

ENVIRONMENTAL PSYCHOLOGY 1989–1994

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ABSTRACT

A review of research and theory on transactions between people and physical environments emphasizes new contributions to theory and empirical research published in major journals of environmental psychology, 1989–1994. Theories focused on arousal, load, stress, privacy-regulation, behavior settings, and transactional analysis; new theory increasingly incorporated situational and contextual variables. Empirical research emphasized field settings over the laboratory and employed increasingly diverse methods, populations, and cultures. Environmental design studies integrated scientific and applied goals through post-occupancy evaluation. New findings concerned features of residences, work places, hospitals, schools, prisons, and larger community environ-

ments. New studies also addressed environmental stressors (e.g. temperature, noise); effects of attitudes and behaviors on conservation, crime, pollution, and hazards; and issues for neighborhoods, public places, and natural environments. Directions for the future include integrated theory to guide research, more design experiments, and development of conventions for case studies.

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INTRODUCTION

Environmental psychology examines relationships between people and their physical environments (e.g. Bell et al 1990, Gifford 1994). This review appears less than three decades after publication of the first textbook of environmental psychology (Proshansky et al 1970) and less than one decade after release of the *Handbook of Environmental Psychology* (Stokols & Altman 1987). Our purpose here is to describe progress in environmental psychology since the last review in the *Annual Review of Psychology* (Saegert & Winkel 1990). Focusing mainly on research published from 1989 through 1994, we review empirical studies in the field's major journals, emphasizing new findings and contributions during the past six years.

Our first section discusses trends in publication, research, and theory. Subsequent sections summarize new findings about various types of physical settings, proceeding from smaller to larger size, and from individual to social-psychological to organizational and community levels of analysis. The second section addresses built environments of relatively small size—residences—and then examines buildings occupied by private organizations and public institutions—work places, hospitals, schools, and prisons. A third section addresses larger community environments and reviews new research on environmental stressors, environmental attitudes and behaviors such as those related to conservation, and issues related to neighborhoods and public places. The fourth section explores natural environments and restorative settings. We conclude by summarizing developments in the field during the past six years and suggesting directions for the future.

RECENT TRENDS

Publication

In the past six years publication in environmental psychology steadily expanded. The empirical research stream continued to flow in the field's primary journals—*Environment and Behavior* and *Journal of Environmental Psychology*—and in *Journal of Architectural and Planning Research*, *Architecture and Behavior*, *Human Ecology*, and *Population and Environment*. Environmental psychologists published occasionally in social psychology journals, such as *Journal of Personality and Social Psychology*, and in community psychology journals such as *American Journal of Community Psychology*.

Expansion continued in edited series as well. Altman's *Human Behavior and the Environment* series added volumes on intellectual traditions (Altman & Christensen 1990), place attachment (Altman & Low 1992), and women and the environment (Altman & Churchman 1994). Zube and Moore's newer *Advances in Environment, Behavior, and Design* added two volumes (1989, 1991), and another is planned. Cambridge University Press's edited series gained volumes on human territoriality (Taylor 1988), public space (Carr et al 1992), natural environments (Kaplan & Kaplan 1989), and applications of environment-behavior research (Cherulnik 1993). Other edited volumes addressed design interventions (Prieser et al 1991), environment and cognition (Gärling & Evans 1991), housing (Arias 1993), isolated environments (Harrison et al 1991), settings for children (Weinstein & David 1990), and theories of environmental psychology (Walsh et al 1992).

A trend in edited collections favored retrospective analyses. These focused on careers of scholars (Altman & Christensen 1990), influential design-re-

search projects (Cherulnik 1993), facility programming (Sanoff 1989), and evaluation of the built environment (Wener 1989). Similar retrospectives appeared in journals (Barker 1990, Gump 1990, Schoggen 1990).

Research

Research in environmental psychology has encompassed individuals, interpersonal relationships, groups, organizations, communities, and even cultures, and their complex relationships with environmental factors. Empirical studies examined environmental variables ranging from *ambient conditions*—temperature, sound, lighting, and air quality—to architectural features of buildings and neighborhoods, to built and natural features of entire communities and regions. The research emphasized individual and interpersonal levels of analysis and examined attitudes and cognitions about the environment more often than it incorporated direct measures or manipulations of objective, physical characteristics of the environment. Examples of studies that used objective measures include Christensen et al (1992), Edwards et al (1994), and Novaco et al (1990).

Four trends appeared in empirical studies cited in this review: 1. More research was conducted in field settings than in laboratories. 2. We see efforts toward cumulative knowledge in studies that replicate or extend earlier work (e.g. Brown 1992, Haggard & Werner 1990, Shaw & Gifford 1994). 3. Empirical studies reflected diverse methods, settings, and populations. Particularly salient is the variety of cultures represented. 4. Researchers were multidisciplinary; perhaps only half were based at universities in traditional departments of psychology.

Environmental psychology maintained its dual orientation to research and application and proceeded further toward integrating them (Farbstein & Kantrowitz 1991, Groat & Despres 1991). Researchers conducted hypothesis-testing studies in controlled settings (e.g. Veitch et al 1991), and practitioners applied research findings in facility programming (Sanoff 1989), design (Lang 1991, Prieser et al 1991), and post-occupancy evaluation (Prieser et al 1988, Wener 1989). The clearest integration appeared in *environmental design research* (e.g. Wisner et al 1991), which uses experimental or quasi-experimental interventions in natural settings to improve environmental design and to test scientific hypotheses. A typical project begins with a background analysis, development of behavioral goals, and identification of environment-behavior relationships. In the design phase the goals are translated into specific environmental features. The new design is introduced into part or all of the setting, and measurements are collected before and after renovation for post-occupancy evaluation and for tests of hypotheses. Cherulnik (1993) described 13 classic examples, including the unpublished, oft-cited quasi-experiment at the

Seattle and Los Angeles Federal Aviation Administration offices by Dennis Green, Walter Kleeman, Sam Sloan, and Robert Sommer that tested the effects of employees' participation in the re-design of their offices on subsequent satisfaction with features of their work environments.

Theory

Environmental psychologists reiterated the difficulty of developing theory on a topic as vast as the physical environment (Ittelson 1989, Kaminski 1989). Even so, theory advanced during the past six years. New theories incorporated detailed analyses of context (Michelson 1994, Wicker 1992), using smaller and more situation-specific units (Walsh et al 1992). One new theory examined the process of design itself (Lang 1991). Others integrated small-scale, proximal environments with large-scale, distal environments (Schoggen 1989) and linked environmental features with interpersonal relationships (Peterson 1992) and cultural patterns (Altman et al 1992). Some theories integrated multiple processes, such as the model by Bell et al (1990) that linked objective and subjective environmental features, perceptions, arousal and stress, coping and adaptation, and aftereffects.

Despite progress in development of theory, environmental psychologists remained far from consensus on a unified theoretical approach, and instead took a variety of approaches. Among theories that guided research, six appeared most influential:

AROUSAL Psychophysiological arousal is well established as a process that mediates influences of environmental features such as sound and temperature. The *arousal hypothesis* predicts optimum performance and satisfaction under conditions of moderate arousal, depending on task complexity and other factors (Thayer 1989). Biner et al (1989) found students' preferences for lighting scenarios consistent with predictions of the arousal hypothesis. Extensions of the hypothesis suggest that through arousal, high temperature increases the likelihood of violence, though the nature of the relationship remains in debate (Anderson 1989, Bell 1992).

ENVIRONMENTAL LOAD The *overload hypothesis* assumes that humans have a finite capacity for processing stimuli and information and predicts that we cope with sensory or information overload through (among other responses) selective attention and ignoring low-priority inputs. Consistent with the hypothesis, a laboratory experiment by Smith (1991) showed that 78dB(A) noise led to reduced performance by college students in a letter writing task but not in a letter-search task. Loewen & Suedfeld (1992) found that masking sound mitigated the performance deficit produced by office noise but added to arousal.

Veitch (1990) extended the arousal hypothesis to individual differences and reported better reading comprehension in noisy conditions by individuals with internal locus of control, and better reading comprehension in quiet conditions by individuals with external locus of control.

STRESS AND ADAPTATION Previous research and theory associated extremes of temperature, sound, and other environmental variables with physiological and psychological stress and with coping and adaptive behaviors that reduce stress or its impact. Environmental stress research of the last six years examined prolonged exposures (e.g. Hedge 1989) and post-traumatic outcomes (Rubonis & Bickman 1991) including chronic illness and psychological impairment. Such findings reinforce the need for theoretical distinction of acute and chronic environmental stress (e.g. Baum et al 1990, Baum & Fleming 1993, Hobfoll 1991).

PRIVACY-REGULATION Research on privacy, spatial behavior, crowding, and territoriality together suggests a human tendency to seek optimum social interaction, partly through use of the physical environment (Altman 1993). *Privacy regulation theory* suggests that when a person fails to achieve the subjective, optimum level of social contact for the situation, the resulting stress motivates coping behavior, which may rely on the physical setting (Brown 1992). Consistent with the theory, Haggard & Werner (1990) found that students who temporarily occupied a laboratory setting rejected intrusions more often when the chair arrangement delineated their work area than when it did not. Block & Garnett (1989) reported higher satisfaction among college students who worked on complex tasks in private rather than nonprivate settings.

ECOLOGICAL PSYCHOLOGY AND BEHAVIOR SETTING THEORY The classic theory by Roger Barker and colleagues analyzes environments in terms of *behavior settings*: “small scale social systems composed of people and physical objects configured in such a way as to carry out a routinized program of activities with specifiable time and place boundaries” (Wicker 1992, p. 166). The July 1990 issue of *Environment and Behavior* reviews the history of ecological psychology. Analysis of a recent worker survey supported the predictions of behavior setting theory (Wicker & August 1995). Extensions of the theory have focused on specific settings (Schoggen 1989), such as gas stations (Sommer & Wicker 1991), and on what Wicker (1992) called a “sense-making” model—based on naturalistic research that addresses occupants’ understandings of the context.

TRANSACTIONAL APPROACH In a substantial extension of privacy regulation theory, Altman (1993) and colleagues (e.g. Brown et al 1992, Werner et al 1992)

elaborated their *transactional* approach, which treats the physical environment as a potential context for social interaction that can support, constrain, symbolize, and confer meaning upon various aspects of social relationships. This holistic, systems-oriented analysis incorporates multiple levels and facets, variation over time, and cyclical processes. It describes social relationships and physical settings in terms of *dialectics*, or tensions between opposing influences. (Dialectics are also central to Lawrence's 1989 theory.) Related, cross-cultural research examined such practices as courtship and weddings (Altman et al 1992, Werner et al 1993).

BUILT ENVIRONMENTS

Residences

RESIDENTIAL PREFERENCE AND SATISFACTION Previous research consistently found the housing type most preferred, especially in North America, is a single-family home away from a central city. Recent surveys also examined populations outside North America. Amerigo & Aragonés (1990) found preferences among women who lived in council housing in Madrid, Spain, closely tied to their attachment to the neighborhood and to the nature of their relationships with neighbors. Kaitilla (1993) found residents of public housing in West Taraka, Papua New Guinea, dissatisfied with the small size of their housing units and with designs of kitchen, toilet, and bath. Kaitilla (1994) studied the Bumbu squatter settlement of Papua New Guinea and observed that availability of desirable building materials was important in construction of dwellings and satisfaction with them. Housing preference and satisfaction were also studied in Venezuela (Wiesenfeld 1992), Australia (Purcell 1991, Smith 1994), Turkey (Imamoğlu & Imamoğlu 1992), Sweden (Lindberg et al 1992), Canada (Cooper & Rodman 1994), the United States (Anthony et al 1990), and England (Shoul 1993). Themes apparent in the research included the importance of adequate space, convenient location for services, sense of security associated with distance from inner cities, attachment to neighborhood and people, and environmental support for changing work and family roles.

Among individuals with disabilities, Cooper & Rodman (1994) found that control over social aspects of housing was more important than control over physical aspects in predicting satisfaction. Components important in the home, such as protection and self-identity, are also important to the homeless (Bunston & Breton 1992). Researchers have conducted preference/satisfaction surveys across age spans. Devlin (1994) found that US children preferred ranch and colonial style houses as well as mobile homes, Quonset huts, and geodesic domes; adults preferred farm, Tudor, Neo-French, and split-level styles. Lindberg et al (1992) found that preferences across the life span were influenced by

comfort, freedom, well-being, and togetherness. Structural adequacy and maintenance quality were found to be the best predictors of satisfaction among a sample of elderly residents (Christensen et al 1992). Among Turkish elderly, Imamoğlu & Imamoğlu (1992) found residential satisfaction correlated with proximity to towns and metropolises, for reasons related to attachment to dwellings and people (including extended family), preferences for same-age interactions, and attitudes toward institutional living. For teenage children and adults, having a disabled elderly relative live in the same home was associated with decreased satisfaction (Pruchno et al 1993).

Other trends in research on residences concern the changing role of women and the rise of single parenting. Hasell & Peatross (1990) discussed correlations between changing gender role patterns (e.g. more women working outside the home, more men taking on domestic chores) and changes in housing between 1945 and 1985 in the United States, which included a doubling of the size of the master bedroom (from 162 to 332 square feet) and an increase in the ratio of master bedroom/bath to total space from 15.5% to 22.8%. Smith (1994) also studied gender roles in relation to housing configurations; among the major findings was that women placed heavier emphasis on personal control than did men. Ahrentzen et al (1989) found that fully employed mothers spent more time than fathers in rooms with other family members. People who work at home may make adjustments among roles and space to manage conflict (Ahrentzen 1990). James (1989) found evaluations of housing negatively correlated with salience of marital role for women, not for men.

A major preference-satisfaction study by Paulus et al (1991) compared US Army families in apartment and mobile home parks. Satisfaction was high in both settings because of perceived choice, expectation of improved future conditions, and contrast with past housing. Those satisfied with mobile homes especially emphasized low noise levels, low perceived crime risk, more distance between units, more privacy, and compatibility of housing with raising children. Those satisfied with apartments cited attractiveness, other people in the complex, convenience of services, fire and weather safety (e.g. feeling safer in case of a tornado), and adequacy of recreation facilities.

HOUSING DESIGN FEATURES In one study on attitudes toward windows, students at a US university saw skylights as desirable in family rooms, living rooms, and kitchens but not as desirable as windows in the same types of rooms (Butler & Biner 1990). Building materials (brick, concrete block, weathered wood, stucco, flagstone, wooden shingles) were associated with perceived social identity of homeowners (Sadalla & Sheets 1993). Another study in the United States found farm and Tudor styles rated most desirable and Mediterranean and saltbox styles as least desirable (Nasar 1989). Kent (1991) reported cultural

variation in partitioning of space; Kent (1990) reviewed use of space and design features.

RESIDENTIAL CROWDING A study in Bangkok, where population density is four times greater than in comparable Western cities, found a nonlinear relationship between household density and *crowding* (experience of stress in high density conditions), indicating a ceiling effect: Increasing household density was associated with increments in crowding only up to a point (Edwards et al 1994). High density and crowding correlated with dissatisfaction in Italian homes (Bonnes et al 1991). Studies of crowded homes in India and the United States found social hassles associated with psychological symptoms of distress and ill health (Evans et al 1989, Lepore et al 1991a) and found that perceived control and social support mediated these links (Evans & Lepore 1993; Lepore et al 1991b, 1992). While seeking privacy may be a common response to distress (Newell 1994), satisfaction with privacy appeared distinct from satisfaction with space (Oseland & Donald 1993). On the other hand, a study of group residences also found solitude an aversive experience, for reasons unrelated to environment (Brown 1992). In Japan, Omata (1992) described how people cope with limited space by not entertaining at home.

PLACE ATTACHMENT Research increasingly focused on psychological attachment to places, often in the context of home and neighborhood (Altman & Low 1992). Residential satisfaction was often tied to place attachment. Studies examined attachment over time as people moved from one place to another (Bih 1992, Burt 1993, Feldman 1990, Lucca-Irizarry & Pacheco 1992, Michelson 1992). Mazumdar & Mazumdar (1993) reported how religious rituals can enhance place attachment. In Berne, Switzerland, Fuhrer & Kaiser (1993) found lower mobility associated with higher attachment to homes and vehicles. Brown & Perkins (1992) analyzed cases of disrupted attachment.

Workplaces

Emerging issues for research in the workplace included stress and health in the workplace (Evans et al 1994, Hedge 1989), physical settings for work groups (Sundstrom & Altman 1989) and collaboration (Becker 1991), electronic communications in groups (Fulk 1993), and the role of computers in collaborative work (Olson 1989) and organizations (Becker 1988). Another emerging topic concerned home-based work, particularly among women (Ahrentzen 1989, Christensen 1988). Ahrentzen (1990, 1992) identified conflicts inherent in home-based work. Case examples (Christensen 1989, 1993) suggested that successful home work requires physical space arranged compatibly with home workers' management of time, social relations, self-identity, and potentially conflicting demands (Christensen 1994).

Research also addressed ambient conditions such as lighting and sound. A simulation study by Katzev (1992) found no adverse effects of a 50% reduction in illumination on clerical workers' mood or performance. A field study of office workers found higher satisfaction, better environmental control, and fewer complaints in offices with under-floor ventilation than conventional systems (Hedge et al 1993). In a field study of office workers at multiple sites, Sundstrom et al (1994) found more than half disturbed by noise and found disturbance correlated with dissatisfaction with the environment and job, but not self- or supervisor-rated performance. Quasi-experimental analysis after relocation or renovation revealed declining environmental and job satisfaction concurrent with increasing noise, and increasing environmental satisfaction concurrent with decreasing noise.

WINDOWS A laboratory experiment briefly placed office workers in various combinations of window size and amount of sunlight and found no differences in preference or satisfaction but found self-rated tension highest in conditions of most and least sunlight (Boubekri et al 1991). Butler & Biner (1989) found an unexpected preference among students for no windows or small windows in some places, such as computer workrooms. Research on indoor windows between rooms revealed favorable attitudes and differing perceptions: Secretaries expected loss of privacy; students saw potential for social interaction (Biner et al 1991). Biner et al (1993) found secretaries unwilling to trade items like plants or pictures for indoor windows.

ENCLOSURE AND PRIVACY Oldham (1988) reported increased ratings of privacy and office satisfaction and decreased crowding associated with decreased density and increased enclosure; individual stimulus screening ability was related to perceptions of crowding. Oldham et al (1991) found that office employees who scored high on stimulus screening and did complex jobs in low-density areas showed greatest productivity and satisfaction. Among secretaries, Duvall-Early & Benedict (1992) found a closeable door and "co-worker not visible" associated with perceived privacy, which in turn correlated with job satisfaction.

FACETS OF WORK ENVIRONMENTS Couch & Nimran (1989) asked managers to name features of their office environments that facilitated or inhibited performance; facilitators included supportive social interaction, inhibitors included distractions, and ambient sound and temperature were named in both categories. Carlopio & Gardner (1992) found bank employees' satisfaction associated with having a personal computer and an ergonomic chair, among

other factors. Mazumdar (1992) recounted anecdotal cases of environmental "deprivation" after office renovation, which elicited reactions by workers such as shame, social withdrawal, and filing of lawsuits. Ornstein (1992) found students able to infer from photos of reception rooms messages about the organizations' consideration and control. In a post-occupancy evaluation of an office renovation, Spreckelmeyer (1993) found workers' satisfaction related to participation in designing the renovations.

Hospitals, Clinics, and Rehabilitation Settings

Despite increasing complexity of hospitals and calls for research (Shumaker & Pequegnat 1989), few studies of health-care settings appeared in the past six years. One study focused on practices of secluding patients (Morrison 1990). Among critical-care nurses, Topf (1989) found resistance to noise-induced stress greatest by those with low noise sensitivity and high commitment. Case studies examined treatment center design (Gifford & Martin 1991) and entryway and access variables (Cherulnik 1993). Design interventions in residential settings for mental patients demonstrated that interaction among patients increased following partitioning of sleeping rooms and introduction of *sociopetal* arrangements, in which chairs are grouped within comfortable conversation distance facing toward one another (Cherulnik 1993). A design intervention by Devlin (1992) in psychiatric wards created home-like conditions that were associated with decreased stereotypy (e.g. head banging) but not the increased interaction often found after adding sociopetal seating.

Schools

In a 1-year study of the effects of elementary school lighting, Kuller & Lindsten (1992) found windowless classrooms with fluorescent lighting associated with undesirable biochemical changes not found in classrooms with natural lighting. A laboratory study found no differences between conventional and full-spectrum fluorescent lighting on college students' performance and mood (Boray et al 1989). Cohen & Trostle (1990) reported that among school children, girls preferred more intense color arrangements, more multi-dimensional shapes, brighter lighting, and more complex scenic arrangements than did boys. Weinstein & Pinciotti (1988) evaluated a playground design intended to promote constructive play and reported increases in active and pretend play and decreases in organized games, uninvolved behavior, and roughhousing.

Reinforcing the well-established association of classroom performance and seating among college students, Brooks & Rebeta (1991) found that compared with men, women sat closer to the instructor, made better grades, and missed fewer classes; distance from the front correlated positively with absence and inversely with grades. Hillmann et al (1991) reported higher self-esteem

among college students seated in the front third of a classroom; these students received better grades, participated more, missed fewer classes, and scored higher on an achievement test than those in the back of the room. Wong et al (1992) evaluated Sommer's (1974) "soft classroom," which was designed to promote interaction through carpet-covered bench seating arranged in a semi-circle. As before, observations revealed more voluntary participation and more student-to-student interaction in the "soft" classroom than in traditional classrooms of similar size.

In a study of transitions by new college students to new school environments, Lakey (1989) found perceived social support higher in suite-style than in corridor style dormitories, where students felt more anxious and saw others as less likely to help. Yamamoto et al (1992) reported that after leaving college for new jobs, students replaced some social contacts but continued to rely on family networks.

Prisons

Prison research examined inmates' perceptions of the environment (Ajdukovic 1990) but focused mainly on population density and housing design. Physiological signs of stress were found lower among inmates living in single cells than in dormitories (Ostfeld et al 1987, Schaeffer et al 1988). Adverse reactions by inmates correlated with the number of inmates per housing unit; fewer adverse reactions occurred in subdivided than unsubdivided dormitories (Paulus 1988). Wener & Keys (1988) found prison density associated with perceived crowding and found higher rates of sick call among prisoners exposed previously to high density conditions than among prisoners who had resided in lower density conditions. In a prison redesign project that applied lessons from research (Farbstein 1986), decentralized suites were associated with more positive outcomes than were conventional arrangements (Wener et al 1985, also in Cherulnik 1993).

Extreme Living Environments

Recent studies examined human adaptations to extreme living conditions such as outer space and Antarctica (reviewed by Harrison et al 1991, Suedfeld 1991, Ursin et al 1991). Some studies described how native and nonnative peoples adapt. For example, Inuit settlements near Nome, Alaska, were usually found close to roads and water and far from hills (Burger & Gochfeld 1991), and much upheaval occurred as the Inuit of Canada adapted to modern changes (Goehring & Stager 1991). Visitors to polar regions face risks to their physical and mental health because of isolation, leading researchers to call them ICE (Isolated and Confined Environments). Carrere & Evans (1994) observed four trends in an Antarctic ICE. 1. Individuals chose to spend much time alone, and design features that helped to increase or decrease social interaction were

valued. 2. Design flexibility to provide a variety of work and leisure activities was desired. 3. Individual and group personalization was prevalent. 4. Evaluation of the quality of the environment remained neutral. Others noted the importance of comfort with group interactions for coping in ICEs (Kahn & Leon 1994, Koscheyev et al 1994, Leon 1991, Leon et al 1991). Successful coping with environmental extremes may have long-term benefits in the form of reduced physical health risks (Palinkas 1991).

ENVIRONMENTAL INFLUENCES IN THE COMMUNITY

Physical Environmental Stressors

NOISE Studies found noise a major source of annoyance in a variety of settings. Levy-Leboyer & Naturel (1991) reported neighborhood noise especially troublesome if it occurred at night and could have been avoided; evidence that the perpetrator of the intrusive noise is unconcerned made it more annoying, as did perceived loss of control. Hopkins (1994) found noise a significant problem in shopping malls.

AIR POLLUTION Past research found lower socioeconomic groups most likely to live in areas with high air pollution (Mukherjee 1993). However, Napton & Day (1992) found predominantly middle-class residents in highly polluted areas in Texas, mostly affiliated with petrochemical industries, where choice of neighborhood was largely dictated by proximity to work. Even low levels of SO₂ were associated with slower reaction time, reduced concentration, and lower psychological well-being in Bavaria (Bullinger 1989). Other studies found people with emotion-oriented coping styles less annoyed by foul odors than were people with problem-oriented coping styles (Cavalini et al 1991, Steinheider & Winneke 1993). In contrast, a laboratory study by Baron (1990) found beneficial effects of pleasant scents. Students exposed to perfume, cologne, and air freshener previously found to elicit positive attitudes set higher goals, adopted more efficient strategies in clerical work, made more concessions during negotiations, and showed less inclination to avoid conflict or use competitive strategies for dealing with future conflict than did members of a control group. Males exposed to pleasant scent had higher self-efficacy than those not exposed to the scents.

HEAT AND VIOLENCE Debate continued over the relationship between ambient temperature and incidence of human violence, including whether a relationship exists (Rotton 1993a,b), and whether violence increases linearly with rising temperature (Anderson 1989, Anderson & DeNeve 1992) or increases to a point of moderate discomfort and then decreases with extreme discomfort at higher

temperatures (the *negative affect-escape model of aggression*; Bell 1992). Data analysis techniques and control of extraneous variables remained issues in the debate (Cohn 1990, 1993, Simpson & Perry 1990). Reifman et al (1991) found professional baseball players more likely to be hit by wild pitches as temperature increased. Ruback & Pandey (1992) found passengers on Indian rickshaws less bothered by heat when given information about its sensory and emotional effects, which increased their perceived control. Rotton et al (1990) studied walking speed as a function of ambient temperature and found that pace was sometimes more rapid in cool settings and at other times more rapid in warm settings.

Attitudes About the Environment

ENVIRONMENTAL CONCERN Studies demonstrating concern about environmental issues accompanied growth of the environmental movement (Krause 1993). Lyons & Breakwell (1994) found that knowledge of science predicted environmental concern, but others found little relationship of environmental concern with environmental knowledge (Arcury 1990) or sociodemographic variables (Samdahl & Robertson 1989, Scott & Willits 1994, Syme & Nancarrow 1992). Among predictors of environmental concern, authoritarianism showed a strong, inverse relationship (Schultz & Stone 1994). Other studies found women higher than men on environmental concern but found men more likely to be environmental activists (Baldassare & Katz 1992, Mohai 1991, Schahn & Holzer 1990, Stern et al 1993). Inconsistent findings appeared on racial differences in environmental concern (Adeloa 1994, Taylor 1989). Eco-centric vs anthropocentric value orientations predicted environmental concern and behavior in one study (Thompson & Barton 1994), but attempts to predict environmental behavior from environmental attitudes continue to yield disappointing results (Oskamp et al 1991).

PERCEIVED ENVIRONMENTAL RISK Environmental psychologists showed increasing interest in perception of risk from toxic exposure, natural and human-caused disaster, ozone depletion and global warming, and injury in built and natural settings (Slovic 1987, also Ewert 1994, Vaughan 1993). Perceived risk was strongly associated with reduced neighborhood satisfaction (Baba & Austin 1989, Gärling & Gärling 1990). In a study by Grieshop & Stiles (1989) over 25% of California respondents said they had suffered illness from pesticide exposure, yet many of those who perceived the risk still used pesticides. Much work examines perceived risk associated with nuclear power (Earle & Cvetkovich 1990, MacGill 1989, Maharik & Fischhoff 1993, Reicher et al 1993). Perceived nuclear risk increased following the 1986 accident at the Chernobyl reactor (Drottz-Sjoberg & Sjoberg 1990, Midden & Verplanken 1990, Peters et al 1990, Renn 1990, van der Pligt & Midden 1990, Verplanken

1989). A new tool—the Environmental Appraisal Inventory (EAI)—assesses perceived threat to self, threat to environment, and perceived control over environmental hazards (Fridgen 1994, Schmidt & Gifford 1989).

Preserving the Environment

COMMONS DILEMMA Hardin's (1968) description of self-interested abuse of a shared environment spawned many laboratory simulations of the *commons dilemma* in which individuals harvest from a shared resource (Fusco et al 1991, Gifford & Wells 1991). The dilemma is that short-term self-interest (making large harvests from the shared resource) is harmful to long-term group interest, because collective short-term self-interest destroys the commons. Research has sought solutions that encourage individual conservative harvests to preserve the commons in the long run. Recent results confirmed and extended past research. Trusting others to conserve emerged as an extremely important factor in willingness to conserve (Mosler 1993, Parks 1994). Rewards for cooperative behavior and punishments for selfish behavior were found beneficial in preserving the commons (Bell et al 1989, Birjulin et al 1993, Harvey et al 1993). Division of the commons into individual territories—the privatization strategy—also helped preserve the commons in laboratory simulations. Such a territorial/privatization solution eliminates the commons and is impractical for some resources, but it also eliminates the need for intricate systems of reward and punishment (Martichuski & Bell 1991). Outside the laboratory, privatization showed promise for preserving low-income housing (Leavitt & Saegert 1989). Debate continues on privatization and group rules (Feeny et al 1990).

CONSERVATION BEHAVIOR Strategies for promoting recycling, energy conservation, and anti-littering behavior continued to draw research interest, as reviewed in the March 1995 issue of *Environment and Behavior* (also DeYoung 1993). Waste source reduction—not producing waste in the first place—clearly has the most beneficial impact on the environment (DeYoung et al 1993). Educational efforts had least impact on pro-environmental behavior (Thompson & Stoutemyer 1991). Recycling knowledge predicted recycling behavior (Gamba & Oskamp 1994, Granzin & Olsen 1991, Vining & Ebreo 1990), but using a person designated as a neighborhood block leader who coordinated and encouraged recycling improved recycling behavior over mere educational strategies (Burn 1991, Hopper & Nielsen 1991). Individual personal belief (Axelrod & Lehman 1993) and commitment to recycling predicted long-term recycling behavior (Wang & Katzev 1990), as did perceived personal benefit (Oskamp et al 1994). Individual and group norms can reduce littering (Cialdini et al 1990), as can shame and embarrassment (Grasmick et al 1991). Howenstine

(1993) found that failure to recycle was associated with indifference, location issues, and household nuisance.

Wayfinding

Recent research examined design features that facilitate cognitive mapping of environments, the role of cognitive maps in finding one's way through them—*wayfinding*—and factors that influence wayfinding (Gärling 1989; Gopal et al 1989; Hirtle & Hudson 1991; Holding 1992, 1994; Kitchin 1994; Leiser & Zilbershatz 1989; O'Neill 1991a; Rovine & Weisman 1989; Sadalla & Montello 1989; Wood & Beck 1989). Peponis et al (1990) introduced the concept of a *search structure* in which properties of layouts combine with navigation rules to determine exploration patterns. O'Neill (1991c, 1992) found lower complexity of layout associated with increased architectural legibility, which in turn correlated with improved wayfinding. O'Neill (1991b) found that signage improved wayfinding, especially in less complex floorplans. Adults are clearly better than children at giving orienting directions, though children improve with age (Blades & Medlicott 1992, Rutland et al 1993). However, cognitive mapping and wayfinding pose special problems for the elderly (Lipman 1991), with a notable exception for elderly hunters (Hill 1992). Among elderly adults, verbal directions and studying maps improved wayfinding more than did either watching videotapes or receiving verbal directions with instructions to form a mental image of the setting (Kirasic & Mathes 1990). Having to realign a map mentally as opposed to aligning it in hand with the floorplan makes wayfinding especially difficult for the elderly (Aubrey & Dobbs 1990, Warren & Scott 1993).

Environment and Crime

Researchers continued to identify environmental contributors to and barriers against crime. One study examined environmental factors in convenience store robberies (D'Alessio & Stolzenberg 1990). Another examined the role of perceived risk of victimization (Brantingham & Brantingham 1993). Brown & Harris (1989) tested predictions related to territoriality and found that the more severe the territorial intrusion in a burglary, the more difficult the long-term coping by the victim. Brown & Bentley (1993) found that burglars were especially wary of signs that residents would show territorial concern. Canter & Larkin (1993) reported that 87% of sexual offenders operated close to their home base. Perkins et al (1992) found territorial functioning, architectural "defensible space" features, and signs of social and physical disorder related to crime and fear of crime. Perkins et al (1993) reported similar findings. MacDonald & Gifford (1989) reported that signs of territorial defense indicated to convicted burglars that a residence contained things worth stealing. Shaw & Gifford (1994) found residents' and burglars' assessments of vulnerability to

burglary inversely related to “surveilability” and positively related to presence of actual barriers. Other studies found fear of crime greatest in places seen as providing refuge for criminals or limiting escape by potential victims (Day 1994, Fisher & Nasar 1992, Loewen et al 1993, Nasar & Fisher 1993).

Commuting Stress

Research on commuting stress by Novaco et al (1990, 1991) found both subjective and objective impedance to be significant predictors of commuter stress, which manifested in both physical and psychological health outcomes. Hanson et al (1994) found longer commutes among women in two US counties, who took jobs further from home than men (perhaps reflecting their lower power or status). Other research found symptoms of stress among public transit drivers (Carrere et al 1991, Evans & Carrere 1991).

Coping with Disaster

Natural and human-caused disasters may have many consequences, including loss of resources, impedance of daily activities, disruption to home and neighborhood, and changes in perception of risk (Hutchins & Norris 1989, Laska 1990). In examining adaptive responses to disasters, Hobfoll’s (1991) *conservation of resources stress theory* posits that the speed and extent of loss or preservation of resources (possessions, loved ones, community services) predicts adaptive efficiency in response to disaster. Baum et al (1992) found that compared with victims of a flood, victims of a toxic waste dump were more anxious, depressed, and alienated and less able to do challenging tasks. Consequences to their resources continued into the future, while flood victims’ consequences were sooner past. Other human-caused technological catastrophes showed a similar pattern, in which longer-lasting consequences to victims’ resources correlated with more adverse aftereffects (Baum & Fleming 1993, Green et al 1990).

Museums

Research on the way people explore museums, in combination with principles of environmental psychology, has guided the design of museums and modifications intended to change the experience of the museum visitor (Loomis 1987). Bitgood & Loomis (1993) summarized current applications. Studies found the museum experience influenced by the type and size of labels (Bitgood & Patterson 1993), availability of comfortable places (Hood 1993), front-end evaluation of exhibit designs (Miles & Clarke 1993, Screven 1990), and maps. Recent evidence suggests that museums can relieve stress and attentional fatigue (Kaplan et al 1993).

NATURAL ENVIRONMENTS

Natural settings have been the focus of much research in environmental psychology. Several recent studies suggested that preferences for natural scenes with greenery and water may be universal (Herzog 1989, 1992; Herzog & Bosley 1992; Hull & Revell 1989; Schroeder 1991; Yang & Brown 1992; Zube 1991). Sebba (1991) suggested that most adults identify the most significant places in childhood as being outdoors. Adding vegetation to built environments enhanced aesthetic value in some but not all settings (Hull & Harvey 1989, Joardar 1989, Orland et al 1992, Sheets & Manzer 1991). One study found that joint experiences in natural settings benefited human groups (Ewert & Heywood 1991).

Why are natural environments so highly valued? Recent research suggests that viewing natural scenery stimulates the parasympathetic nervous system and has a calming effect on people under stress (Hartig et al 1991, Ulrich et al 1991). Ulrich (1993) theorized that such effects may even have an evolutionary basis in that natural selection may have favored those who can relax in a natural setting—the *biophilia hypothesis*. Kaplan et al (1993) noted that a visit to a museum or similar setting can also have restorative effects on stressed individuals. Kaplan & Kaplan (1989) proposed that prolonged attention to a task leads to *directed attention fatigue*, which is relieved in natural environments.

CONCLUSIONS

Advances

Environmental psychology advanced in many areas from 1989 through 1994. We identified six themes:

1. Multiple theories. Environmental psychology's theories expanded, addressed more contextual factors, and increasingly spanned individual, interpersonal, organizational, community, and cultural levels of analysis. Research was guided by theories on arousal, stress, privacy regulation, behavior settings, and the transactional approach. Environmental psychology has yet to embrace a unified theory.
2. Field research. Natural settings predominated in empirical research, which used methods ranging from systematic observation and interviews to design interventions and detailed case studies. Laboratory experiments appeared less common than in the past.
3. Cumulative knowledge. Though some studies represented one-time efforts, others built on previous work. Examples of cumulative research included

studies of vulnerability to residential burglaries and responses to environmental disaster.

4. Applied orientation. Environmental psychology kept a focus on designing settings that promote occupants' goals, often in environmental design research.
5. Interdisciplinary collaboration. The field maintained its multidisciplinary roots. Perhaps only half of the studies in this review came from university-based researchers in traditional departments of psychology.
6. Cross-cultural focus. Environmental psychology maintained an international character through data from a variety of cultures and a focus of research on cross-cultural differences and commonalities.

Future Directions

In the *Annual Review of Psychology* chapter on environmental psychology in 2002 we expect to read that trends of 1989 to 1994 continued: Rising volume of research in natural settings, integration of research and practice, greater diversity of researchers and settings. We hope to read of advances in three specific areas:

1. Stronger theory. In the past six years theories became more differentiated and integrative, perhaps forming the basis for a more unified theoretical approach to guide future research and practice. Current theories suggest potential elements of a unified theory: systems principles; integration of psychological processes like arousal and stress with social-psychological, social, and cultural processes; ecological analysis; and others.
2. Environmental design research. Many classic studies of environmental psychology involved design experiments, which we hope will become more common. Such projects could increasingly serve both the applied and the scientific goals of environmental psychology.
3. Case studies. As the literature of case studies and design experiments expands, the field needs methodological conventions, a shared vocabulary, and accepted models for reporting case studies. We hope to see progress on these in the 2002 review.

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