technique, however, the free modulus variation does not provide standard stimuli for establishing a frame of reference for judgment of the dimension, nor number values for the end points or any other reference point in the rating system to be used by the observer. Instead, the observer is instructed to select the number he considers appropriate for the first and every subsequent stimulus. The chief virtue of the method is that it prevents the experimenter from biasing the character of the overall judgmental framework in the direction of his own preconceptions.

The peculiar limits and needs of the present task made the free-modulus, magnitude estimation method particularly appropriate. Only the six original room environments could be used for the complexity rating task so that the resulting judgments would be comparable to the ratings made by the original experimental subjects with the semantic differential. It seemed inadvisable to sacrifice two of

these as standards, since their evaluation on the complexity dimension was of paramount interest. Adding two other rooms as standards would have resulted in a different rating task than the original, and one of uncertain comparability.

The free-modulus variant was further modified by requiring the rater to divide a 130 mm line into segments by making a mark representing the relative complexity of each room (see Collins, 1971). The end points of the line were labelled "most simple" and most complex. One-half of the subjects used sheets on which the endpoint descriptor, most complex, appeared on the right endpoint of the line. The other half utilized sheets in which most complex appeared at the left endpoint. The subjects were asked to label each mark with the letter of the room it represented. They were instructed to adjust the distances between the marks to represent the magnitudes of the differences between the rooms in terms of visual complexity.

After the subjects had revised their complexity rating to their satisfaction they were asked to explain on the back of the sheet, the basis upon which they made their judgments.

Findings

The magnitude of complexity estimation for each room was determined by simply measuring the distance between the endpoint labelled "most simple" and the mark representing each room. This was done for each subject and the estimates

were summed and averaged across the 60 subjects who had viewed the simulations. Separate averages were, of course, calculated for the subjects who made their estimates while viewing the actual rooms (in situ). These averages appear in Table 12.

TABLE 12
MEAN ESTIMATES OF VISUAL COMPLEXITY
OF THE ROOMS

Room	Simulation (<u>N</u> = 60)	In Situ (<u>N</u> = 12)
Powel	115.82 mm	104.27 mm
Wentworth	91.67 mm	80.91 mm
Bowler	79.72 mm	77.00 mm
Almodington	75.42 mm	100.27 mm
Newington	53.92 mm	58.27 mm
Hart	40.13 mm	37.09 mm

Considering the simulation condition first, it is apparent that the Powel room was rated as most complex and Wentworth, Bowler, Almodington, Newington, and Hart rooms as successively less complex in that order. This is almost exactly the same order that was obtained through the use of the semantic differential ratings; in fact, the sequential orders correlated at $r_s = +.943$ (Spearman ρ , $p = .02$, two tail, $N = 6$). Magnitude estimates and semantic differential scales also permit parametric correlation, however, and the Pearson correlation between them was even higher than the

above coefficient; namely, $r = +.992$ ($p < .001$, two tail, $df = 4$). The two scaling methods are compared in Figure 2 which also presents the equation of the depicted line-of-best-fit for the data points. The obtained function is remarkably linear, obviating any need for the usual logarithmic transformation of the magnitude estimation data (Engen, 1971). It would seem then, that in the present instance, semantic differential ratings and magnitude estimations of room complexity produce very similar judgments.

It seemed reasonable to compare the two types of scaling for inter-subject agreement to see if the methods were comparable in this respect as well. Since the floor-plans simulation group demonstrated insignificant and negligible inter-subjective agreement in its semantic differential ratings of the complexity dimension, it was eliminated from the data and the remaining 48 subjects' ratings were intercorrelated. Once again Kendall's coefficient of concordance was utilized to estimate inter-subjective agreement for both the semantic differential ratings group ($W = .26$, $p < .001$, two tails, $df = 5$); and the magnitude estimations group ($W = .40$, $p < .001$, two tails, $df = 5$). Although the difference between these two correlations is not significant, it does suggest that there was more agreement among subjects using the magnitude estimation method than those using the semantic differential scaling; agreement, that is, in the rank orderings of the six rooms in terms of complexity. Inspection of the data

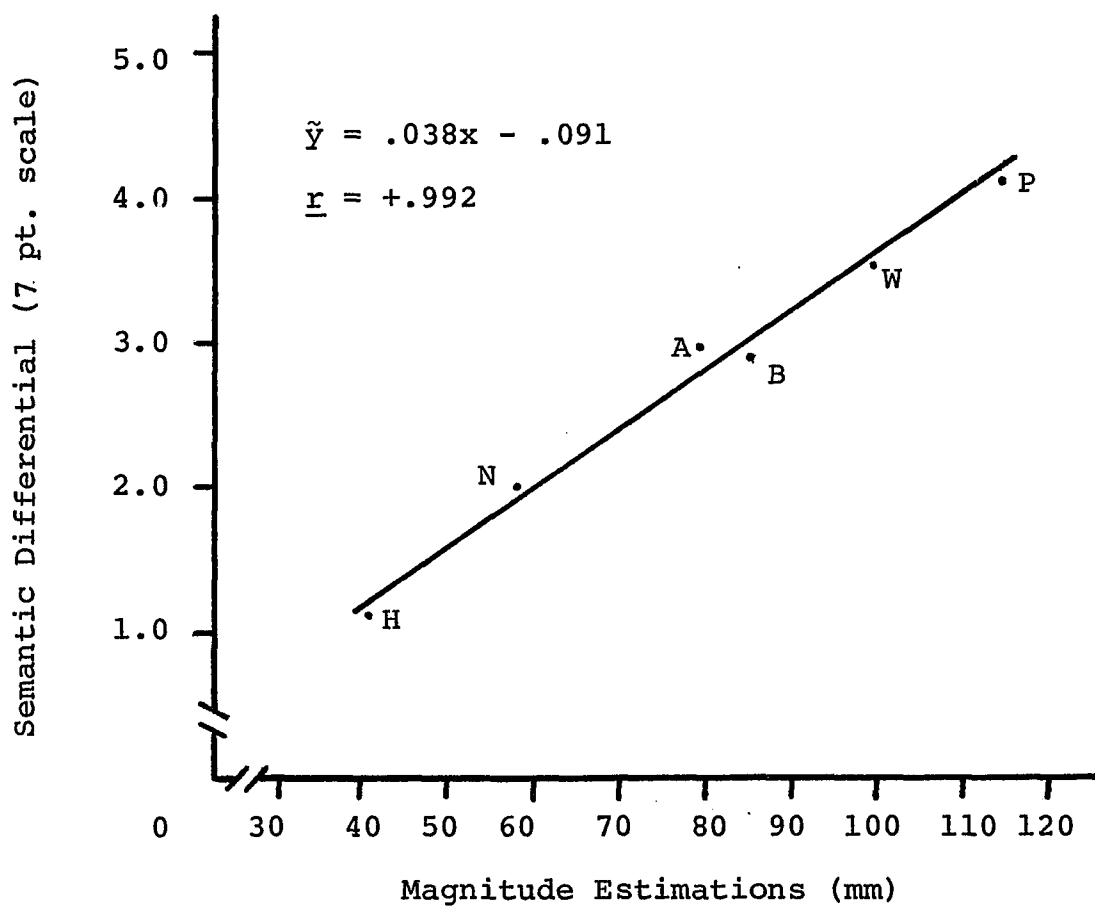


Fig. 2. Average semantic differential ratings of complexity plotted against average magnitude estimations for each of the rooms in simulation.

corroborated this for the most part. Inter-subjective agreement among the ranked judgments for each scaling method are displayed in Table 13. The first two columns from the left list medians (Mdn) and inter-quartile ranges (IQR) for the rankings of each room in both the semantic differential (S.D.) and the magnitude estimation (M.E.) scaling procedures for the simulation condition. For all of the six rooms, variability in the rankings was less for the magnitude estimation scaling than for the semantic differential ratings. This makes sense since magnitude estimation scaling in the present task required direct comparison of the stimuli to be evaluated; while the semantic differential ratings involved relatively isolated judgments of each room simulation on an individual basis.

The two scaling methods were also compared with respect to complexity evaluations of the actual rooms in situ. The results were similar to the comparisons made within the simulation condition, but there were some differences. The Powel room once again proved to be the most complex room and the Hart and the Newington rooms were judged least and second least complex, in that order, as they had been in the simulation condition. The other three rooms switched places somewhat; but the overall correlation between the average complexity values for the two scaling techniques was again quite high and significant ($\underline{r} = .887$, $\underline{p} < .02$, two tails, $\underline{N} = 6$). The data points for the two methods, the best fitting regression line and its equation, appear in Figure 3.

TABLE 13
 INTERSUBJECTIVE AGREEMENT FOR
 ROOM COMPLEXITY RANKINGS

		S.D. Sim	M.E. Sim	S.D. Act.	M.E. Act.
A	<u>Mdn</u>	4.136	3.395	4.350	5.000
	<u>IQR</u>	2.514	1.824	2.108	1.000
B	<u>Mdn</u>	4.056	3.500	3.617	3.250
	<u>IQR</u>	2.271	1.937	2.417	1.667
H	<u>Mdn</u>	1.750	1.289	2.223	1.250
	<u>IQR</u>	1.400	1.355	1.750	1.330
N	<u>Mdn</u>	2.667	2.233	2.412	2.500
	<u>IQR</u>	1.842	1.642	1.083	2.333
P	<u>Mdn</u>	5.540	5.756	4.950	5.500
	<u>IQR</u>	1.520	1.197	1.786	1.500
W	<u>Mdn</u>	4.250	4.346	4.783	3.167
	<u>IQR</u>	1.571	1.150	2.063	2.250

The correspondence between the two scaling methods is all the more surprising because of the disproportionately small group judging the rooms with the magnitude estimation technique ($N = 12$) when compared to the size of the semantic differential rating group ($N = 48$). Unfortunately, the museum rooms were closed for extensive renovation before the planned sample of thirty subjects could be completed. Such a sample would have provided more reliable comparisons between the scaling methods for the in situ condition.

The magnitude estimation method again produced more inter-subjective agreement (Kendall's coefficient of concordance; $\underline{W} = .52$, $\underline{p} < .001$, two tailed test, $\underline{df} = 5$), than

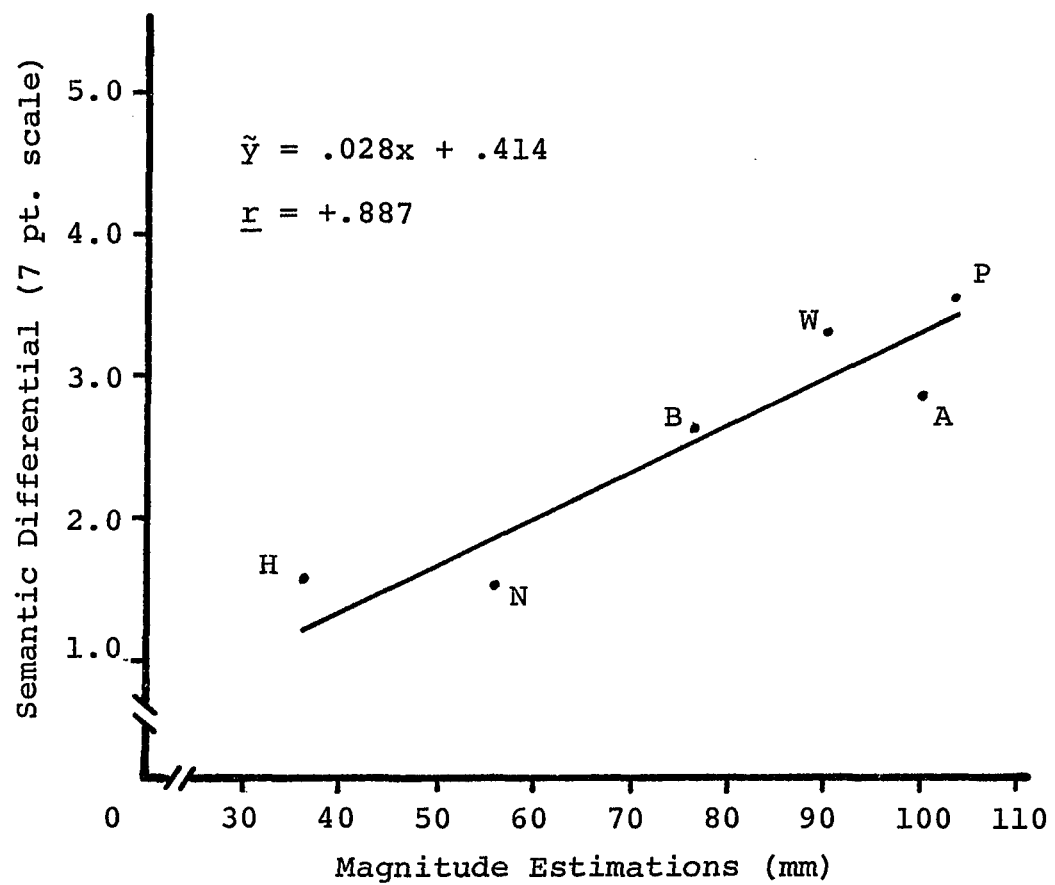


Fig. 3. Average semantic differential ratings of complexity plotted against average magnitude estimations for each of the actual rooms.

did the semantic differential method ($\underline{W} = .25$, $\underline{p} < .001$, $\underline{df} = 5$). Here, however, the smaller sample size for the magnitude estimation method is probably responsible for the high concordance coefficient. The two columns on the right in Table 13 tell very much the same story. Here the median rankings for both scaling methods are again quite similar and the inter-quartile ranges indicate that, for four of the rooms, the magnitude estimations showed less variability than the semantic differential scales.

Perhaps the most valuable aspect of this comparison is the enhanced credibility it lends to the dimension of room complexity. Two different groups of subjects viewing somewhat different simulations and using different scaling procedures produced remarkably similar complexity judgments about very complex stimulus displays.

Defining Complexity

For the purposes of the present study, the term "complexity" had been defined intuitively, in terms of the intrinsic visual interest of the environmental display. This included such aspects as: the number and variety of discrete items in the stimulus array; the number, variety and brightness of the attention-getting areas of color; and the ornateness of textures, objects and surfaces in the rooms. In order to get some notion of how the subjects defined the term complexity they were asked, as mentioned earlier, to write down the basis upon which they had made their magnitude

estimations after these had been completed. Some subjects found this a very difficult question and did not respond. A majority of the subjects listed at least one basis for the complexity judgment and a small number listed several criteria. These responses have been grouped and tallied in Table 14.

TABLE 14
SUBJECTS' REPORTED CRITERIA FOR
COMPLEXITY JUDGMENTS

Criteria Used	Freq.
amount of furniture (clutter)	11
colorfulness	5
organization	5
ornateness	5
physical size	5
busyness of furnishings	4
lines	3
space	3
structure of the room	2
style of furniture	2
no response	15
Total	60

It would seem, then, that a majority of the magnitude estimation subjects shared with the experimenter at least some common notions about the meaning of the term complexity.

Further comparisons were made with the responses that had been elicited from 48 of the original experimental subjects who had used the semantic differential rating scale. Once again the floorplans group was omitted from consideration since their evaluations of the rooms on the complexity

dimension showed negligible inter-subject agreement. Only the simulation condition scores were used for the following correlations since the group that evaluated the actual rooms with the magnitude estimation method was small ($N = 12$) and provided too few responses for meaningful comparison. The complexity item ratings were correlated with those of a number of other items on the EDS chosen to correspond as closely as possible to the rating framework suggested by the magnitude estimation subjects (see Table 14) and to notions entertained by the experimenter. The resulting correlation coefficients presumably indicate the degree of similarity of usage (and meaning) between complexity and these other items. In a sense, the pattern of correlations amounts to a rough, empirical definition of the term. These correlations, for each of the six simulated rooms, and for all of the rooms averaged, appear in Table 15. Correlation coefficients significant at the five percent level or better are indicated.

The patterns of correlations for the six rooms provide general support for both the intuitive notion of the experimenter and the composite definition derived from the subjects' suggestions. Judged complexity tended to be associated with ratings on scales descriptive of ornateness, clutter, color, and/or style for the rooms rated as relatively complex; that is, the Powel, Almodington, Bowler, and Wentworth. Low complexity or judged simplicity tended to be associated with, at most, two of these descriptive dimensions,

TABLE 15

CORRELATIONS BETWEEN "COMPLEXITY" AND OTHER RELATED DESCRIPTIVE SCALES FOR EACH SIMULATED ROOM DISPLAY

Almodington	Bowler	Hart	Newington	Povel	Wentworth	Average $\bar{x}$
Elegant (.46) Ornate (.43)	Elegant (.38) Ornate (.30)	Elegant (.42) Ornate (.34)		Elegant (.24) Ornate (.30)	Elegant (.35) Ornate (.24)	Elegant (.34) Ornate (.30)
	Crowded (.45) Cluttered (.31) Full (.37)		Crowded (.48) Cluttered (.31) Full (.39) Restricted Space (.34)	Crowded (.33) Cluttered (.32) Full (.24) Restricted Space (.31)	Cluttered (.41) Full (.30) Adequate Size (.30)	Crowded (.31) Cluttered (.30) Full (.26)
Bright Colors (.44) Colorful (.49) Flashy Colors (.42)	Bright Colors (.41) Colorful (.35) Flashy Colors (.30)		Bright Colors (.29)	Bright Colors (.28) Colorful (.29)		Bright Colors (.30) Colorful (.26)
Good Lines (.31) Stylish (.50)	Stylish (.30)	Good Lines (.26) Stylish (.23)		Stylish (.24)	Good Lines (.41)	Stylish (.23)

for the Hart and Newington rooms. Judged room complexity seems to be related, then, to the amount of visual interest the environment provides for the observer. This, in turn, seems to be determined by a number of additive dimensions; such as, the number of objects and their variety, attention-getting colors and patterns of color, ornate textures and decorative elements, and stylishness. The last column in Table 15 lists the average correlations for each descriptor across all six of the rooms. Although they are all low, they are all significant and might be thought of as outlining a definition of complexity; limited, of course, to simulations of museum reproductions of eighteenth-century American sitting rooms.

Complexity and Preference

Although the complexity variable could not be manipulated very readily in the present study, it seemed worth looking for possible relations between the perceived visual complexity of the several environments and their relative preferability. As mentioned earlier, a number of studies have linked preferences for stimuli with their perceived complexity (Munsinger & Kessen, 1964; Terwilliger, 1963; Vitz, 1966a; Wohlwill, 1968). Two analytic approaches were utilized here to answer this question; first, the overall preference order for the rooms was compared with the order in which they were ranked on the complexity dimension; and second, the preference rankings and the complexity

ratings were intercorrelated for each individual and then averaged across all the subjects. These two approaches yielded mutually corroborating results.

The overall rank orderings of the rooms in terms of preference and complexity were derived earlier in this chapter by means of Kendall's coefficient of concordance. The two sequences for both the in situ and the simulation viewing conditions appear in Figure 4.

For the in situ condition, i.e., the viewing of the actual rooms, the two rank orders were perfectly correlated ($r_s = 1.000$, $p < .01$, two tail test, $N = 6$). The relationship between preference and complexity for the simulation condition was also positive; but just short of significance ($r_s = +.771$, $p < .08$, two tails, $N = 6$). Hence, to the extent that average rankings provide empirically valid rank orderings, the relationship between preference and complexity is reasonably clear. Preferred rooms tend to be more visually complex than non-preferred rooms, especially when viewing the actual rooms in situ.

The relationship between preference and complexity was also examined at the level of the individual subject's responses. Each subject's room preferences were correlated with his ratings of the rooms on the semantic differential complexity scale for both the in situ and simulation viewing conditions. In order to make the present comparisons

Viewing Condi- tion	Character- istic	Sequence--From Left to Right--In Order of Decreasing Rank					
In Situ	Preference	Powel	Wentworth	Almodington	Bowler	Hart	Newington
In Situ	Complexity	Powel	Wentworth	Almodington	Bowler	Hart	Newington
Simula- tion	Preference	Almodington	Powel	Wentworth	Bowler	Hart	Newington
Simula- tion	Complexity	Powel	Wentworth	Almodington	Bowler	Newington	Hart

Fig. 4. Preference and complexity rank orderings compared

comparable to previous analyses of complexity, the floorplans group was not included in these calculations.

The Spearman rank order correlations were for the most part positive and low to moderate. For the in situ viewing condition, the median correlation was positive and moderate with a fairly wide interquartile range (Mdn. = +.460, IQR = .617). For the simulation viewing condition, the median correlation was also positive; but low with an even wider interquartile range than the above (Mdn. = +.300, IQR = .800). Though these correlations are modest they may suggest a closer relationship between these two dimensions than their values attest. They are attenuated somewhat by the inherent stability limits of individual semantic differential items which DiVesta and Dick (1966) have shown to have stability coefficients ranging from .73 to .94 for immediate test-retest conditions. More importantly, however, is the differences in the format of the preference and complexity evaluations. The preference judgments were made on a comparative, ranking basis; the complexity ratings were made on each room considered in a more or less isolated fashion.

Complexity and Recognizability

The possible relationship between these two aspects was explored in essentially the same way in which the preference-complexity relation was analyzed. The rooms were ranked on an overall group basis for both recognizability

and complexity. The number of recognitions of each room was pooled for all 60 subjects as the basis for the recognition rankings. For the complexity rankings, only the ratings from the semantic differential scale item, complexity-simplicity, were used. The resulting rank orders, one for recognizability, and two for complexity, were then correlated by means of the Spearman procedure. The correlation between room recognizability and judged complexity in the simulation condition was positive, low ($r_s = +.371$, $p > .50$, $N = 6$), and non-significant. For the in situ condition the correlation was higher ($r_s = +.600$, $p > .20$, $N = 6$); but also non-significant. This possible relationship was further analyzed on the basis of individual subject's scores. The complexity rating of each room was correlated with its recognition score for each subject and across all 60 subjects. This was done for both simulation and in situ viewing conditions, proving negligible and insignificant for both conditions. The point-biserial correlations were as follows: for the simulation condition, $r_{pb} = +.006$; and for the in situ condition, $r_{pb} = +.090$. Quite clearly, there was no relationship whatever between the judged complexity of a room and its recognizability.

In summation then, room complexity was found to be highly positively correlated with room preferability; but not with recognizability. Moreover, the recognizability of a room was also not correlated with its preferability.

CHAPTER V

ENVIRONMENTAL DESCRIPTION SCALE FINDINGS

This last results chapter deals with the use of the Environmental Description Scale for discriminating the rooms from one another and with the factor structures derived from factor analysis of the EDS data for each room. In general, the obtained factor structures for the six interiors were similar; an expected result since the rooms were selected to be similar in function, historical period, gross size, etc. Moreover, the factor structures were very consistent with those obtained by Kasmar in her original study of university rooms in which she used the slightly longer, complete version of the Environmental Description Scale (Vielhauer [Kasmar], 1965). Finally, an ancillary study using a different sample of 53 subjects evaluated the concept "living room" using the EDS. Factor analysis of these ratings also yielded a factor structure sharing much in common with those made in response to the actual living room environments. This miniature study resembled, somewhat, the comprehensive investigation by Lowenthal and Riel (1972), mentioned earlier.

Differentiating the Rooms

In order to compare the present results with those obtained by Kasmar (1970) only the in situ ratings of the

six interior environments on the EDS were utilized. Kasmar had found it possible to distinguish between three actual, and quite different, environments on the basis of their EDS ratings. She had used the reserve reading room in a university library, a dining room in a student union, and a large lecture hall as the environments to be discriminated by means of the EDS ratings. The present study, by using relatively similar interior environments, was expected to provide a much more difficult discrimination task for the subjects and one which would test the limits of the EDS scale as a device for differentiating between environments.

In order to ascertain whether the rooms were descriptively different from one another, the ratings were averaged for each of the 56 descriptive scales across all of the experimental subjects. These average ratings were then subjected to an analysis of variance for repeated measures. Once again, the EDS proved useful for distinguishing environments from one another ($F = 68$, $p < .001$, $df = 5,275$). The 15 possible discriminative differences between the 6 rooms taken as pairs were compared by means of the Duncan Multiple-Range Test. Of these 11 were significant (all differences $p < .05$, $df = 5,275$); the other 4 did not reach significance. This, of course, far exceeds the number of significant differences to be expected on a purely chance basis. The EDS, then, seems to be sensitive enough for differentiating between environments that are quite similar as well as those grossly different from one another. Kasmar's expectations

in this direction have been corroborated. Table 16 summarizes the analysis of variance and the multiple-range test results that support this conclusion.

TABLE 16

DIFFERENTIAL RATINGS OF ROOMS ON THE EDS, ANOVA
SUMMARY AND PAIRWISE COMPARISONS OF MEANS

A. Source of Variance	<u>df</u>	<u>ss</u>	<u>ms</u>	<u>F</u>	<u>p</u>
Rooms	5	43.406	8.681	68.789	.001
Variables	55	245.323	4.460	35.344	.001
Error	275	34.702	0.126	--	--
Total	335	323.431	--	--	--

B. Source of Difference ^a	difference	<u>p</u>
Almodington vs. Bowler	0.483	.005
Almodington vs. Hart	0.539	.001
Almodington vs. Newington	0.159	Non-sign.
Almodington vs. Powel	0.982	.001
Almodington vs. Wentworth	0.054	Non-sign.
Bowler vs. Hart	0.056	Non-sign.
Bowler vs. Newington	0.324	.05
Bowler vs. Powel	0.499	.005
Bowler vs. Wentworth	0.537	.001
Hart vs. Newington	0.380	.05
Hart vs. Powel	0.443	.005
Hart vs. Wentworth	0.593	.001
Newington vs. Powel	0.823	.001
Newington vs. Wentworth	0.213	Non-sign.
Powel vs. Wentworth	1.036	.001

^aThe Duncan Multiple-Range Test was used for these comparisons.

Factor Structures of the Rooms

The EDS ratings for each room were separately factor analyzed in order to determine what these descriptive differences between rooms might be and to see if the factor

structures obtained by Kasmar in her original study would again appear. Pearson product moment correlation coefficients were calculated to provide the initial intercorrelations among the 56 variables for each of the interiors. These correlations were based on a sample size of 60, which is about minimal size for this number of variables (Nunnally, 1970). The intercorrelation matrices were then subjected to principle components analysis and the resulting components that had eigenvalues of unity or higher were retained and rotated to orthogonal, simple structure solutions by means of the Varimax method. The actual factor loadings for each room are included as Appendix D. The computer program used for this purpose was the SPSS:PA-2, Principal Factoring with Iteration, a widely accepted factor analysis program currently in use in the social and behavioral sciences (Nie, Bent & Hull, 1970).

The resulting factor structures for the rooms were generally similar to one another, and to the structures obtained by Kasmar. There were many differences, however: in the number of factors contributing substantially to the shared common variance, in the amount of variance these factors accounted for, and in the patterning of the factor loadings. An attempt has been made to summarize these similarities and differences in Table 17. The table has been organized around the factors suggested by Kasmar because the factor patterns and loadings obtained in this study were very similar to her findings (see Vielhauer [Kasmar], 1965,

TABLE 17

FACTOR STRUCTURES FOR THE SIX ACTUAL ROOM ENVIRONMENTS

	Almudington	Bowler	Hart	Hewington	Powell	Ventworth
Aesthetic Appeal	I Coloring (12.14)	I Coloring (12.74)	I Coloring (10.11)	I Appealing-Coloring (13.34)	I Coloring (13.74)	I Coloring (11.34)
	Cheerful ^a .92	Colorful .83	Colorful .84	Attractive .90	Colorful .82	Good lighting .83
	Bright colors .91	Bright colors .82	Bright .82	Appealing .88	Bright Colors .79	Bright colors .80
	Bright .88	Cheerful .79	Gay .79	Beautiful .82	Bright .78	Colorful .79
	Gay .80	Gay .78	Stylish .74	Elegant .74	Cheerful .75	Bright .75
	Good lighting .82	Bright .74	Light .74	Cheerful .75	Good colors .74	Gay .74
	Colorful .79	Light .72	Bright colors .71	Tasteful .74	Gay .70	Cheerful .72
	Light .77	Sparkling .70	Cheerful .69	Pleasant .72	Sparkling .70	Good colors .70
	Flashy colors .73	Good lighting .64	Good colors .68	Bright .70	Flashy color .63	Flashy color .66
	Sparkling .63	Flashy colors .64	Good lighting .63	Inviting .69	Efficient .53	Sparkling .62
	Tasteful .56	Good colors .53	Sparkling .57	Stylish .67	Elegant .51	Elegant .51
	Good lines .54	II	Elegant .57	Colorful .67	IV	Diffuse lighting .53
	Beautiful .54	Appealing (14.01)	Tasteful .52	Sparkling .64	Style (5.71)	Appealing (15.71)
	Elegant .54	Appealing .83	Ornate .52	Gay .63	Stylish .67	Appealing .85
	Pleasant .51	Beautiful .82	Flashy colors .51	Comfortable .61	Ornate .61	Attractive .81
Physical Organization	VIII Expensiveness (2.74)	Attractive .81	II	Good colors .60	Expensive .59	Comfortable .58
	Expensiveness .66	Tasteful .73	Appealing (2.14)	Adequate size .58	VIII Appealing (3.14)	Stylish .58
	Distinctiveness .64	Pleasant .65	Inviting .82	Efficient .55	Style (13.14)	Stylish .58
	X Appealing (2.14)	Expensive .51	Pleasant .81	Well planned .54	Beautiful .79	Style (1.14)
	Attractiveness .67	Convenient .51	Comfortable .74	Convenient .52	Attractive .73	Stylish .39
	Appealing .63	VII Complexity (3.34)	Attractive .63	V Complexity (4.51)	Appealing .71	Tasteful .37
	Beautiful .53	Complex .72	Convenient .58	Contemporary .62		
	Stylish .52	Distinctive .55	Tasteful .56	Distinctive .50		
		Ornate .54	Beautiful .55			
			Good lighting .54			
Size	II Organization (10.94)	III Cleanliness (7.74)	V Organization (3.94)	III Cleanliness (7.54)	V Cleanliness (4.44)	II Organization (10.84)
	Well planned .88	Clean .80	Well planned .82	Clean .82	Neat .74	Well planned .87
	Well organized .86	Tidy .78	Well organized .81	Neat .75	Organized .76	Well scaled .79
	Well scaled .78	Neat .69	Organized .53	Tidy .71	Well balanced .67	Well balanced .78
	Comfortable .69	Well kept .69	Well scaled .53	Orderly .60	Well scaled .60	Well organized .75
	Convenient .68	VI Organization (4.24)	XII Cleanliness (1.94)	Diffuse light .52	Pleasant .58	V Cleanliness (4.54)
	Well balanced .66	Well organized .77	Neat .72	IV Organization (4.74)	Functional .57	Neat .75
	Organized .56	Organized .76	Clean .64	Well balanced .71	Well-kept .57	Clean .74
	IV Cleanliness (5.84)	Well planned .71	Well-kept .56	Well scaled .63	Orderly .54	Tidy .72
	Neat .82	Well balanced .71	Expensive .56	Well planned .62	Good lines .51	Well-kept .60
	Clean .78	Well scaled .65	Tidy .54	Convenient .62		
	Tidy .72	Orderly .60		Functional .61		
	Well-kept .63			Well organized .57		
				Efficient .53		
				Useful .53		
Lighting	III Phenomenological Size (4.34)	V Phenomenological Size (4.34)	IV Phenomenological Size (4.04)	II Phenomenological Size (3.64)	II Phenomenological Size (4.34)	III Phenomenological Size (4.34)
	Uncluttered .87	Uncluttered .80	Uncluttered .78	Uncluttered .82	Uncluttered .79	Uncluttered .88
	Uncrowded .83	New .75	Uncrowded .76	Uncrowded .78	Uncrowded .74	Uncrowded .75
	Orderly .82	Uncrowded .70	Empty .59	Ruomy .72	Empty .65	Free space .65
	Free space .56	Modern .64	II Physical Size (12.04)	Empty .56	Ruomy .54	Poomy .65
	VI Physical Size (4.34)	Free space .63	Large .85	Organized .53	Well organized .54	Empty .59
	Large .72	IV Physical Size (4.84)	Huge .83	VI Physical Size (3.24)	Well planned .51	IV Physical Size (4.54)
	Huge .67	Wide .75	Loomy .79	Flashy colors .67	III Physical Size (6.74)	Adequate size .67
	Roomy .55	Huge .69	Free space .69	Large .63	Large .77	Wide .64
	Adequate size .52	Large .62	Adequate size .58	Good colors .60	Adequate size .68	XI Physical Size (7.14)
			Wide .55	Good lighting .60	Free space .53	Huge .64
				Wide .57		Large .52
				Gay .56		
				Free space .56		
Age	V Modern (5.04)	III Modern (6.74)	III Modern (6.74)	X Modern (7.54)	VI Contemporary (7.04)	VI Modern (4.04)
	Modern .75	Modern .85	Modern .76	Modern .58	Contemporary .89	Modern .80
	Contemporary .75	New .76	New .76	Modern .55	Modern .77	Contemporary .75
	New .62				New .62	New .72
	XI Diffuse lighting (2.14)	X Soft lighting (2.34)	VII Soft lighting (2.24)	VIII Soft lighting (2.04)	VII Diffuse lighting (3.44)	IX Private (2.14)
	Diffuse lighting .71	Soft lighting .70	Soft lighting .65	Soft lighting .70	Diffuse lighting .62	Soft lighting .67
		Distinctive .58	Distinctive .58	Distinctive .50	Good lighting .58	Soft lighting .50
				Diffuse lighting .45		
Total & Common Variance Accounted for						
31.64 49.34 66.74 70.34 66.54 72.24						

^aOnly the positive polar endpoint of each bi-polarity is included throughout the chart for brevity's sake.

p. 66). These include the following main factors:

- I Aesthetic Appeal (22-38% of common variance)
- II Physical Organization (13-25% of common variance)
- III Size (11-18% of common variance)
- V Lighting (5-14% of common variance)

Factor IV--Temperature-Ventilation--did not appear in the present data since the polar adjectives describing these characteristics had been eliminated from the version of the EDS used in this study. This was done in order to permit the same scale items to be used for evaluating both the actual interiors and the purely visual simulations of them. In addition, another factor emerged in this study which did not appear in Kasmar's--an Age factor which is presumably due to the fact that obviously antique, period rooms were used as the experimental environments.

Between five and six factors were required to account for about 70% of the common variance in the present data as was the case in Kasmar's study; but there is much less consistency in factor structures across the several rooms in this investigation than was obtained in hers. (Kasmar had found the same four factors, in the same sequence of decreasing principal components, for each of the rooms she investigated.) Table 17 displays the composition of the factor structure for each room. The Roman numeral over the factor name indicates its position in the component sequence for that room. As can be seen, all the rooms share a reasonably similar first principal component, but apart from

that, the sequencing of the other components varies considerably from room to room. Only the Almodington and Powel rooms come close to sharing the component sequence Kasmar obtained, i.e., aesthetic appeal, physical organization, size, and lighting, in that order. A brief comment on the factor structure of each room, as displayed in Table 17, will suggest some of the differences that contribute to the discriminability of the rooms from one another.

The Almodington room. This room is somber and quite formal in manner. It is fairly large with a good deal of furniture around the walls and a relatively large open space in the center. The factor structure reflects this, the major evaluative dimensions in order of decreasing importance are: color, organization, phenomenological size (felt spaciousness), cleanliness, age, physical size, and lighting. The first factor, color, was quite global, including many loadings connoting aesthetic aspects.

The Bowler room was evaluated primarily in terms of color, appeal, cleanliness, physical size, phenomenological size, and organization, in that order. This room was more dimly lit than the Almodington and less attractive. Here the first factor is less global and the second factor, appeal, is independent of the first and important for describing the room. Interestingly, the variables loading on age are subsumed here under the phenomenological size factor.

The Hart room was the darkest of all the rooms, the second smallest and had an extremely low ceiling. It was the oldest room with very primitive furniture and furnishings. The factor structure reflected these characteristics, with color, physical size, age, phenomenological size, and organization assuming primary descriptive importance, in that order. Appeal and cleanliness were much less important for describing this room where architectural features were strongly predominant.

The Newington room. This room was the smallest, dreariest, and homeliest of the six interiors. It was the least preferred and least recognizable of the rooms and the only one for which subjects spontaneously expressed dislike. The factor structure reflected this in the global first factor, the broadest first component obtained for any of the rooms. This room was negatively evaluated on almost all counts. The cluttered feeling of the room was reflected in the second, third, and fourth factors; phenomenal size, cleanliness, and organization. The sixth factor, physical size, was a strange admixture of loadings on physical dimensions, color, and lighting, again expressing a global negative reaction to the room.

The Powel room. This was the brightest, most elegant, and cluttered of all the rooms and the one with the highest ceiling. The feeling of congestion was strongly augmented by the small roped-in area within which visitors were confined in the room. The factor structure reflected these

impressions in succession: coloring, phenomenological size, physical size, style, and cleanliness. This was the only room which evidenced a really definite descriptive factor for lighting, accounting for 3.4% of the variance by itself, apart from the global first factor which also connoted brightness. The fourth factor, style, reflected the obvious elegance and luxuriance of the furnishings of this living room from the home of a socially prominent, sophisticated, mercantile millionaire in colonial Philadelphia.

The Wentworth room. The Wentworth was the largest interior and was rated as the most preferred, inviting, attractive, and appealing room. It exhibited the basic configuration of factors that Kasmar attained in her study, but the aesthetic factor was more complex than she found and so was the physical space factor. The latter was split up, curiously, into two sets of loadings; adequate size/wide and huge/large.

Factor Structure of a Conceptual Living Room

In the early stages of this study the author became concerned with the possibility of purely semantic response sets relating to the usefulness of the EDS for the evaluation of environments. It seemed possible that at least some of the consistency in the semantic differential ratings of the experimental rooms might be due to habitual ways of using descriptive words when thinking or communicating about such environments, rather than perceived common aspects of the

actual rooms or the simulational displays. This would seem particularly likely to occur in rating situations like the present, where the rater does not formulate an explicit frame of reference for his judgments by simultaneously comparing a series of environments before rating any of them. The experimenter found these ratings difficult to make and wondered how much his own ratings were being influenced by a priori notions of how such rooms are typically described, for example, "friendly, warm, and inviting" or "formal, elegant, and expensive." Habitual usage of synonym pairs could also inflate common variance, such as: "bright and cheerful, big and roomy, neat and clean, sparkling and gay, dark and gloomy," etc.

In order to determine whether or not semantic response sets might be contributing to the common variance in the EDS factor structures obtained above, the following ancillary study was performed. A class of 53 introductory psychology students rated the concept of "living room" on the EDS, after the scales and their use had been explained to them. They were asked to consider, generally, its functions, dimensions, and other characteristics. They were further requested not to base their ratings on any particular room, either actual or planned, but to concentrate on the typical aspects of living rooms as a category of environments. Obviously, this was not an easy task to perform, and many of the subjects required more than ten minutes to complete their ratings of the conceptual room. This was about as long as the slower

subjects took to evaluate an actual room in the original study.

The data was treated in exactly the same manner as that for the actual rooms and the factor loadings appear in Appendix E. The overall factor structure was again somewhat diffuse involving 15 factors with eigenvalues in excess of unity. Some of these were uninterpretable because the factor loadings were very low and largely uniform across many of the variables. Table 18 displays the factors that are reasonably clear, i.e., ones which have four or more variables loading on a factor at a substantial level (.50 or higher), or at least two substantial loadings that are clearly consistent in meaning. This table is also organized around the factors found by Kasmar, for purposes of comparison.

Factor I--Physical Organization. The subjects tended to describe their concept of living room primarily in terms of its orderliness, that is, neatness and organization. This global factor is almost exactly what Kasmar found for two of the rooms she used, the reserve reading room and the cafeteria. It is also very similar to the cleanliness factor for the Powel room in this study. What is different here, of course, is that for the imaginary room, Physical Organization is the first and predominant factor, accounting for 28% of the common variance. This was not the case for any of the rooms in this or Kasmar's study.

Factor II--Age. This factor is very similar to that found in the present study of room interiors, but once again,

TABLE 18
FACTOR STRUCTURE OF A CONCEPTUAL LIVING ROOM

1. Physical Organization	<u>I Neat & Organized (28.0%)</u>	
	Neat	.87 ^a
	Well-kept	.87
	Well-organized	.84
	Organized	.78
	Orderly	.67
	Tidy	.66
	Well-planned	.64
	Well-balanced	.62
2. Age	<u>II Age (8.0%)</u>	
	Modern	.80
	Contemporary	.79
	Multi-purpose	.64
	Good lines	.50
3. Aesthetic Appeal	<u>III Appeal (6.2%)</u>	
	Tasteful	.65
	Appealing	.62
	Attractive	.57
	Comfortable	.56
	Convenient	.56
	Pleasant	.54
	Beautiful	.52
	<u>IV Coloring (5.5%)</u>	
	Bright colors	.82
	Bright	.78
	Gay	.72
	Cheerful	.58
	Free space	.50
	<u>V Complexity (4.6%)</u>	
	Ornate	.86
	Stylish	.62
	Complex	.61
	New	.53
4. Lighting	<u>VIII Lighting (3.1%)</u>	
	Good lighting	.82
	Light	.66
5. Size	<u>XII Physical size (2.3%)</u>	
	Wide	.67
	Huge	.62
	<u>XIII Phenomenological Size (2.2%)</u>	
	Uncrowded	.77
	Uncluttered	.57
Total % of common variances accounted for		59.9%

^aOnly the positive endpoint of each bi-polarity is included for brevity's sake.

it is more salient in the description of the conceptual living room, accounting for 8% of the variance, compared to an average of 3 or 4% for the above mentioned rooms.

Factors III, IV and V--Aesthetic Appeal. For the imaginary room Kasmar's first factor is divided here into three separate sub-factors which are much less salient than the first factors were for any of the rooms in Kasmar's study or in the present investigation. Altogether, they account for about 20% of the common variance as opposed to 30-40% accounted for by the Appeal dimension in those analyses.

Factors XII and XIII--Size. For the conceptual room these components: Physical Size and Phenomenological Size, respectively, were poorly represented and together account for only 4.5% of the common variance. For five of the six rooms investigated here, and for Kasmar's rooms, size factors accounted for between 8% and 17% of the common variance.

Factor VIII--Lighting. The only other interpretable factor for the imaginary room was Lighting. It too was poorly defined, only two factor loadings, and accounted for a mere 3.1% of the variance. It was in all respects similar to the Lighting factor obtained for the six experimental interiors. Kasmar found this factor to be salient for only one of her three rooms, the auditorium.

A comparison of Tables 17 and 18 suggests, to some extent, the contribution that semantic aspects are making to the factor structures obtained for the actual rooms in this

investigation. The choice of items for the EDS, shared linguistic habits, and common conceptions among subjects as to what a particular environment should encompass, are probably responsible, in part, for similarities in the obtained factor structures in both the imaginary interior and in the six, actual, period living rooms. The present comparison does not permit a quantitative estimation of this contribution, but these observations should be kept in mind:

1. The same eight or so factors that accounted for about 70% of the common variance in the actual living rooms accounted for 60% of the variance of the conceptual room.

2. The factors for the conceptual room were defined by considerably fewer high factor loadings than were those for the actual rooms, indicating that the evaluative dimensions used for its description are not as global or rich in connotative content as those used to describe the actual environments.

3. The sequencing of the principal factors for the conceptual room was importantly different than that for any of the rooms used in the present study or reported by Kasmar, that is, considerations of orderliness and modernity are predominant for the description of the conceptual room whereas, aesthetic considerations are most salient for the description of the actual rooms.

CHAPTER VI

DISCUSSION

The Simulations

In general, the hierarchy of relative effectiveness of the several simulation methods for facilitating accurate judgments about architectural interiors was reasonably close to the expected order, with some reversals. As mentioned earlier, slides were best and movies second best for the recognition, preference, and environmental description ratings. Drawings were the least adequate simulation for all of these judgments. The color photos and floorplans ranged between these endpoints of effectiveness; floorplans facilitating recognition better than the photos, and the latter being more useful for accurate preference and descriptive judgments than the floorplans.

These results are in remarkably good agreement with findings by Acking and Küller in the only reasonably comparable study to date. These investigators found that color movies and color slides, taken at eye-level in naturalistic models of housing areas, were better than perspective drawings and illustrational plans for making accurate semantic differential type descriptive ratings (Acking & Küller, 1973).

As far as the present study is concerned, the differences in effectiveness between the slide and movie simulations were insignificant in all instances and so the inconsistency of present findings with Acking's and Küller's is more apparent than real. Moreover, the quality of the movie simulation was inferior to that of the slides in the present study, making comparison between these two methods essentially unfair. While the slides, photos, drawings, and floorplans could be considered to be of professional quality, the movies were somewhat less adequate. They were marred by uneven lighting, inadequate breadth of visual field, and the relatively low image brightness of super-eight movie film. Cost and time limitations prevented the use of professional quality, 16 mm movie equipment. More adequate production of the movies than was possible here is necessary for a definitive test of their simulational effectiveness.

The poor showing of the perspective drawings in both the Acking and Küller study and in the present investigation is especially noteworthy because of the very heavy use of this simulation mode in the design professions. The drawings used in the present study were limited to two or three wall representations, similar to those employed in relevant previous studies (Canter, 1969; Wools, 1970) and typical of contemporary interior design practice. Interestingly, the two wall representations (Hart and Bowler rooms) did not seem to be less effective for the recognition judgment than those depicting three walls (see Table 9). Nonetheless,

the drawings, as such, obviously excluded a considerable amount of the information subjects probably needed to make accurate recognition, preference, and evaluative judgments about the rooms. A fairer test than the present one is required to adequately assess the usefulness of drawings as simulations. Such a test would involve the full representation of the architectural environment, in separate drawings as needed, whether or not this typifies design practice or the research literature.

The photos were surprisingly poor for facilitating recognition responses although they were third best for the preference and evaluative judgments, as had been expected. This is difficult to explain since they were made directly from the slides, the most effective simulation, with a very similar breadth of visual field and very comparable color rendition. Moreover, they were presented simultaneously to the subject for inspection in whatever way he desired rather than appearing in a fixed sequence as did the slides. The photos were expected to be nearly as good as the slides; lacking perhaps the slide simulation's advantages of large scale, brightness, and less obtrusive surround. They were, however, significantly inferior to the floorplan simulations and not significantly better than the drawings for the recognition responses. It may be that they and the drawings appeared more pictorial than the slide and movie simulations and did not communicate the illusion of an actual three dimensional environment as well as the projected modalities

did. It is also possible that some of the subjects did not organize coherent impressions of the environments because the sequence in which they inspected the views of each room was uncontrolled. By switching back and forth among the four corner views of each individual room, in an inconsistent manner, some subjects may have simply confused rather than coordinated their impressions of the environments.

This, however, would not explain the superiority of the minimally illustrated floorplans over the photos. The floorplans, it must be remembered, were accompanied by detailed verbal descriptions of the rooms. Unfortunately, it is not clear from this study just how the verbal descriptions of the rooms facilitated their recognition when viewed in situ; that is, whether the ambience and basic characteristics of the room were verbally communicated and remembered or if an accurate image of the room was evoked by its description and then recognized when seen in actuality. It does seem likely however, that the subjects were aided in their recognition of some of the rooms by remembering verbal descriptions of relatively unique items of furniture and decor in them rather than their architectural features or ambience. It is also likely that college students would be particularly attuned to verbal material and disposed toward remembering it.

Complexity

The present study found a strong, positive relationship between the preference for and the judged visual complexity of interior environments. This agrees basically with findings for exterior environments of a primarily natural or man-made character (Kaplan, R., 1973; Kaplan, S., Kaplan, R. & Wendt, 1972; Wohlwill, 1968). Wohlwill reported a curvilinear function relating preference and judged visual complexity wherein environments of an optimal level of visual complexity were judged as preferred to those tending toward either relative simplicity or excessive complexity. The present study did not find the latter part of the inverted u-shaped function, i.e., the decline in preferability with increasing complexity. Unlike Wohlwill's procedure which utilized a comprehensive series of depicted environments, selected to range from the extremely simple to the extremely complex; the present study was limited to actual, intact environments, that did not represent the possible range of the dimension, simplicity/complexity, with respect to room environments. For the in situ viewing condition, preference and judged visual complexity were perfectly positively correlated (+1.000). For the simulation viewing condition the correlation was also positive; but much more modest (+.771) and short of the significance level required. There was an indication in the simulation viewing condition that the relationship might be somewhat curvilinear (see Figure 4), but the use of rankings for the preference

judgments and the small number of possible ranks (six) argue against any attempt to estimate any such trend with curve fitting procedures. Although it runs counter to the original intent of the present study to keep the experimental procedures at the simplest, common sense level, it would probably have been better to measure preference with an interval rating procedure to permit parametric operations on the data.

CHAPTER VII

CONCLUSIONS AND IMPLICATIONS

Summary

The most important conclusions to be derived from the present study pertain to the relative usefulness of the simulation methods for communicating to laymen about room interiors. Projected photographic representations appear to be the most effective methods and probably deserve even wider use in architectural design practice than they currently enjoy. Perspective drawings and enlarged photos, however, which are typically employed to represent room interiors, are surprisingly inadequate as simulations for the client-user who usually lacks the training to interpret them accurately. Floorplans with verbal descriptions of room interiors are also useful, though less adequate than the projected photographic images. The findings concerning the drawings and the photos confirmed, in part, a suggestion mentioned to the author by several architects, i.e., that designers probably communicate most effectively with other design professionals by using lots of drawings and photos but for the layman as client, words are probably best.

The preferability of a room interior was found to be positively related to its judged visual complexity. This

represents another instance of the widely observed relationship between stimulus complexity and preference. In examining the relationship between complexity and preference, the present study utilized a type of magnitude estimation scaling. This technique permits finer and more consistent judgments of room complexity than does the semantic differential method. The method is easily explained to subjects and produces data amenable to parametric statistical analysis. It deserves wider application in environmental research.

A number of other methodological considerations also merit concluding comments. The advisability of a multivariate approach to environmental research has been borne out in the present study. Environments are complex and their investigation should remain related to this situational complexity. Our responses to environments are also manifold. The utilization of several different response measures produces a fuller picture of the man-environment interaction. It also permits the cross-validation of the response measures themselves.

There are serious problems involved in the utilization of the semantic differential for the investigation of environments. Some of these result from the response biases, semantic sets and linkages, and measuring problems that beset the technique itself. Others stem from the likelihood that the most important responses humans make to environments may not be primarily verbal, and therefore, not schematizable within a framework of semantic space.

Similarly, the wholesale use of factor analysis in conjunction with semantic scales may not be the best way to sketch out the dimensions of environmental cognition. The underlying factors arrived at through factor analysis are largely determined by the numbers of similar and synonymous scale items employed, the generality of the descriptors, the number of subjects surveyed, and the methods used in factoring the data and rotating to the simplest solution. Instead of hoping for some blindly empirical Deus ex machina from the factor analysis of semantic scales, investigators might proceed more profitably by inferring the likely cognitive dimensions of space on the basis of a theoretical model of the man-environment transaction. These inferences could then be tested and the model and the proposed cognitive framework revised accordingly. Ittelson (1973) has initiated just such a process.

Superiority of Projected Images

Both the present study and the work done by Acking and Küller (1973) indicate that projected photographic imagery may be superior to other illustrational modes currently employed in the design professions, at least, when only one type of simulation is used to communicate with laymen about an architectural environment. This finding requires further corroboration, but it is noteworthy that two independently conceived studies, using different environments and different response measures, converge to

essentially similar conclusions. In both studies the differences between cinematic and projected still photography were more or less negligible, but both methods were significantly superior to the more traditional techniques used to communicate design concepts to clients; viz., photographic enlargements, perspective drawings, and schematized plans.

The application of this finding to design practice involves an obvious dilemma, the impossibility of photographing a designed environment before it is constructed. The answer to this problem can only be hinted at presently, but several suggestions come to mind. Slides or movies made from eye-level in scale models (Acking & Küller, 1973; Cunningham et al., 1973; Pyron, 1971, 1972) have been quite successful. Slides could be made from detailed drawings, to which they may very well be superior because of the greater verisimilitude and the better illusion of depth that projected images seem to provide. Designers frequently use photographs of existing buildings to illustrate similar or contrasting concepts for a planned environment. In the light of the present evidence this practice may be more useful than one would have expected, provided that the images are projected in logical sequences, rather than presented in groups of enlarged photos. The uselessness of the latter for facilitating recognition of the rooms in the present study was quite surprising. Apparently, the smaller image size of the color enlargement compared to the projected

slide, the salience of its surround, and its picture character, seriously limit the verisimilitude of this technique. Perspective drawings also share these limitations in addition to providing less information than photographs do about surface textures and light values.

Measuring Responses to Environments

The present study attempted to use methods of response measurement derived from common sense notions and from relevant previous research. There were a number of problems, however, some of which could have been easily resolved, at least, in retrospect. It would have been better to measure room preferences, for example, with a procedure yielding interval or ratio data than with the rank ordering method. This would have permitted the use of more sensitive and powerful parametric statistical tests, regression methods, and curve fitting procedures, all unemployable with the ordinal data that ranking produces.

There was remarkably good agreement between interval and ratio scale data with respect to room complexity in the present study and with openness/closedness in Gärling's study (1971a). The magnitude estimation method which yielded the ratio data seemed superior, however, to the semantic differential procedure that produced the interval data in the present instance in so far as inter-subjective agreement was concerned. This was probably due to the fact that the magnitude estimation method involved the

simultaneous comparison of all the rooms on the complexity dimension rather than the relatively isolated evaluation of each room when rated on the semantic scales. Magnitude estimation also permits enormously finer, discriminative ratings than does the semantic differential scaling procedure. These two characteristics could have contributed to the greater consistency in the magnitude estimation data, compared to the semantic differential data. In view of its impressive utilization in recent psychophysical research and its ready adaptation to non-verbal response styles (e.g., marking a point on a line, or adjusting a lever or pointer on a dial), magnitude estimation deserves more attention from environmental researchers.

Problems with Factor Analysis

The current availability of computers and "canned" multi-variate statistical programs has made the use of semantic differential scales and their factor analysis very tempting to investigators in the environmental disciplines. Perusal of the literature leaves one with an uneasy feeling that these two very complicated and somewhat mysterious techniques are frequently used without much insight as to their appropriateness, mechanics, limitations, and controversial aspects. It doesn't make much sense to the present investigator to take one's basic soundings in uncharted waters with somewhat quixotic and inscrutable instruments. What effects do the verbal response tendencies and semantic

sets, mentioned earlier, have on the usefulness of semantic scales for describing environments or differentiating between them? Other kinds of response sets pertain to tendencies to check extreme values for the scale items or to choose the midpoint of indifference or meaninglessness. How do these tendencies affect the reliability of the semantic differential procedure? Subjects often report that an item is irrelevant to a particular environment; but there is no way to indicate this so they must check the mid-point, spuriously indicating that their evaluation of the environment is moderate with respect to that dimension, when this might not be the case. Kasmar suggests including an "inappropriate" category in each semantic scale as a rating opinion (Vielhauer [Kasmar], 1965), but how is such a response to be scored? If items so checked are excluded from the analysis, how is a correlation matrix to be generated where each subject provides a different, idiosyncratic set of response variables for intercorrelation?

Other problems pertain to the conduct of the factor analysis itself. Osgood et al. (1957) prefer "D" factoring to the more typical manipulation of a correlation matrix. They feel that the so-called "distance" measure (the square root of the sum of the squared differences between ratings on each scale) represents a better measure than correlation of the relationship between the ratings given by different individuals, or the same individual at different times, etc. Hardly any of the environmental studies, to date, have used

"D" factoring though they too are ostensibly looking for the connotative dimensions of a cognitive meaning space. It is not clear whether or not these two different ways of preparing the basic data matrix for factoring lead to essentially similar results.

Furthermore, there is very little recognition of two important facts: (1) that evaluative scales are much more reliable than those pertaining to potency and activity (Norman, 1959); and (2) that the number of items pertaining to a dimension importantly determine the amount of variance the obtained factor accounts for in the final set of principal components. Consequently, semantic differential scales that are heavily interlarded with general, non-discriminating, evaluative items are likely to produce very similar factor structures for environments (or their simulations) which, in reality, may very well evoke quite different cognitive responses. This is probably the major drawback of the longer environmental scales referred to in this study. A shorter more refined scale, such as Kasmar's final version of the EDS, would eliminate this problem, but may not be broadly applicable. It seems likely, as she suggests, that different scales will have to be generated for different kinds of environments. The use of short, specifically designed scales of perhaps 7 to 15 items, would present problems with respect to unreliability in many applications. It would not be problematic, however, in procedures such as factor analysis where the original data is usually summed or averaged across

many individuals before being subjected to statistical analysis (Heise, 1969).

Finally, some mention must be made of an unfortunate shortcoming of the present study; i.e., the impossibility of comparing the factor structures obtained for the different rooms across the several methods of simulation. This was due entirely to the small number of subjects in each simulation group (12) and the relatively large number of items in the EDS (56). It is considered inadvisable to subject data to factor analysis unless the number of subjects is at least equal to the number of variables (Nunnally, 1970). This prescription was tested, nonetheless, by choosing one of the rooms at random, the Bowler room, and factor analyzing its EDS ratings for each experimental group in both the in situ and simulation viewing conditions. This produced ten factor matrices in all, each and every one proving to be uninterpretable. Only a handful of loadings in each matrix were at all substantial (.40 to .65). The vast majority of loadings were very low (.00 to .20). Rarely did one factor have even as few as three substantial loadings and these were typically disparate and difficult to interpret. Obviously, the data from so few subjects does not provide relationship patterns clear enough for factor analytic interpretations. Summing across the six rooms for each experimental group would have increased the sample sizes; but would also have proven to be largely uninterpretable

because of the amalgamation of the characteristics of obviously different environments.

Limitations of the Present Study

The generality of the present findings is somewhat limited. To begin with, the experimental sample is, at best, representative of the York College population enrolled in elementary psychology courses. It is, therefore, not likely to be representative of the broader population for which architects and related professionals must design. College subject populations can be expected to have somewhat higher IQs, more education, and perhaps higher family incomes than that hypothetical reference group, to name only a few of the more obvious potential differences. Research samples should eventually include subjects more representative of the general population if findings are to have more than problematic generality.

It was originally hoped that the present study would include environmental design students as a second subject sample. Unfortunately, this proved to be impractical. However, the need for information concerning the effectiveness of simulations for designers is urgent. Even more important is an understanding of the differences between the lay person's and the design professional's comprehension of environmental simulations.

The range of simulations used was also limited, though broader than almost any other simulation study available to

the experimenter. Time limitations and cost considerations prevented using more simulations and various combinations of those used. Much more research utilizing many more of the simulation modalities listed in Appendix A is necessary before any conclusive position can be taken on the relative effectiveness of the various methods available.

The uncertainty of the relative quality of the simulations used also presents problems for this kind of research and necessarily limits its generality. There seems to be no way of dealing with this limitation directly except to run more studies with additional representative simulations.

A wider range of environments also needs to be investigated. As of this writing, only the interiors of a few Canadian post offices and the exterior siting arrangements of two Swedish housing projects have been studied with different simulation methods in addition to the present sample of reconstructed eighteenth-century American sitting rooms. Different kinds of environments, e.g., exterior versus interior, or small scale as compared to the monumental, may very well require different modes of simulation for maximally effective communication.

Finally, the present study shares a bias with the design practices whose methods it compares, namely, an over-emphasis upon the purely visual, and more or less pictorial, representation of environments. Much more attention should be paid, both in designing and in research, to those aspects

of environments that only become salient when people are functioning within them as part of them.

APPENDIX A

A LISTING OF SIMULATION METHODS FOR
RESEARCH IN SIMULATION METHODS
(AFTER CRAIK, 1970)

Currently Used (or Usable)

1. Large scale experimental environments that are simplifications of ordinary environments (Dalkvist & Gärling, 1971).
2. Three dimensional detailed models that permit the viewer to "move" around at will within them by means of driving simulators or walking treadmills (Acking & Küller, 1973; Appleyard et al., 1973).
3. Conventional, detailed architectural models viewed from above (Lau, 1970).
4. Conventional, simplified, "massing"¹ models viewed from above (Acking & Küller, 1973).
5. Color movies of actual environments (Collins, 1971; Cunningham et al., 1973; and the present study).
Black and white movies of actual environments (Collins, 1971).
6. Color videotapes of actual environments.
Black and white videotapes of actual environments (Bonsteel & Sasanoff, 1967; Cunningham et al., 1973).
7. Color movies of detailed models.
Black and white movies of detailed models.
8. Color videotapes of detailed models (Bonsteel & Sasanoff, 1967).
Black and white videotapes of detailed models (Cunningham et al., 1973).
9. Color movies of massing models (Acking & Küller, 1973).
Black and white movies of massing models (Pyron, 1971, 1972).
10. Cineramic color and black and white movies.
11. Cineramic color slide projection, using sequential views from different points on paths through the architectural space (Winkel & Sasanoff, 1966).
Cineramic black and white slide projection (as above).
12. Cineramic color and black and white slide projection without sequential views.

¹Massing models are simple volumetric shapes without surface details used by designers to represent the overall form and mass of a building.

13. Stereoscopic color and black and white movies.
14. Stereoscopic color and black and white slide projection with sequential views from different points on paths within the architectural space.
15. Stereoscopic color and black and white slide projection without sequential views.
16. Color sequential slide views of detailed models and massing models.
Black and white sequential slide views of environments and detailed and massing models.
17. Color single slide views of actual environments (Acking & Küller, 1973; Flachsbart & Peterson, 1973; Gärling, 1971a; Sörensen & Floderus, 1971).
Black and white single slide views of actual environments.
18. Sequential color slides from eye-level within a detailed model (Acking & Küller, 1973).
Sequential black and white slides from eye-level within a detailed model.
Color and black and white sequential slides of massing models.
19. Single view color slides of detailed scale models (Wools, 1970).
Single view black and white slides of detailed models (Wools, 1970).
20. Color and black and white photographic enlargements, the "glossies" of the design professions (the present study).
21. Detailed perspective drawings rendered in color (the present study).
Detailed perspective drawings in black and white (Gärling, 1971a; 1971b).
22. Simplified perspective drawings in color (Acking & Küller, 1972).
Simplified perspective drawings in black and white (Canter, 1969; Floderus & Sörensen, 1971; Hesselgren, 1971; Wools, 1970).
23. Isometric architectural drawings in color or in black and white.
24. Architectural elevations in color.
Architectural elevations in black and white (Acking & Küller, 1973).

25. Sectional architectural views in color and black and white.
26. Site plans, ground plans and floorplans (the latter used in the present study).
27. Verbal descriptions of environments (the present study).
28. Imaginative and memory based internal representations of buildings or interiors (Appleyard, 1969; the present study).

Under Development

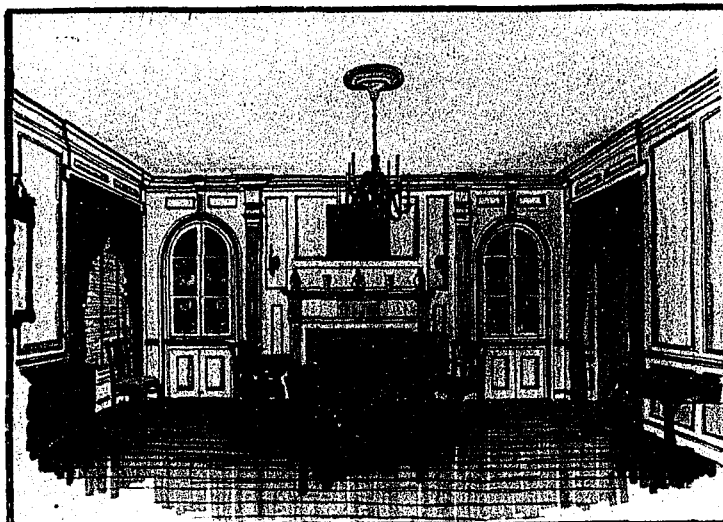
29. Computer generated graphical representations of architectural spaces (Greenberg, 1974).
30. Holographic photographic projection that permits visual movement around objects and within spaces.

APPENDIX B

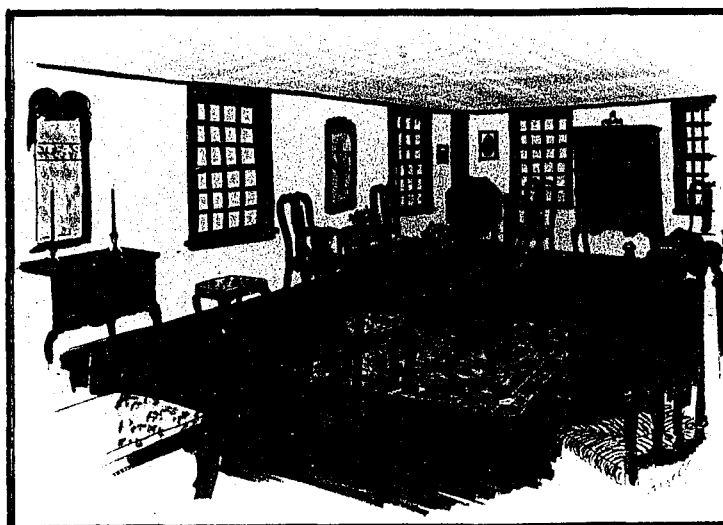
SIMULATION MATERIALS FOR SLIDES, PHOTOS, DRAWINGS AND FLOORPLANS

Note: Movies, of course, could not be represented meaningfully.

Drawings of the Rooms

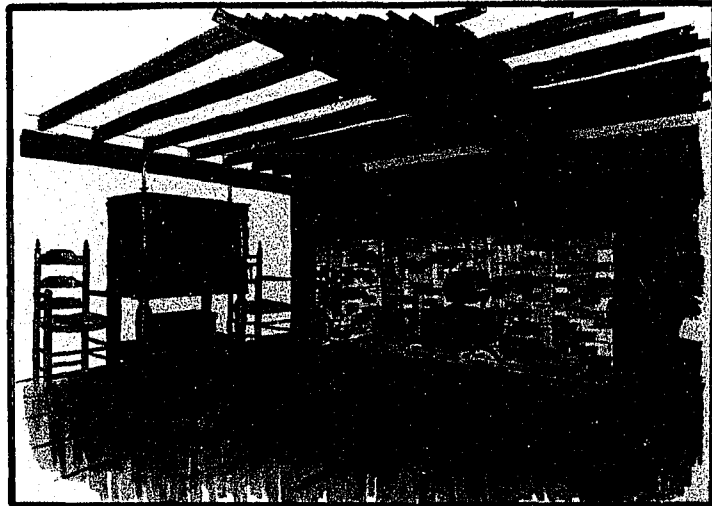


The Almodington Room

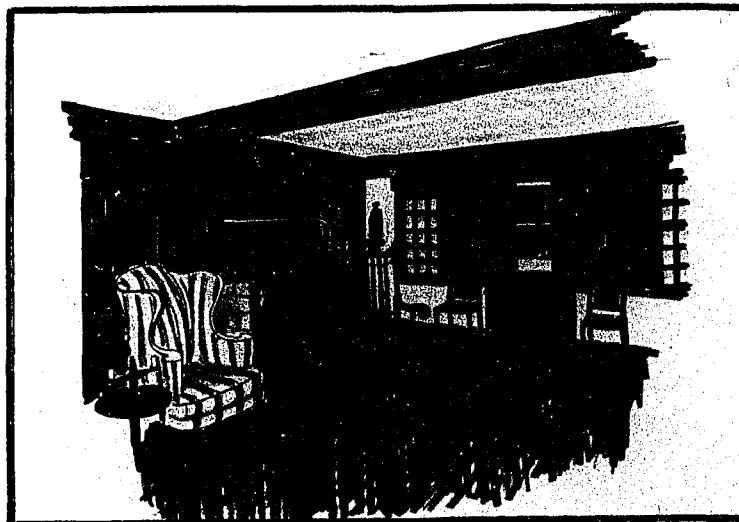


The Bowler Room

Drawings of the Rooms



The Hart Room



The Newington Room

Drawings of the Rooms

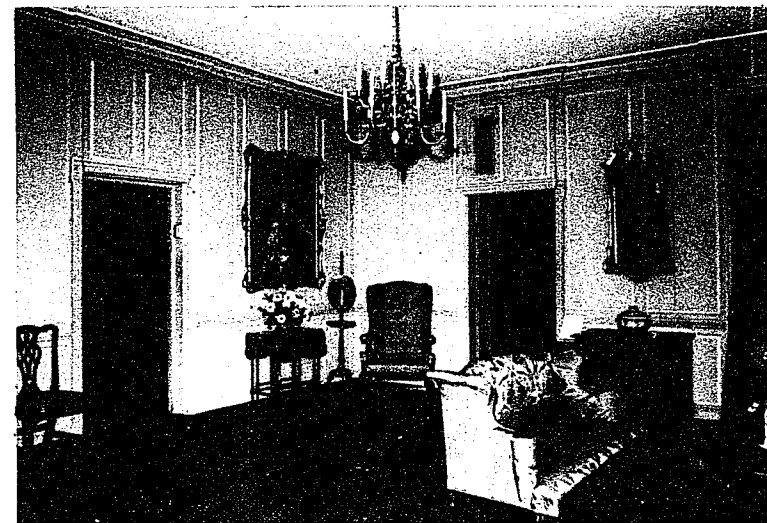
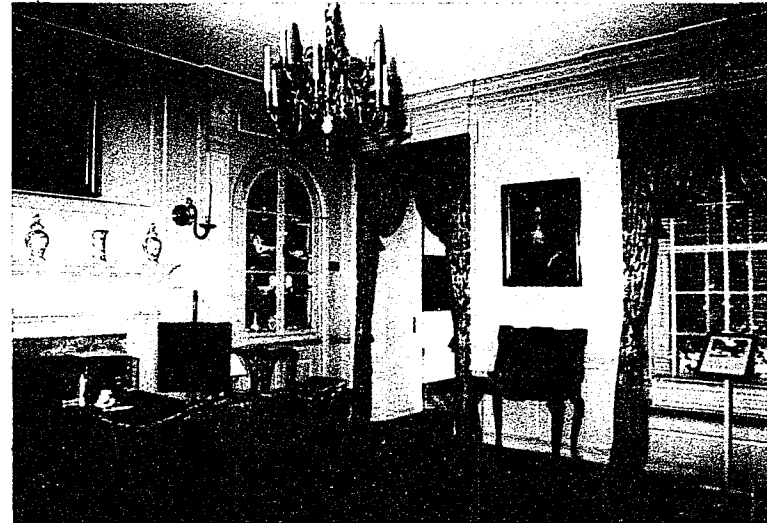
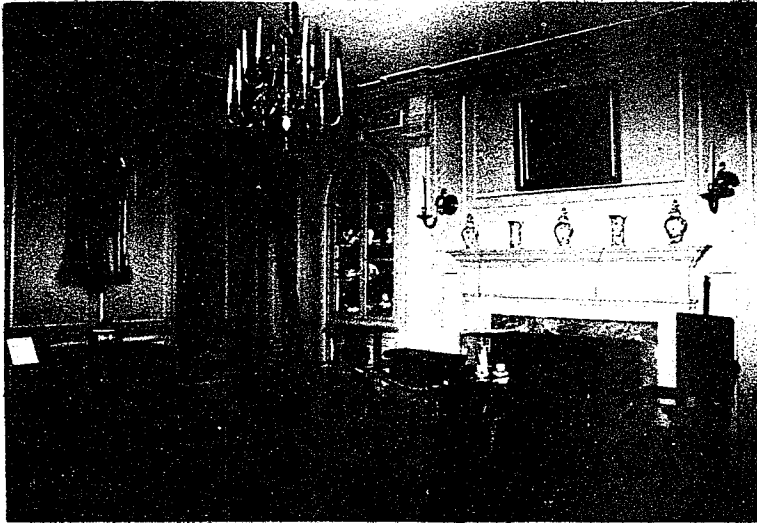


The Powel Room

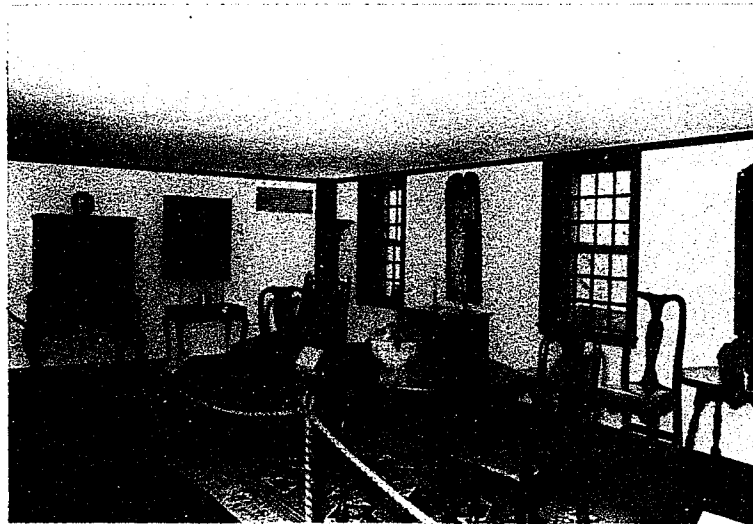
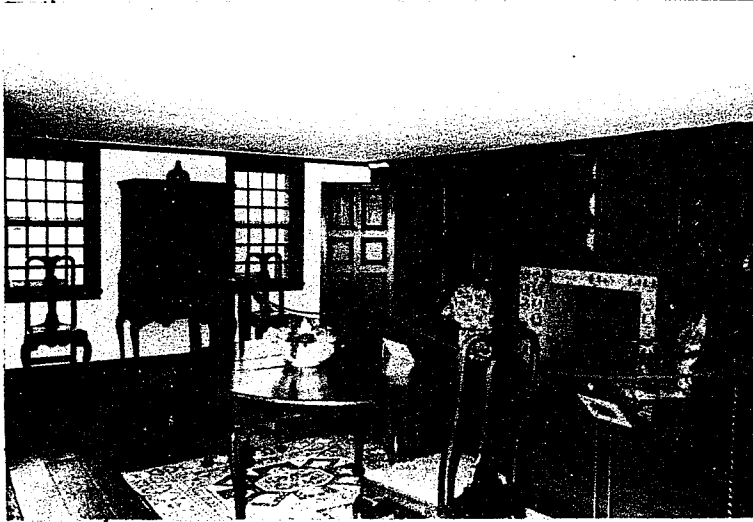


The Wentworth Room

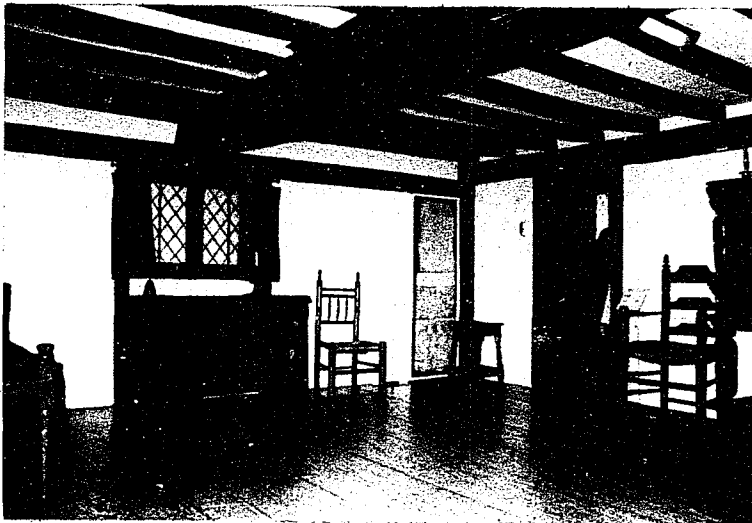
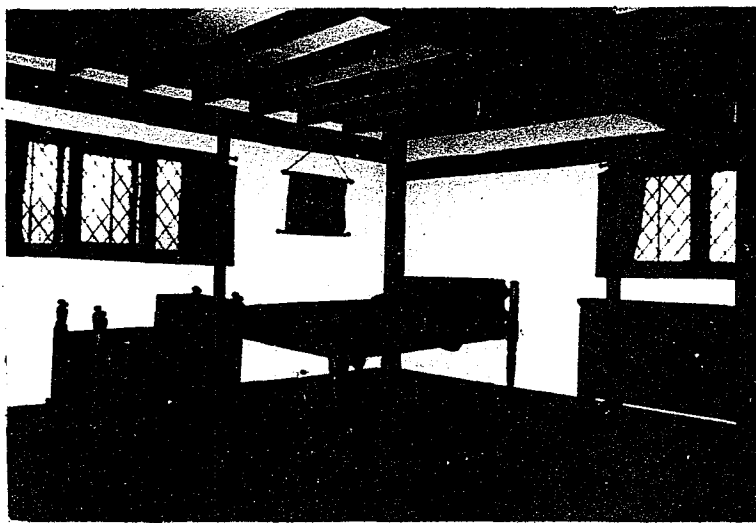
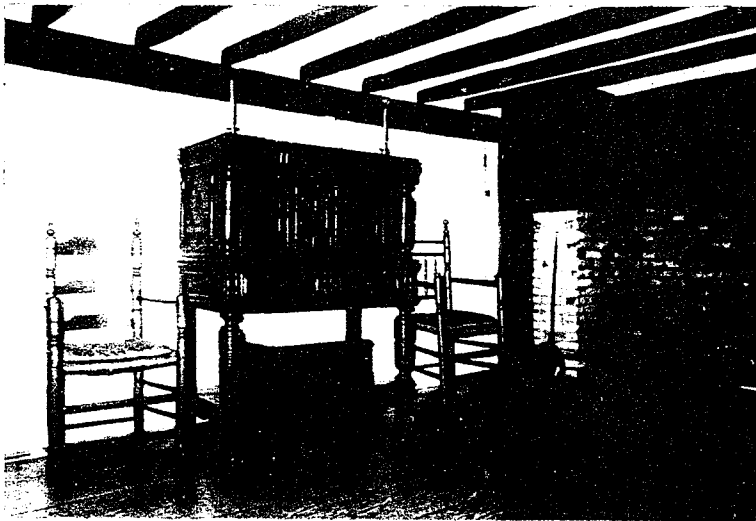
Photos (and Slides) of the Almodington Room



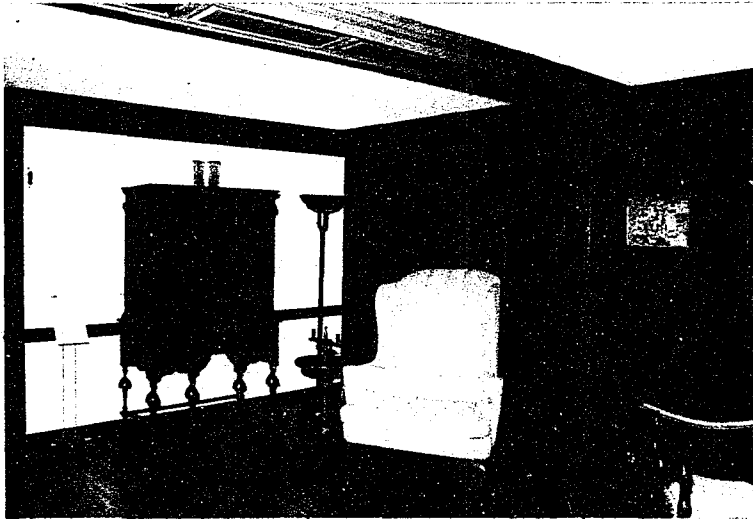
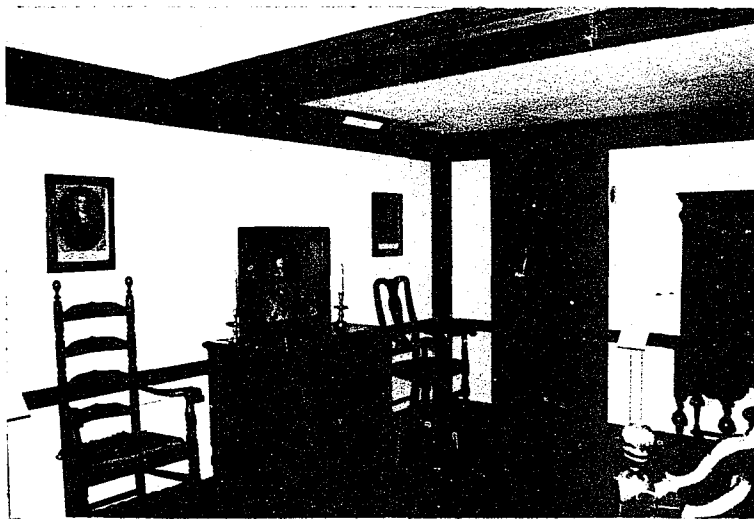
Photos (and Slides) of the Bowler Room



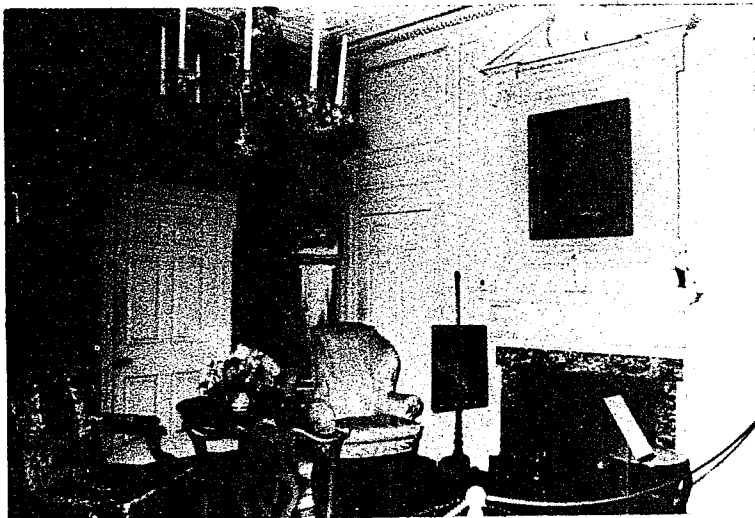
Photos (and Slides) of the Hart Room



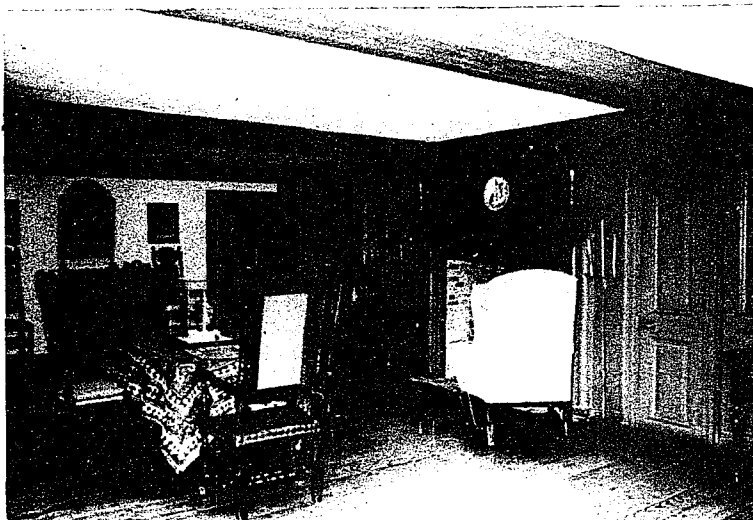
Photos (and Slides) of the Newington Room

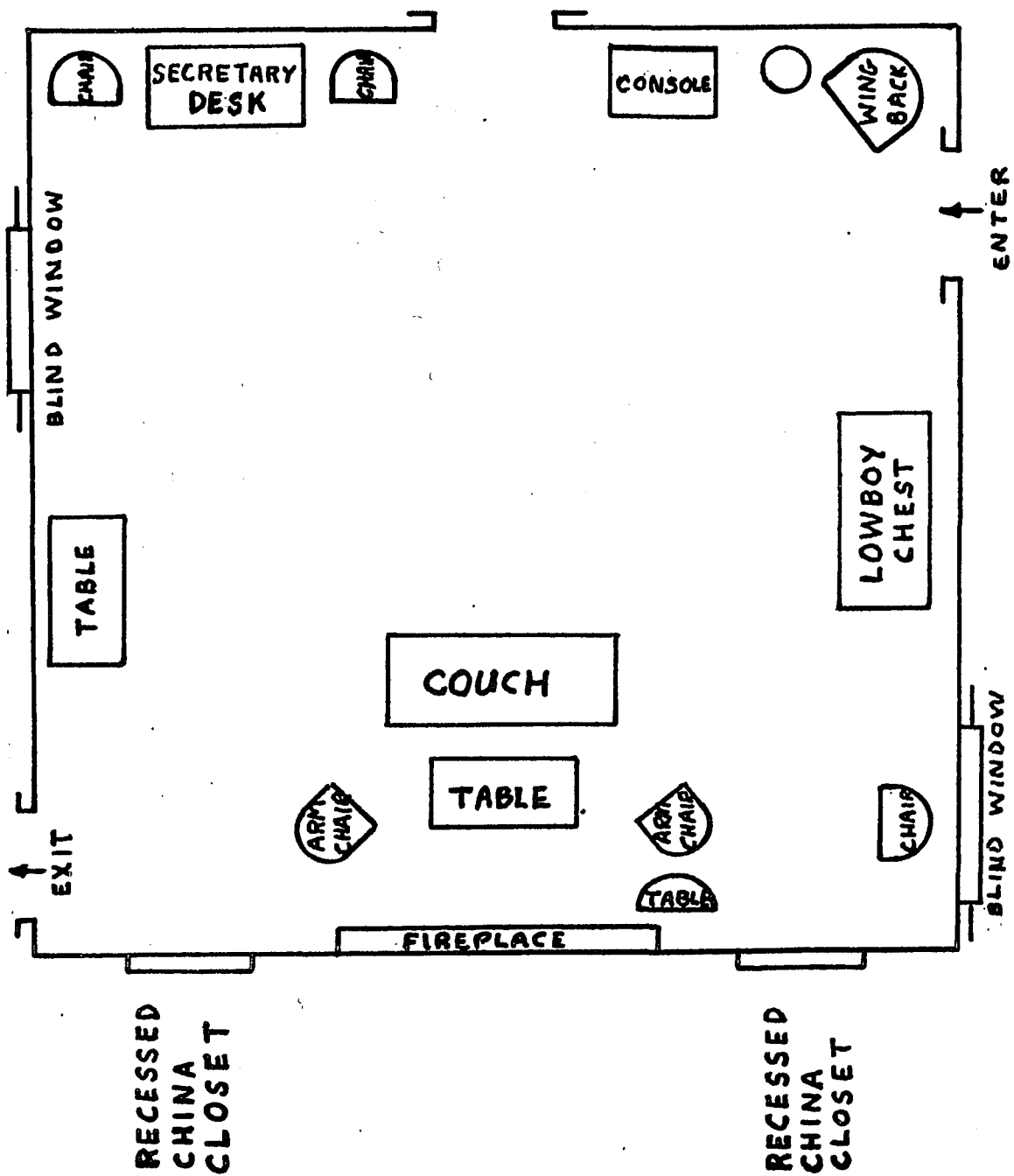


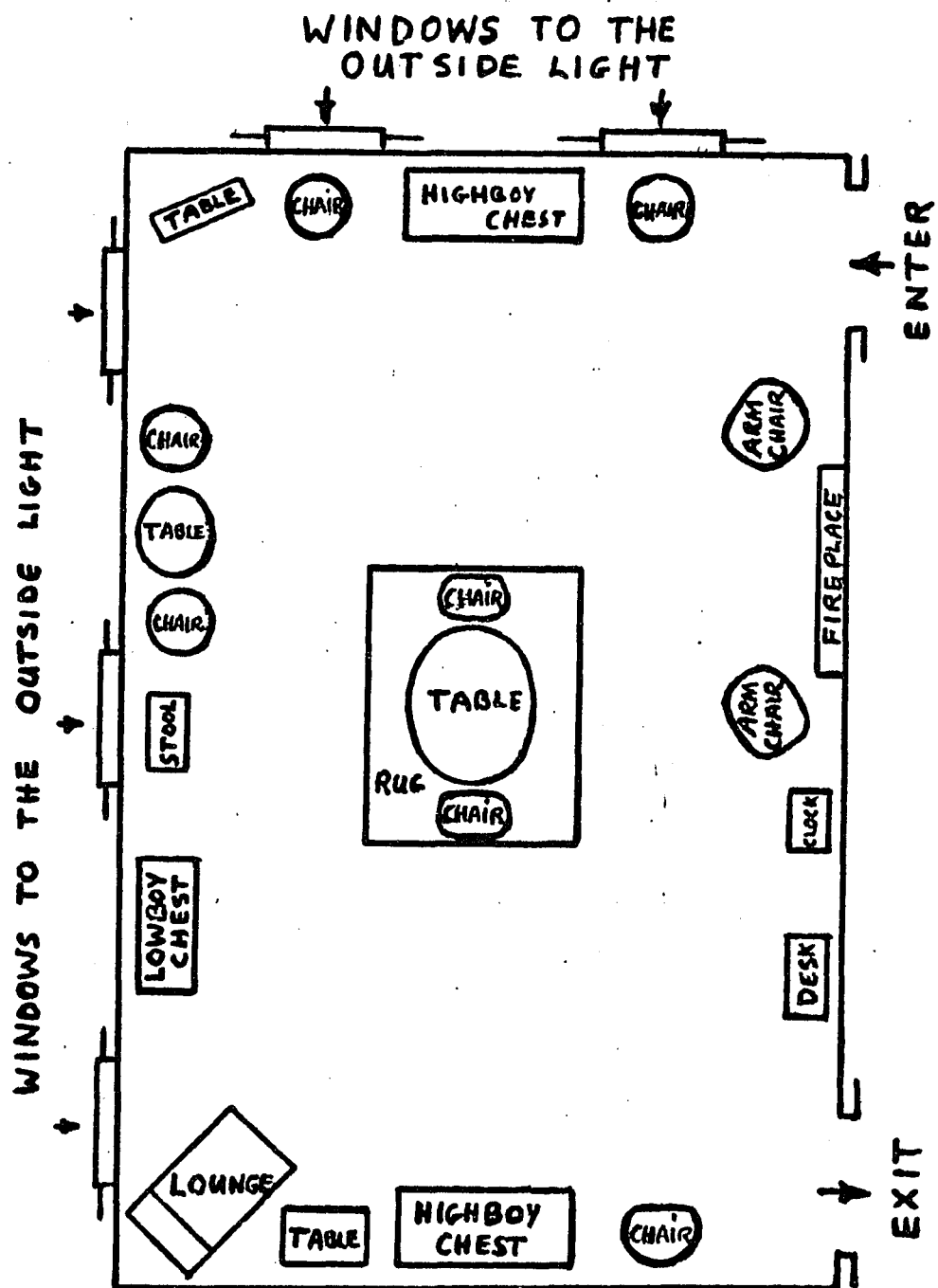
Photos (and Slides) of the Powel Room

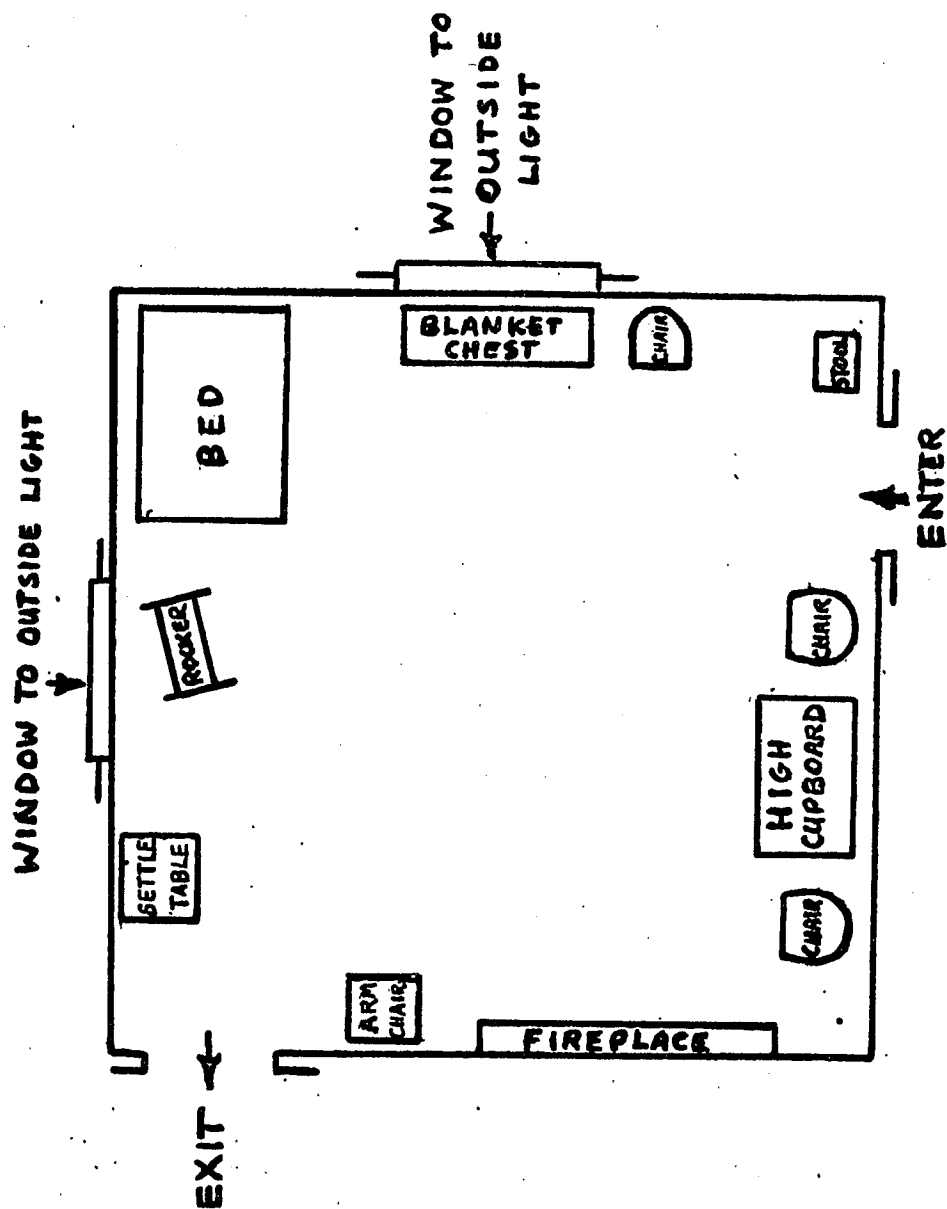


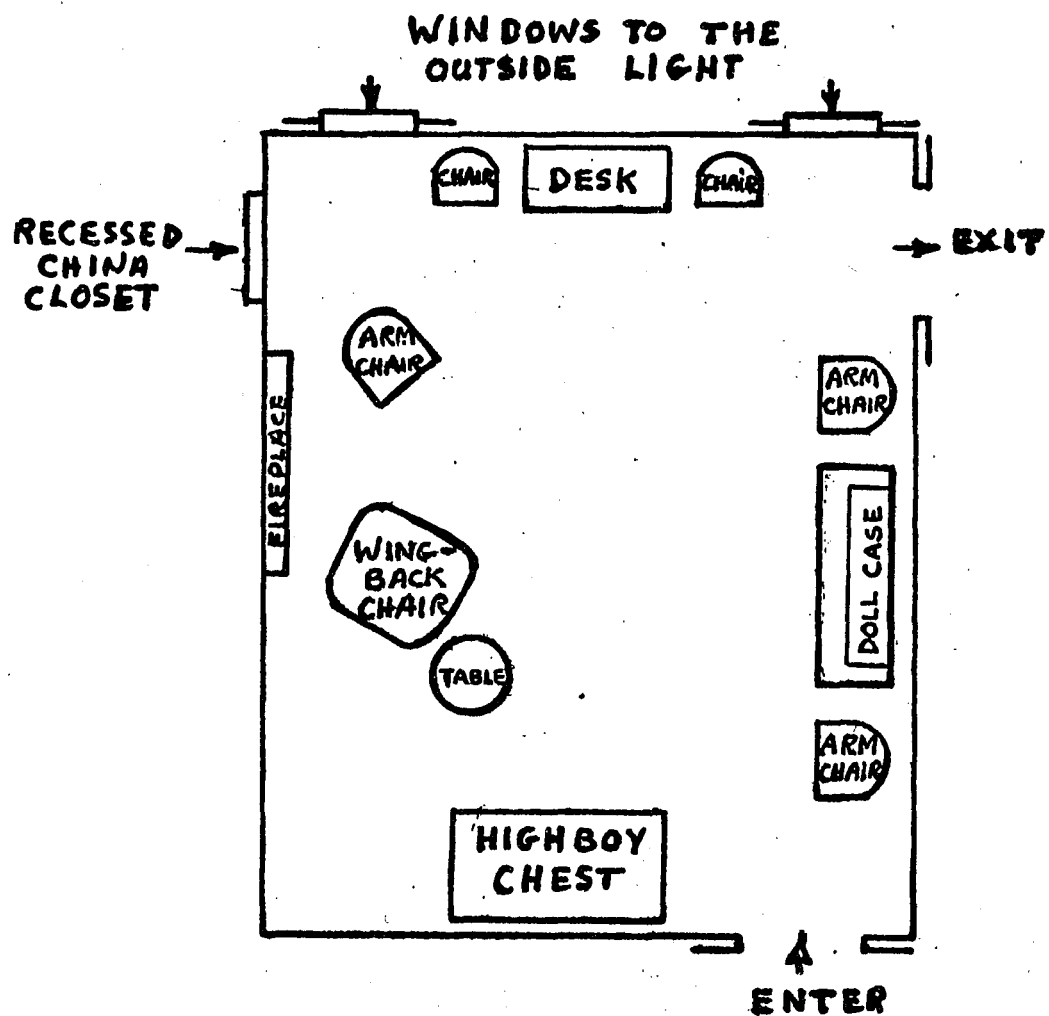
Photos (and Slides) of the Wentworth Room

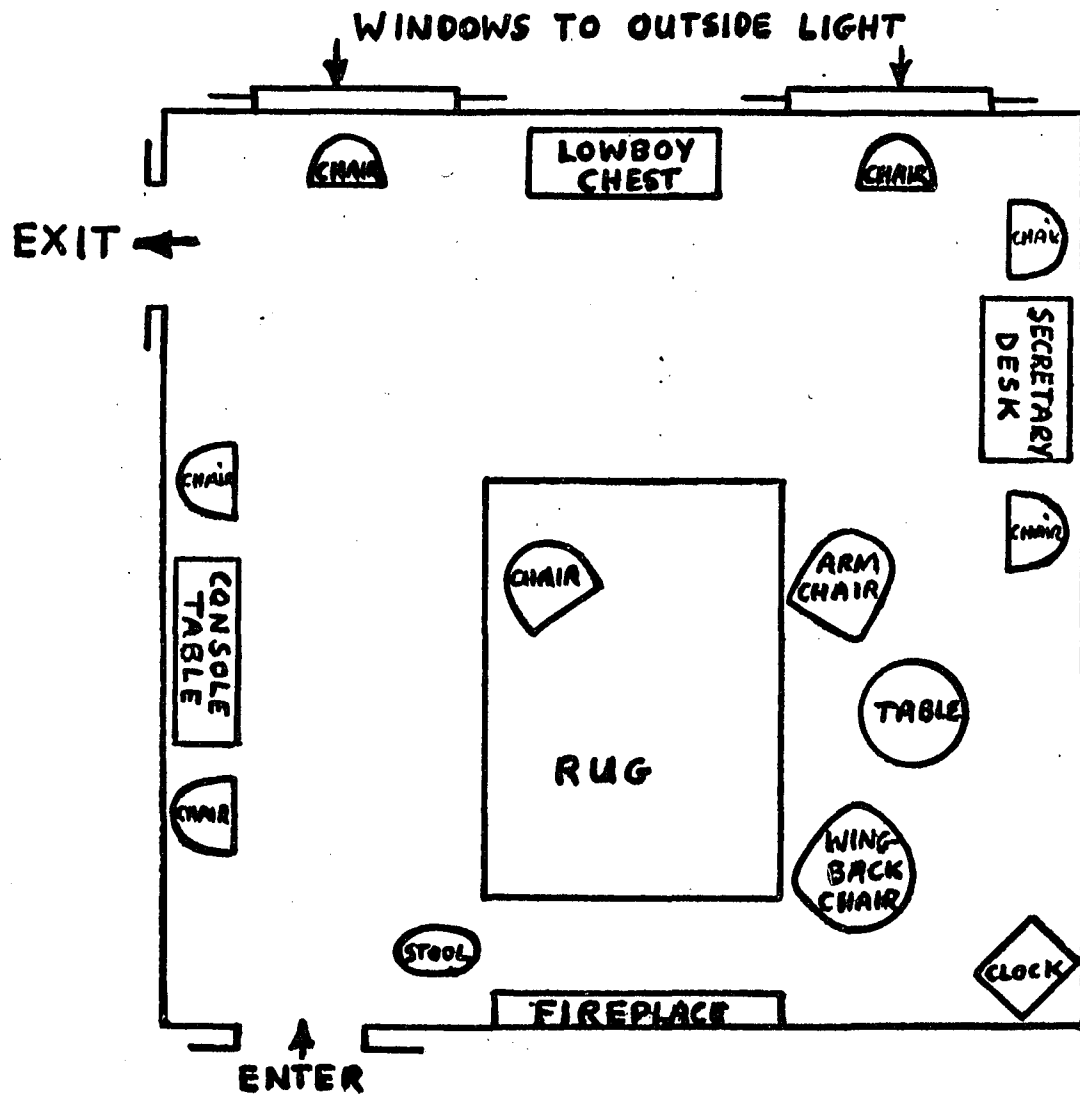


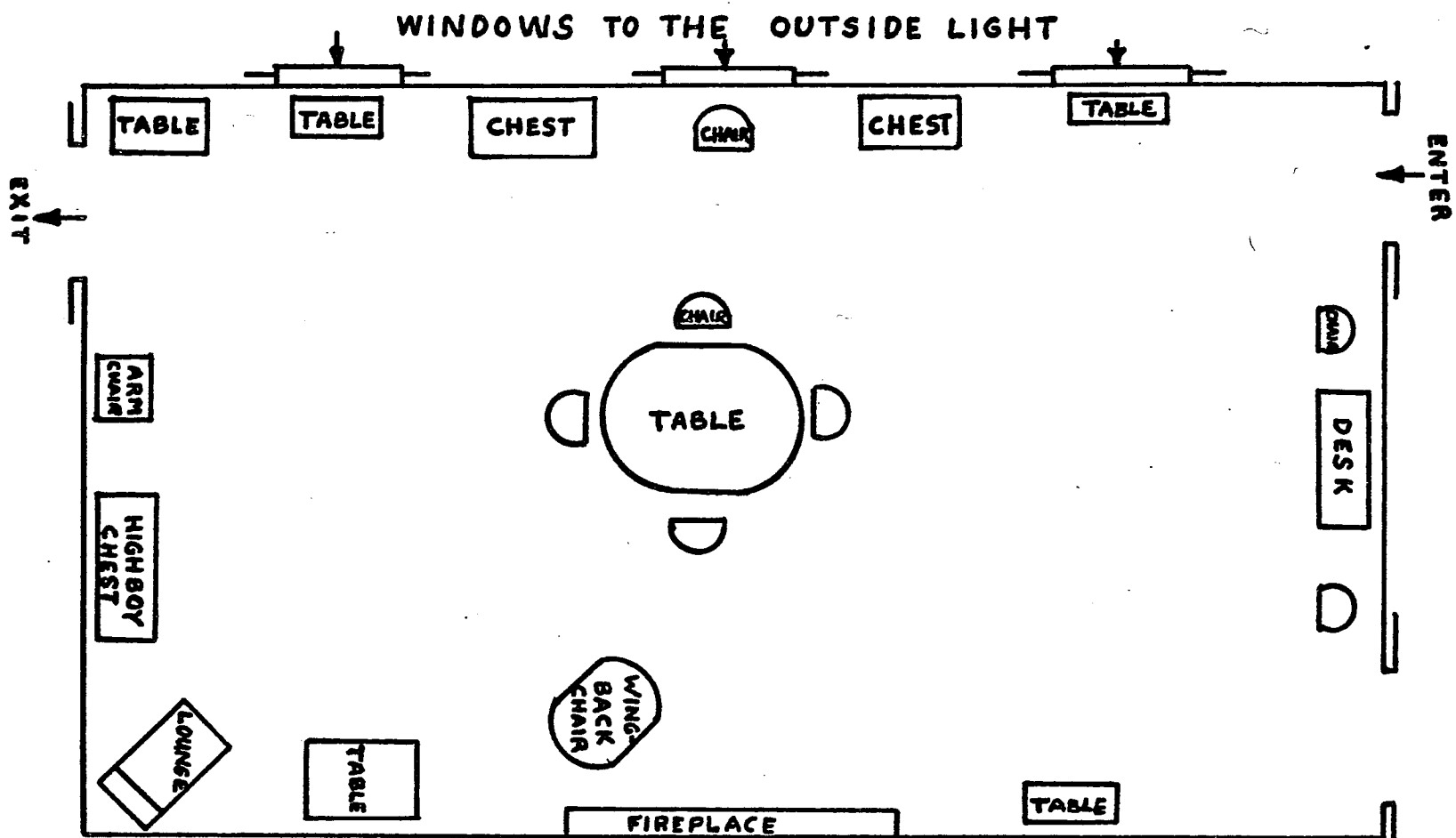
Floorplan of the Almodington Room

Floorplan of the Bowler Room

Floorplan of the Hart Room

Floorplan of the Newington Room

Floorplan of the Powel Room

Floorplan of the Wentworth Room

Verbal Description--The Almodington Room

This is a very large sitting room, about 22 feet by 20 feet whose spaciousness is accentuated by a minimal amount of furniture. It is an unusual room in that it has a doorway in each of three walls and its two windows do not open to the outside light. The walls are completely covered with panelling, shaped with simple geometric lines, beveled edges and classically simple mouldings. The walls are painted a light bluish gray. The ceiling is white and from its center hangs a large elaborate brass chandelier. Despite the several spot lights fastened to the ceiling around the chandelier, the room is very unevenly illuminated and somewhat somber.

On the left as you enter the room is a handsome, polished, dark mahogany lowboy and over it hangs a large mirror framed with dark wood trimmed with gold leaf. Next to these is one of the room's two large windows, about 7 feet high by 4 feet wide. Like the other window it is closed off by a tightly shut venetian blind and decorated with a rich looking, red damask drape.

Moving around the room in clockwise fashion one comes to the fireplace wall next which tends to dominate the room. The fireplace is not large and is faced with tan marble. On the narrow mantle piece above it, is an interesting display of maroon and white delft china vases. Above these is a dark toned oil painting of an action scene at sea. The painting seems too small for the area above the mantle. On each side of the fireplace is a handsome china closet built into the wall. The interiors are illuminated and painted a dull red providing a good contrasting background for displays of blue and white delft china.

In front of the fireplace is a small assemblage of furniture consisting of two small dark mahogany tables, two fancy straight back mahogany chairs with upholstered seats and an upholstered sofa. All of the upholstering has been done with the same red damask used in the draperies.

The third wall has only one piece of furniture against it, namely a dark mahogany gaming table, placed between the exit doorway and a window. The doorway is also hung with red damask drapery. Above the table is a large, dark oil painting of a woman.

A tall and massive secretary desk stands against the remaining wall. It is made of dark walnut and is highly polished. On either side of it is a straight back chair like the ones in front of the fireplace. Between the doorway which pierces the center of this wall and the entrance doorway stand a handsome, tall, upholstered wing back chair, and a small table. Above the table hangs a very large oil painting of a young woman, in an ornate gold frame.

Verbal Description--The Bowler Room

This is a long, rectangular room, about 15 feet by 25 feet, with a rather low ceiling just a little less than 7 feet from the floor. Three of the walls and the ceiling are painted white. The wall containing the fireplace is completely covered by a handsome wood panelling with carved fluted columns. It is stained a rich mahogany brown as is the flooring of varying width oak boards. The room is rather brightly lit by windows in two of the walls. It served the purposes of both the present day dining and living rooms and contains many tables, chairs and chests of drawers.

The entrance to the room is through a doorway in the panelled wall. The fireplace, though not large, is impressive because of its blue and white delft tile facing depicting country scenes. In front of the hearth are two small arm-chairs covered with crewel work upholstery. Between the fireplace and the exit doorway is a tiny, light mahogany grandfather's clock and a small, dark mahogany desk.

Moving in clockwise fashion you see the windowless end wall next. It is dominated by a tall and wide highboy dresser, painted black, and by a large oil portrait of an elderly Dutch gentleman. Along this wall also stands a tall, black, straight back chair and under the painting a small dark mahogany table. A long, dark stained chaise longue stands in the corner next to a window.

The long wall opposite the fireplace contains three good sized windows. Arrayed between and in front of these windows is a lowboy chest, a footstool, two highback chairs, and a round table, all made of dark stained mahogany.

Two windows pierce the remaining end wall and between them stands another tall, black highboy dresser very similar to the one at the opposite end of the room. A folding table with an octagonal top and two high back chairs also line this wall.

In the center of the room is an oval mahogany dining table with two more high back chairs. Underneath them is a patterned rug in rich shades of blue and red against a tan background.

Verbal Description--The Hart Room

This rather small square room is dimly lit but cozy. It measures about 15 feet on a side and functioned as an all-purpose room for cooking, dining, and sleeping. Tiny windows of antique, heavily leaded glass on two of the walls admit only minimal light into the room. The sparse furnishings are rustic for the most part and their placement along the walls leaves the center of the room uncluttered and open.

Three of the walls and the ceiling are painted white. The fourth wall which contains the fireplace is panelled in darkly stained rough pine boards. Similarly stained beams cross the ceiling and in the center a massive supporting beam crosses the room, the bottom of which is less than six feet from the floor. The ceiling is uncomfortably low and the person of average height invariably ducks a little as he walks through the room.

Upon entering the room one's attention is drawn to the large, heavy oak and walnut cabinet on the left. It is ornately carved, stained a very dark brown and highly polished. On either side of it is a straight back arm chair with a colorful cushion.

As one moves around the room clockwise, the fireplace dominates the view. It is massive, made of bricks of several shades of red, brown, and tan and contains an oven, a large cauldron, huge andirons and logs, and heavy, cast iron cooking implements. Between the fireplace and the exit doorway stands a large, ornately carved, straight back arm-chair made of dark stained oak.

The wall opposite the entrance doorway contains one of the small windows. To the left of the window is an ingenious folding table made of oak and pine. When not being used for dining this table stands against the wall with its top folded back to form the back rest of a chair. Below the window is a carved walnut rocker-cradle. Like the folding table it is stained a very dark brown. To the right is a low roughly hewn bed.

The remaining wall contains another small window and beneath it a handsomely carved oak blanket chest. To the right of this is a small straight back chair and a low table.

Verbal Description--The Newington Room

This is a small sitting room, somewhat somberly lit but cozy. It measures about 13 by 16 feet and has a somewhat low ceiling, about 7-1/2 feet high. Three of the walls and the ceiling are painted white. A massive panelled beam spans the ceiling supporting it. The floor is made of darkly stained oak boards of varying width.

Immediately to the left of the doorway as you enter, stands a very tall, mahogany highboy chest of drawers. The room is dominated by the panelled wall containing the fireplace, however. The pine panelling is stained a dark walnut and is elaborately carved with geometric designs and columns. An illuminated china closet is built into the panelling at the end near the window. In front of the small fireplace are two chairs facing each other; a handsome, yellow wing back chair, and a tall, carved arm chair painted black.

Proceeding around the room in a clockwise direction, one comes to the wall containing the room's two small windows. Between them stands a small dark walnut slant-top desk flanked by two small straight-back chairs. Above the desk hang two small pastel portraits of a man and a woman. They are hard to see in the shadows between the two windows.

In the middle of the remaining wall is a large, decorated blanket chest. On top of this is a dark wooden display case containing a large china doll. On either side are tall mahogany-colored arm chairs with red upholstered seats. Over each chair is a small, framed etching.

Verbal Description--The Powel Room

This is an elegant sitting room from the home of a very wealthy Philadelphia merchant. It is a large square room, measuring about 19 feet on a side with a very high ceiling, nearly 13 feet above the floor. The room is brightly lit by sunlight through two enormous windows.

Three of the walls are covered with a delicate Chinese wallpaper depicting scenes filled with fanciful birds and gardens in shades of green, blue, and white on a golden tan background. The fourth wall, containing the fireplace is elaborately panelled and painted a putty color as is the woodwork and wainscoting in the rest of the room. The plaster ceiling is painted white and is decorated with relief sculptures of ribbons, musical instruments, and garlands of leaves. A large ornate crystal chandelier hangs from the center of the ceiling.

Alongside the wall to the left as you enter the room is a large, intricately carved ebony console table. On top of it is a delicate china tea set enclosed in a glass case. Above this hangs a large mirror with a very ornate frame gilded with yellow gold. On each side of the table is a fancy straight back chair made of dark stained mahogany with a bright yellow upholstered seat. These are two of a set of seven such chairs in this room.

Proceeding around the room clockwise one comes to a wall with two enormous windows, which are nearly eight feet high and four feet wide. The windows are hung with bright yellow damask drapes that match the upholstery in the room. In front of each window is one of the straight back chairs mentioned above. Between the windows stands a highly polished, mahogany lowboy chest of drawers.

A huge, highly polished, mahogany butler's cupboard dominates the third wall. This chest, a full seven feet tall, is something like a tall secretary desk with drawers in the bottom part and cabinet doors in the top. Flanking it on either side is another of the set of straight back chairs with a yellow upholstered seat. In the corner formed by this wall and the panelled fireplace wall stands a very tall and highly polished grandfather's clock.

The most impressive feature of this room is the panelled fireplace wall. This is made up of beveled panels, mouldings, carved scroll-work supporting the fireplace mantle, and an architectural cornice that surmounts a large, elegant oil portrait of an aristocratic woman. The fireplace opening is faced with polished gray marble.

Verbal Description--The Powel Room--continued

In front of the fireplace is a tall wing back chair and a matching footstool upholstered in the bright yellow damask used in the draperies. Next to it is a large, round mahogany table. Facing these is a handsome arm chair upholstered with a gold and pink damask cloth. On the floor in front of the fireplace is a patterned rug about 6 feet by 9 feet done in shades of red, blue, and tan. Though the room contains a good deal of furniture, it does not seem to be cluttered or crowded.

Verbal Description--The Wentworth Room

This is a very large, long, rectangular room about 17 feet by 30 feet that was used for sitting and dining. It has a lot of furniture in it and is only dimly lit despite its three windows. In the center of the room stands an oval dining table covered with a rug of muted colors, tan, red, and blue and surrounded by four tall straight back chairs made of ebony stained wood. The ceiling is fairly low, about 8 feet from the floor and is painted white, as are three of the walls in the room. Heavy beams cross the ceiling. They are painted a dark maroon (called Indian red) and are the same color as the panelled fireplace wall. The floor is made of oak planks of varying width, stained a medium brown.

As you enter the room the nearest wall to the left has a dark stained desk and mirror displayed against it. Flanking the desk on each side is a tall, straight back chair and above each chair hangs a small framed etching of one of the previous owners of the room.

The fireplace wall is completely panelled in wood painted Indian red. The fireplace itself is large and lined with brick. In front of it is a handsome wing back chair with yellow upholstery. A small, darkly stained wood table stands against the wall on either side of the fireplace.

Proceeding to the far end of the room, we come next to a yellow chaise longue in the corner where the panelled fireplace wall and end wall meet. Next to it is a tall dresser (called a highboy chest) painted black and a black leather arm chair.

Along the window wall stand a small table and two darkly stained small chests of drawers called lowboys. The three windows are small and in front of each is a foot stool or a highback chair.

APPENDIX C

A SHORTENED VERSION OF KASMAR'S EDS

Adequate size-inadequate size
Appealing-unappealing
Attractive-unattractive
Beautiful-ugly
Bright-dull
Bright colors-muted colors
Cheerful-gloomy
Clean-dirty
Colorful-drab
Comfortable-uncomfortable
Complex-simple
Contemporary-traditional
Convenient-inconvenient
Diffuse lighting-direct lighting
Distinctive-ordinary
Efficient-inefficient
Elegant-unadorned
Empty-full
Expensive-cheap
Flashy colors-subdued colors
Free space-restricted space
Functional-nonfunctional
Gay-dreary
Good colors-bad colors
Good lighting-poor lighting
Good lines-poor lines
Huge-tiny
Inviting-repelling

Large-small
Light-dark
Modern-old fashioned
Multi-purpose-single purpose
Neat-messy
New-old
Orderly-chaotic
Organized-disorganized
Ornate-plain
Pleasant-unpleasant
Private-public
Roomy-cramped
Soft lighting-harsh lighting
Sparkling-dingy
Stylish-out-of-style
Tasteful-tasteless
Tidy-untidy
Uncluttered-cluttered
Uncrowded-crowded
Unusual-usual
Useful-useless
Warm-cool
Well-balanced-poorly balanced
Well kept-run down
Well organized-poorly organized
Well planned-poorly planned
Well scaled-poorly scaled
Wide-narrow

APPENDIX D

FACTOR LOADINGS FOR THE ACTUAL ROOMS

The Almodington Room

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10	FACTOR 11	FACTOR 12
VAR001	0.23198	0.13161	0.02510	0.08967	0.05563	0.52269	-0.13831	-0.35149	-0.22726	0.21066	0.56493	0.00106
VAR002	0.33558	0.25129	-0.30789	0.12937	0.10759	0.20336	-0.18980	0.11990	-0.23782	0.53333	0.34457	0.25038
VAR003	0.44553	0.37282	-0.10445	0.17771	0.23712	0.19843	-0.15635	0.24732	0.17123	0.67094	0.00005	0.03389
VAR004	0.53909	0.30920	0.15716	0.02915	0.22720	0.13663	-0.16513	0.38622	0.37951	0.52835	-0.11795	-0.11017
VAR005	0.88123	0.18201	-0.03016	-0.03177	-0.02926	0.16045	0.06392	0.31963	0.07134	0.17123	-0.36822	-0.39072
VAR006	0.50782	0.08139	0.39439	0.02748	0.02557	0.02146	0.04947	0.13089	-0.36623	0.04374	-0.07284	-0.10056
VAR007	0.71019	0.03052	0.30483	0.20672	0.12725	0.33713	0.33036	0.37682	0.37682	0.06667	-0.31112	-0.31112
VAR008	0.10218	0.12073	-0.36993	0.08155	0.08759	-0.05891	0.31178	-0.37983	0.37973	0.13497	-0.12450	-0.08867
VAR009	0.29376	0.46374	-0.03245	0.16482	0.08542	0.17872	0.39435	0.24897	-0.24757	0.12011	-0.34712	0.15774
VAR010	0.53733	0.13995	0.35239	0.34145	0.10746	0.30367	-0.12066	0.34753	0.37915	-0.12011	-0.12011	0.01395
VAR011	-0.36734	-0.14817	0.29068	0.07051	-0.02900	0.39764	-0.13919	0.36932	0.73056	-0.00119	-0.12011	0.15774
VAR012	0.37517	0.31333	-0.21814	0.17644	0.05636	0.19028	-0.14634	0.56251	0.13553	0.16934	0.11135	-0.18273
VAR013	0.78669	0.26979	-0.39792	-0.05147	0.08130	0.36676	0.33620	0.55435	0.33914	0.16738	0.11135	-0.18273
VAR014	0.21875	0.68608	-0.39805	-0.07236	0.30014	0.09343	0.05563	0.04243	-0.07422	-0.16918	0.11135	-0.18273
VAR015	-0.21673	-0.15672	-0.27225	-0.21387	0.25133	0.15713	0.33211	0.33211	-0.33211	-0.33211	0.11135	-0.18273
VAR016	-0.39406	-0.02455	-0.13012	-0.20062	0.75111	0.10051	-0.32049	0.33071	-0.33071	-0.33071	0.11135	-0.18273
VAR017	0.16815	0.68644	0.17057	-0.01832	0.05555	-0.01383	0.16132	0.32387	-0.32387	-0.32387	0.11135	-0.18273
VAR018	-0.34641	0.17842	0.37056	-0.11737	-0.05676	0.01431	0.02866	-0.02866	-0.02866	-0.02866	0.11135	-0.18273
VAR019	0.49413	0.16131	0.22418	-0.00208	-0.03293	0.67032	-0.32338	0.53612	-0.33914	-0.12185	-0.12185	0.24512
VAR020	0.22904	0.26613	0.22073	0.11819	0.03634	0.67032	0.37433	0.53612	0.37433	-0.37433	-0.37433	0.34192
VAR021	0.72776	0.09159	-0.12486	-0.04903	-0.04550	0.13258	-0.02266	0.36885	-0.19711	-0.36885	-0.36885	0.34192
VAR022	0.28594	-0.23048	0.55933	0.16052	0.26831	0.37637	0.11482	0.24659	0.02560	0.11033	0.11033	-0.17561
VAR023	0.22631	0.49176	0.32336	0.09280	-0.23292	-0.23292	0.35937	-0.24433	-0.01532	0.21150	0.21150	-0.17561
VAR024	0.87729	0.36635	0.35513	0.09666	0.28634	0.18017	-0.35937	-0.24433	-0.01532	0.21150	0.21150	-0.17561
VAR025	0.74350	0.27417	-0.11748	-0.05947	0.03408	0.09847	0.32381	0.10336	-0.10336	0.22132	0.22132	-0.07137
VAR026	0.81488	0.37652	0.19576	-0.01786	0.01610	0.08939	0.10081	-0.32387	-0.32387	0.16453	0.16453	-0.07137
VAR027	0.54028	0.35575	0.15781	0.21035	-0.23492	0.34933	-0.32387	0.16453	0.16453	-0.32387	-0.32387	-0.07137
VAR028	0.35825	0.27031	0.15433	-0.02854	0.14505	-0.18869	0.34933	0.16453	0.16453	-0.32387	-0.32387	-0.07137
VAR029	0.49042	0.43981	-0.14463	0.18495	0.21026	0.27273	0.12859	-0.11739	-0.11739	0.17133	0.17133	-0.08450
VAR030	0.38760	0.19338	0.35150	0.30470	-0.14347	0.71924	0.08033	0.15285	0.38521	-0.20770	-0.20770	0.34322
VAR031	0.76829	0.14275	0.34436	0.20088	-0.23443	0.13533	0.13938	0.34374	0.13938	0.01271	0.01271	-0.15943
VAR032	0.21558	0.12748	0.37823	-0.13579	0.74223	0.18866	0.16539	0.16539	0.16539	0.13938	0.13938	-0.15943
VAR033	0.11543	0.04630	-0.04151	-0.07227	0.26583	0.08631	0.66217	-0.35771	-0.10956	-0.21453	-0.21453	0.01691
VAR034	-0.08703	0.31673	0.39923	0.82375	-0.31192	0.09157	-0.11617	0.12262	-0.35350	-0.35350	-0.35350	0.17911
VAR035	0.59927	-0.07194	0.00071	-0.10391	0.52239	-0.15722	0.34395	-0.32655	0.23120	0.15475	-0.15475	-0.03779
VAR036	0.23631	0.23631	0.81564	0.10508	0.09500	0.02367	-0.26876	0.15481	0.10035	-0.06275	0.06275	-0.03779
VAR037	0.56291	0.56291	0.33818	0.13788	-0.31913	0.23055	-0.18188	0.13127	-0.32238	0.21693	0.21693	0.11054
VAR038	0.33237	0.25048	0.22627	-0.20324	-0.37938	0.45973	0.35335	0.21045	0.38639	0.41745	0.41745	-0.06337
VAR039	0.51021	0.37123	0.15034	0.26252	0.24255	0.18845	0.26695	0.11476	0.32241	0.22613	0.22613	0.06734
VAR040	0.46413	0.19718	0.17025	0.10921	0.07546	-0.07595	-0.00283	0.13569	0.33175	0.51691	0.51691	-0.21552
VAR041	0.55796	0.14379	0.28257	0.18652	-0.11558	0.04831	0.20375	0.20983	0.25042	0.34518	0.34518	0.00072
VAR042	0.20447	0.09126	0.36826	0.30166	-0.22883	0.54797	0.11973	0.37573	0.01241	0.14112	0.14112	-0.32935
VAR043	-0.10051	0.11253	0.37155	-0.27136	0.20324	0.11453	0.09028	0.34634	0.37323	0.38603	0.38603	-0.30035
VAR044	0.63185	0.31323	0.15681	0.20272	-0.37378	0.07237	0.24078	0.15953	0.18466	0.01575	0.01575	-0.14695
VAR045	0.19113	-0.02554	0.19115	-0.11374	-0.39972	-0.02546	0.35991	0.13363	0.15147	0.16655	0.16655	-0.06228
VAR046	0.32585	0.32585	0.18539	0.07472	0.31355	0.08622	0.35991	-0.35991	-0.35991	0.16655	0.16655	0.18573
VAR047	0.43370	0.14234	0.21413	0.19008	0.08231	0.28373	0.66190	0.36950	-0.36950	0.16655	0.16655	0.18573
VAR048	0.36011	0.36011	0.15413	0.39729	0.15746	0.13012	0.06016	0.36950	-0.36950	0.16655	0.16655	0.18573
VAR049	0.39325	0.00334	0.26537	0.71784	0.12332	0.17296	0.19731	0.33312	-0.33312	0.00072	0.00072	0.17776
VAR050	-0.13971	0.21664	0.86618	0.12902	0.08156	0.09618	0.37058	-0.37058	0.37058	-0.37058	-0.37058	0.32893
VAR051	0.33065	0.27832	0.37091	0.15993	0.32469	0.13253	0.13008	0.03152	0.17626	0.23255	0.23255	-0.05698
VAR052	0.25341	0.20353	0.36941	0.63075	-0.19534	0.15714	0.17144	0.22058	-0.22058	0.23255	0.23255	0.36798
VAR053	0.11810	0.21445	0.04332	0.43375	-0.05339	0.15768	0.33532	0.32272	-0.32272	0.23255	0.23255	0.36798
VAR054	0.15465	0.87929	0.59730	0.12445	-0.04966	0.17517	0.22292	0.33656	0.12634	0.15121	0.15121	-0.35621
VAR055	0.23120	0.78442	0.19282	0.10264	-0.31457	0.10264	0.22292	0.33656	0.12634	0.15121	0.15121	-0.35621
VAR056	0.26938	0.03622	0.40336	-0.15711	0.37702	0.07034	0.35992	-0.35992	0.35992	0.06059	0.06059	-0.35621

The Bowler Room

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10	FACTOR 11	FACTOR 12	FACTOR 13
VAR001	0.26196	0.16728	-0.00201	-0.27879	-0.01557	0.27163	-0.20236	-0.10775	-0.02992	-0.05767	-0.52677	-0.03983	-0.20163
VAR002	0.26031	0.03378	0.12321	0.03688	0.26092	0.26123	0.07192	0.12357	0.10388	-0.26352	-0.52677	-0.03983	-0.20163
VAR003	0.22693	0.08872	0.29529	0.22326	0.23557	0.26123	0.23616	0.12357	0.10388	-0.03743	-0.11326	0.16641	-0.25132
VAR004	0.22752	0.01849	0.29382	0.13421	0.23557	0.03641	0.23616	0.12357	0.10388	-0.26352	-0.52677	-0.03983	-0.20163
VAR005	0.27354	0.24448	0.03632	0.11724	-0.02844	-0.01149	0.14128	-0.17397	-0.11347	-0.02129	-0.26352	-0.52677	-0.03983
VAR006	0.18221	0.26077	0.10015	0.27315	0.09335	0.05225	0.07894	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR007	0.29211	0.35094	0.15634	0.15634	0.23616	0.23616	0.23616	0.23616	0.23616	0.23616	0.23616	0.23616	0.23616
VAR008	0.28196	0.18319	0.32123	-0.29443	-0.03291	-0.02553	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR009	0.26231	0.30786	0.45000	-0.11689	0.03122	0.36112	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR010	0.38761	0.28915	0.28555	-0.18139	0.20046	0.13665	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR011	-0.29058	0.22641	-0.29554	-0.10073	0.43392	0.03657	-0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR012	0.21155	0.12463	0.12463	0.23235	0.06716	0.03657	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR013	0.21333	0.12463	0.12463	0.23235	0.06716	0.03657	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR014	0.15540	0.14627	0.14627	0.23235	0.06716	0.03657	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR015	-0.29936	0.09531	0.03572	-0.02928	0.24437	-0.23616	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR016	-0.29936	0.09531	0.03572	-0.02928	0.24437	-0.23616	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR017	0.31056	0.11794	0.11794	-0.27423	-0.13399	-0.13399	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR018	-0.39315	-0.00827	0.33177	-0.26287	-0.24676	0.11437	0.05864	-0.05864	-0.05864	-0.05864	-0.05864	-0.05864	-0.05864
VAR019	0.11782	0.06513	0.37594	0.09122	0.03577	0.26239	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR020	0.33026	0.11339	0.23759	0.09122	0.03577	0.26239	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR021	0.66169	0.35954	-0.03870	0.15356	0.18137	0.13985	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR022	0.12803	0.16029	-0.02726	0.18239	0.62735	0.12644	0.04679	0.09640	0.04679	0.09640	0.04679	0.09640	0.04679
VAR023	0.17327	0.24123	0.44936	0.00598	0.07987	0.22655	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR024	0.78130	0.16183	0.09632	0.18239	0.16375	0.22655	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR025	0.52833	0.15033	0.09632	0.15993	0.16375	0.22655	0.23616	-0.26252	-0.26945	-0.26352	-0.52677	-0.03983	-0.20163
VAR026	-0.54421	-0.02811	-0.25639	0.26326	0.26357	0.21547	0.15071	0.21659	0.05711	-0.01603	-0.05285	-0.05285	-0.05285
VAR027	0.46924	0.17775	0.17775	-0.12679	0.08473	0.35431	-0.17451	-0.21512	0.13893	0.25354	-0.25354	-0.25354	-0.25354
VAR028	0.11619	0.13436	0.01429	0.06030	0.16079	-0.10091	-0.20207	0.17682	0.16862	0.02047	0.02047	0.02047	0.02047
VAR029	0.15147	0.03554	0.30554	0.09555	0.09598	0.35122	0.32001	0.45721	0.23282	-0.05833	-0.05833	-0.05833	-0.05833
VAR030	0.26769	0.23554	0.24314	0.13174	0.21581	0.11727	0.23547	0.11842	-0.29914	0.21472	0.29274	0.08615	0.29274
VAR031	0.27029	0.26232	0.15337	0.26523	0.15337	0.17127	0.23547	-0.25129	-0.25129	-0.25129	-0.25129	-0.25129	-0.25129
VAR032	0.15048	0.10128	0.01068	0.13752	0.02831	0.09933	0.12036	0.16868	0.16868	0.16868	0.16868	0.16868	0.16868
VAR033	0.117601	0.21057	0.24655	0.16232	0.09393	0.40393	0.25096	0.46497	-0.22554	-0.05357	-0.05357	-0.05357	-0.05357
VAR034	-0.54126	0.42493	0.33445	0.33445	0.22822	0.22822	0.11915	-0.20269	-0.20269	-0.20269	-0.20269	-0.20269	-0.20269
VAR035	0.16181	0.03223	0.36499	0.05885	0.74970	-0.05861	0.15289	-0.23328	-0.23328	-0.23328	-0.23328	-0.23328	-0.23328
VAR036	0.05127	0.02317	0.25290	-0.02180	0.17551	0.59646	-0.21128	-0.18573	-0.18573	-0.18573	-0.18573	-0.18573	-0.18573
VAR037	0.27474	0.11597	0.37179	0.11812	0.05641	0.75714	-0.05371	-0.15729	0.21036	0.03592	-0.03592	-0.03592	-0.03592
VAR038	0.36250	0.21229	0.03872	0.21558	-0.21558	0.23613	0.53375	-0.12653	-0.00250	0.00250	0.00250	0.00250	0.00250
VAR039	0.27733	0.05247	0.23894	0.18754	-0.00713	0.23613	0.33642	0.13997	-0.33232	0.22835	-0.22835	-0.22835	-0.22835
VAR040	0.19624	0.57484	0.037474	0.16174	-0.00314	0.42266	-0.23642	0.13997	-0.33232	0.22835	-0.22835	-0.22835	-0.22835
VAR041	-0.28094	0.23783	0.23094	0.26425	0.02738	0.22329	0.26181	0.01587	0.26497	0.09345	-0.09345	-0.09345	-0.09345
VAR042	0.33556	0.37823	0.23589	0.3664	0.26833	0.31473	-0.11473	0.26497	0.09345	-0.09345	-0.09345	-0.09345	-0.09345
VAR043	-0.23739	0.26677	0.22499	0.26157	0.06950	0.26361	0.17368	0.26497	0.09345	-0.09345	-0.09345	-0.09345	-0.09345
VAR044	0.06919	0.13139	0.18572	0.16659	-0.20738	0.13216	0.07215	0.01398	0.04676	0.04676	0.04676	0.04676	0.04676
VAR045	0.20518	0.02045	0.23162	0.24292	0.06645	0.23162	0.26201	-0.10139	0.17235	0.25193	-0.25193	-0.25193	-0.25193
VAR046	0.19026	0.35652	0.25652	-0.03824	0.06978	0.26821	0.26013	0.53036	0.21614	0.21614	0.21614	0.21614	0.21614
VAR047	0.27773	0.03396	-0.21869	-0.21869	-0.06795	0.06795	0.47796	-0.47796	-0.47796	-0.47796	-0.47796	-0.47796	-0.47796
VAR048	0.22274	0.21748	0.17683	0.16637	0.29635	0.16637	0.11772	0.19675	0.04611	-0.02722	0.04611	0.04611	0.04611
VAR049	0.25979	0.23233	0.23233	0.10223	0.15106	0.13334	0.13157	0.11573	0.23449	0.23449	0.23449	0.23449	0.23449
VAR050	-0.32369	-0.02558	0.11096	0.05341	0.00042	0.40668	-0.23746	0.01576	0.23449	0.23449	0.23449	0.23449	0.23449
VAR051	-0.23068	-0.32378	0.14355	0.18336	0.70070	0.33621	-0.17316	0.00294	0.23449	0.23449	0.23449	0.23449	0.23449
VAR052	-0.23673	0.17867	0.46918	0.11414	0.23818	0.22772	0.23592	0.22442	0.23884	0.23884	0.23884	0.23884	0.23884
VAR053	0.21187	0.08133	0.11843	0.07352	0.07352	0.71704	0.29604	0.22807	0.23884	0.23884	0.23884	0.23884	0.23884
VAR054	0.21903	0.25908	0.14251	0.18981	0.33765	0.71431	0.29604	0.22807	0.23884	0.23884	0.23884	0.23884	0.23884
VAR055	0.26794	0.10623	0.17471	0.11795	0.16052	0.64656	0.13362	0.18719	0.23884	0.23884	0.23884	0.23884	0.23884
VAR056	0.26794	0.05885	-0.22683	0.35254	0.13337	0.51516	-0.21734	-0.21734	0.23884	0.23884	0.23884	0.23884	0.23884

The Hart Room

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10	FACTOR 11	FACTOR 12	FACTOR 13
VAR001	0.39648	0.54633	-0.37916	0.13057	0.25358	0.06811	-0.16037	0.18682	0.23358	-0.30035	0.06528	0.00051	0.15033
VAR002	0.26787	0.17653	0.30158	0.30158	0.25917	-0.31132	0.11693	0.03096	-0.00019	0.18333	0.11653	0.11653	0.11653
VAR003	0.46863	0.01335	-0.42311	0.17024	-0.27127	-0.22111	-0.28845	-0.35497	-0.35497	0.16557	0.02410	0.21693	-0.23983
VAR004	0.56461	0.00480	0.32636	0.05636	0.05636	0.08557	0.26823	0.36632	0.30187	0.16757	-0.30782	0.31693	-0.35321
VAR005	0.81661	0.00853	0.31531	0.11454	0.02116	-0.07194	-0.07194	0.15963	0.20611	-0.06835	0.05456	-0.04739	-0.37433
VAR006	0.71134	0.02714	0.11053	0.32611	0.10317	0.04682	0.04684	0.21978	0.20659	-0.15279	0.41195	0.21522	0.21522
VAR007	0.69773	0.02052	0.14791	0.07310	0.03694	-0.08898	0.08898	0.16526	0.19857	-0.31511	0.25307	0.21522	0.21522
VAR008	0.07939	0.44071	-0.35190	0.07624	-0.20532	-0.08425	-0.02196	-0.03022	0.12213	-0.16990	-0.10985	0.71823	0.71823
VAR009	0.20735	0.19285	-0.34432	0.31593	0.27418	-0.00133	0.08325	0.49636	0.05162	0.16833	0.10051	-0.09213	-0.27511
VAR010	0.56673	0.01385	0.31675	0.31675	0.14731	0.12283	0.37357	0.37357	0.17336	0.16833	0.33510	0.26509	-0.37510
VAR011	0.26863	0.15335	0.31675	0.31675	0.14731	0.12283	0.37357	0.37357	0.17336	0.16833	0.33510	0.26509	-0.37510
VAR012	0.16234	0.07659	-0.06260	-0.33905	-0.00115	0.1886	0.11971	-0.37092	-0.37092	0.16833	0.17883	-0.36493	-0.37510
VAR013	0.84177	0.05272	-0.11139	-0.33975	0.13318	-0.04523	-0.02176	-0.03089	0.32421	0.15882	0.12429	-0.24030	-0.37510
VAR014	0.31882	0.03724	-0.31882	-0.37313	0.30713	0.11551	-0.31533	0.21533	0.32421	0.08613	0.23570	0.06097	-0.16173
VAR015	0.10730	0.15325	-0.32654	0.79459	0.00674	0.48452	-0.37692	-0.37692	0.37162	-0.33672	0.55534	0.18725	0.17736
VAR016	-0.10590	0.09545	-0.37603	-0.07091	0.00851	0.48452	-0.37692	-0.37692	0.35926	0.30817	0.17736	-0.35926	-0.37455
VAR017	0.33373	0.11522	-0.35555	0.23930	0.23930	0.28534	0.04256	0.28534	-0.39730	-0.32571	0.25867	0.25867	0.25867
VAR018	0.18788	0.13527	-0.35555	-0.38411	0.32676	-0.15513	0.23555	0.25939	-0.32676	-0.18454	-0.10966	0.12893	-0.10966
VAR019	0.19080	0.10215	-0.10410	0.06972	0.34567	0.05165	0.58151	-0.35035	-0.32233	0.33333	0.44187	0.23692	0.23692
VAR020	0.56642	0.02564	0.10344	-0.04412	-0.01179	0.18883	0.33874	-0.35423	-0.32336	0.00558	0.33700	0.23692	0.23692
VAR021	-0.50892	-0.07572	-0.14225	0.23676	0.23676	-0.00557	0.13270	-0.35974	0.13135	-0.32333	0.33466	0.23692	0.23692
VAR022	-0.15956	0.23676	-0.15110	0.15110	0.15110	-0.08784	0.19942	-0.35974	0.13135	-0.32333	0.33466	0.23692	0.23692
VAR023	0.78755	0.00687	-0.10067	0.00687	0.19978	0.05395	-0.39148	-0.39148	0.03283	0.13226	0.19659	0.19659	0.19659
VAR024	0.67482	0.03722	0.24222	0.10632	0.24222	0.03283	-0.39148	-0.39148	0.03283	0.13226	0.19659	0.19659	0.19659
VAR025	0.62455	0.06083	0.10632	0.06083	0.24222	0.03283	-0.39148	-0.39148	0.03283	0.13226	0.19659	0.19659	0.19659
VAR026	0.31772	0.13487	0.08342	0.08342	0.24222	0.03283	-0.39148	-0.39148	0.03283	0.13226	0.19659	0.19659	0.19659
VAR027	0.10931	0.21551	0.33283	0.33283	0.24222	0.03283	-0.39148	-0.39148	0.03283	0.13226	0.19659	0.19659	0.19659
VAR028	0.36311	0.02591	0.33283	0.33283	0.24222	0.03283	-0.39148	-0.39148	0.03283	0.13226	0.19659	0.19659	0.19659
VAR029	0.44452	0.04772	0.12733	-0.03544	-0.02727	-0.04772	-0.10308	0.16755	-0.35096	-0.06131	0.46239	-0.06131	-0.35096
VAR030	0.73556	0.15965	0.01434	0.06643	0.02627	-0.02644	-0.13866	-0.11656	-0.35096	-0.06131	0.46239	-0.06131	-0.35096
VAR031	0.22571	0.30821	0.34675	0.02612	0.02627	-0.02644	-0.13866	-0.11656	-0.35096	-0.06131	0.46239	-0.06131	-0.35096
VAR032	-0.20931	-0.01970	0.37658	-0.17357	-0.14439	0.34631	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223	0.11095
VAR033	-0.33283	0.33283	-0.17357	-0.17357	-0.14439	0.34631	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223	0.11095
VAR034	-0.20825	0.15889	-0.16216	-0.16216	-0.14439	0.34631	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223	0.11095
VAR035	0.13578	0.13578	-0.16216	-0.16216	-0.14439	0.34631	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223	0.11095
VAR036	0.05733	0.32780	-0.15562	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223	0.11095
VAR037	0.51973	-0.36137	0.11387	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223	0.11095
VAR038	0.34646	-0.10442	0.12605	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223	0.11095
VAR039	-0.31435	-0.01405	-0.12605	-0.12605	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR040	0.73633	-0.05075	-0.12605	-0.12605	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR041	0.35203	0.79125	-0.32122	-0.32122	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR042	0.39309	0.09449	-0.32122	-0.32122	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR043	-0.11013	0.04449	-0.32122	-0.32122	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR044	-0.57101	0.35825	-0.20778	-0.20778	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR045	-0.11879	-0.11759	-0.36303	-0.36303	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR046	-0.22932	0.37448	-0.14176	-0.14176	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR047	-0.20358	0.20358	-0.30444	-0.30444	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR048	0.36721	-0.26728	0.11932	0.11932	0.26442	0.26442	-0.17924	0.25574	0.18339	0.10535	-0.26223	0.11095	-0.26223
VAR049	0.11794	0.35730	-0.36497	0.27785	0.27785	0.04426	0.21553	-0.37092	-0.37092	0.16833	0.33510	0.26509	-0.37510
VAR050	0.13734	0.35730	-0.36497	0.27785	0.27785	0.04426	0.21553	-0.37092	-0.37092	0.16833	0.33510	0.26509	-0.37510
VAR051	0.22827	0.31566	-0.30811	0.76030	0.29249	-0.12533	0.37293	0.14214	0.00380	-0.00703	0.26676	-0.22577	-0.13755
VAR052	0.32697	0.31565	-0.30811	0.76030	0.29249	-0.12533	0.37293	0.14214	0.00380	-0.00703	0.26676	-0.22577	-0.13755
VAR053	0.27303	0.17953	-0.30503	0.05935	0.81269	-0.00332	0.11605	0.35352	-0.35352	0.17719	0.32655	-0.32655	-0.32655
VAR054	0.16868	0.19793	-0.31557	0.14873	0.84245	-0.00332	0.11605	0.35352	-0.35352	0.17719	0.32655	-0.32655	-0.32655
VAR055	-0.31166	0.08186	-0.17011	0.39032	0.52445	0.15512	-0.06432	0.02115	0.15653	-0.32655	0.32655	0.32655	0.32655
VAR056	-0.34684	0.55135	0.39447	0.12890	0.36040	0.07996	0.15348	0.35554	0.32333	0.32333	0.32333	0.32333	0.32333

The Newington Room

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	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10	FACTOR 11	FACTOR 12
VAR001	0.56079	0.12426	0.17192	0.17655	0.27493	0.07661	0.26625	-0.11999	-0.10281	0.01324	-0.27023
VAR002	0.87539	0.11729	0.13329	0.26285	0.00276	-0.09955	-0.04525	-0.03799	-0.39280	0.02427	-0.34122
VAR003	0.90355	0.15120	0.22937	0.20555	-0.32227	-0.10286	-0.08777	0.06094	0.06094	0.06557	-0.03853
VAR004	0.81991	0.14859	0.23050	0.15696	-0.04439	-0.01975	-0.21035	-0.13011	-0.31619	-0.06752	-0.01378
VAR005	0.70191	0.12787	0.24023	0.24994	0.07015	0.33135	-0.26890	0.32379	-0.36174	-0.01713	-0.02793
VAR006	0.46506	0.19133	0.13122	0.01756	-0.13431	-0.09669	0.09860	0.32879	-0.36174	0.06648	0.26610
VAR007	0.75249	0.14887	0.10666	0.11255	-0.17737	0.31235	-0.22157	0.02144	-0.04123	0.06648	0.26610
VAR008	0.16393	0.04472	0.81873	0.07710	0.17737	0.14582	-0.22157	0.02144	-0.04123	0.06648	0.26610
VAR009	0.55352	-0.01238	0.17362	0.51114	0.32635	-0.05133	-0.04050	0.32547	-0.36174	0.06648	0.26610
VAR010	0.18120	-0.06425	0.37624	0.31176	0.35617	0.02413	-0.13455	-0.32530	-0.36174	0.06648	0.26610
VAR011	0.56485	-0.07248	-0.06461	-0.11136	-0.00794	0.16493	-0.14575	0.32530	-0.36174	0.06648	0.26610
VAR012	0.53368	0.07248	0.11086	0.11747	0.55611	0.14670	0.02166	0.12750	-0.36174	0.06648	0.26610
VAR013	0.87138	0.02586	0.23522	0.17476	0.27552	0.40733	0.02661	0.12750	-0.36174	0.06648	0.26610
VAR014	0.50873	0.16837	-0.23920	0.23929	0.26779	0.42454	-0.08973	0.12934	-0.09740	0.12934	0.12934
VAR015	0.16007	0.11929	0.31191	0.19146	0.77601	0.03753	-0.12934	-0.03672	-0.10335	-0.10335	-0.10335
VAR016	-0.35601	-0.08725	0.23333	0.23333	0.62031	0.02019	-0.00852	-0.10335	-0.10335	-0.10335	-0.10335
VAR017	0.52236	-0.01283	0.31845	0.61432	0.33449	0.27735	-0.00852	-0.10335	-0.10335	-0.10335	-0.10335
VAR018	-0.24872	-0.01657	0.51829	0.10859	0.30559	0.27735	-0.15534	-0.10335	-0.10335	-0.10335	-0.10335
VAR019	0.29026	-0.31116	-0.23116	0.14054	0.50263	0.21480	-0.09840	0.32518	0.26327	0.10738	0.10738
VAR020	0.17119	0.38663	-0.23643	-1.8537	0.27273	0.20317	0.68667	-0.00021	-0.10335	0.10738	0.10738
VAR021	-0.02233	0.16588	-0.23643	-1.8537	0.27273	0.20317	0.68667	-0.00021	-0.10335	0.10738	0.10738
VAR022	0.14672	0.15027	0.14113	0.23337	0.33449	0.06618	0.25753	0.37812	-0.08354	-0.08354	-0.08354
VAR023	0.20827	0.15027	0.14113	0.23337	0.33449	0.06618	0.25753	0.37812	-0.08354	-0.08354	-0.08354
VAR024	0.62708	0.14552	-0.20826	0.81306	0.47137	0.56055	-0.02146	0.18039	0.37812	-0.08354	-0.08354
VAR025	0.50187	0.35357	-0.20826	0.81306	0.47137	0.56055	-0.02146	0.18039	0.37812	-0.08354	-0.08354
VAR026	0.53357	0.18787	-0.20826	0.81306	0.47137	0.56055	-0.02146	0.18039	0.37812	-0.08354	-0.08354
VAR027	0.54623	-0.02745	0.29752	0.66637	-0.04055	0.60030	-0.04722	0.37812	-0.08354	-0.08354	-0.08354
VAR028	0.10639	-0.10977	0.35599	0.11332	-0.35817	-0.35817	-0.18611	0.37812	-0.08354	-0.08354	-0.08354
VAR029	0.99046	0.06526	-0.23858	0.67697	-0.06456	0.18687	-0.23811	0.21386	0.29555	-0.03099	-0.17431
VAR030	0.36703	0.11062	-0.12835	0.13132	0.35777	0.62617	-0.06456	0.29555	-0.03099	-0.17431	-0.17431
VAR031	0.66494	-0.15523	0.34477	0.11076	0.46477	0.46477	0.06011	0.32328	0.11615	0.14432	0.14432
VAR032	-0.11136	-0.10371	-0.37955	0.39839	0.22119	0.35411	0.27511	-0.32672	0.03812	0.15946	0.15946
VAR033	0.19222	-0.13391	0.20314	0.61432	0.11132	0.06435	0.24237	-0.32672	0.03812	0.15946	0.15946
VAR034	0.51713	0.13391	0.20314	0.61432	0.11132	0.06435	0.24237	-0.32672	0.03812	0.15946	0.15946
VAR035	0.16113	-0.25977	-0.16378	0.30132	0.10032	-0.07608	-0.24855	-0.32672	0.03812	0.15946	0.15946
VAR036	0.15019	0.27440	0.35693	0.35693	0.35693	-0.03059	-0.05976	-0.32672	0.03812	0.15946	0.15946
VAR037	0.22238	0.53442	0.25695	0.11133	0.18990	-0.20177	-0.03017	0.35693	-0.10520	-0.16027	-0.16027
VAR038	0.33527	-0.30571	-0.26523	0.13397	0.27930	0.23452	-0.26666	-0.01059	0.35693	-0.16027	-0.16027
VAR039	0.72028	0.32242	0.12253	0.25254	0.10212	0.09853	-0.10926	0.18032	0.29178	0.29178	0.29178
VAR040	0.67676	-0.06932	0.10056	0.25936	0.16663	0.17862	-0.32672	0.29178	0.29178	0.29178	0.29178
VAR041	0.74160	-0.35835	0.11262	0.23949	0.03311	0.15863	-0.11795	0.18876	-0.15437	-0.15437	-0.15437
VAR042	0.11240	0.72412	0.16075	0.07136	-0.14632	0.18863	-0.22372	0.02727	0.02727	0.02727	0.02727
VAR043	0.37725	0.15126	0.23712	0.11554	-0.14632	0.18863	-0.22372	0.02727	0.02727	0.02727	0.02727
VAR044	0.64609	-0.06355	0.24193	0.25956	0.16737	0.18124	0.01611	0.10706	-0.19652	-0.19652	-0.19652
VAR045	-0.06287	-0.05351	-0.29163	-0.16932	-0.29732	-0.25521	-0.22112	0.10706	-0.19652	-0.19652	-0.19652
VAR046	0.47952	0.14039	0.21333	0.25851	0.60089	0.16486	-0.22112	0.10706	-0.19652	-0.19652	-0.19652
VAR047	0.23950	0.26020	0.01803	0.15512	0.06937	0.03163	-0.22112	0.10706	-0.19652	-0.19652	-0.19652
VAR048	0.28683	0.25539	0.26572	0.71450	0.00890	-0.02369	-0.11473	0.21683	0.34884	0.34884	0.34884
VAR049	0.18411	0.25539	0.26572	0.71450	0.00890	-0.02369	-0.11473	0.21683	0.34884	0.34884	0.34884
VAR050	0.24526	0.27798	0.23651	0.21058	-0.11473	0.21683	-0.22112	0.10706	-0.19652	-0.19652	-0.19652
VAR051	0.06625	0.81894	0.11932	0.18801	-0.10108	0.15896	-0.22112	0.10706	-0.19652	-0.19652	-0.19652
VAR052	0.19436	0.19765	0.38935	0.46259	0.09411	0.07516	-0.01874	0.34649	0.00669	0.18037	0.18037
VAR053	0.37888	0.27451	0.20802	0.56481	0.08899	0.23375	-0.21011	-0.29813	0.29813	0.29813	0.29813
VAR054	0.53936	0.26879	-0.20802	0.68229	0.08899	0.23375	-0.21011	-0.29813	0.29813	0.29813	0.29813
VAR055	0.44099	0.16167	-0.20802	0.68229	0.08899	0.23375	-0.21011	-0.29813	0.29813	0.29813	0.29813
VAR056	0.10813	0.27137	0.15913	0.15913	0.15913	0.15913	0.15913	0.15913	0.15913	0.15913	0.15913

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The Powell Room

VARIANX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10	FACTOR 11	FACTOR 12	FACTOR 13
VAR001	0.46683	0.18857	0.468273	-0.30558	0.15775	-0.10541	0.09726	0.09280	0.00935	-0.04253	-0.14817	0.07821	0.12130
VAR002	0.41199	0.06323	0.19610	0.12232	0.26735	-0.00384	0.23998	0.11175	0.02891	-0.14636	-0.09415	0.07697	0.06402
VAR003	0.45526	0.02562	0.12638	0.12638	0.12638	-0.00384	0.23998	0.11175	0.02891	-0.14636	-0.09415	0.07697	0.06402
VAR004	0.40886	0.20059	0.21110	0.15709	0.14885	0.01983	0.03615	0.18628	0.03615	0.02478	-0.02466	-0.01771	-0.01833
VAR005	0.17850	-0.11141	0.26437	0.13457	0.19937	0.11076	-0.08118	0.08305	-0.01053	-0.04126	0.09289	-0.00615	-0.03035
VAR006	0.19415	-0.05572	0.21579	0.13457	0.19937	0.11076	-0.08118	0.08305	-0.01053	-0.04126	0.09289	-0.00615	-0.03035
VAR007	0.15209	0.19171	0.19365	0.19365	0.19365	0.19365	0.19365	0.19365	0.19365	0.19365	0.19365	0.19365	0.19365
VAR008	0.22120	-0.14795	0.19196	0.19196	0.19196	0.19196	0.19196	0.19196	0.19196	0.19196	0.19196	0.19196	0.19196
VAR009	0.52745	0.00120	0.23937	0.35623	0.15793	0.19006	0.08493	0.20560	0.12327	0.04993	-0.17765	0.20331	0.22277
VAR010	0.51518	0.04623	0.34727	0.35623	0.15793	0.19006	0.08493	0.20560	0.12327	0.04993	-0.17765	0.20331	0.22277
VAR011	0.01217	0.03579	0.13371	-0.04089	0.35492	0.13433	0.20923	0.33355	0.13304	0.03157	-0.03457	0.14883	0.08120
VAR012	0.38928	0.03759	0.13371	-0.04089	0.35492	0.13433	0.20923	0.33355	0.13304	0.03157	-0.03457	0.14883	0.08120
VAR013	0.82401	0.03854	0.16024	0.20041	0.20041	0.15669	0.15119	0.19641	0.09441	0.06090	0.09214	0.10132	0.11745
VAR014	0.40925	-0.00123	0.12037	0.19031	0.21913	0.11717	0.06581	0.13693	0.24448	-0.08387	0.13137	0.10132	0.11745
VAR015	0.29288	-0.46755	0.11355	0.19031	0.21913	0.11717	0.06581	0.13693	0.24448	-0.08387	0.13137	0.10132	0.11745
VAR016	0.18042	-0.12691	-0.26643	0.21218	-0.04532	-0.16735	-0.26034	0.33227	0.21413	0.13137	-0.11215	-0.03451	-0.03451
VAR017	0.18042	-0.12691	-0.26643	0.21218	-0.04532	-0.16735	-0.26034	0.33227	0.21413	0.13137	-0.11215	-0.03451	-0.03451
VAR018	-0.24149	-0.14493	-0.35310	-0.12117	0.34345	0.22813	-0.15064	-0.11215	-0.11215	-0.11215	-0.11215	-0.11215	-0.11215
VAR019	0.18421	-0.00466	-0.14801	-0.03363	0.06612	0.04464	0.61537	0.11839	-0.10243	0.25119	-0.16999	-0.07817	-0.07817
VAR020	0.36029	-0.02723	0.77327	0.47766	0.11036	0.14050	-0.15555	0.37225	0.33858	0.14226	-0.12544	-0.07723	-0.07723
VAR021	0.30089	-0.02062	0.70163	0.12316	0.37994	-0.01852	-0.05827	0.38776	0.33858	0.14226	-0.12544	-0.07723	-0.07723
VAR022	0.55626	0.45811	0.53281	0.05520	0.21312	-0.02128	-0.01338	0.16554	0.15913	0.30637	0.02367	-0.02367	-0.02367
VAR023	0.39033	0.05647	0.37875	0.37875	0.57435	-0.12098	-0.02161	0.32818	-0.03953	0.34421	-0.18976	0.20032	0.18181
VAR024	0.70415	0.24678	0.12832	0.10793	0.12336	-0.06527	-0.09350	0.32818	-0.03953	0.34421	-0.18976	0.20032	0.18181
VAR025	0.13255	0.01177	0.14483	-0.12171	0.11727	0.21547	-0.31734	0.15211	-0.03953	0.34421	-0.18976	0.20032	0.18181
VAR026	0.44460	0.01177	0.14483	-0.12171	0.11727	0.21547	-0.31734	0.15211	-0.03953	0.34421	-0.18976	0.20032	0.18181
VAR027	0.35905	0.05265	0.02740	0.14530	0.25539	0.00943	-0.51532	0.38871	-0.03953	0.34421	-0.18976	0.20032	0.18181
VAR028	0.39285	0.32727	0.02740	0.14530	0.25539	0.00943	-0.51532	0.38871	-0.03953	0.34421	-0.18976	0.20032	0.18181
VAR029	0.17305	-0.03179	-0.10246	0.46833	0.10720	-0.01252	-0.30706	0.32944	0.37555	0.16114	-0.16114	-0.16114	-0.16114
VAR030	0.23108	-0.10317	-0.10246	0.46833	0.10720	-0.01252	-0.30706	0.32944	0.37555	0.16114	-0.16114	-0.16114	-0.16114
VAR031	0.34487	0.02641	0.13468	0.08711	-0.02146	0.03815	-0.03558	0.19596	0.16730	0.46833	0.46833	0.46833	0.46833
VAR032	0.34487	0.02641	0.13468	0.08711	-0.02146	0.03815	-0.03558	0.19596	0.16730	0.46833	0.46833	0.46833	0.46833
VAR033	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR034	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR035	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR036	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR037	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR038	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR039	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR040	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR041	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR042	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR043	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR044	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR045	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR046	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR047	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR048	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR049	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR050	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR051	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR052	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR053	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR054	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR055	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181
VAR056	0.37636	0.02351	0.13759	0.00339	0.07574	-0.08115	-0.30011	0.11655	-0.06413	0.34421	-0.18976	0.20032	0.18181

The Wentworth Room

VARIAN ADJUSTED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10	FACTOR 11	FACTOR 12	FACTOR 13
VAR001	0.04372	0.09005	-0.00394	0.16699	-0.03037	0.12259	0.05555	-0.05090	-0.06970	0.03698	-0.01145	0.03945	
VAR002	0.26178	0.17818	0.08856	0.07754	-0.08536	0.06475	0.05656	-0.03492	-0.03492	0.03945	0.01058	0.01079	
VAR003	0.04635	0.12625	0.00455	0.13617	-0.01211	0.06074	0.17688	0.11572	0.10056	0.03058	-0.03827	0.03049	
VAR004	0.30728	0.10658	0.00758	0.14659	0.00001	0.11441	-0.03093	0.22645	0.12559	0.06253	0.02368	0.02182	
VAR005	0.74931	0.15693	0.12725	0.15793	0.10691	0.18792	-0.02523	-0.02735	0.05912	0.05912	0.11704	0.03684	
VAR006	0.79769	0.03753	0.01306	0.09675	-0.01729	0.28696	-0.03321	-0.02644	0.05912	0.05912	0.05912	0.05912	
VAR007	0.71506	0.13916	-0.02723	0.03421	0.01021	0.32339	0.07574	-0.01553	0.06223	0.06223	0.06223	0.06223	
VAR008	0.14328	0.07443	0.09093	0.07447	0.01021	0.32339	0.07574	-0.01553	0.06223	0.06223	0.06223	0.06223	
VAR009	0.22545	0.03443	0.16606	0.02119	0.02425	0.23968	0.02514	-0.01167	0.03443	0.03443	0.03443	0.03443	
VAR010	0.50881	0.02843	-0.16986	0.02119	0.02425	0.23968	0.02514	-0.01167	0.03443	0.03443	0.03443	0.03443	
VAR011	-0.14532	-0.14732	0.58459	-0.12235	0.12435	0.12435	0.12435	0.12435	0.12435	0.12435	0.12435	0.12435	
VAR012	0.23863	0.02335	-0.10078	0.11051	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	
VAR013	0.79318	0.05993	0.08373	0.13119	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	
VAR014	0.37273	0.16113	0.08373	0.13119	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	0.04553	
VAR015	0.22745	-0.09433	-0.09317	0.22712	-0.09317	-0.17132	-0.09317	-0.09317	-0.09317	-0.09317	-0.09317	-0.09317	
VAR016	-0.32786	-0.03714	0.01491	0.17921	0.16464	0.16464	0.16464	0.16464	0.16464	0.16464	0.16464	0.16464	
VAR017	0.11893	0.03460	0.03074	0.21013	0.09082	0.09082	0.09082	0.09082	0.09082	0.09082	0.09082	0.09082	
VAR018	-0.53312	0.02969	0.13662	0.03776	0.03776	0.03776	0.03776	0.03776	0.03776	0.03776	0.03776	0.03776	
VAR019	0.24423	0.03541	0.03448	0.17776	0.08874	0.08874	0.08874	0.08874	0.08874	0.08874	0.08874	0.08874	
VAR020	0.24423	0.03541	0.03448	0.17776	0.08874	0.08874	0.08874	0.08874	0.08874	0.08874	0.08874	0.08874	
VAR021	0.65777	0.02819	-0.03708	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR022	-0.07093	0.02819	0.04482	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR023	0.12193	0.02819	0.11726	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR024	0.14427	0.11944	0.15082	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR025	0.70201	0.02819	0.12921	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR026	0.82779	0.05821	-0.03653	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR027	0.39746	0.03927	-0.18966	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR028	0.10646	0.16124	0.07385	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR029	0.46311	0.02207	0.00683	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR030	0.17362	0.05334	0.15235	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR031	0.74923	0.07927	0.15803	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR032	0.23557	0.07045	0.03653	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR033	0.13021	-0.01103	0.09823	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR034	0.29913	0.01059	-0.06453	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR035	-0.29135	0.02815	-0.10123	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR036	0.17412	0.03803	0.00945	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR037	0.41776	0.09723	-0.03221	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR038	0.39941	0.06335	0.12993	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR039	0.25826	0.02763	0.02526	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR040	0.36405	0.13159	-0.02004	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR041	0.27957	0.03443	0.05475	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR042	-0.13523	0.17233	-0.12195	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR043	0.62416	0.02425	0.16136	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR044	-0.4459	0.05035	0.08821	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR045	0.21563	0.03927	0.02535	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR046	0.34793	0.07927	-0.03622	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR047	0.06615	0.07742	0.07425	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR048	-0.21532	0.03651	-0.12811	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR049	0.07319	0.03651	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR050	0.02250	0.03651	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR051	0.18354	0.07500	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR052	0.16333	0.07500	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR053	0.07321	0.07500	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR054	0.07321	0.07500	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR055	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR056	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR057	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR058	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR059	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR060	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR061	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR062	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR063	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR064	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR065	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR066	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR067	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR068	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR069	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR070	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR071	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR072	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR073	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR074	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR075	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR076	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	0.00993	
VAR077	0.15568	0.06460	0.07500	0.03448	0.00993	0.00993	0.						

APPENDIX E

FACTOR LOADINGS OF THE CONCEPTUAL LIVING ROOM

4.

LIT

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