Annu. Rev. Public Health 2006. 27:297–322
doi: 10.1146/annurev.publhealth.27.021405.102100

First published online as a Review in Advance on September 30, 2005

AN ECOLOGICAL APPROACH TO CREATING ACTIVE LIVING COMMUNITIES

James F. Sallis
Department of Psychology, San Diego State University, San Diego, California 92103; email: sallis@mail.sdsu.edu

Robert B. Cervero
Department of City and Regional Planning, University of California, Berkeley, California 94720; email: robertc@uclink.berkeley.edu

William Ascher
Department of Government and Economics, Claremont McKenna College, Claremont, California 91711; email: william.ascher@claremontmckenna.edu

Karla A. Henderson
Department of Parks, Recreation, and Tourism Management, North Carolina State University, Raleigh, North Carolina 27695; email: karla_henderson@ncsu.edu

M. Katherine Kraft
The Robert Wood Johnson Foundation, Princeton, New Jersey 08543-2316; email: kkraft@patmedia.org

Jacqueline Kerr
Department of Psychology, San Diego State University, San Diego, California 92103; email: jkerr@projects.sdsu.edu

Key Words physical activity, environment, policy, prevention, behavior change

■ **Abstract** The thesis of this article is that multilevel interventions based on ecological models and targeting individuals, social environments, physical environments, *and* policies must be implemented to achieve population change in physical activity. A model is proposed that identifies potential environmental and policy influences on four domains of active living: recreation, transport, occupation, and household. Multilevel research and interventions require multiple disciplines to combine concepts and methods to create new transdisciplinary approaches. The contributions being made by a broad range of disciplines are summarized. Research to date supports a conclusion that there are multiple levels of influence on physical activity, and the active living domains are associated with different environmental variables. Continued research is needed to provide detailed findings that can inform improved designs of communities, transportation systems, and recreation facilities. Collaborations with policy researchers may improve the likelihood of translating research findings into changes in environments, policies, and practices.

EVOLUTION OF THE PHYSICAL ACTIVITY FIELD

Physical activity is widely recognized for its ability to prevent and treat a wide range of physical and psychological disorders (17, 82). The high prevalence of inactive lifestyles is a critical public health challenge worldwide (85). As researchers, practitioners, and policymakers devote increasing attention to promoting physical activity, ways of conceptualizing physical activity and opportunities for intervention have evolved. This evolution has been driven by new data, but perhaps more so by the expansion of professions engaged in physical activity work.

The "exercise" guidelines in the 1970s were issued by exercise scientists trained in physiology (82). People meeting the guidelines by doing vigorous exercise, such as jogging or aerobic dance, for 20 minutes at a time, three or more times per week, were less likely to suffer from many chronic diseases. In the mid-1990s, based on findings of a dose-response relation between physical activity and various outcomes, epidemiologists developed public health guidelines that emphasized the benefits of accumulating at least 30 minutes of moderate intensity "physical activity," such as brisk walking, each day (61). These guidelines provided people with more options for obtaining health-protective amounts of physical activity.

Most of the physical activity studies conducted by public health and behavioral scientists assessed only recreational or leisure-time physical activity. In the late 1990s public health professionals discovered that professionals from other disciplines were also interested in physical activity. Transportation planners, urban planners, and urban designers had been studying how to design cities so people would walk and cycle more (24). They were interested in walking and cycling for transportation to ease traffic congestion, reduce air pollution, and enhance a sense of community. They studied physical activity done for transportation purposes, which was distinct from the leisure-time activity studied by health professionals. As the data, concepts, and methods from the planning and transportation fields have been integrated into public health, opportunities for promoting physical activity expanded again. "Active living" is a broader concept that incorporates exercise, recreational activities, household and occupational activities, and active transportation (69). The change in terms from exercise to physical activity to active living symbolizes the evolution in how physical activity is conceived, in disciplines engaged, and in conceptual models used to guide research, policy, and practice.

The thesis of this paper is that multilevel interventions based on ecological models and targeting individuals, social environments, physical environments, *and* policies must be implemented to achieve population change. Multilevel research and interventions require multiple disciplines to combine their concepts and methods to create new transdisciplinary approaches. The application of multilevel models and transdisciplinary methods to promote active living is in its early stages but is expanding rapidly. For progress to be made, the ability of multiple disciplines to contribute to research, practice, and policy change must be better understood. This chapter describes a model of active living, outlines the contributions being made by selected disciplines, and proposes methods of research and intervention informed by transdisciplinary collaboration.

APPLYING ECOLOGICAL MODELS TO THE STUDY OF ACTIVE LIVING

Theories and models that specify psychological and social influences on behavior have been the dominant frameworks for physical activity research and practice. Use of the Health Belief Model, Theory of Planned Behavior, Social Cognitive Theory, and the Transtheoretical Model (30) has led to an almost-exclusive focus on interventions that target individuals or small groups. Though these models have led to effective interventions (16, 44), important limitations of the models and resulting interventions are apparent. First, effect sizes for many types of physical activity interventions are small to moderate (3, 16). Second, recruitment rates to programs tend to be modest. Third, maintenance of physical activity following programs is poor (57). Any expectation that programs with moderate and temporary effects that reach small numbers of people will create population-wide increases in physical activity is unreasonable.

There is growing interest in ecological models as a more productive framework for physical activity promotion. In public health, ecological models refer to people's interactions with their physical and sociocultural surroundings (75). Ecological models are distinguished by their explicit inclusion of environmental and policy variables that are expected to influence behavior. Rather than positing that behavior is influenced by a narrow range of psychosocial variables, ecological models incorporate a wide range of influences at multiple levels (58, 70). Levels of variables often included in ecological models of physical activity include intrapersonal (biological, psychological), interpersonal/cultural, organizational, physical environment (built, natural), and policy (laws, rules, regulations, codes). Psychosocial models can be integrated into ecological frameworks to provide specific hypotheses for a given level, such as intrapersonal.

A key precept is that interventions will be most effective when they operate on multiple levels (70). According to ecological models, the most powerful interventions should (*a*) ensure safe, attractive, and convenient places for physical activity, (*b*) implement motivational and educational programs to encourage use of those places, and (*c*) use mass media and community organization to change social norms and culture.

Ecological models are becoming widely used and are the basis for the Institute of Medicine Report on Health and Behavior (40), Healthy People 2010 national objectives (81), and the most effective approaches for tobacco control (83). Numerous authors have identified environmental and policy interventions as the most promising strategy for creating population-wide improvements in eating, physical activity, and weight status (8, 20, 26, 29, 37, 54). Environmental and policy changes are the primary strategy proposed for obesity control by the World Health Organization (86), the Institute of Medicine report on preventing childhood obesity (52), and the Centers for Disease Control and Prevention (51).

Ecological models are particularly well suited for studying physical activity, because physical activity is done in specific places. Studying characteristics of places that facilitate or hinder physical activity, therefore, is a priority.

Ecological models direct attention to environmental and policy factors that may be root causes of the epidemic of sedentary lifestyles (54). Trends that produced extensive use of cars and electronic entertainment, zoning codes that require building auto-dependent suburbs, limited investment in pedestrian and cycling facilities, computer-centric work environments, proliferation of labor-saving devices, and fire codes that require stairways to be closed are plausible explanations of the development of sedentary lifestyles. Population-wide declines in knowledge, self-efficacy, enjoyment, and social support related to physical activity are much less plausible explanations.

Staff at the Robert Wood Johnson Foundation (RWJF), a large health philanthropy, determined that the most promising approaches to increasing physical activity were being studied the least. In 2000, RWJF launched a multi-strategy active living initiative that devoted over $70 million to environmental and policy approaches to research, practice, and policy change (see http://www.rwjf.org/index.jsp). Active Living Research was one of the national programs established as part of the initiative. Active Living Research takes a transdisciplinary approach to prioritize a research agenda, build capacity of investigators within multiple disciplines to conduct the research, and communicate findings to policy makers and advocates (see http://www.activelivingresearch.org/). The authors of this chapter were drawn from the staff and national advisory committee of Active Living Research and RWJF. We have been working to overcome the challenges of conceptualizing and developing a new transdisciplinary field that requires close collaboration between people in professions who do not necessarily share common academic homes (departments), language, concepts, and methods.

A FRAMEWORK FOR ACTIVE LIVING POLICY AND ENVIRONMENTAL RESEARCH

A multilevel model was developed to illustrate the roles numerous disciplines can play in research on active living. Figure 1 is an ecological model built around four domains of active living with multiple levels of influences specific to each domain. Figure 1 builds on previous ecological models of physical activity (8, 52, 67, 79).

Broad categories of intrapersonal variables are shown at the center to represent the individual. Psychosocial theories could be used to provide more specificity for this level. Individuals' perceptions of environments are distinguished from more objective aspects of environments, and both are likely to be important influences.

Behavior represents the interaction of the person and the environment, with the domains of active living shown at this boundary. The four active living domains of recreation, transport, occupation, and household are consistent with contemporary concepts (79) and are useful for identifying the variety of environments and policies that may influence active living. The physical activity domains are likely affected by distinct policies and environments. The imperative to consider domains separately

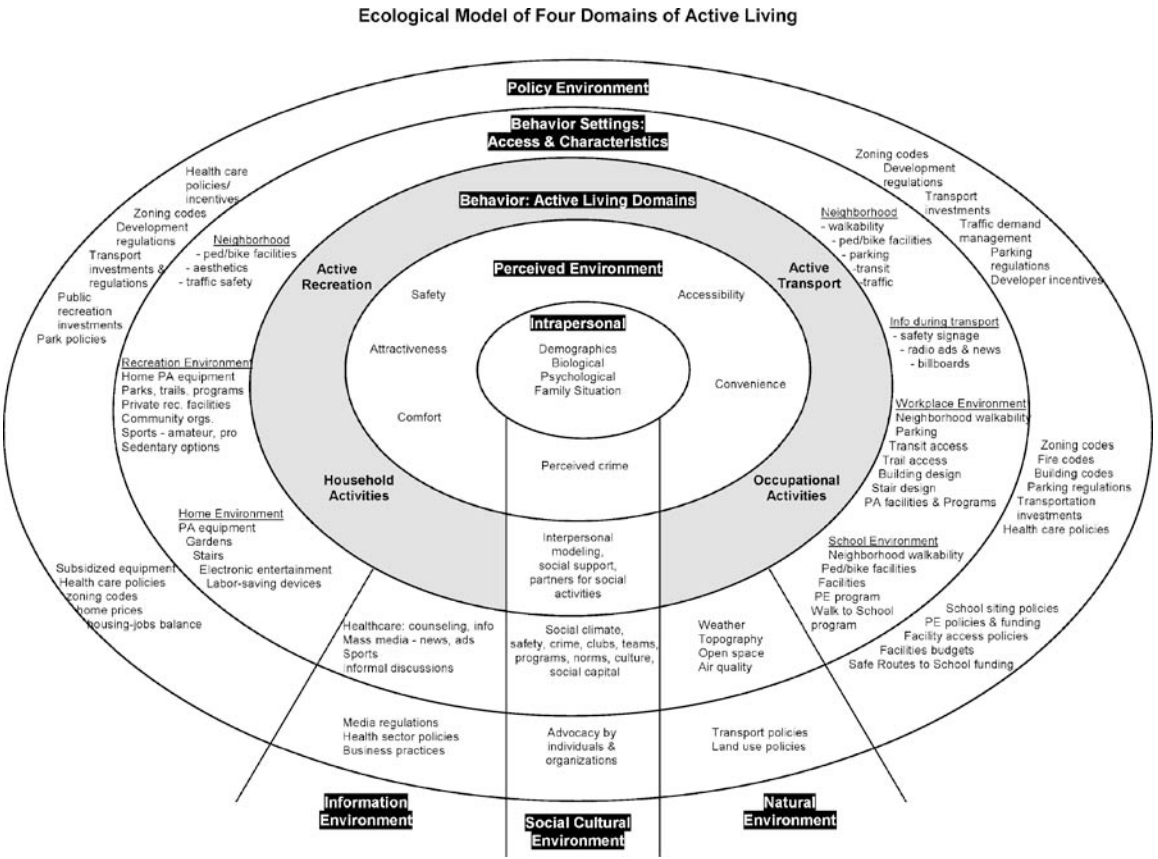

Figure 1 Ecological model of four domains of active living.

is driven in part by different trends by domain over time (9, 49). The behavioral level is highlighted because this is the outcome of interest.

Behavior settings are the places where physical activity may occur, and it is useful to consider both access to settings and their specific characteristics. For each active living domain, key behavior settings are listed with illustrative components or characteristics. There are commonalities and differences of relevant environmental factors across active living domains. For example, walkability of neighborhoods refers to the ability to walk to nearby destinations such as shops. This characteristic is relevant for active transport and for walking around workplaces, but probably not relevant for active recreation. Trail systems that link homes and workplaces would be relevant for recreational, transport, and work-related physical activity. Some influences listed could be expanded greatly. For example, many types of community organizations, such as churches, social service agencies, sports clubs, and child care centers, could provide places, programs, and policies that are relevant to active recreation.

The policy environment can influence active living through a variety of mechanisms, such as the built environment, incentives, and programs. Some policy realms, particularly zoning, development, land use, and transportation regulations, may affect several active living domains.Other policies are domain-specific, such as budgets for public recreation facilities and traffic demand management policies meant to encourage use of public transit in the commute to work. Health care policies that provide incentives or counseling for physical activity are relevant to all domains.

The interpersonal environment has been conceptualized in different ways by different authors (8, 52, 79). In Figure 1, social and cultural environment variables are shown as cutting across the other levels. Family structure can be seen as a demographic variable; modeling and social support are behaviors; social climate, crime, programs, and culture vary by behavior settings; and advocacy by individuals and organizations contributes to policy change.

Natural environment variables of interest include weather, topography, open space, and air quality, and their influences are not confined to specific behavior settings. Land use policies can affect availability of open space, and transport policies can affect air quality.

Information is present in virtually every behavior setting, and commercial promotion of sedentary behaviors is particularly ubiquitous. The information environment can include counseling in health care settings; news, advertising, and program components of mass media; and sports-related information to promote either active participation or sedentary spectating. Setting-specific information sources can be identified, such as televisions and the internet in homes, printed and electronic notices at work, and promotional materials in fitness facilities. Diverse information is transmitted during transportation, such as signs about pedestrian zones, signs pointing to park access, dazzling arrays of commercial signs, an occasional billboard promoting healthful behaviors, and radio broadcasts that inform about exercise events or advertise cars.

Figure 1 communicates complexity about the hypothesized influences on active living and implies that creating significant changes will be difficult and time-consuming. Multilevel intervention strategies need to be informed by research. Many of the proposed influences on physical activity have not been tested, so the model lays out an ambitious research agenda that will require the combined efforts of investigators from a variety of disciplines. In the following sections, the concepts, methods, and findings from various fields engaged in active living research are summarized to illustrate what each field can contribute to transdisciplinary research on active living.

CONTRIBUTIONS OF PUBLIC HEALTH AND BEHAVIORAL SCIENCES TO ACTIVE LIVING RESEARCH

Public health and environmental health have been linked since the eighteenth century. Most research on the environment and public health in the twentieth century focused on air and water quality and motor vehicle and pedestrian injuries and fatalities. Physical activity has been recognized as an environmental health issue only recently (4, 27).

Epidemiologic studies on physical activity began in the 1960s, and by the end of the 1980s a large number of studies had documented multiple health outcomes. By the mid-1990s, several consensus statements had been published on the health benefits of physical activity for longevity, prevention, and treatment of cardiovascular diseases and risk factors, diabetes, obesity, some cancers, osteoporosis, and mental disorders (82). Physical activity is a leading indicator in Healthy People 2010 (81) and has become a public health priority internationally (85, 86).

Behavioral scientists have been extensively engaged in physical activity research. In the 1980s and 1990s most research on physical activity from the fields of health psychology and health promotion focused on strategies to change individual behavior applied in settings such as schools, health care practices, the workplace, and the community. By the end of the 1990s, reviews indicated that interventions at the individual level had modest effects (16) on long-term behaviorial change at the population level, but that initial investigations into environmental and public policy approaches were promising (3, 49). The first environmental physical activity studies in the early 1980s evaluated signs that encouraged use of stairs. By 2002, 18 environmental and policy intervention studies were reviewed by the Task Force on Community Preventive Services (44), while Humpel and colleagues (39) reviewed 19 studies assessing associations between environmental factors and physical activity. In 2003, two public health journals published special issues relevant to physical activity and the environment (1, 4). Since then, the number of published studies has increased enormously, and other journal supplements have appeared (2, 43).

Methods and Findings

There has been substantial innovation and development of measures of environments, in collaboration with professionals in urban planning, transportation, geography, and recreation. Based on concepts of community design related to people's ability to walk or cycle to destinations near their homes, several self-reported measures of neighborhood characteristics have been evaluated (10). Using direct observation, more detailed objective measures of environments are being applied to neighborhood characteristics (38, 62), parks (65), and trails (80). Health researchers are incorporating powerful Geographic Information Systems (GIS) software into their studies. These measurement advances will facilitate more sophisticated and detailed analyses of the links between physical activity and environmental variables.

The first generation of studies on environmental correlates was limited to recreational physical activity. Reviewing 19 adult studies, Humpel et al. (39) found that accessibility of facilities, opportunities for activity (i.e., programs), and aesthetic attributes had significant associations with physical activity. Another review emphasized that neighborhood facilities, including streets, were popular activity locations, with long distances and lack of safe places as common barriers to physical activity (55). A review of child and adolescent studies found that access to recreational facilities and programs were consistently related to physical activity (71).

Because walking is the most common form of physical activity and can serve multiple purposes, it is possible to differentiate environmental correlates for walking done for recreation and for transportation. In their review of environmental attributes of walking, Owen et al. (60) found that walking for recreation was repeatedly associated with aesthetics, convenience of facilities, and traffic volumes. Walking for transportation was related to traffic concerns, access to open space, and design of the neighborhood that would allow walking to nearby destinations.

The literature on active transportation was reviewed by a team of health and transportation researchers and reported in a health journal (66). There were consistent associations of the overall "walkability" of the neighborhood design with walking and cycling for transportation. Walkability was indicated by the combination of mixed land use, connected streets, and high residential density. The Task Force on Community Preventive Services concluded there was "sufficient evidence" to recommend creation of walkable neighborhoods to increase physical activity (33). Multidisciplinary teams are now collaborating routinely, and studies have emerged linking the walkability of neighborhoods or sprawl of regions with physical activity (25), obesity (21, 23), and risk of chronic diseases (21, 78).

Studies of the environmental correlates of physical activity for recreation and transportation strongly support a conclusion that environmental factors are important for both outcomes. However, the near-exclusive reliance on cross-sectional studies limits interpretations of causality, so prospective studies are needed to strengthen evidence of causality. There are insufficient data to make specific recommendations to policy makers, urban designers, or the construction industry, so

more detailed studies are needed. Because of the large financial implications of changing how communities are built, studies need to explore the economic costs and benefits as well as repercussions for multiple health and mental health outcomes. Virtually all studies published to date involved only adults, so studies are needed of understudied groups such as youth, older adults, racial/ethnic subgroups, low-income populations, and people living in rural areas.

Engagement in Active Living Research

Investigators in the fields of public health, exercise science, and behavioral science have greatly increased their involvement in studies of environmental and policy topics related to active living in recent years. Funding opportunities are expanding. The Centers for Disease Control and Prevention (CDC) developed the Active Community Environments initiative to fund research on environments and physical activity. More recently, CDC established a Physical Activity Policy Research Network. Active Living Research is managing a $12.5 million research fund devoted to supporting transdisciplinary research on environmental and policy aspects of active living. Public health and behavioral scientists have been prominent in the hundreds of submitted applications. A focus on obesity and the built environment has been adopted by the National Institute of Environmental Health Science (NIEHS) through conferences and studies funded through a special call for applications in 2004. Other NIH institutes have sponsored workshops to inform the development of research initiatives on physical activity, nutrition, and obesity that include environmental and policy components. These expanding funding opportunities suggest physical activity research guided by ecological models may become a long-term line of investigation, but the actual investment to date has been small, especially in light of the potential public health impact.

CONTRIBUTIONS OF URBAN PLANNING AND TRANSPORTATION TO ACTIVE LIVING RESEARCH

Public health has always been a central consideration of urban planning. The premise of municipal zoning (upheld by the U.S. Supreme Court under Village of Euclid v. Ambler Realty Co., 1926) was to buffer residents from smoke-belching factories, crowding, and infectious disease risk. Building codes reflect public safety protections such as ensuring sufficient road width to accommodate fire trucks and emergency equipment. Federal clean-air mandates have enabled planners to stop proposed freeways.

Transportation is a prominent component of urban planning not only because it comprises the channel-ways for connecting urban spaces but also because its environmental footprint is large. Historically, transportation planning has focused on predicting traffic volumes to guide long-term capital investments, mainly in the form of highways (42). Elevated freeways and six-lane arterials—which

have provided unprecedented mobility but have also spawned sprawl and severed communities—are the most visible products of this supply-side mentality. The cumulative consequence of planning and designing cities for auto-mobility spurred two significant changes in the 1990s. One notable piece of federal legislation was the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), which required a balanced, multimodal approach to transportation planning and prevented the building of mega-highway projects in areas that violated clean-air standards. Second was a series of grass-root movements among reform-minded architects and planners calling for a return to traditional neighborhood designs that facilitated more walking and less driving while increasing what many modern suburbs lack: cultural diversity and social capital (45). What these movements—under the banners of New Urbanism, neo-traditional design, transit-oriented development (TOD), and smart growth—share is a disdain for car-dependent living and the monotony of sprawl. By placing people and shops closer together, shrinking average lot sizes, designing grid-like street networks laced with sidewalks, and concentrating housing around rail stops, the car's domineering presence could be reduced, as could other urban ills such as traffic congestion, air pollution, unaffordable housing, and social disengagement (19). Resulting increases in active travel like walking and cycling could yield the bonus of healthier residents.

Methods and Findings

Interest in making American cities less car-dependent has spurred planning research on how the built environment influences travel behavior. One review counted over 50 articles on this topic published in planning and transportation journals (22). Informing these analyses have been self-reported data from large samples on daily travel over one- to two-day periods. The primary focus has been on modeling motorized travel for utilitarian purposes (e.g., work, shopping, personal business). Outcomes have generally been expressed as "modal splits" (e.g., shares of trips by automobile), daily vehicle miles or hours of travel, and daily vehicle trip rates (22).

To overcome a dearth of adequate land-use databases, some studies adopted a quasi-experimental "matched pairs" approach wherein neighborhoods were stratified by factors such as population densities and street patterns (12, 32). GIS advances and the availability of secondary databases on land uses opened the door to more robust regression analyses that predicted non-motorized travel as functions of myriad built-environment predictors.

The urban planning and transportation fields have arguably made the greatest contributions to the study of active transportation by conceptualizing and measuring the built environment. The "3 D" model has gained currency as a framework for defining core dimensions of built environments: density, diversity, and design (13). These dimensions are tied to explicit measures of density (e.g., households per acre, floor area ratio), diversity (e.g., land-use mix, presence of neighborhood retail), and design (e.g., street connectivity indicators, road network density,

completeness of sidewalk networks). Because many of these measures are correlated (e.g., neighborhoods with connected grid streets tend to have complete sidewalk networks), factor analysis has often been used to collapse these measures into the "3 D" core dimensions.

Methodological inroads have also been made in modeling mode choice, a staple in travel-demand analyses. Historically, mode choice models (e.g., predicting whether people drive or walk) have focused on time and cost differences in connecting origins and destinations among competing modes as opposed to physical attributes of origins and destinations themselves. Research shows built environment measures provide significant explanatory power, beyond traditional utility-based measures, for understanding travel choice behavior (11). Another notable trend has been a shift from trip-based to activity-based analyses; e.g., studying the influences of built environments on trip chains, such as driving from work to an urban village, walking to several restaurants and shops, and then driving home (42).

Recently, planning researchers have begun to study the importance of built environments on the decision to walk and bicycle (24), fueled in part by grant funding from programs like Active Living Research. Planners have profited from collaborations with scholars in disciplines such as public health and environmental psychology. For example, more sophisticated specifications, like hierarchical models that distinguish the influences of person-level attributes (e.g., age, gender) from place-level attributes (e.g., county-level sprawl indices), have begun to penetrate the planning literature (21, 47). Ecological models are also influencing research in planning. Boarnet and colleagues (7), for instance, found that mediators like perceived safety were related to the decision to walk to neighborhood schools.

Studies have yielded surprisingly consistent results. Walking and cycling for utilitarian purposes is generally higher in the presence of mixed uses, street connectivity, and higher population densities. This was the conclusion of a review sponsored jointly by the Transportation Research Board and the Institute of Medicine (79). When the "3 D's" are configured to create walkable communities, the increased walking and cycling for transportation appear to contribute to higher levels of total physical activity. The influences of design features, such as sidewalk connectivity and the presence of walkways, have been much weaker (22).

Engagement in Active Living Research

Planning academics are increasingly collaborating with scholars from other fields, marked by the sharp increase in cross-disciplinary publications (24, 68), including several journal special issues cited above. While planners are often looked upon to conceptualize and measure built environments, they also offer insights on how to bridge theory and practice and implement changes, e.g., what kind of zoning and building code reforms make sense in different urban settings?

The mounting interest among planners in the built environment–active living connection has yet to appear in the curricula of graduate courses in land use and

transportation planning. A recent review of syllabi used in graduate "land-use-transportation" courses at 15 U.S. and Canadian planning programs found no instances where active living was a defined topic, but relevant content was covered (53). Within the larger community of planning and transportation professionals, active living is a hot topic, as evidenced by special sessions on physical activity at recent annual meetings of the American Planning Association and Institute of Transportation Engineers, an issue of the *Journal of the American Planning Association* devoted to health, and the initiation of a health special interest group at the Association of Collegiate Schools of Planning. Many planners realize that strength lies in numbers, and partnering with colleagues from the medical and public health fields provides a potentially potent force for promoting active living and healthy cities while at the same time tackling age-old problems such as haphazard growth and car-dependent sprawl.

CONTRIBUTIONS OF LEISURE STUDIES AND RECREATION STUDIES TO ACTIVE LIVING RESEARCH

Leisure and recreation research related to active living has two broad foci. One is the analysis of leisure behavior pertaining to activities that people consider meaningful and enjoyable in their "unobligated" time. The second focus is the role of park and recreation organizations, primarily public agencies, in facilitating and managing opportunities to be recreationally active.

The century-old park and recreation field has a rich history of promoting a variety of activities for youth and adults (31). Numerous facilities, programs, and park areas are publicly supported to encourage the involvement of people of all age groups in active "play." An interdisciplinary examination of leisure and leisure behavior as a "serious" area of study evolved within the past 40 years and includes research on time use, activity participation, and the social psychological meanings of choice and enjoyment.

Physical activity has been an important, but not central, component of research about leisure behavior and programming within parks and recreation agencies. Recreation includes a plethora of activities such as arts, music, outdoor aesthetics, play, culture creation, stress reduction, in addition to fitness, sports, and physical activity. Nevertheless, leisure behavior researchers and parks and recreation managers have significant roles to play in understanding and facilitating active living (5, 31).

The role of recreation and leisure relative to active living might be described as "physical activity by choice." People might define their leisure goals as "feeling good," but this might emanate from physical, mental, social, spiritual, or aesthetic outcomes. Improved quality of life through active living is an explicit goal of park and recreation management.

Researchers studying leisure and recreation have focused on applications to recreation management. This literature has not been widely indexed and cited

outside the field, so research from recreation and leisure has not been a major part of the active living discourse until recently. Professionals in recreation and leisure now are interpreting that literature to broader professional and public audiences and explicating the many contributions leisure and recreation can make to active living.

Methods and Findings

This notion of "physical activity by choice" can contribute to a broader understanding of physical activity related to topics such as outdoor recreation, community recreation areas (spaces) and facilities (places), time usage, barriers and constraints, social interdependence, and research and evaluation methods. Many researchers studying recreation have focused on aspects of the outdoors and the human dimensions of natural resources. Federal governmental agencies such as the U.S. Forest Service, National Park Service, and Army Corps of Engineers as well as state-funded recreation and conservation organizations have recreation as a central aspect of their missions. The value of the outdoors for physical activity and the concomitant psychological, sociological, and spiritual dimensions have been documented (18). Physical activity, however, is often seen as only one dimension of a total outdoor experience.

A substantial area of research has focused on management topics applied to designing and maintaining recreation spaces and places. A special issue of the *Journal of Parks and Recreation Administration* was devoted to "trails and greenways" (59) and illustrated the breadth of research on an active living-related topic. The research on trails included recreation conflict (e.g., how bicyclists and walkers co-exist on a trail), carrying capacity (e.g., what is the effect of too many or too few people using a trail on users' experience), satisfaction (e.g., what amenities do users want on a trail), substitution and displacement (e.g., if an individual cannot use a trail or finds it no longer adequate, what does he/she do), place attachment (e.g., how much does loyalty to a trail influence participation), volunteerism (e.g., what role do citizens play in maintaining trails), and partnerships (e.g., who should be involved in designing trails and developing policy). Trails research also addressed access and views, how parks might be physically connected in a city, what impacts trails have on the natural environment, how many recreational trails are needed, and what trail types (e.g., surfacing) are optimal.

The leisure and recreation profession has made important contributions to understanding how people use their time. Leisure time appears to be increasing (64), yet many people feel there is never enough time given all the demands of life. These time pressures are closely associated with physical activity and especially with leisure constraints.

Within leisure studies, Jackson (41) specified a "constraint" to leisure as anything that inhibits people's ability to participate in leisure activities, take advantage of leisure services, or achieve an expected level of satisfaction. Thus, constraints include dimensions of participation and satisfaction. Leisure researchers appear to be moving beyond this constraints model toward a focus on what "facilitates" leisure involvement (63).

Another focus of leisure and recreation professionals with implications for active living is the study of social and cultural influences. What an individual does is shaped by the cultural meanings of activities as well as social interactions. These aspects are evident in the research in leisure that addresses social capital (34), social identity (46), and social support (35).

Though survey research dominates the leisure and recreation literature, there is a recent trend to include interpretive, qualitative, and case studies. As is true in other social sciences, researchers are recognizing that if only averages are considered, important aspects of the experience are missed. Therefore, in attempting to understand not only the "what" related to physical activity, leisure researchers are finding the questions of "how" and "why" to be of importance (e.g., 36).

Engagement in Active Living Research

Although many aspects of recreation have been commercialized, parks have been preserved across the United States and remain a "public good." Therefore, recreation facilities have been enabled legislatively in virtually all communities and provide widespread opportunities for physical activity. The recreation activities offered are typically free or low cost compared with what might be available in the private sector. These recreation programs are required to be inclusive and enable participation from the entire community, including citizens who have typically been underserved or who have disabilities. Programs often are designed to serve the "whole" person and include the promotion of physical, social, emotional, environmental, and economic benefits. Park and recreation providers address the cultural dimensions of communities and are founded on the idea that each program should be designed to address specific needs in a community. Recreation professionals can no longer be modest or implicit about the contributions that can be made to promoting active living.

Parks as public spaces offer a unique amenity for promoting physical activity, with more people likely having access to urban parks than to any other type of natural setting (31). Efforts are under way to create partnerships for promoting recreation and physical activity. For example, the National Recreation and Park Association (NRPA) is one of the leading members of the National Coalition for Promoting Physical Activity. NRPA's "Hearts N Parks" effort has involved over 60 pilot communities in active community recreation programs. The "Step Up to Health" campaign has the goal of recruiting 500 public agencies for Hearts N Parks in 2005. The National Park Service adopted a "Healthier U.S. Initiative" aimed at helping local communities to provide inviting environments close to home to encourage regular physical activity. Leisure researchers interested in health issues pertaining to older adults, youth, women, and people of color held a "Leisure and Health" summit in June 2004 to identify a research agenda. In addition, a special issue of *Leisure Sciences* was published in late 2005 with a theme of "leisure and active lifestyles."

The relatively young field of parks and recreation is expanding its view of recreation and developing partnerships with complementary fields to become more

integrated in active living work. Through these partnerships, the profession of parks and recreation will become more effective in its own efforts as well as provide needed concepts, methods, and findings to broader transdisciplinary research and promotion of active living.

CONTRIBUTIONS OF PUBLIC POLICY, ECONOMICS, AND POLITICAL SCIENCE TO ACTIVE LIVING RESEARCH

Public policy studies, economics, and political science have only recently begun to address strategies to promote physical activity. Therefore a review of these fields has to focus largely on potential contributions, based on experiences and understandings emerging from broad areas such as environmental protection (14), land use (28), and health (84). Because public policy studies incorporate many of the insights and tools of economics and political analysis, as well as its own frameworks, this review of the existing and potential contributions of public policy studies covers the contributions of all three fields.

Public policy studies examines how public decisions are and can be made to develop and apply better analytical methods, institutional designs, and promotional strategies. Policies are identified that are not only technically sound, but also politically and administratively feasible. For promoting greater physical activity, public policy studies focuses on (*a*) selecting and funding investments in physical activity resources, and (*b*) creating or terminating regulations that promote or discourage physical activity. This includes examining policies that are not conventionally viewed as "physical activity policies" but have collateral impacts nonetheless [e.g., zoning (72), building codes, school budgets, etc.]. Public policy studies also examine decision-making structures and processes. Some planning processes focus attention on the importance of physical activity, whereas others do not; some may create obstacles to coordination that undermine initiatives.

By examining different aspects or functions of the policy process, public policy studies identify obstacles and strategies related to each. Each function presents its own technical challenges, institutions, relevant participants, and criteria for judging success. This functional analysis does not imply a rational policy process, as the pervasive limitations of information, analytic capacity, cooperation, and institutional structure amply demonstrate.

Examining the "intelligence" (or "estimation") function focuses on how officials (and advocates) identify and evaluate the opportunities to provide physical activity and the threats posed by other policies (such as school budget cutbacks). The most relevant contributions of economics to the intelligence function include benefit-cost and cost-effectiveness analyses. To determine the weighting of goals to pursue, benefit-cost analysis is essential for assessing both the likely benefits and costs expected of each option, and the value of each benefit or cost. Valuation of physical activity entails a complex mix of relatively easily gauged benefits arising from

improved health (e.g., lower hospitalization costs) and less tangible benefits such as the enjoyment of the activity per se. If a community has already chosen a particular balance of objectives, cost-effectiveness analysis explores how to achieve them at least cost. Insofar as costs are not just economic (e.g., an outdoor basketball court may cause annoying night-time noise and light), some cost valuation is still necessary.

A broader insight from economics is that because resources (including time and effort) are finite, people make tradeoff decisions of a more global nature than the physical-activity advocate may anticipate. Benefit-cost analysis often fails to elevate the funding for physical activity in light of other goals, and it is easy to overestimate the use of physical activity opportunities, as people make tradeoff decisions for their use of time and energy (77).

The obstacles to the intelligence function include limited information, lack of expertise, and difficulties of estimating how people will value and respond to opportunities. However, economic valuation is informed by psychological theories of how people balance long-term gains of physical activity against short-term conveniences of inactivity (56).

"Promotion" (otherwise known as advocacy) entails efforts to mobilize support for policies. Numerous frameworks help elucidate how issues get onto the policy agenda (50); how coalitions are formed (73), and how "policy entrepreneurs" operate (15). Because no issue exists in a vacuum, successful strategies for promoting physical activity must consider the timing and linkage to other issues, such as conservation, urban renewal, and transportation.

The most useful research on the success of public policy initiatives is based on single or comparative case studies (74). Aggregate quantitative analyses often have disappointing results, because complex contextual patterns are frequently crucial to the outcomes, but escape the central tendency findings of large-sample multivariate analysis.

"Prescription" refers to the formal approval of laws, regulations, and budget decisions, while "invocation" covers the often conflictual process of determining which prescriptions will be applied in particular cases. The difference highlights that sound policy may be untracked by court challenges, and, conversely, that initially successful promotion often requires follow-up to ensure that policies are properly invoked and applied. For example, environmental groups used the United States courts to force Congress to fund the Environmental Protection Agency adequately so that it could develop the regulations needed to invoke environmental laws.

Examining the "application" (or implementation) function of public policy highlights administrative capability and potential resistance. Statutes and regulations are ineffective unless they are implemented, which requires administrative capability and willingness. Approved budgets go unspent, mandated school programs are not implemented, and building codes go unenforced. Both case studies and comparative analyses are employed to identify obstacles to implementation and strategies for overcoming them; these include streamlining administrative

procedures, strengthening administrative accountability, and creating incentives for bureaucrats to embrace implementation. Political science also emphasizes bureaucratic politics among administrative units, contesting with one another to pursue their own mandates and expand jurisdictions and resources. Initiatives that engage the institutional interests of administrators, or create institutions mandated to promote physical activity, can change the promotional balance.

"Termination" research focuses on the difficulties of ending programs and policies. Administrative challenges entail transitioning from one approach to another, often requiring institutional restructuring, personnel retraining, etc. Political challenges entail overcoming opposition of vested interests in the status quo. The major obstacle may not be in formulating new zoning laws, building codes, or transportation policies, but rather in the resistance to terminating the existing prescriptions (6).

Finally, the "appraisal" function focuses on assessing the policy or program performance. Though distinct from the intelligence function in evaluating past performance rather than projecting future outcomes, appraisal feeds back into the intelligence function (in fact, all these functions are iterative and frequently occur simultaneously). For physical activity initiatives, the challenges include difficulties of measuring utilization and outcomes, ambiguity in benchmarks of success, and uncertainty about how other options would have succeeded. Physical activity initiatives are often assessed in comparison with efforts in other locales, raising the question of comparability in light of each context's distinctiveness.

The insight that these policy-related fields offer to the design disciplines is that for projects to be politically and administratively feasible, study design criteria ought to include the potential to mobilize community support, and the study design process ought to include the stakeholders and policymakers. The design of greatest technical potential for physical activity may be unwise if it cannot mobilize sufficient buy-in from relevant groups and officials. Conversely, sound benefit-cost and cost-effectiveness analyses must rely on the behavioral sciences to assess what will induce physical activity in the most people to achieve health outcomes. Health impact assessment may represent a methodology for integrating a variety of methods and perspectives to inform policies in a variety of settings that can affect public health (48). Policy analysts have the framework to assess the value of physical activity programs, but they need the input from experts on program effectiveness to conduct the analysis. Similarly, policy analysts cannot evaluate how to improve zoning codes, transportation policies, or other aspects of the built environment without the expertise of land-use and transportation planners.

BUILDING A TRANSDISCIPLINARY FIELD

Our vantage point of being involved in the Active Living Research program and as participants in cross-disciplinary research has given us an unusual view of the opportunities and challenges in transdisciplinary research on physical activity.

Though collaboration among all the disciplines reviewed in this paper, and others, is necessary for improved research and practice on physical activity-related policies and environments, these collaborations also may have benefits for research within each discipline.

Each field engaged in active living research contributes unique concepts. The health and behavioral sciences have strengths in physical activity measurement and behavior change models. Ways of conceptualizing environmental factors are contributed by urban planning and design, transportation, recreation and leisure studies, architecture, and landscape architecture. Policy studies, political science, and economics inform efforts to advocate the adoption of policies and environmental changes shown to be related to physical activity. A key lesson from policy studies is that advocated changes need to be politically feasible, suggesting that assessments of political acceptability could be integrated into studies at an early stage.

Transdisciplinary collaboration has expanded the outcomes of interest in individual fields. Before being exposed to the transportation literature, health researchers primarily studied recreational activity, but now active transport is seen as another option. Transportation researchers understand that people use transportation infrastructure, such as sidewalks and trails, for recreation. Park and recreation and leisure researchers realize their interests overlap with urban and transportation planners. For example, trails can be used for reaching destinations, and the design of the transportation system affects people's access to parks.

The outcomes of the built environment cut across the usual disciplinary boundaries. For example, well-designed trails can contribute to recreation, transportation, health, and mental health outcomes. Neighborhoods designed to be safe and attractive for pedestrians and cyclists may help increase active transportation, active recreation, social capital, and home values while reducing traffic congestion, pedestrian injuries, health care costs, air pollution, and loss of open space. Basing advocacy on multiple societal benefits of recommended policy and environmental changes and combining the resources of multiple interest groups may be more effective than if each advocacy group focuses only on its narrow agenda.

Environmental and policy issues are complex enough that multiple perspectives are needed to obtain a complete picture. A trail may be seen as a resource for outdoor recreation by a leisure researcher, a seldom-used facility for active transport by a transportation researcher, an opportunity for activity that needs to be promoted by a physical activity researcher, and as a potential tourist destination by an economist. The same trail may be viewed as a source of maintenance costs by park managers, a wildlife corridor by conservationists, a source of pleasure by users, a safe place for children to ride bicycles by parents, and a potential liability by city managers. These multiple views need to be understood by researchers and advocates.

Each discipline brings strengths in some research and statistical methods. For example, strong traditions of qualitative research in leisure studies and case study methods in urban planning and policy research have not been used much in physical

activity studies. More cost-benefit analyses could be useful in advancing physical activity and leisure research, while other fields could benefit from the evidence-based reviews commonly used in public health.

Physical activity investigators often use objective measures of physical activity that provide detailed information on duration, frequency, and intensity, but do not reveal the purpose or place of the behavior. Transportation researchers use travel diaries to indicate where and how people travel and what they do at each destination, but these measures do not assess leisure physical activity. Leisure researchers use time-use diaries and trail counters to assess the time and place of activities, but there has been limited interest in quantifying physical activity. Combinations of these methods may be required to improve understanding of how people use environments for a variety of purposes.

Cross-sectional studies of "activity-friendly" environments have been criticized because the results may be due to self-selection of people into neighborhoods or parks that are consistent with their desires and previous behavior (79). Transportation researchers have attempted to control for attitudinal variables in predictive models, but engaging cognitive psychologists and anthropologists could improve understanding of how people choose their neighborhoods. Economists with expertise in hierarchical models of choice could assess how predictions of travel behavior are nested within models that explain residential location choice.

Stokols and colleagues (76) indicated that success in transdisciplinary research collaboration was related to familiarity with collaborating fields and investigators, physical proximity, and frequency of communications. The most obvious challenge was differences in technical language. Ongoing efforts to facilitate productive functioning of transdisciplinary teams is likely to be needed.

CHALLENGES TO ECOLOGICAL APPROACHES

The potential of ecologically based multilevel interventions to increase population levels of physical activity is of great public health significance. The proliferation of studies published in prestigious journals on environmental correlates and interventions related to physical activity demonstrates the viability of the research area. Numerous benefits of transdisciplinary research are described in this paper. Nevertheless, significant challenges to conducting research based on ecological models and implementing multilevel interventions remain.

The daunting complexity of the research agenda is evident from the sheer number of variables on land use, transportation, recreational, school, worksite, and home environment that have been proposed as being related to physical activity (2, 4, 8, 24, 67). As shown in the model in Figure 1, different types and purposes of physical activity take place in different settings and are expected to be affected by different sets of environmental characteristics. Each environmental characteristic is affected by a variety of policies emanating from multiple government agencies and sectors of society. Built environment variables are expected to interact with

perceptions of those environments, the natural environment, the social/cultural environment, and the information environment. Prioritizing a few of the many research questions and deciding where to start the investigations are major tasks. The large number of variables and the complexity of interactions across components of the model suggest this needs to be a long-term research enterprise. Though the benefits of the resulting transdisciplinary concepts, methods, and results may be substantial, an ongoing investment of time and energy is required to sustain the team. These difficulties should not discourage investigators from pursuing these lines of inquiry.

Most of the active living research so far has involved middle class, mostly white adults living in urban and suburban settings. However, there are likely to be environmental barriers and facilitators that vary by population characteristics and locations. Thus, studies that focus on under-studied and at-risk groups are especially needed. Determining the environmental and policy factors of most relevance to low-income groups, specific racial/ethnic populations, older adults, youth, and rural residents may be challenging.

If the purpose of active living research is to inform and motivate policy changes that will improve public health, merely documenting the relation of environmental and policy variables to physical activity is probably insufficient to overcome opposition from those whose economic or political positions might be threatened by recommended changes. At some point the research will need to include assessments of broader health outcomes, such as on chronic diseases and health care costs, as well as the economic costs and benefits of proposed policy changes on affected sectors, such as real estate, transportation, electronic entertainment industries, and various government agencies.

The complexity of conducting the research may seem trivial compared with the challenges of implementing multilevel interventions. Within the physical activity field, practitioners are most experienced with interventions that target the individual, so partners from multiple sectors will need to become involved in implementing environmental and policy changes. Much can be learned from the tobacco control experience (83, 87). Challenges specific to each level of intervention can be expected. Implementing evidence-based programs for individuals will require trained staff and supportive policies. Changing environmental factors related to community design, transportation infrastructure, and investments in recreational facilities will require public support and political will. Changing policies to require environmental change, regulate powerful industries, and create incentives for physical activity is an obvious challenge, and it cannot be predicted when or if the political feasibility of major policy change will develop. All intervention efforts will take time and money, so physical activity will need to become a much higher societal priority to sustain a multilevel intervention. Funding sources for a multilevel effort to promote active living are not apparent at this time.

Obtaining funding for multilevel research and interventions is a central challenge. This type of comprehensive community initiative is expensive, and identifying the most promising strategies among the many options is difficult. Multilevel

interventions necessitate a funding collaboration if they are to be sustained, which can take time to develop. Perhaps the most challenging aspect of funding multilevel intervention approaches is the "impact" orientation that leads funders to narrowly define project objectives and timelines. The impact of multilevel strategies can be difficult to track, and the time horizon for change may exceed that which funders can accept. Educating funders on the benefits of approaches based on ecological models, and their potential for widespread and sustained behavior change will be essential if funders are to support more of these important research, policy, and program models.

REALIZING THE PROMISE OF ECOLOGICAL MODELS FOR CREATING ACTIVE LIVING COMMUNITIES

Research is a critical component of a larger effort to increase physical activity throughout the population. A rough sequence of types of studies is proposed. The initial step must be to conceptualize the factors that influence physical activity, develop specific hypotheses, and prioritize factors to be measured and studied. The conceptualization process is ongoing, and there has been partial progress in measuring variables at all levels of the multilevel model in Figure 1. Current research is dominated by identifying the most strongly associated policies and environmental variables and evaluating policy and environmental interventions. Once a better consensus has been reached on the most promising correlates, a next priority may be to conduct studies that examine how environmental/policy and psychosocial variables interact and evaluate multilevel interventions. For the most promising environmental variables, policies, and programs, research can examine the policy change process and determine how economic, public opinion, and political forces need to be harnessed to achieve active living objectives. Ongoing surveillance activities need to be expanded to encompass the environmental factors, policies, and programs shown to promote active living.

This ambitious research agenda will require a sustained commitment to funding. Current commitments to a broad active living research agenda from The Robert Wood Johnson Foundation, National Institute of Environmental Health Sciences, and the Centers for Disease Control and Prevention are insufficient to address the research priorities that have been identified so far. Other National Institutes of Health (NIH) institutes have prioritized environmental research mainly in specific settings, such as schools and workplaces, but major commitments to this research area have not been made. Thus, efforts are needed to increase funding so it is more consistent with the public health promise of multilevel research and intervention. The challenges of operationalizing ecological models may be daunting for funders more familiar with basic biomedical or behavioral research, though increased commitment to transdisciplinary research programs at NIH may provide new opportunities. Funding prospective multilevel research or long-term interventions

that require diverse collaborators is a challenge to foundations that prioritize short-term solutions or highly defined interventions.

As research identifies the most effective environmental and policy changes that will promote physical activity, efforts to put those findings into practice will need to be increased. The best-developed model for implementing multilevel strategies to promote physical activity comes from New South Wales, Australia (67), and should be applicable elsewhere. A government-sponsored steering committee received support from numerous government agencies and coordinated the efforts of partner organizations in multiple sectors of society, including health advocacy groups, professional organizations, and businesses. Similar large-scale efforts to promote physical activity are not apparent in the United States at this time. The creation of well-funded physical activity task forces and availability of resources to advocate for policy changes that will support environmental changes, economic incentives, and broad implementation of evidence-based programs will be a signal that improvements in the population's physical activity can be expected.

ACKNOWLEDGMENTS

This work was supported by Active Living Research, a program of The Robert Wood Johnson Foundation. C. Tracy Orleans and J. Michael McGinnis were major contributors to the creation of Active Living Research. Irvin Harrison contributed to preparation of this manuscript.

DISCLOSURE STATEMENT

K.A.H. is a member of the National Advisory Committee for Active Living Research and is a former Board of Trustees member for the National Recreation and Park Association.

The *Annual Review of Public Health* is online at http://publhealth.annualreviews.org

LITERATURE CITED

1. Am. J. Health Promot. 2003. Health promoting community design. *Am. J. Health Promot.* 18:1–119
2. Am. J. Prev. Med. 2005. Active living research. *Am. J. Prev. Med.* 28(2 Suppl. 2): 93–219
3. Am. J. Prev. Med. 1998. Physical activity interventions. *Am. J. Prev. Med.* 15:255–432
4. Am. J. Public Health. 2003. Built environment and health. *Am. J. Public Health* 93:1376–590
5. Bedimo-Rung AL, Mowen AJ, Cohen DA. 2005. The significance of parks to physical activity and public health: a conceptual model. *Am. J. Prev. Med.* 28(2 Suppl. 2):159–68
6. Behn R. 1978. How to terminate a public policy: a dozen hints for the would-be terminator. *Policy Anal.* 4:393–413
7. Boarnet MG, Anderson CL, Day K, McMillan T, Alfonzo M. 2005. Evaluation of the California safe routes to school legislation: urban form changes and children's

active transportation to school. *Am. J. Prev. Med.* 28(2 Suppl. 2):134–40
8. Booth SL, Sallis JF, Ritenbaugh C, Hill JO, Birch LL, et al. 2001. Environmental and societal factors affect food choice and physical activity: rationale, influences, and leverage points. *Nutr. Rev.* 3:21–39
9. Brownson RC, Boehmer TK, Luke DA. 2005. Declining rates of physical activity in the United States: What are the contributors? *Annu. Rev. Public Health* 26:421–33
10. Brownson RC, Chang JJ, Eyler AA, Ainsworth BE, Kirtland K, et al. 2004. Measuring the environment for friendliness toward physical activity: a comparison of the reliability of 3 questionnaires. *Am. J. Public Health* 94:473–83
11. Cervero R. 2002. Built environments and mode choice: toward a normative framework. *Transp. Res. Part D* 7:265–84
12. Cervero R, Radisch C. 1996. Travel choices in pedestrian versus automobile oriented neighborhoods. *Transp. Policy* 3:127–41
13. Cervero R, Kockelman K. 1997. Travel demand and the 3Ds: density, diversity, and design. *Transp. Res. Part D* 78:48–58
14. Clark TW. 2002. *The Policy Process: A Practical Guide for Natural Resource Professionals*. New Haven: Yale Univ. Press
15. de Leeuw E. 1999. Healthy cities: urban social entrepreneurship for health. *Health Promot. Int.* 14:261–69
16. Dishman RK, Buckworth J. 1996. Increasing physical activity: a quantitative synthesis. *Med. Sci. Sports Exerc.* 28:706–9
17. Dishman RK, Washburn RA, Heath GW. 2004. *Physical Activity Epidemiology*. Champaign, IL: Human Kinetics
18. Driver B, Brown P, Peterson G, eds. 1991. *Benefits of Leisure.* State College, PA: Venture
19. Duaney A, Plater-Zybeck E, Speck J. 2002. *Suburban Nation: The Rise of Sprawl and The Decline of The American Dream*. New York: North Point
20. Egger G, Swinburn B. 1997. An 'ecological' approach to the obesity pandemic. *BMJ* 315:477–80
21. Ewing R, Schmid T, Killingsworth R, Zlot A, Raudenbush S. 2003. Relationship between urban sprawl and physical activity, obesity, and morbidity. *Am. J. Health Promot.* 18:47–57
22. Ewing R, Cervero R. 2001. Travel and the built environment: a synthesis. *Transp. Res. Rec.* 1780:87–114
23. Frank LD, Andresen MA, Schmid TL. 2004. Obesity relationships with community design, physical activity, and time spent in cars. *Am. J. Prev. Med.* 27:87–96
24. Frank LD, Engelke PO, Schmid TL. 2003. *Health and Community Design: The Impact of The Built Environment on Physical Activity*. Washington, DC: Island
25. Frank LD, Schmid TL, Sallis JF, Chapman J, Saelens BE. 2005. Linking objectively measured physical activity with objectively measured urban form: findings from SMARTRAQ. *Am. J. Prev. Med.* 28(2 Suppl. 2):117–26
26. French SA, Story M, Jeffery RW. 2001. Environmental influences on eating and physical activity. *Annu. Rev. Public Health* 22:309–25
27. Frumkin H, Frank L, Jackson R. 2004. *Urban Sprawl and Public Health: Designing, Planning, and Building for Healthy Communities*. Washington, DC: Island
28. Gerber E, Phillips J. 2004. Direct democracy and land use policy: exchanging public goods for development rights. *Urban Stud.* 41:463–79
29. Giles-Corti B, Macintyre S, Clarkson JP, Pikora T, Donovan RJ. 2003. Environmental and lifestyle factors associated with overweight and obesity in Perth, Australia. *Am. J. Health Promot.* 18:93–102
30. Glanz K, Rimer BK, Lewis FM, eds. 2002. *Health Behavior and Health Education: Theory, Research, and Practice.* San Francisco: Jossey-Bass. 3rd ed.
31. Godbey GC, Caldwell LL, Floyd M, Payne L. 2005. Contributions of leisure studies and recreation and park management research to the active living agenda. *Am. J. Prev. Med.* 28(2 Suppl. 2):150–58

32. Handy S. 1992. Regional versus local accessibility: neo-traditional development and its implications for non-work travel. *Built Environ.* 18:253–67
33. Heath GW, Brownson RC, Kruger J, Miles R, Powell KE, Ramsey LT and the Task Force Commun. Prev. Serv. 2006. The effectiveness of urban design and land use and transport policies and practices to increase physical activity: a systematic review. *J. Phys. Act. Health.* In press
34. Hemingway JL. 1999. Leisure, social capital, and democratic citizenship. *J. Leisure Res.* 28:150–65
35. Henderson KA, Ainsworth BE. 2000. The connections between social support and women's physical activity involvement: The Cultural Activity Participation Study. *Women Sport Phys. Act. J.* 9(2):27–53
36. Henderson KA, Ainsworth BE, Stolarzyck LM, Hootman JM, Levin S. 1999. Notes on linking qualitative and quantitative data: The Cross Cultural Physical Activity Participation Study. *Leisure Sci.* 21:247–55
37. Hill JO, Peters JC. 1998. Environmental contributions to the obesity epidemic. *Science* 280:1371–74
38. Hoehner CM, Ramirez LKB, Elliott MB, Handy SL, Brownson RC. 2005. Perceived and objective environmental measures and physical activity among urban adults. *Am. J. Prev. Med.* 28(2 Suppl. 2):105–6
39. Humpel N, Owen N, Leslie E. 2002. Environmental factors associated with adults' participation in physical activity: a review. *Am. J. Prev. Med.* 22:188–99
40. Inst. Med. 2001. *Health and Behavior: The Interplay Of Biological, Behavioral, and Societal Influences*. Washington, DC: Natl. Acad.
41. Jackson EL. 1988. Leisure constraints: a survey of past research. *Leisure Sci.* 10: 203–5
42. Johnston R. 2004. The urban transportation planning process. In *The Geography of Urban Transportation*, ed. S Hanson, G Guiliano, pp. 115–40. New York: Guilford
43. J. Phys. Act. Health. 2006. Active living research. *J. Phys. Act. Health.* In press
44. Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, et al. 2002. The effectiveness of interventions to increase physical activity: a systematic review. *Am. J. Prev. Med.* 22(Suppl. 4):73–107
45. Katz P. 1994. *The New Urbanism: Toward An Architecture of Community*. New York: McGraw-Hill
46. Kelly J. 1983. *Leisure Identities and Interactions*. London: George Allen & Unwin
47. Kelly-Schwartz AC, Stockard J, Doyle S, Schlosberg M. 2004. Is Sprawl unhealthy? A multilevel analysis of the relationship of metropolitan sprawl to the health of individuals. *J. Plan. Educ. Res.* 24:184–96
48. Kemm J, Parry J, Palmer S. 2004. *Health Impact Assessment*. New York: Oxford
49. King AC, Jeffery RW, Fridinger F, Dusenbury L, Provence S, et al. 1995. Environmental and policy approaches to cardiovascular disease prevention through physical activity: issues and opportunities. *Health Educ. Q.* 22:499–511
50. Kingdon J. 1995. *Agendas, Alternatives and Public Policy*. New York: Harper Collins. 2nd ed.
51. Koplan JP, Dietz WH. 2000. Caloric imbalance and public health policy. *JAMA* 282: 1579–81
52. Koplan JP, Liverman CT, Kraak VI, eds. 2004. *Preventing Childhood Obesity: Health In The Balance*. Washington, DC: Inst. Med.
53. Krizek K, Levinson D. 2005. Teaching integrated land use-transportation planning: topics, readings, and strategies. *J. Plan. Educ. Res.* 24:304–6
54. Lavizzo-Mourey R, McGinnis JM. 2003. Making the case for active living communities. *Am. J. Public Health* 93:1386–88
55. Lee C, Vernez-Moudon A. 2004. Physical activity and environment research in the health field: Implications for urban and transportation planning practice and research. *J. Plan. Lit.* 19:147–81

56. Loewenstein G, Read D, Baumeister RF, eds. 2002. *Time and Decision: Economic and Psychological Perspectives on Intertemporal Choice*. New York: Russell Sage Found.
57. Marcus BH, Dubbert PM, Forsyth LH, McKenzie TL, Stone EJ, et al. 2000. Physical activity behavior change: issues in adoption and maintenance. *Health Psychol.* 19:17–32
58. McLeroy KR, Bibeau D, Steckler A, Glanz K. 1988. An ecological perspective on health promotion programs. *Health Educ. Q.* 15:351–77
59. Moore RL, Shafer CS. 2001. Introduction to special issue trails and greenways: opportunities for planner, managers, and scholars. *J. Park Recreat. Admin.* 19(3):1–16
60. Owen N, Humpel N, Leslie E, Bauman A, Sallis JF. 2004. Understanding environmental influences on walking: review and research agenda. *Am. J. Prev. Med.* 27:67–76
61. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, et al. 1995. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 273:402–7
62. Pikora T, Bull F, Jamrozik K, Knuiman M, Giles-Corti B, Donovan R. 2002. Developing a reliable audit instrument to measure the physical environment for physical activity. *Am. J. Prev. Med.* 23:187–94
63. Raymore L. 2002. Facilitators to leisure. *J. Leisure Res.* 34:37–51
64. Robinson JO, Godbey GC. 1999. *Time For Life: The Surprising Ways Americans Use Their Time*. Univ. Park: Penn. State Univ. Press. 2nd ed.
65. Saelens BE, Frank LD, Auffrey C. 2006. A direct observation measure of parks. *J. Phys. Act. Health.* In press
66. Saelens BE, Sallis JF, Frank LD. 2003. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. *Ann. Behav. Med.* 25:80–91
67. Sallis JF, Bauman A, Pratt M. 1998. Environmental and policy interventions to promote physical activity. *Am. J. Prev. Med.* 15:379–97
68. Sallis JF, Frank LD, Saelens BE, Kraft MK. 2004. Active transportation and physical activity: opportunities for collaboration on transportation and public health research. *Transp. Res. Part A: Policy Pract.* 38:249–68
69. Sallis JF, Linton LS, Kraft MK. 2005. The first Active Living Research conference: growth of a transdisciplinary field. *Am. J. Prev. Med.* 28(2 Suppl. 2):93–95
70. Sallis JF, Owen N. 2002. Ecological models of health behavior. In *Health Behavior And Health Education: Theory, Research, and Practice*, ed. K Glanz, BK Rimer, FM Lewis, pp. 462–84. San Francisco: Jossey-Bass. 3rd ed.
71. Sallis JF, Prochaska JJ, Taylor WC. 2000. A review of correlates of physical activity of children and adolescents. *Med. Sci. Sports Exerc.* 32:963–75
72. Schilling J, Linton LS. 2005. The public health roots of zoning: In search of active living's legal genealogy. *Am. J. Prev. Med.* 28(2 Suppl. 2):96–104
73. Signal L. 1998. The politics of health promotion: Insights from political theory. *Health Promot. Int.* 13:257–64
74. Ståhl T, Rütten A, Nutbeam D, Kannas L. 2002. The importance of policy orientation and environment on physical activity participation—a comparative analysis between Eastern Germany, Western Germany and Finland. *Health Promot. Int.* 17:235–46
75. Stokols D. 1992. Establishing and maintaining healthy environments: toward a social ecology of health promotion. *Am. Psychol.* 47:6–22
76. Stokols D, Harvey R, Gress J, Fuqua J, Phillips K. 2005. In vivo studies of transdisciplinary scientific collaboration: lessons

learned and implications for active living research. *Am. J. Prev. Med.* 28(2 Suppl. 2):202–213
77. Sturm R. 2004. The economics of physical activity: societal trends and rationales for interventions. *Am. J. Prev. Med.* 27(3S):126–35
78. Sturm R, Cohen DA. 2004. Suburban sprawl and physical and mental health. *Public Health* 118:488–96
79. Transp. Res. Board-Inst. Med. 2005. *Does the Built Environment Influence Physical Activity? Examining the Evidence*. Washington, DC: Natl. Acad.
80. Troped PJ, Cromley EK, Fragala MS, Melly SJ, Hasbrouk HH, et al. 2006. Development and reliability and validity testing of an audit tool for trail/path characteristics: the Path Environmental Audit Tool (PEAT). *J. Phys. Activity Health.* In press
81. U.S. Department of Health and Human Services. 2000. *Healthy People 2010* (017-001-00547-9). Washington, DC: USDHHS
82. U.S. Department of Health and Human Services. 1996. *Physical Activity And Health: A Report Of The Surgeon General*. Atlanta, GA: USDHHS, CDC Prev.
83. Warner KE. 2000. The need for, and value of, a multi-level approach to disease prevention: the case of tobacco control. In *Promoting Health: Intervention Strategies From Social And Behavioral Research*, ed. BD Smedley, SL Syme, pp. pp. 417–49. Washington, DC: Natl. Acad.
84. Weissert CS, Weissert WG. 1996. *Governing Health: The Politics of Health Policy.* Baltimore, MD: Johns Hopkins Univ. Press
85. World Health Organization (WHO). 2003. *Diet, Nutrition, And The Prevention Of Chronic Disease. Report Of A Joint WHO/FAO Expert Consultation. Technical Report Series No. 916.* Geneva: WHO. www.who.int/nut/documents/trs˙916
86. World Health Organization. 2004. *Global Strategy On Diet, Physical Activity And Health.* Geneva: WHO. www.who.int/gb/ebwha/pdf_files/WHA57/A57˙R17-en.pdf
87. Yach D, McKee M, Lopez AD, Novotny T for Oxford Vision 2020. 2005. Improving diet and physical activity: 12 lessons from controlling tobacco smoking. *BMJ* 330:898–900

Annual Review of Public Health
Volume 27, 2006

CONTENTS