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BEHAVIOR AND ARCHITECTURE

The relationship between architecture and human behavior has recently emerged through a field commonly known as environment and behavior. This discipline is also termed environmental psychology, people–environment studies, design–behavior, people–environment relations, and environment–behavior studies. Its roots lie in the links between the environmental design professions (architecture, interior design, landscape architecture, and city planning) and the social sciences (psychology, sociology, anthropology, and geography). This field has both a theoretical side, attempting to explain and predict phenomena related to environment and behavior, and an applied side, seeking to implement findings from various research endeavors to specific design projects.

One of the most comprehensive accounts of both the history and theory of environment and behavior can be found in Gary Moore’s chapter in the Handbook of Environmental Psychology (1). Much of the first two sections of this article are based on Moore’s work. For a more complete review of these two topics, consult the original work. It is a valuable resource to anyone seriously intrigued by field.

BRIEF HISTORY OF THE FIELD

Environment and behavior first became a recognized discipline in the 1960s with the establishment of the Environmental Design Research Association in 1968 and the inaugural issue of the Journal Environment and Behavior in 1969. Widespread systematic research in the United States began in earnest in the late 1960s and early 1970s. However, the origins of many concepts central to environment and behavior were stated much earlier. For instance, the notion of environmental symbolism, a concept that only recently attracted the attention of researchers, was foreshadowed by the writings of the influential nineteenth-century landscape architect Andrew Jackson Downing in his book The Architecture of Country Houses. In it, he wrote, “... much of the character of every man may be read in his house” (2). In 1938, social critic Emily Post, in a book entitled The Personality of a House, elaborated on this idea when she wrote, “A front door of lovely design and perfect scale is like a beautiful hand held out in welcome. A hideously untidy door is like a dirty hand that is repellent to touch” (3). The symbolism accorded Japanese gardens has been described for centuries. The publication of Kevin Lynch’s landmark book The Image of the City in 1960 helped launch the beginning of environment–behavior research in the environmental design professions (4). Lynch, an urban planner and professor at the Massachusetts Institute of Technology (MIT), was the first U.S. designer to challenge traditional modes of planning and design by carefully examining the everyday person’s reaction to cities and their buildings. His basic premise in this work and others that followed was that the opinion of the “person on the street” was just as, if not more, important than that of the design professional, be it the planner, the architect, the landscape architect, or other environmental decision maker. The Image of the City is still one of the most widely read books in the field. Lynch’s impact on the environmental design professions and on environment and behavior has been profound and long-lasting (5–8). The work of Lynch’s protege, Donald Appleyard, has had a similar influence on the field (9–12). With Man in Mind, a convincing plea for the use of behavioral research in environmental design written by city planner Constance Perin, also helped set this new field in motion (13).

Sim Van der Ryn and Murray Silverstein’s pioneering report on Dorms at Berkeley, published in 1967, took a similar stance toward the architectural profession (14).
Through systematic interviewing and observations of dormitory residents, these architectural researchers discovered that the ways in which the building's occupants and the architectural community evaluated these dormitories were remarkably different. Constructed in the late 1950s as part of a major program to house thousands of University of California, Berkeley, students, the buildings had received accolades and professional awards. To a great extent, however, students who participated in this study found their dormitories unsatisfactory, largely because of their inflexible architectural designs and because some of the assumptions made by the architects about student behavior in dormitories (e.g., that most students studied in their bedrooms) proved to be incorrect.

Environment and behavior's origins can also be traced back to early studies in its parent disciplines of psychology, sociology, geography, and anthropology. Berkeley psychologist Edward C. Tolman conducted early studies in the 1940s on cognitive maps of both animals and humans, setting the stage for further research in this area. A classic 1950s social psychology study discovered that the arrangement of the physical environment had a distinct influence on human behavior. Through systematic investigation, Festinger, Schachter, and Back discovered that friendship patterns of married students at MIT were closely linked to the relative location of their apartment units (15). Roger Barker and his colleagues were among the first psychologists to examine child development in its natural environment, as opposed to a psychological laboratory. Ecological psychology, a precursor of environment and behavior, was born out of this research in the early 1950s (16,17).

Research psychiatrist Humphrey Osmond's work, in conjunction with that of architect Kiyo Izumi, on the effects of psychiatric ward design on patient behavior, conducted in Canada in the 1950s, discovered the commonly used concepts of sociopetal space, which encourages group interaction, and sociofugal space, which discourages group interaction (18). Osmond's work spawned the work of Robert Sommer, a social psychologist, who described early environment-behavior research in mental hospitals, dormitories, and bars in another landmark book published in 1969 entitled Personal Space: The Behavioral Basis of Design (9). Along with Lynch's Image of the City, Personal Space is another of the most widely read and often cited works on environment and behavior. Sommer's other books have continued to have a major impact on sensitizing design professionals to users' needs (20–22).

Walter Firey's 1945 article on urban symbolism, followed in 1961 by Anselm Strauss's book Images of the American City and later by William Michelson's book Man and His Urban Environment, were among the earliest ecological accounts of environment-behavior issues (23–25). In 1947, geographer J. K. Wright was the first in a field to create the terms geosynergy or terrae incognitae to study them to analyze people's conceptions of their graphical environment (26). Two well-known books at addresses environment-behavior issues from yet another viewpoint were The Silent Language and The Hidden Dimension, written by Edward Hall, an anthropologist (7,28). These two books were mavericks in their field, cultural communication is affected by the use of the physical environment.

AN OVERVIEW OF ENVIRONMENT—BEHAVIOR THEORIES

A number of theorists have attempted to explain the complex relationship between environment and behavior. A variety of philosophical approaches, frameworks, conceptual models, and explanatory theories have been proposed over the years, reflecting the diverse, multidisciplinary nature of the field (1). As could be expected, no one theory has gained universal or even widespread acceptance. The development of theory is an evolutionary process, with constant revision and refinement. Theory is an interpretive endeavor, so that although some theoreticians may view an idea one way, others see it differently.

Philosophical Approaches

In a recent chapter for the Handbook of Environmental Psychology, theoretician Irwin Altman and his colleagues proposed that three philosophical approaches underlie research and theory in environment and behavior: interactional, organicist, and transactional. This typology is based on the philosophical frameworks of John Dewey, Arthur Bentley, and Stephen Pepper. The interactional approach considers environmental factors, personal or group qualities, psychological processes, and temporal variables each as independent entities. Interactional research and theory describes the dimensions of these variables, examines their interactions, and attempts to understand causal relationships among them. To a certain extent, some environment-behavior research on crowding, environmental perception, environmental cognition, and post-occupancy evaluations (POEs) of housing projects, workplaces, and other settings adopts an interactional approach by examining how personal and group factors interact with physical design characteristics to affect attitudes, satisfaction, performance, or other outcomes.

The organismic approach examines dynamic and holistic psychological systems in which personal and environmental components exhibit complex, reciprocal relationships and influences. This viewpoint emphasizes the overall complex pattern of relationships between system components rather than the characteristics of each element in isolation or in specific relationships with other elements. Some environment-behavior research incorporating this general framework includes work on hospitals, schools, dormitories, and elsewhere that views a number of subsystems (environmental, organizational, and personal) embedded in a larger system (29).

The transactional approach stresses that people, psychological processes, places, and temporal flow form intrinsic aspects of a whole and do not exist as separate elements (30). Aristotle was a major influence on this approach with his view of causation. Some phenomenological approaches to environment and behavior, particularly in the context of homes, are transactional in many respects (31,32). The phenomenological perspective especially addresses subjec-
ment, and affective orientations of people to places. Related to this is a recent study of residential autobiographies and residential histories (33).

Overarching Theories

The major theories put forth in environment and behavior parallel these philosophical approaches. Based on the work of sociologist Robert Merton, theorist Gary Moore has drawn a distinction between "big T" and "little t" theories. Big T theories are those overarching theories that relate to the field as a whole, whereas little t theories pertain to only a subdiscipline within the field (1).

Concerning big T theories, one of those most widely discussed during the early development of the field was environmental determinism, a viewpoint suggesting that environment determines behavior. However, determinism was soon viewed as being overly simplistic. Basically a causal model, it did not allow for any of the more subtle nuances that might better articulate this relationship.

Another major big T theory put forward soon after was interactionism. This theory was based on the model first proposed by psychologist Kurt Lewin, stating that

\[ B = f(P,E) \]

that is, that behavior is a function of the person and the environment. However, this has also been viewed as a relatively simplistic and often unidirectional model.

At present, one big T theory that has gained some support is the transactional theory (34). In contrast to the previous two, this theory emphasizes the reciprocal effects between the environment and psychological, behavioral, cultural, social, political, and economic processes. It views these variables as parts of an integrated system. Each variable can function as an independent, mediating, or dependent variable, depending on the particular situation. The transactional theory is helping to transform the nature of environment-behavior research from a focus on people's short-term reactions to isolated environmental conditions (such as lighting, density, or noise) to more complex compositions of activities, places, and time. Both the spatial and temporal dimensions of research have broadened. In addition, a more Gestalt approach to research has evolved. Rather than focusing strictly on cognition, stress, or behavior, for example, the current trend is toward analyzing the linkages among these diverse processes (1,34).

Theories Within Specific Areas of Environment and Behavior

A variety of little t theories have been proposed to help explain several subdisciplines within environment and behavior. For example, the Gestalt theory has been linked to the study of environmental perception, suggesting that people perceive the environment as a whole, greater than the sum of its parts, rather than as a group of discrete entities. Developmental theories have been offered to help explain how children acquire mental images of spaces and places over time. The arousal theory has been used to address the study of performance in learning and work optimal level of arousal, caused by noise for example, can help make individuals more alert and attentive, often benefiting performance on simple tasks. However, when noise is intense, it can lead to a state of overarousal, which adversely affects task performance. The theory of information overload has been used to help explain how people respond to crowded conditions in cities.

The evolution of theoretical perspectives in environment and behavior is significant because it has helped shape and direct the nature of research in the field. Much more can be said about theory than space permits here. For a more comprehensive review, consult Refs. 1, 29, and 34. In sum, these theorists suggest that the field is simply maturing from a stage of descriptive research to one of causal research and to the notion of multiple complex causalities with respect to time.

AN OVERVIEW OF ENVIRONMENT-BEHAVIOR RESEARCH METHODS

One of the chief features of environment and behavior that distinguishes it as a separate discipline, related to but distinctly different from architectural criticism, is its reliance on specific research methods. Architectural critics typically base their impressions of buildings on their own opinions of good architecture. Environment-behavior specialists base their views of architecture primarily on research about the buildings' occupants. Understanding users' assessments of architectural work is often achieved through the use of POEs. See Table 1 for a comparison of architectural criticism and POE.

Once a research problem has been clearly defined, environment-behavior researchers work out a research design that attempts to answer the problem. Research design is the arrangement of conditions to collect and analyze data in a way that is relevant to the purpose of the research. The purpose of a research endeavor generally falls into a number of broad groupings: formulative or exploratory studies to gain familiarity with or to achieve new insights into a phenomenon; descriptive studies to portray characteristics of a particular individual, situation, group, or place (with or without an initial hypothesis) or to determine the frequency with which something occurs or of its association with something else; and studies that test a causal hypothesis of a relationship between variables. For more information on research design, data collection, and analysis consult Refs. 36–39.

Once a research design has been established, a set of research methods is selected to collect the desired information. A sample is chosen from which to collect information, a standardized procedure is developed for collecting and checking the data, and the results are analyzed and reported.

Research methods used in environment and behavior are derived from parent disciplines in the social sciences, primarily psychology and sociology. The most widely used data-gathering techniques are divided into two categories: unobtrusive and obtrusive. When using unobtrusive techniques, the researcher typically does not talk with users,
<table>
<thead>
<tr>
<th>Architectural Criticism</th>
<th>POE</th>
</tr>
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<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td><strong>Communicate views to professional peers and often to the public</strong></td>
</tr>
<tr>
<td><strong>General orientation</strong></td>
<td><strong>Subjective, seen from the individual critic’s viewpoint.</strong></td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td><strong>Primarily on aesthetics—quality of design and its place in the history of artistic ideas and concepts.</strong></td>
</tr>
<tr>
<td><strong>Typical process</strong></td>
<td><strong>Visit site, examine photographs or other buildings by the same designer—methods depend on the critic.</strong></td>
</tr>
<tr>
<td><strong>Timing</strong></td>
<td><strong>Typically occurs after final drawings are produced, but before building is completed or occupied. Sometimes occurs soon after building completion.</strong></td>
</tr>
<tr>
<td><strong>Origins</strong></td>
<td><strong>Criticism in the arts—music, drama, the literary world, etc.</strong></td>
</tr>
<tr>
<td><strong>Similarities</strong></td>
<td><strong>Examine historical context of a building. Examine circumstances leading to the design of a building. Examine issues such as circulation, image, and fit into local context.</strong></td>
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<tr>
<th>Architectural Criticism</th>
<th>POE</th>
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</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td><strong>Give immediate feedback for a given project. Develop information for future designs—offer feedback to designers, managers, and users.</strong></td>
</tr>
<tr>
<td><strong>General orientation</strong></td>
<td><strong>Objective, using systematic methods of investigation to gain the users’ viewpoints.</strong></td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td><strong>Examines aesthetics, but simply as one of many design elements affecting users.</strong></td>
</tr>
<tr>
<td><strong>Typical process</strong></td>
<td><strong>Uses relatively standard and tested procedures of investigation so that information is not biased.</strong></td>
</tr>
<tr>
<td><strong>Timing</strong></td>
<td><strong>Occurs after occupants move into building— Can be relatively soon after occupancy and can be checked periodically.</strong></td>
</tr>
<tr>
<td><strong>Origins</strong></td>
<td><strong>Social sciences.</strong></td>
</tr>
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*Ref. 35.*

nor are users even aware that they are being studied; since people are less likely to react to being the subject of investigation, this is often referred to as nonreactive research. The use of obtrusive techniques, however, implies that the users are contacted and that they are aware of the study; since, in this instance, people are more likely to react to being studied, such techniques are often termed reactive measures.

Data-gathering techniques can also be viewed along a spectrum from quantitative to qualitative. Quantitative ally does not. Furthermore, all data-gathering techniques need to be assessed for their reliability, that is, the extent to which a research instrument is likely to produce similar results when replicated, and their validity, the extent to which the instrument in fact measures what is intended. Much of the following section is based on Ref. 40.

Depending on the information desired, observations of the behavior of building occupants and passers-by on the street may span sizable periods of time, such as a week or a month, and take into account different times of day, days of the week, and if an outdoor space is observed, weather or time of year. Researchers systematically seek to answer the following types of questions: Who is doing what with whom? In what relationship, in what context, and where? Among the types of behavior observed are the simple presence or absence of people; if they are sitting, standing, walking at a leisurely pace, or rushing by; if they are alone or in groups; if they are silent or talking with others; if they are eating, reading, or simply people-watching; how long they stay; and specifically where they are located in a particular setting. The particular kinds of behavior observed will depend on the concerns of each study.

Behavior observations are often recorded through behavioral mapping techniques, which plot out specific behaviors and their frequency on a floor plan, site plan, map, or penciled checklist and often use photography (time-lapse photography is especially useful), film, or videotape.

Physical traces involve examining the physical surroundings to learn clues about previous behavior. For example, by-products of use include places where steps are worn down and empty apartment balconies. Office partitions erected long after building completion are types of adaptations for use. Photographs hung on a wall or numbers displayed in front of a home are displays of self. Commercial signs and graffiti writings are examples of public messages (40). Another distinction can be drawn between accretion (what people have added to the environment) and erosion (what they have taken away).

Archives are used in environment–behavior research to examine data gathered for one purpose and transform it into useful information for another (40). These usually take one of three forms: words, numbers, or graphic representations. Examples of archival data that researchers might use include a speech delivered at the opening ceremonies of a new building, written architectural criticism of a building in professional architectural journals, and absenteeism or turnover rates in an office. Diagrams, photographs, plans, sketches, drawings, and models are especially useful archives for architects.

Interviews are commonly used to gain firsthand responses from either users or nonusers of a particular building or space. They differ from questionnaires and surveys in that they involve either a face-to-face or telephone conversation and in that responses are oral. A structured interview uses a predetermined set of questions, whereas an unstructured one involves a much looser free-flow of information. Questions can be either open-ended, as in
choose from several predetermined categories, as in a multiple-choice test. The purpose of interviews in environment–behavior is generally to learn how strongly a respondent feels about a particular situation or environment. Understanding this kind of information can help designers establish priorities and decide on tradeoffs for design decisions, such as privacy vs safety.

Questionnaires are similar in purpose to interviews, as is the type of questions asked. They differ from interviews, however, in that they are generally administered to a large group of people simultaneously and are often sent by mail. Any confounding effects of the interviewer–interviewee interaction are removed through the use of questionnaires. Responses are written, and little or no verbal contact is made with each respondent. Compared to interviews, questionnaires are a less costly and less time-consuming way of gathering information, and they have been used increasingly in recent environment–behavior research.

Cognitive maps are used to help understand people’s images of buildings, open spaces, neighborhoods, and cities. They are among the commonly used techniques for studying environmental cognition, or people’s mental representations of their physical environment. Much as in a geography class, people are asked to draw maps of an area or to identify places or parts of a building on a pre-drawn map or plan. Researchers then note such features as the order, content, strength, and accuracy of a map. Cognitive mapping is a useful way to record orientation and how people find their way around environments, and it has design implications, primarily in the area of circulation.

Time-budget studies are sometimes used in environment–behavior research to record what a person has done during a specific period of time and where that set of activities occurred. The format of these studies is either precoded or open-ended and is often similar to that of a diary.

Environmental simulation is a way of showing representations of the environment to groups of individuals. The intention is to replicate closely an existing or proposed environment and to measure people’s reactions to it. Environmental simulation involves going beyond drawings, plans, and models typically used by architects. A movie camera is sometimes used to document the effect of traveling through a model. In recent years, computers have begun to be used for the same purpose, and it is expected that they will be widely used in the future.

Gaming uses simulated representations of buildings and rooms in workshops for designers and users. Gaming examines real-life situations and helps people deal with changing, complex environmental problems. A variety of design games have been developed by researcher Henry Sanoff(41). The practical application of games is to enable the public to participate in environmental decisions. For example, gaming was recently used in a design research project in a low-income public housing project in Aurora, Ill.

Participant observation is a technique borrowed from both sociology and anthropology that involves the researcher as a participant and as an observer simultaneously. For instance, in studying a housing project for the elderly, a researcher might move into the facility for a week or so, dine regularly with residents, discuss their surroundings with them informally, and attempt to gain some experience of the setting as they see it.

Rather than relying exclusively on any one data-gathering technique, most research employs a combination of methods, usually a balance between unobtrusive and obtrusive measures and qualitative and quantitative techniques (Fig. 1). Each technique has its strengths and shortcoming and is not relied upon solely. The validity and reliability of specific data-gathering techniques must be taken into account in designing any environment–behavior research project.

ENVIRONMENT–BEHAVIOR RESEARCH AND ITS DESIGN APPLICATIONS

Small-scale Settings: Interior Design and Furniture Arrangement

One research issue often studied in small-scale settings is personal space; its implications concern interior design, furniture arrangement, and space planning. Edward Hall was the first to propose the four interpersonal distance zones typically used in social interactions. The study of proxemics, “the interrelated observations and theories of human use of space as a specialized elaboration of culture,” has led to distinctions among these three types of spaces (28). Fixed-feature space is that usually considered in architectural design: walls, ceilings, and floors. Semifixed features include chairs, tables, and other furniture that can be moved around in fixed-feature space. Informal space includes the distances maintained in encounters with others. Cultural variations exist. The design implications here often address seating arrangements in various settings.

Robert Sommer’s Personal Space examines the invisible “space bubble” that surrounds human beings and the way in which people use space to reflect their behavior. He has argued that the physical arrangements of many interior spaces are inappropriate for the behavior that occurs there. His work has led to the redesign of airports and office buildings, among other places (19, 22). Personal space patterns seem to differ according to cultural background, age, stage of development, personality, and sex. Researchers have also discovered that in smaller, more enclosed, and corner-like rooms with lower ceilings greater personal space is desired (43). Other research issues studied in connection with small-scale settings include territoriality, privacy, and crowding. These have also been central research issues in the study of institutional buildings and housing projects (44).

A useful perspective in examining human behavior in small-scale settings is sociologist Erving Goffman’s theatrical analogy. Goffman argues that furniture, decor, physical layout, and other background items supply the scenery and stage props for performances. Places where performances are given are termed front-stage regions; these are easily accessible and open to the public. In a house, for instance, a living room, dining room, or kitchen would
qualify. Back-stage regions are more private, hidden, and less accessible. Bedroom closets, bathroom cabinets, and dresser drawers constitute such back-stage places (45).

Some design interventions have been found to help promote a positive sense of personal space. The size and shape of rooms, degree of openness, access to the outside, complexity and displacement, brightness, and extent of partitioning are among these interventions (46).

Housing

Housing is among the most highly developed areas in environment and behavior. Although some researchers have addressed the concept of “home” and how it differs from “housing” or “house,” others have examined special problems encountered in the design of housing for special user groups. This section addresses both the concept of home and user-needs research: housing for children, students, and low-income, disabled, and elderly people.

The Concept of Home. Through interviews, questionnaires, and card-sorting tasks, one large study conducted by psychologist D. Geoffrey Hayward identified nine clusters of the meaning of home. Most important was home as a relationship with others, followed (in order) by home as a social network, self-identity, a place of privacy and refuge, continuity, a personalized place, a base of activity, a childhood home, and a physical structure (47).

Along these lines, another study examined the experience of moving and individuals’ memories of favorite homes. Open-ended interviews with 97 southern California residents revealed that most people had a negative reaction to moving and a strong psychological attachment to their previous home.

In terms of Hayward’s typology, the strongest concepts of home were home as physical structure and home as a place of privacy and refuge. Remembrances of landscapes surrounding the home figured prominently in most people’s descriptions (48). These findings confirm previous studies that have used residential autobiographies as a way of understanding designers’ attitudes toward housing (49).

Clare Cooper Marcus was among the first in the environment–behavior field to address the notion of residential symbolism, or how the homes people occupy often reflect their character and psyche. She relied on psychologist Carl Jung and his notion of archetypes as a way to help understand this relationship (50). The experience of burglary has been the topic of some fascinating recent research in France. Findings indicate that burglary victims experience a trauma similar to that of being raped. After being burglarized, they take great pains to redefine their home as a private and safe place (51).
Others have examined the meanings of different symbols within the home across a wide geographic area. The symbolism of the landscaping in front of single-family houses has also been examined. The area of residential symbolism has only recently prompted serious exploration; further research is needed. For a comprehensive overview of current research on home environments, consult Ref. 52.

**Housing for Children.** Although children are frequent residents of housing projects, the environments provided for them are often inadequate. A number of studies have shown that by far the greatest users of public outdoor areas in multifamily housing are children. However, such spaces are often planned more appropriately for adults. Children are often relegated to neatly labeled play areas, which are able to capture their interest for only short periods of time. A set of guidelines for designers has been developed based on findings from a wide body of social science research to help improve the design of housing for children. A few of the findings and recommendations are summarized below.

1. Children tend to play anywhere and everywhere, not just in designated play spaces. The entire site should be designed with this in mind.
2. To increase a sense of internal security, access to the site by outsiders should be discouraged.
3. Families with small children should be located on ground-level units with enclosed yards or patios and be able to overlook an enclosed common space for preschool play from a slightly elevated position.
4. Small children tend to play close to the most frequently used entrance to a dwelling or building.
5. Boundaries between private and communal outdoor spaces need to be strictly defined.
6. Many observation studies indicate that when given a choice, children tend to play more frequently on hard surfaces than on grass. A variety of hard surface areas, away from the circulation system, should be provided for hopscotch, small ball games, jumping rope, tricycle riding, and other activities. Nonetheless, for aesthetic reasons, hard surfaces should not predominate.
7. Trees that can be used by children for climbing should be selected—ideally, they should have sturdy, low branches.
8. Play equipment should be chosen with children’s preferences in mind. Children prefer equipment that moves such as swings, on which they can move such as jungle gyms, and places where they can sit, watch activity, and play quietly, such as benches and tables (Fig. 2).
9. Teenagers prefer informal gathering places where they can “check out” the action (54).

A study of over 300 children living in apartments furnished by the New York City Public Housing Authority examined the relationship between residential density (in three- vs 14-story buildings) and children’s well-being. Results indicate that higher-density homes have some deleterious effects on children’s health and well-being (55).

**Sample Applications.** Another aspect of housing for children involves the design of day care centers. As the number of dual-career and single-parent families has risen sharply, this building type has become increasingly important. Gary Moore, Uriel Cohen, Tim McGinity, and their colleagues at the University of Wisconsin-Milwaukee, conducted a series of studies detailing design needs for child care facilities and outdoor play environments. The Department of Defense, the largest purveyor of child care in the world, has adopted their results in the form of recommendations for all new Armed Forces child care centers (56,57). Both governmental and private centers have been constructed around the country based on these recommendations.

**Housing for Students.** A large body of environment-behavior literature, too great to cite here, is available on housing for students. Most such studies have addressed particular issues that occur in dormitory settings, such as personalization, density, and friendship formation. A sophisticated instrument for evaluating social and psychological characteristics of dormitories, the University Residence Environment Scale, was developed and administered at a renovated dormitory at the University of Rhode Island (58,59). A few researchers have taken more of a Gestalt approach, studying the dormitory environment as a whole rather than focusing on a single issue. Studies of university dorms, the International House at Berkeley, and six college dormitories in New York State are three such examples (14,60,61).

**Sample Applications.** Four generations of dormitories have been built at Indiana State University based on user-needs research through the cooperative efforts of a behavioral scientist and an architect (56). The student center at California State University, Los Angeles, was designed
by the firm of Deasy and Bolling using behavioral research conducted by social scientist Thomas Lasswell. Management and program planning at the University of California's International House have also been influenced by environment–behavior research (61).

Housing for Low-Income People. Low-income housing has captured the attention of environment–behavior specialists, perhaps because it is here that the satisfaction (or lack thereof) of user needs is most critical. One of the most extensive studies on low-income housing was conducted by a team of researchers at the Housing Research and Development Program at the University of Illinois at Urbana-Champaign. This seminal work won the Applied Research Award from Progressive Architecture magazine in 1980. It examined residents' satisfaction in 37 publicly assisted housing projects located in 10 states from New York to California, in both central city and rural locations. Among the goals of this research were to identify and measure specific physical, manageral, social, and psychological factors that influenced the degree of residents' satisfaction. Over 1900 residents responded to the questionnaire, and over 18,000 behavioral observations were recorded. Results from the research indicate that most residents (66%) were satisfied with Department of Housing and Urban Development (HUD)-assisted housing and that "the overwhelming negative image of assisted housing frequently encountered in impressionistic and journalistic accounts is not deserved." Three major factors explained a high proportion (74%) of the total variance in overall satisfaction: satisfaction with other residents, pleasant appearance, and economic value (62). Both physical and nonphysical qualities of the housing development influenced residents' satisfaction (Fig. 3).

One of the more well-known pieces of work concerning housing for low-income residents is Defensible Space: Crime Prevention Through Urban Design by Oscar Newman (63). This controversial book attempts to demonstrate that the way in which housing structures are arranged on a site and the manner in which each building is designed can reduce the amount of crime occurring in a housing project. Newman's key argument is that providing residents with a clear sense of territoriality can actually help reduce crime. This could be accomplished by designing limited entrances to the building for a small number of families, by subdividing massive, anonymous, public, open spaces in the middle of housing projects into smaller, more identifiable, private or semiprivate pieces of land, and by allowing a strong sense of surveillance from each apartment unit to the open space outside. Other recommendations for designing low-income multifamily housing to increase resident satisfaction are described by Clare Cooper (64).

The study of housing for low-income people has only

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**Figure 3.** Model of residential satisfaction (62). Courtesy of the U.S. Department of Housing and Urban Development.
recently begun to examine the special needs of single-parent families. Needs for privacy within the dwelling unit, opportunities for social interaction within the housing pro-
et, and on-site day-care facilities are among the issues being addressed (65). One housing project exclusively devoted to providing housing for single-parent, female-
headed households is Warren Village in Denver, Colo.

Sample Applications. The Housing Research and Devel-
opment Program at the University of Illinois at Urbana-
Champaign, has conducted post-occupancy evaluations and programming studies for several low-income housing projects in Illinois. The program's research includes design
recommendations, many of which have since been im-
plemented (53). Similarly, housing authorities in Albu-
querque, N. Mex., changed design sites based on post-
occupancy research, and two federally subsidized housing
projects designed by Lou Sauer and Associates also made
use of behavioral research in the programming process
(56).

One housing project that exemplifies the behavioral
design concept of defensible space is St. Francis Square,
a cooperative low-rise apartment complex for low-income
residents located near Japantown in San Francisco's West-
ern Addition. A study involving interviews with almost
300 St. Francis Square residents found that residents
viewed the project very favorably (66). Among the chief
reasons for high resident satisfaction was the strong empha-
sis on exterior landscaping in three courtyards forming
the core of the project, on providing each apartment unit
with its own private outdoor space, and on breaking the
project into smaller, discrete units.

Housing for Disabled People. The study of housing for
the disabled from a user-needs perspective has been bur-
genous in recent years. A number of researchers have
specialized in this area and produced documents to assist
designers with specific housing concerns, above and beyond
the specifications of building codes (67–69).

One of the most pressing problems encountered in
studying housing for the disabled is architects' frequent
assumption that the disabled population is a monolithic
group. Often, all units are designed for residents who are
wheelchair bound, when many people suffer from different
kinds of disabilities. In fact, those individuals confined
to wheelchairs constitute a relatively small segment of
the total disabled population. At last count, approximately
10% of the U.S. population suffered from some form of
physical handicap: limited vision (5.5 million), hearing
(8 million), or movement (22 million). Of these, 400,000
are permanently and totally confined to a wheelchair; the
rest can walk, but have difficulty moving their hands, or
need canes, braces, crutches, or other aids. Each of these
disabilities requires a different kind of housing environ-
ment to help support rather than interfere with the user's
behavior. The width of doorways, stair gradients, height
of window controls, location of electrical outlets and light
switches, and type of operative fixtures on stoves, ovens,
refrigerators, sinks, and other appliances are all affected
by the nature of the occupant's disability. Even industrial
design is important in designing for the disabled, as often

standard store-bought appliances are inappropriate for
certain types of disabilities.

Standard drawings found in architects' codebooks, of
wheelchair-bound people with muscular arms outstretched
from the body, imply a robust, healthy person who is simply
movement impaired. This picture is inaccurate, as most
problems are more severe and involve weakness, muscular
difficulty, and lack of coordination. To that end, a number
of authors have advocated careful examination of disabled
people's behavior as it occurs in their housing environ-
ments. One suggestion is the use of the performance inter-
view or scenario, where the researcher observes disabled
people carrying out a specific task, such as serving a midaf-
ternoon snack to a friend, and then holds a discussion
about how easy or difficult it was to perform that task
and what specific environmental features either helped
them or got in their way (69).

Others have pointed out the psychosocial effects of inac-
cessibility (68). These include the notion that the environ-
ment sends out a negative message to disabled people,
that people's mental maps of a place or a building may
well be dramatically different and less accurate than those
of able-bodied people, that environmental barriers serve
as "no trespassing" signs to disabled users, and that dis-
able people often possess a high level of competence to
master their environment, but that an inaccessible build-
ing fails to allow them to exercise it. All of these factors
may result in strong negative consequences for their self-
esteeem and personal identity.

Housing for the Elderly. In recent years, as the percent-
age of elderly in the overall population has risen, housing
for the elderly has become an increasingly important
force on the national housing scene. It has also become a major
focus for environment–behavior research. The location
of housing sites, the scope of the program, and architectural
and site design issues have been addressed by recent user-
needs research. Congregate housing that provides transpor-
tation, meal service, programmed activities, outpatient
medical clinics, and the like; fully independent housing
projects; and alternative housing types have been studied.

Many elderly people have particular needs that require
special housing environments. Failing vision and hearing,
a variety of physical disabilities, as well as the psycholog-
ical change of identity accompanying retirement, loss of
a spouse, and relocation are among the factors that influ-
ence the design of housing for the elderly.

Several books address user needs in elderly housing
and provide behavioral criteria for planning and design
over and above HUD's Minimum Property Standards for
Housing for the Elderly (70,71). Unfortunately, in many
housing projects the minimum standards quickly become
the norm. The purpose of environment–behavior research
in this area has been to sensitize designers to both large-
scale site planning issues (such as designing a series of
buildings that face an inner courtyard, for example, thus
couraging social interaction) and small-scale interior
design issues (such as designing door handles, grab bars,
and kitchen cabinetry). Additional research has investi-
gated the concept of intergenerational housing, which inte-
grates the elderly with younger residents, as well as other alternative housing types for the elderly.

**Sample Applications.** One housing for the elderly project whose design was specifically influenced by POE research is San Rafael Commons in San Rafael, California. The project, designed by architects Kaplan/McLaughlin/Diaz, was influenced by the results of a POE from Martinelli House, a nearby elderly housing complex designed by the same firm (72). Among the POE's recommendations were relocating the mail area to serve as an activity hub and using outdoor courtyard furniture to encourage social interaction. A second POE was conducted on San Rafael Commons, and results indicate that resident satisfaction was extremely high (71). Another such example is the Rosa Park Towers, where environment–behavior research was used to transform an abandoned San Francisco high-rise (formerly known as the Pink Palace) into award-winning housing for the elderly.

User-needs research was also incorporated in the design of the Captain Clarence Eldridge House in Hyannis, Mass. Architect Barry Korobkin, research sociologist John Zeisel, and associated architects Donham and Sweeney collaborated on the planning and design of this congregate housing complex. The project consisted of an 8500-ft² addition to a nineteenth-century sea captain's house. In response to interviews with prospective tenants, residents of other elderly housing facilities, and elderly home-care personnel, the designers opted to offer each tenant a private room with its own private front porch overlooking an atrium, its own sink and toilet, showers and tubs shared by four, and shared living spaces: front and back parlors (originals of the old house), a sitting room, a large dining room, and a long front porch with rocking chairs and tables. Many residents came from nursing homes to Eldridge House and "without exception, all said it has revolutionized their lives. Some, who have been in nursing homes for a long time, say they feel they are now living for the first time in years" (73).

**Institutions**

Erving Goffman has drawn a distinction between total and partial institutions (74). A total institution is much more restrictive, and one of its major purposes is to protect people who cannot fend for themselves or are deemed threats to the community. These people are removed from the outside world and thus separated from society. Correctional facilities, hospitals, mental health care facilities, and nursing homes are examples of total institutions. By contrast, partial institutions require individuals to be at specific spots for prescribed periods of time (for work, learning, etc.), but are far less restrictive. Time, activity, and use of the environment are somewhat regimented. Examples include schools, day-care centers, workplaces, camps, and communes.

**Correctional Facilities.** The study of jails and prisons, otherwise known as correctional facilities, has attracted the interest of environment–behavior researchers. In past decades, the United States has been plagued by severe prison riots; the reasons for rioting can often be traced in part to overcrowded conditions and obsolete physical environments. The social and psychological reasons for imprisonment remain controversial, and the efficiency of today's prison and criminal justice system remains in doubt. Nonetheless, some studies have implemented user-needs research in the design of prisons and jails.

**Sample Applications.** The San Francisco architecture firm Kaplan/McLaughlin/Diaz has done some work in this area, applying environment–behavior research to the design of correctional facilities at the Contra Costa County Detention Facility in Martinez, Calif., and elsewhere.

Another California-based firm, Patrick Sullivan and Associates (PSA), headquartered in San Luis Obispo and Palo Alto, has also employed a behavioral consultant in its design work at Kings County Juvenile Center in California. Their research findings have indicated that the severity of the crime committed should be reflected in the design of each individual cell. A prisoner who has committed a severe crime ought to be housed in a high-security cell with restricted activities and no carpeting, but with cameras, towers, and so on. In contrast, one who has committed a moderate crime would best be served in a low-security cell with high ceilings, wood doors, and private toilet facilities. More violent criminals require more stringent codes and more costly construction techniques. A common error made in prison design is to design all units uniformly. In fact, tremendous savings can be had if a variety of units are provided, so that costly security measures are only built for those who really need them. In this regard, PSA was able to save its client a considerable amount of money because of findings from user-needs research; one building was constructed at $90/ft² instead of $125/ft². The same design firm was able to save another client $34,000–39,000 per bed based on user-needs research findings indicating that rehabilitation of existing structures, rather than a new building, would better help solve the client's space problem (75).

A POE of three metropolitan correction centers in Chicago, New York, and San Diego influenced the design of the Contra Costa County Detention Center in California. In addition, researchers have developed an evaluation system supported by the National Institute of Corrections resulting in an improved generation of correctional facility designs (56).

**Hospitals.** As a complex and large building type, hospitals house an exceptionally wide variety of users, including nurses, doctors, paramedics, managers, administrators, executive officers, boards of directors, trustees, and most importantly, patients and their visitors. Because the user is not the paying client, architects often design hospitals that fail to take user needs into account. The spatial requirements of equipment often supersede those of human beings. One of the major issues examined in hospitals has been environmental cognition, or how people find their way around the building. Time is of utmost importance in emergencies, so designing hospital facilities that are clearly marked is critical. The relationship of spaces, signs and
graphics, color coding, lines on the floor or walls, and redundant cuing have been shown to help make hospitals more easily understood.

By examining work-sampling and staff questionnaires over an 82-day period, an extensive study compared patient and personnel preferences for different floor plans. Results indicated that in most cases, radial (round) design is superior to double-corridor (racetrack), which in turn is better than single-corridor design. Furthermore, based on average salaries at the time, it was calculated that compared with those in radial units the extra travel costs in the single- and double-corridor units amounted to about $77 per bed per year (76). Other studies have found that triangular-shaped nursing units offer the greatest flexibility and efficiency and link easily with future expansions (77).

One POE of hospitals has produced recommendations for the design of waiting rooms, and urges designers to consider the length of time people are waiting, the population mix, the type of activities that occur in the waiting room, and the range of anxiety level. Where people are most anxious, separate comfortable furniture groupings, televisions with private earphones, soft light, reading lamps, and opportunities for privacy are recommended (78).

Yet another issue addressed in the hospital POEs has been the comparison between single and double rooms as far as administering medication is concerned. Instances where nurses actually confused prescriptions for two patients sharing the same room have been documented (79). Researchers have examined the role of nature in hospital patients' recovery. Results indicate that patients recover more rapidly when treated in a room with plants or with a view of nature (80,81). A field called horticultural therapy has developed around this premise.

Sample Applications. Environment–behavior research has produced a variety of design recommendations for hospital design. In fact, the 'Veterans' Administration has begun to use POEs to learn more about the designs of its hospitals. The New York State Veterans' Home, designed by The Architects Collaborative, and the rehabilitation facility at Rhode Island Medical Center in Cranston, R.I., were based on user-needs research (56). POEs have also been used to assess the impact of design on institutionalized elderly patients suffering from chronic brain syndrome, an illness that leaves patients confused and immobile. User-needs research conducted at the Philadelphia Geriatric Center served as background information for the design of a new institution, and another POE was conducted in which the new design was very highly rated (56). Another project called "Plane Tree" involved the use of research to convert a San Francisco hospital into a facility for more humane care for the sick and dying.

Regarding the issue of way finding, some detailed design guidelines based on award-winning user-needs research have been developed by a research team at the University of Michigan Medical Center (82,83). Its Patient and Visitor Participation (PVP) Project gathered data from over 2500 patients and visitors and over 1200 staff in 32 different studies. Results have already been applied to the redesign of existing facilities and will also be incorporated into the design of a new $285 million University of Michigan Hospital complex.

Mental Health Care Facilities. Environment–behavior research in mental health care facilities was pioneered by Kiyoh Izumi, Robert Somner, and Humphrey Osmond. While working at a mental hospital in Canada and experimenting with a variety of seating arrangements in the day room of a mental hospital, Somner and Osmond discovered a change in patients' behavior. When rows and columns of chairs were transformed into small-scale groupings of chairs around tables and magazines, patients who had otherwise remained quiet and withdrawn began talking with each other (18,19). Two admissions wards at one psychiatric hospital were studied as part of another experiment. One ward was remodeled based on user-needs research; the other was not. Those patients in the remodeled ward socialized more and had a more positive attitude toward their environment (84).

A number of researchers have shown that typical psychiatric facility designs serve the purposes of the administration and staff rather than the needs of the patients. Others have shown that such features as long corridors with windows at only one end exaggerate the already distorted vision of many patients (85).

Some sensitive guidelines for designers have been produced by interior designer Victoria Jane Willis based on her observations, interviews, and questionnaires at six different mental health care facilities in Indiana. Among her recommendations are that the scale, color, and shape of the building should all be given proper consideration since they help form the first impression of the building. The admissions office should be extremely private to protect the confidentiality of patients. Waiting areas need a variety of seating arrangements; accommodations for one or two people are best. Day rooms should reflect a hierarchy of spaces for different levels of social interaction, and they should include windows, clocks, and calendars to maintain time-space relationships. In the therapist's office, the doctor's chair should not block the entrance, as it could cause the patient to feel trapped.

Willis also concluded that cafeterias should avoid lines and rectangular tables; round tables are best since no one has to sit at the head. The cafeterias ought to be made to appear more like restaurants than institutions by featuring walls, ceilings, and floors of different colors and materials. Throughout the facility, mirrors, glass, and highly polished floors should be avoided, as the reflections they create tend to cause visual distortions for patients. Similarly, wood, natural materials, and live (as opposed to artificial) plants should be used to avoid confusing patients. Within each patient's room, personal storage areas and individually controlled lighting units (table or pole lamps) are desirable, as they offer a greater sense of control over the environment (86).

Sample Applications. The new Mental Rehabilitation Center at San Diego's Grossmont District Hospital, designed by Kaplan/McLaughlin/Diaz, was strongly influenced by POEs of other facilities. It features an especially
strong relationship to outdoor spaces, with three different levels of security as well as a “no corridors” design (56). An addition to Herrick Memorial Hospital in Berkeley, Calif., designed by the same firm, was also influenced by POE research.

Schools. A great deal of attention has been paid to social and psychological aspects of school design. One of the most often cited studies compared big and small schools, finding that smaller schools, or “undermanned settings,” elicited greater participation in student activities, greater sense of responsibility, and greater satisfaction (87). The school environment as a source of stress has been the subject of extensive research (88). Much of the research has focused on classrooms, particularly on their seating arrangements, design, density, and noise. In addition, researchers have examined the controversial debates between traditional vs open classrooms and windowed vs windowless classrooms. In these last two areas, research findings have been somewhat inconclusive and contradictory. Other research has addressed the influence of the design of special education settings on developmentally disabled students (89).

Sample Applications. A few researchers have conducted systematic POE studies of high schools in, for example, Albuquerque, N. Mex., and Rosemead, Calif. (90,91). The latter study involved a multimethod approach, including a literature review; observations of behavior and physical traces; a review of over 30 years’ worth of school archives; interviews with students, faculty and staff, and the school architect; student cognitive maps; and questionnaires of approximately 230 students and faculty and staff. It developed some guidelines and recommendations, which have since been implemented by the School Board. Rosemead High School has been repainted, and the lighting in its corridors has been significantly altered as a result of the POE. At another location, the College of Osteopathic Medicine of the Pacific, Pomona, Calif., significant design changes to the campus—particularly in the campus graphics, signs, and outdoor entranceways to the campus—also resulted from a POE and a behavior-based program (92).

Office Buildings. Environment–behavior research on office environments is perhaps most comparable to that on housing environments because it has become extremely well developed and sophisticated and has produced specific design recommendations. Researchers have examined how the physical environment influences the ability of workers to perform work-related tasks. They have discovered that characteristics of the ambient environment such as heating, ventilation, and air conditioning, as well as the concentration of irritants such as tobacco smoke, asbestos fibers, and so on, may result in worker headaches, fatigue, or interference with concentration. They may even significantly impact physical and mental health. Office furnishings, layout, and the size of the workspace have been shown to influence worker satisfaction and performance. Ergonomic studies indicate that improper seating heights, each length, arm angles, viewing angles, and distances affect personal comfort and efficiency. Additionally, researchers have found that natural lighting and a view contribute to worker satisfaction. When artificial lighting is required, adjustable lighting is preferred, hence the current trend toward task lighting. Some evidence indicates that fluorescent lights can be harmful, as they decrease the ability of the body to absorb calcium (93).

Other studies have addressed privacy and social interaction in offices, discovering that both visual and auditory privacy are key ingredients to worker satisfaction. Phones and other people talking are cited as the most bothersome types of noise. Other research has examined symbolic identification or status indicators and perceptions of status. Such indicators include the size or square footage of office space; the amount of enclosure provided by walls, partitions, and doors; the location of an office (at the corner of a building, adjacent to the window wall, or close to management); and the amount and quality of furnishings. Status incongruence, or environmental symbols that are in conflict with perceived or achieved status, may impact worker satisfaction and performance as well as mental and physical health (93).

A few major studies are particularly applicable to design and have also helped to shape the direction of subsequent research. Steelcase Inc., a major producer of office furniture, conducted a comprehensive national study of office environments based on a survey of 1047 office workers from 178 federal, state, and local government agencies. Its findings revealed that about one-third (30%) of the employees work in office landscapes (the physical grouping of people working together through the use of component furniture and movable half-height partitions) or open-plan offices (usually with fixed or no partitions) and that over half (54%) use or operate data processing, word processing, or other electronic equipment. Almost half (43%) are unhappy with the way their present offices look, and three-quarters (74%) said that given better working conditions, they could probably do more work (94). A four-year study by the Buffalo Organization for Social and Technological Innovation (BOSTI), a basic research and consulting group, examined 18 environmental variables in offices, such as the amount of floor area per employee, layout, enclosure, temperature/air quality, lighting, windows, status, and privacy, through a 500-item questionnaire of about 5000–6000 workers at over 70 office sites. Respondents were questioned two to four months before a facility change to new and upgraded offices and then about eight months to a year later. Several variables were shown to affect job satisfaction, environmental satisfaction, and ease of communication on the job. These are shown in Figure 4. Job performance and satisfaction fluctuate depending on the nature of specific environmental changes. The study places a dollar value on these variables, concluding that through improved office design, companies can increase annual productivity by up to 17% of the average annual salary for clerical workers and about 15% of the annual average salary for professional/technical employees and for managers (95).

A team of researchers at the University of Michigan conducted a POE of the new State Office Building in Ann Arbor, designed by Tarapata, MacMahan, and Paulsen of Bloomfield Hills, Mich. This detailed evaluation helped set a model for future research (96). Another major study,
Figure 4. Environmental facets relating to environmental satisfaction, ease of communication, job satisfaction, and job performance in office environments (95). Courtesy of Workplace Design and Productivity, Inc.

"Organizations, Buildings, and Information Technology" (ORBIT-2), based on user-needs research and sponsored by 18 different organizations, has developed strategies to help businesses cope with change, the introduction of new technology, and facility management (97).

Among the newly emerging issues in office research are the impact of office automation, open-office planning, and degree of environmental control. Recent studies have discovered that video display terminals have generated a variety of physical and psychological problems, including a high level of anxiety, depression, fatigue, eyestrain, and muscle strain. Problems have been associated with keyboard height, gaze angle, lighting, and glare.

Open-office problems with privacy have resulted in worker dissatisfaction and reduced work performance. To date, no research has indicated that the greater communication promoted by open offices leads to a greater amount of work accomplished. Researchers have discovered the importance of employees being able to control heating, ventilation, air conditioning, windows or shades, and furniture (93).

Sample Applications. Environment–behavior research has influenced the design of several office facilities, including those of the Federal Aviation Agency in Seattle, an AT&T branch office, and the U.S. Senate office complex in Washington, D.C. (98). Recent POEs have been conducted for Amoco, Aroa, Citibank, Nestles, Proctor and Gamble, and TRW (98). One of the world’s largest building clients, the U.S. General Services Administration, routinely uses POEs to evaluate its facilities; user-needs research has also been used to help design new office spaces for the engineering and research building of the Research Triangle Institute in North Carolina. The New Zealand Ministry of Works and Development recently sponsored research to enable its client regional departments to evaluate their own government buildings; orientation and way finding have been major focuses to date (98).

Large-scale Architecture and Urban Design

A variety of work has investigated large-scale architecture and urban design, including the human use of open space. Some studies have examined how people remember buildings in cities. Results indicate the importance of the following factors: movement, contour, size, shape, use, singularity, significance, and quality (9,99). A large body of work has addressed the social and psychological impacts of high-rise buildings (100).

A number of POEs of major downtown buildings and open spaces have been conducted in various cities across the country (100). A recent study of users’ relations to enclosed and semileenclosed public spaces found that indoor pedestrian spaces (arcades, atriums, and galleries) perform many of the same functions as outdoor pedestrian spaces (parks and plazas) and actually perform some of them better. The study also demonstrated that agoras possess desirable qualities in their own right (101). A comparative analysis of several urban open spaces across the United States, spanning almost a decade, was conducted by William Whyte and his Street Life Project and is summarized in his well-known book The Social Life of Small Urban Spaces and a television film, part of the Nova television science series (102). Through an extraordinarily detailed set of behavior observations recorded through time-lapse photography, Whyte and his research team were able to distill the key ingredients of successful (i.e., heavily used) urban plazas. These are a large amount of sitting space (one linear foot for every 30 ft² of plaza) and a choice of seating areas, preferably with movable chairs; adequate sun; provision of trees; protection from wind; access to water; presence of food through cafes, kiosks, and street vendors; triangulation, or the provision of an external stimulus (like a piece of sculpture, a fountain, or entertainment); and a very close relationship to and high visibility from the street.

A large body of research has linked behavioral issues to the study of the large-scale landscape. The subdiscipline of landscape assessment has become particularly well developed (103); researchers have even addressed such far-reaching topics as perceptions of the sky (104). Others have examined perceptions of and responses to a variety of environmental changes in urban settings (examining such issues as growth, urban renewal, historic preservation, gentrification, neighborhood conservation, mobility, and relocation) and rural settings (natural and recreational environments, agriculture, rural development, and energy production and development) (105).

Sample Applications. Whyte’s research resulted in significant amendments to New York City’s 1975 zoning codes, and his follow-up assessments have further modified zoning rules. His research has had a tremendous impact in altering the streetscape of downtown Manhattan. For example, food kiosks and open-air cafes previously classi-
Lynch’s studies of city imageability and Appleyard’s research on residents’ views of their city also influenced the design of the Ciudad Guayana, Venezuela, and the Village of Woodbridge (planned by the Irvine Company with landscape design by Sasaki Walker Associates), Irvine, Calif. (4,9). Lynch’s concepts of landmarks, nodes, edges, paths, and districts can be clearly seen in Woodbridge, located in Southern California’s Orange County.

**ENVIROMENT–BEHAVIOR RESEARCH**

**Colleges and Universities**

A number of colleges and universities in the United States and abroad offer courses and programs in environment and behavior. At present, U.S. doctoral programs in architecture with an emphasis on environment and behavior exist in only a handful of institutions; however, several universities offer this specialty in other departments. In 1987, about 24 universities had doctoral programs focusing on environment and behavior (Table 2).

**Private Firms and Other Organizations**

A small number of design firms specialize in environment–behavior research as an integral part of their practice. According to a recent informal survey of members of the Professional Practice Committee of the Environmental De-

| Table 2. North American Doctoral Programs in Environment and Behavior |
|-------------------------|-----------------------------|
| **Architecture**        | Georgia Institute of Technology |
|                         | University of California, Berkeley |
|                         | University of California, Los Angeles |
|                         | University of Michigan |
|                         | University of Montreal |
|                         | University of Wisconsin-Milwaukee |
| **Psychology**          | Arizona State University |
|                         | City University of New York |
|                         | Claremont Graduate School |
|                         | Colorado State University |
|                         | Rutgers University |
|                         | University of Arizona |
|                         | University of British Columbia |
|                         | University of Utah |
| **Sociology**           | Michigan State University |
|                         | Rutgers University |
|                         | University of Kansas |
|                         | Washington State University |
| **Geography**           | University of California, Santa Barbara |
|                         | University of Nebraska |
|                         | University of Toronto |
| **Natural Resources**   | University of Arizona |
|                         | University of Michigan |
Professional Organizations

The oldest and largest professional organization devoted to environment–behavior concerns is the Environmental Design Research Association (EDRA). Beginning in 1969, EDRA has held a series of conferences bringing together architects, landscape architects, interior designers, urban designers, planners, psychologists, sociologists, human/social ecologists, geographers, and anthropologists to discuss common research issues through papers, symposia, workshops, poster sessions, and field trips. These conferences are held annually on various university campuses across North America, and papers are published in a set of annual conference proceedings. EDRA's headquarters are located in Washington, D.C., and its membership is approximately 900. Although 27 countries are represented, about three-quarters of the members are from the United States (1).

Another organization, more international in scope, is the International Association for the Study of People and Their Physical Surroundings (IAPS). IAPS is headquartered in the United Kingdom and its members meet biannually throughout Europe. Environment–behavior research organizations have recently been established in New Zealand and Australia [People and the Physical Environment Research (PAPER), formalized in 1983] and in Japan [Man and Environment Research Association (MERA)]. These organizations are devoted primarily to the discussion and dissemination of environment–behavior research. Other organizations whose members include researchers with environment–behavior specialties are the Association of Collegiate Schools of Architecture, the American Psychological Association, whose Division 34 is devoted to population and environmental psychology, the Association of American Geographers, the International Association of Applied Psychology, and the American Sociological Association.

Major Journals and Publications

In recent years, the field has expanded to include three major journals: Environment and Behavior (E&B), the Journal of Architectural and Planning Research (JAPR), and the Journal of Environmental Psychology (JEP). A number of other publications carry occasional articles on environment–behavior research, and newsletters such as Design Research News, published by EDRA, the Population and Environmental Psychology Newsletter, published by the American Psychological Association's Division 34, and the Architectural Psychology Newsletter, published by IAPS, also provide updates on current scholarly activities in the field.

Current Trends and Future Directions

Current trends in the field include examining issues such as the behavior of salad bar patrons (which often violates the canons of hygiene); consumer behavior in supermarkets, farmers' markets, and cooperatives; commuters' responses to traffic jams; human responses to environmental pollution; residents' perceptions of nuclear power plants; and habitability in space stations (107–109). Studies are now underway by NASA/Ames Research Center's Space Habitability Research Group to try to troubleshoot the design of space station systems while they are still under conceptual development. The research team is especially interested in helping maximize work performance of astronauts and providing comfortable spaces for privacy, territoriality, and stress reduction (110).

Some other research has involved the use of behavioral studies in the design of a combined tactile/electronic guidance system for visually impaired persons. The system has been installed in two buildings and about 2000 ft (600 m) of outdoor track connecting major buildings at the University of New Mexico campus. This system allows the blind and sight impaired to travel more easily and safely, both indoors and outdoors (111,112).

Another area of research conducted through the U.S. Department of Energy addresses occupants' responses to passive solar commercial buildings (113). Other researchers have also begun to explore some of the same user groups, but in different locations; for example, the perception and use of performing arts centers by the elderly (114). Although the field has generally encompassed place research, user-group research, responses to social and technological change, basic research, and process research, the current effort is to try to better expand and more effectively integrate these different approaches.

A recent EDRA task force under a grant commissioned by the National Endowment for the Arts Design Arts Program developed a set of future priorities for the field. Gary Moore, D. Paul Tuttle, and Sandra Howell encapsulated their views in a recent book entitled Environmental Design Research Directions. Among the priorities identified were to more effectively communicate examples to the general public and the professions and to improve education in environmental design research (115). In this regard, some revisions to the National Architectural Accreditation Board (NAAB) guidelines, which stipulate the criteria necessary for professional accreditation of schools of architecture across the United States, will have an impact on the environment–behavior field and architectural education. The recently adopted guidelines specify that schools of architecture must include courses on social and behavioral factors that also apply that information to design. Hence, in the next few years, virtually all accredited schools of architecture will offer coursework in environment and behavior; this change alone is likely to have a profound influence on a new generation of architects.

The implementation of environment–behavior research in architectural practice is not without its difficulties. A number of scholars have pointed out the many impediments to translating research into design. Nonetheless, a solid body of environment–behavior user-needs research with applicability to particular building types, such as those listed in this article, is now developing. More and more studies that present research findings and design recommendations through both well-documented text and
careful illustrations are being published, thus increasing their value to both academic and professional audiences. The expansion of this type of data base and its increased visibility will help make the field of environment and behavior even more useful to practicing architects.

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See also Association of Collegiate Schools of Architecture (ACSA); Day Care Centers; Education, Architectural; Elementary Education; Health Care; Justice Buildings—Courts and Correctional Institutions; Multifamily Housing; National Council of Architectural Registration Boards (NCARB); Office Interior Planning; Residential Buildings; Secondary Schools; Single Parent Housing.

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BEHNISCH, GÜNTER

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