INTERIOR DESIGN RESEARCH: A REVIEW OF THE LITERATURE

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Interiors research since 1966 is reviewed. Interior research is defined as data-based research applicable to the field of interior design. The only publications considered are those currently applicable and appropriate for the design professions: interior design and architecture. A discussion of applicability of design research is presented first. Then, an organization is developed to include basic knowledge, the design process (people, places and processes) and analysis. Next, the important contributions of research are presented according to the organization that had been developed. Finally, conclusions and recommendations are made.

Applicability of Interior Design Research

Published research contributing to the field of interior design is found primarily within the disciplines of Anthropometry, Architecture, Environmental Psychology, Housing and Home Economics, and Human Factors (called economics outside the United States). At least thirty other disciplines or subject areas have provided research related to interior design problems. Other contributing fields include Acoustics, Anthropology, Art, Cartography, Computer Science, Demography, Ecology, Engineering, Ethnology, Geography, Gerontology, Illuminating Engineering, Industrial Design, Landscape Architecture, Law, Linguistics, Medicine, Operations Research, Ophthalmology, Optics, Orthopedics, Physiology, Psychiatry, Sociology, and Urban Planning (Kleeman, 1981, p. lx).

Anthropometry began as a field within physical anthropology that researched human body size. Today, it is considered a field within itself and often overlaps the works in ergonomics. Architecture is a discipline and profession concerned with building and planning structures. Environmental Psychology developed out of Social Psychology. "Environmental Psychology is a discipline that is concerned with the relationship between human behavior and the physical world." (Halseth, McFarling, 1978, p.2) It deals with all aspects of the physical environment (the built and natural environment) of which interiors is only one part.

Housing is the area of study concerned with buildings or parts of buildings "designed for occupancy by a single family or individual." (Kesler, 1978, p. 3) The interior is called the micro-environment in the field of housing. The interior aspect of this field addresses activities or processes taking place within the space. It also considers symbolism, socialization, mental health and ambient factors: lighting, temperature, acoustics, sanitation, and safety.
Economics is the study of the family as a social and consumer unit with areas of specialization including food and nutrition, home management, child and family development, interiors and housing.

Ergonomics, called human factors in the United States, is "the study of the relation between people and their work environment." (Aberg, 1977) It is an applied field that primarily deals with place and people problem-solving as it interfaces with process.

Each discipline is concerned with the quality of life for humans within the physical environment. Environmental psychology provides a theoretical framework of the environment and social behavior with the concepts of crowding, personal space, territoriality, privacy and density. (Hilmastra, McParling, 1978, p. 181-2)

Ergonomists are concerned with the well-being of humans. They consider many environmental factors: physical, chemical, physiological (both physiology and perception), psycho-social (freedom/confineement, communication, social contact, independence, responsibility and safety.) (Aberg, 1977)

A special contribution by ergonomists is a job design process that includes many integrative phases including data-collection. They have input from users, decision-makers and organizers. Their goal is to optimize the design for the whole system. See Appendix I for the ergonomists stages of project work: the technical part and the human contact part. (Aberg, 1977)

The fields of interior design and interior architecture would benefit from a translation of the interiors research. This research is scattered and written in discipline dialects that are unavailable and unintelligible to practicing designers. Even many educators and academicians in the field of interior design grapple for understanding, appropriateness and clarity. The goal of this paper is to develop an organization for interior design research appropriate to the field of interior design and to discuss the relevant conclusions of the current research.

Organization of Interior Design Research.

Interior design research can be applied to three aspects of design: basic knowledge, the design process and analysis of design. As research is translated for designers, usability of research is of primary consideration after the evaluating the validity of the research. Since interior design research is in its infancy stage, the aforementioned criteria and organization can provide a framework for further interior research and research translation.

"Basic knowledge" is the first category of this framework. This is commonly presented in book form. Environmental psychology has made a major contribution to this area. Issues like privacy, crowding, territory, personalization and personal space are aspects of human behavior relating to environment. They are definable objectives in human behavior used by people to maintain one's culture and one's mental health.

The second category is the "design process." This is the work of professional designers, including client identification, activity definition, and exploration of the space and its function. This is called programming and
involves all work prior to the actual designing of space; it is the process that precedes the drawing, model-making, critiquing, and installation. All of the aforementioned procedures are part of an interior designer’s work. The most appropriate use of research in this aspect of design is in the development of design guidelines.

The third category for interior design research is “analysis.” This includes studies of human behavior and human responses to the built interior environments; portions of the design field recognize the importance of post-occupancy studies for testing quality design. Such successful studies are conducted both within six weeks and after 6 months of occupancy. Likewise, environmental psychologists often conduct analysis studies within interior environments in order to find probable human responses and behavior patterns in certain situations.

Finally, facility planning and management also deals with analysis, especially for office spaces. They are the generalists (and the environmental psychologists are the research academics.) The facility planner integrates company objectives, management planning, human factors and the effects of the interior environment. They understand intangible factors such as personnel and the work process. The facilities planner makes decisions on space design in order to improve business organization and functioning. (Facilities Management Institute, 1982)

The environmental psychologist researches the “relationships in which the environment has an effect on” (Helmsley, McParling, 1978, p. 6) human behavior.

Applicable contributions of the literature since 1966.

**Basic Knowledge**

Within the category of “basic knowledge”, few publications have provided the data-based information needed by designers. A significant contribution is *The Challenge of Interior Design* by Walter Kleman. This 1981 publication represents research contributions from 30 disciplines (and subdisciplines). The text looks at general problems in interior design: liveliness of quality interiors, differences in various population groups, elements of design and health, seating, desk design and non-verbal communication. Also, Kleman addresses certain facilities: elderly spaces, mental health facilities, residences, offices, learning spaces and outer space. He, then closes the book with six case studies. This book addresses varied human factors. (Kleman, 1991)

Two other publications providing important adjacent, data-based information are in the field of environmental psychology: *The Environment and Social Behavior* by Irvin Altman and *Environmental Psychology* by Helmsley and McParling. Altman “presents an analysis of privacy, crowding, territory, and personal space.” (Altman, 1975, p. viii) Through direct application to interior design is not made, the integrative presentation provides important base-line knowledge. *Environmental Psychology* presents the discipline that is concerned with the relationships of the physical environment and human behavior. This book discusses research methods and human behavior in specific places: rooms and housing, offices, hospitals, social institutions, college dormitories, schools, and other commercial spaces. (Helmsley, McParling, 1978)
The field of housing, an area of specialty within home economics, has also made some contributions. Marjorie Kaiser in Part Three of Housing deals with the microenvironment: the interior. She addresses issues of personal activities (dressing, for example), work space (food preparation, laundry, etc.), leisure activities, organization and ambient factors. Numerous drawings, charts, plans and sections integrated into the text can provide the designer easy access to much of the data presented. Wheelchair mobile persons are considered, too. Zoning is developed into five sections: semi-private, operative, semiprivate, circulation and private. Also adjacency of zones is discussed. Finally, in part three is concluded with ambient factors. (Kaiser, 1978) Within part four of Housing Perspectives, selected readings are found appropriate to interiors. Issues of symbolism, socialization, safety, mental health and evaluation of floor plans are presented.

An additional important contribution to basic knowledge is A Pattern Language (Alexander, et. al., 1977). This publication develops design criteria and gives solutions for building elements associated with interior spaces.

Finally, Human Dimension and Interior Space makes an important contribution in the field of anthropometrics, the study of human body measurements on a comparative basis. This book deals with actual human body interfacing with individual parts of interior spaces. The first section introduces the designer to the field of anthropometry and its theories, limitations and applicability. The second section presents the hard data in the form of tables and illustrations. The third and final section presents the designer with design reference standards. These are scaled drawings of floor plans and wall sections showing appropriate space planning criteria according to anthropometric data. His book directly addresses itself to the interior designer and architect. (Ferencz, Kelik, 1979)

DESIGN PROCESS

Within the organizational category of the design process, contributions of interior design research must be presented in the form of design guidelines. This form of presentation should be similar to other reference materials. The architectural and interior design professions have reference materials dealing with space planning and designing; for example, the Architectural Graphic Standard. The design process developed during this century has included the use of these reference materials; there is a long standing history of using reference books. The professional designing interiors use interiors research when data is translated and presented in the form of guidelines or design reference standards.

Interior design research organized under the following categories; people, places and process, (Armstrong, D. and Dent, J.B., 1961) would well serve the design professions.

People

* "People" refers to the various population groups that, at this point in time, are rarely or recently considered in interior design, i.e. children.
handicapped, elderly. The publication Out of the Cellar and into the Parlor: Guidelines for the Adaptation of Residential Space for Young Children is the outstanding example of the guideline approach. This publication organizes the guidelines according to various rooms in the residence. Each section is preceded by a concise report of basic knowledge in the subject. It also presents the research methodology in its appendix. (Johnson, BACK, and Oster, 1980)

As the Human Dimension and Interior Space makes a major contribution when dealing with elderly and physically disabled people; chairbound and ambulant disabled people as well as mobile persons. Also, it presents charts of body size for men and women, boys and girls at interval years. It includes stature, eye height, elbow height, sixteen sitting dimensions, body reach, breadth and depth. The illustrated design standards are given for the full range of places. (Panzer, Zelnik, 1979)

Designing for the handicapped calls for barrier-free design, standards development and compliance, and specialized therapeutic environments. (Schweiklehorn and Hunter, EDAH 12, 1981) Designing for the Elderly integrates floor plans and sections with the written text. The chapters on programming, design, and technical standards would be most useful to the interior designer and architect. (Green, A.I.A. et. al., 1975) Spatial Behavior of Older People (Pestalas and Carson, 1980), also presents many major considerations for the design of the elderly.

Furniture arrangements preferred by the elderly are symmetrical and against the wall. (Hep, 1981) Lighting should be full spectrum in order to help maintain the elderly person's biochemical process. Also, the lighting plan should avoid excessive brightness, disability glare and reflections. (Hughes and Neer, 1981). "A review of published design standards, guidelines and recommendations about bedrooms in housing for the elderly...demonstrate that much remains to be done." (Parsons, 1981)

The design consideration of "places" related to the kind of space being designed. The major space breakdowns are residential (homes), commercial (places of business, offices, stores, restaurants, hotels and motels) and institutional (health care facilities, group residences and educational facilities). Also, individual rooms as a specialty space are considered within this category.

Two rooms that have been research are the bathrooms (Kira, 1976) and the elevator. A study of crowding in an elevator may be suggesting to the designer to develop other things for passengers to stare at especially materials that give a larger sense of space. The use of mirrors could be used and twisted, as well as existing materials like clear glass and mirrors.

Residential design refers to the design process for where people live or at least store their clothes. The home environment can indirectly and directly contribute to accidents and safety. Take, for example, the fact that an "increased portion of the population who are in good physical condition" are also more likely to avoid injury if an accident does happen, (Neuro, 1972). Therefore one might assume allowing...
space for recreation and exercise in homes could indirectly encourage safety. Often the environment can directly prevent accidents. For example, the materials chosen for bathroom flooring and bathtubs could be slip-proof. Also electrical outlets could be designed so small, children could not insert small metal objects. Electrical outlets in bathrooms increase the chance of electrocution occurring. Therefore, deforming bathrooms without the electrical outlet (or having them far away from water sources) would be appropriate. Also often the sinks and toilets act as a foot ladder for children reaching the medicine cabinet. Proper storage within children's reach should be low and easy to open. In the kitchen, designs are often arranged so one has to reach over the stove to get something out of an upper cabinet or storage unit. It may be wise to have no storage unit over the stove. Tempered glass could reduce injury from glass accidents. Using fire-proof unhulatory and slip-cover fabric would minimize burns injuries. Fewer corners on furniture could help young and old to have less injuries when they fall. (Neutra, 1972).

Falling is a major problem for home injury. Forty percent of the home accidental deaths are due to falls. Young children have the most falls. Small children learning to crawl and walk often create lots of anxiety for parents of young children as they approach stairs. The other group of people who fall often are the elderly. Falls especially involve stairs, slipping, and tripping over objects. The cushioning of a fall by using padding and carpeting might reduce injuries in the home. Adequate handrails are another issue. Handrails for showers, handrails for tubs, handrails for stairs are all important for elderly and handicapped and general safety. Poison is also a problem in American homes. But rarely is a home designed with special locking storage units for poisons that are used in the home. (Neutra, 1972).

Two rooms that are well researched are the bathroom and the bedroom when compared to other rooms in a home whether a house or apartment. The bathroom does a good job of analyzing bathroom use. One problem with this book is that very few of the recommended fixtures are available on the market. Also, the recommendations involve major changes in cultural habits which are very slow to change.

The bedroom was studied by a thorough review of the literature, including Altman, Kinsey and Consumer Reports. Persons looked at activities of bedroom users including sleeping, lying behavior, sexual activity, housekeeping, sitting, and observing. Also, he looked at ambience of furniture, decor, and furnishings, as well as, consumer information dealing with bed coverings and bed construction. He believes that more studies need to be done in the areas of sleep, bedding, and how a bedroom is used. (Parson, 1970).

Office design is becoming the most richly researched space. Unfortunately much of the research is conducted by firms who have not made public their results. Noise in the office environment has been a subject of some concern. One paper (Montgomery et. al., 1981) presents noise standards and various design alternatives. The acoustical consultants of BOM, Baranek and Newman, Inc. has prepared a final document on this subject. (Currie, 1979). It analyzes speech, noise and privacy, defines terms, and explains noise measurements. Finally, it provides advice to the designer.
Anthropomorphic design guidelines for posture are published. (Ayoub, 1973) It considers the physical well-being of the user during various tasks. Along the same line, but more in depth, is the book, Fitting the Task to the Man (Grandjean, 1978). It outlines the ergonomic approach to the design of the work environment.

Libraries have been researched very little. One study shows that design factor preference by user varies according to use: studying and social. A business-like environment isn't used much; whereas, an attractive environment is used for social reasons. (Krupat, and Altapher, 1976)

One study on museums (Nelson, 1972) found that visitors pay attention to the related positions of objects in museums, groupings of objects when referenced to eye level and the quantity of objects. Also double row display is less effective than single row display. The recommendation for a curator is to place as many objects as possible in a single row, a few inches apart.

An appropriate study of classrooms deals with desk design (Kira, 1980). Kira's article presents outstanding ideas for a functional desk designed for the many student activities. Much research remains to be done on places in buildings.

Process is the third consideration within the area of the design process. It relates to the activities and/or job being performed in a particular space. Also, it includes what people do and what activities and functions they perform.

The Bathrooms (Kira, 1976) represents a most thorough study measuring people's activities commonly performed in American bathrooms. Many recommendations are made for designing bathroom fixtures. The design field should have such studies for all aspects of human activity.

An other important publication is Visual Display Terminals - A Manual Covering Ergonomics, Workplace Design, Health, Safety and Task Organization. (Calk, Hart and Stewart, 1980) This book is the result of a two-year study by leaders in their field. It has five parts: VDT Basics, Light, Vision and Optical Characteristics of Visual Displays, Ergonomic Requirements for VDT's, Ergonomic Requirement for VDT Workplaces and the Health, Safety and Organizational Aspects of Working with VDT. Also, useful appendices are included.

Analysis

Analysis of an interior environment usually occurs after the space is completely constructed and installed. Some work has been done using scale models for spatial behavioral research. (Keesman, 1981, p. 184-187) There is a long history of scaled models being used for aesthetic analysis in architecture.

Evaluation of environments may be post-occupancy evaluation. A number of monographs of completed post-occupancy studies are available through the Institute for Environmental Education at the University of New Mexico, Albuquerque, New Mexico.
Clotis Heimath in Behavioral Architecture begins to address accountability in design. Since this book is written by an architect, it presents the psychological contribution to this design field in the language of the architect. It emphasizes analysis within the design process.

For the social scientists point of view, one could review Inquiry by Design: Tools for Environment Behavior Research (Bailey, 1981). It takes a serious look at research design interaction and presents six significant research methods. Whether one is concerned with post-occupancy studies, behavior patterns, design analysis or human response to interior space, information on analysis is available. Often, design researching firms will specialize in these aspects of interior design research.

Conclusions

Interior design research is beginning to make a mark on the design professions of interior design and architecture. Applicability to professional practice, validity and reliability of the data-base research are equal in importance. Academic contributions can be categorized in the following areas: basic knowledge, the design process (guidelines and design standards), and analysis. Often published literatures will extend into more than one of the categories of people, places, and process. "Professional transformation will largely depend on the future endeavors made in interior design education and professional research." (Hartman, Kiesew, and Giesey, 1977)

Recommendations

Additional interior research is needed in most areas. The practicing designer requires translation of academic literature and the establishing of reference guidelines and standards. These reference materials need to be categorized according to people (children, aged, handicapped), places (rooms, residential, commercial and institutional spaces) and processes (functions and activities people perform). Cross-referencing is needed for overlapping literature. Continuing development of design analysis will provide research methods for design evaluation and accountability. Translated research needs to be published in journals that practicing designers read. Also, this information should be presented at professional conferences.
Appendix 1

Enqvist's Stages of Project Work
(Easily adapted for Interior Design)

Technical Part

Preparation stage: physical measurements, interviews, organization studies, criteria, financing, restriction
Idea stage: lay-out, allocation, spatial conceptions
Priorities and selection: technical feasibility, cost, benefit, time aspect
Construction and development: experiments, drawing and design, models, computing, prototype, partial tests
Industrial adaptation: safety, production, learning, patents, strength of materials
Education: physical measurements, interviews, criteria achievement

Human Contact Part

Preparation stage: sponsors, interested industry, management, production personnel
Idea stage: Industrial Reference Group, Industrial Specialists
Priorities and selection: sponsor, industrial specialists, shop steward, trade union, production personnel, reference group
Construction and development: reference group, workers, management, production engineers, process engineers
Industrial adaptation: workers, shop steward, trade union, sponsors, production engineers, safety engineers, management, patent engineers, construction companies
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Abstract
Interiors research since 1966 is reviewed. Categories of research include: ergonomics, environmental psychology, research methods, specific types of environments in residential and commercial spaces. This research has implications for the nature of interior environments within the context of basic knowledge, programming, and analysis. These areas are interwoven with issues pertinent to people, process and places. Recommendations are made for research translation into design guidelines.

LA INVESTIGACIÓ D'AMBIENTS INTERIORES: UNA REVISIÓ DE LA LITERATURA

Resum
Nom reviure la investigació d'interiors des de 1966. Les categories de la investigació inclouen aspectes ergonòmics, psicologia de l'environament, mètodes d'investigació i tipus específics d'environaments en espais residencials i comercials. Aquesta investigació té implicacions en la natura dels entornos interiors en un context de coneixements bàsics, programació i analisi. Aquestes àrees estan vinculades a qüestions relatives a persones, procediments i llocs. Es fan recomendacions per aplicar la investigació a les línies-guia del disseny.

LA INVESTIGACIÓN DE AMBIENTES INTERIORES: UNA REVISIÓN DE LA LITERATURA

Resumen
Se revisa la investigación de interiores desde 1966. Las categorías de la investigación incluyen: aspectos ergonómicos, psicología del entorno, métodos de investigación y tipos específicos de entorno en espacios residenciales y comerciales. Esta investigación tiene implicaciones en la naturaleza de entornos interiores en un contexto de conocimientos básicos, programación y análisis. Estas áreas están vinculadas a cuestiones concernientes a personas, procedimientos y lugares. Se hacen recomendaciones para aplicar la investigación a las líneas-guía del diseño.