The Handbook of Health Behavior Change

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Social ecological analyses of health and health behavior have gained increasing prominence in the fields of health education, behavioral medicine, and public health from the 1990s onward (cf. Green, Richard, & Potvin, 1996; McLeroy, Bibeau, Steckler, & Glanz, 1988; Sallis & Owen, 1997; Smedley & Syme, 2001; Stokols, Allen, & Bellingham, 1996; Winnet, King, & Altman, 1989). The emergence of ecological models of health, behavior, and disease has been fueled by a growing recognition among scientists and practitioners that the etiology of contemporary public health problems is jointly influenced by diverse causative factors situated at multiple levels of analysis (e.g., ranging from molecular and genetic to behavioral, environmental, and societal levels). It is now widely acknowledged among health scholars and professionals that chronic diseases including diabetes, cardiovascular disease, cancer, and the threats to public health
posed by community violence must be approached from a multilevel, ecological systems perspective to adequately understand their diverse etiologic underpinnings and to develop effective strategies for preventing or ameliorating them (Abrams, 2006; Best et al., 2003; Breslow, 1996; Glass & McAtee, 2006; Schneider & Stokols, 2000; Stokols, Grzywacz, McMahan, & Phillips, 2003).

The present chapter highlights the core assumptions and principles of multilevel ecological analyses of health and health-behavior change. Unlike earlier biomedical and biopsychosocial models that focus on the interplay among genetic, physiological, psychological, and social factors in health and illness, social ecological analyses place greater emphasis on the role of environmental conditions that influence an individual’s or group’s health status (Schwartz, 1982; Stokols, 2000). Environmental influences on health and health behavior are found both in the immediate, micro-level settings of everyday life (e.g., in one’s home or workplace) and in the more distal, macro-level conditions that are pervasive in one’s community (e.g., levels of unemployment, social capital, and income disparities existing within a particular society (cf. Kaplan, 1998; Kawachi & Berkman, 2003; Macintyre, 2003). Moreover, contextual influences on health behavior and illness symptoms include features of built as well as natural environments (e.g., exposure to urban traffic congestion vs. living in a rural wilderness area). Objective attributes of these environments (e.g., the spatial and social density of a dwelling measured in terms of its square footage and the number of residents living there), as well as individuals’ perceptions of them (e.g., perceived crowding and related feelings of stress), must be considered in ecological analyses, since both have the capacity to influence health behaviors and outcomes (Lazarus, 1966; Lepore, Evans, & Palsane, 1991; Stokols, 1972). Thus, the environmental contexts of health are multifaceted, encompassing objective and subjective features of built and natural settings, and distributed across different levels of geographic scale; they influence well-being both directly and through their interaction with biogenetic and psychological factors.

Social ecological analyses also emphasize systems processes in health and illness, such as the ways in which chronic exposure to environmental stressors and coping challenges can undermine immunologic functioning and deplete the individual’s capacity to resist or recover from a variety of health threats (McEwen, 2006; Miller, 1978; Seeman, McEwen, Rowe, & Singer, 2001). Systems processes of adaptation, homeostasis, and coping behavior regulate individuals’ interactions with their everyday surroundings and are a major facet of ecological analyses of human resistance and vulnerability to disease (Antonovsky, 1987; Lazarus & Folkman, 1984; Selye, 1956).

The social ecological perspective on health behavior is also inherently interdisciplinary in its approach to scientific research and its translation into practice. Social Ecology spans several different fields, including neuroscience, medicine, epidemiology, health psychology, sociology, anthropology, health education, and community health promotion. Moreover, social ecological analyses emphasize not only personal health decisions and behavior but also other-directed behaviors enacted by physicians, case managers in health maintenance organizations, corporate managers, and elected officials that have a direct bearing on the well-being of hundreds and sometimes thousands of other people (Stokols, 1996).

In the following sections of the chapter, social ecological principles of health and behavior change are illustrated in relation to a variety of health risks, behaviors, and outcomes.
multilevel, ecological etiologic underpinnings or ameliorating them (Atee, 2006; Schneider & 2003). The principles of multilevel change. Unlike earlier interplay among health and illness, role of environmental status (Schwartz, and health behavior in everyday life (e.g., in-level conditions that influence, social capital, contextual influences of built as well as estion vs. living in amenities (e.g., the square footage and perceptions of them must be considered in health behaviors 1991; Stokols, 1972). eted, encompassing, and distributed well-being both di- and psychological factors. stresses in health and environmental stressors tioning and depleting of health threats (ng, 2001). Systems regulate individuals major facet of ecosee (Antonovsky, the inherently inter-slation into practice. Oncology, medicine, health education, and analyses emphasize her-directed behaviors based on the well-e (Stokols, 1996). Logical principles of a variety of health risks, behaviors, and illnesses including obesity, smoking, diabetes, cardiovascular disease, cancer, and the common cold. Implications of social ecological analyses of these health problems for disease prevention, wellness promotion, and public policy are also discussed. Finally, we discuss unresolved conceptual and methodological issues and identify high-priority directions for future social ecological research on health behavior formation, maintenance, and change.

Foundations of the Social Ecological Framework

A 1993 report by McGinnis and Foege (1993), replicated and updated in 2004 by Mokdad and colleagues (2004), showed that the top causes of death in the United States are tobacco use, poor nutrition, physical inactivity, and alcohol consumption. This report represented a paradigm shift, in which causes of mortality were depicted not in terms of the diseases that lead to organ failure (i.e., cancer, heart disease, stroke) but in terms of the behaviors that contribute to the development of disease. Moreover, these behaviors were recognized as calling for comprehensive intervention strategies that integrate medical, psychological, organizational, cultural, and regulatory perspectives. The Social Ecological Framework (SEF) has emerged as an approach toward behavior change that encourages researchers to incorporate these disparate influencing factors into a causative web that spans multiple disciplines and extends across levels from the microscopic (i.e., cellular) to the global (i.e., economic and environmental). Research in the area of tobacco use, for example, has demonstrated that smoking behavior is influenced by genetic susceptibility to nicotine addiction (MacLeod & Chowdhury, 2006); stress, social influence, and depression (Schepis & Rao, 2005); and the consumer price of cigarettes (Ding, 2005; Siegel, 2002).

The danger inherent in this inclusive approach is that the causative web becomes so unwieldy that its very complexity reduces its utility. Thus, there is a tension between the practitioner’s desire to identify an intervention target and the theorist’s drive to delineate all possible avenues of influence. In recognition of this tension, the SEF has as its aim the goal of detecting “high-impact leverage points” (Stokols, 1992). These targets of intervention represent especially promising pathways for stimulating positive health behavior change. An assumption, then, of the SEF is that each element in a model should be examined with respect to its relative utility for affecting behavior change as compared to other elements in the model.

Bronfenbrenner’s (1992) Bioecological Systems Theory of child development illustrates both the promise and the pitfalls of an expansive approach to model building. Bronfenbrenner’s theory features multiple “layers” of environment, each of which influence child development (see Figure 5.1). In this model, the microsystem includes structures with which the child has direct contact, such as family, school, or neighborhood environments. These structures shape the child’s behavior and, in turn, may be shaped by the child’s behavior. There are also connections between the various structures within the child’s microsystem, which Bronfenbrenner designates as the mesosystem. The exosystem is the larger social system with which the child does not interact directly but by which the microsystem may be influenced, such as parent worksite policies that
may limit a parent's availability to the child during work hours. The outermost layer of the child's environment is the macrosystem, composed of cultural values, customs, and laws. The effect of these distal influences on the child is mediated by the micro-, meso-, and exosystems. Overall, Bronfenbrenner's model is an elegant example of incorporating multiple levels, yet it also demonstrates the downside to complex model building: the potential for becoming overwhelmed by its very complexity, and the unanswered question as to which of the model's variables offer the greatest potential for improving health.

Recently, Glass and McAtee (2006) proposed an even more elaborate depiction of the "society-behavior-biology nexus" (p. 1653). Their representation of
the many influences on human behavior features several layers of factors residing within the individual (the genomic substrate, the subcellular/molecular level, the cellular level, and the multi-organ system level), as well as a temporal dimension from conception to old age. These additional dimensions of complexity serve simultaneously to expand the range of theoretically significant pathways of influence and to emphasize the critical importance of seeking out pathways of greater potential influence.

Both Bronfenbrenner’s and Glass and McAtee’s models embody the SEF in that they include influences from the immediate to the more distal environment and emphasize the bidirectional nature of the relationships between the individual and the environment. Both models also emphasize the role that the social environment plays in influencing health behavior. The Glass and McAtee (2006) representation, however, goes further in terms of acknowledging the physical environment as a contextual variable that should be considered. They point out, for example, the contribution that both the built environment and the local food environment make to the behaviors that lead to obesity. In this recognition of the physical environment as an integral part of the forces shaping health behavior, Glass and McAtee’s model exemplifies the approach of the SEF.

### The Impact of Environmental Context on Health

The concept that individual susceptibility to disease is influenced by both the social and the physical environment has long been recognized. Cassel (1976) posited that the social context within which an individual resides has a non-specific impact on health; that is, the social environment can increase or reduce susceptibility to a wide array of chronic diseases (cf. Kawachi & Berkman, 2003; Smedley & Syme, 2001). More recently, Cohen’s research on the moderating effect of life stress on susceptibility to colds (Cohen et al., 1998; Cohen, Tyrrell, & Smith, 1991) showed that, indeed, individuals exposed to a cold virus under controlled conditions are more likely to develop viral infections and more severe cold symptoms if they have recently been experiencing great amounts of psychological stress, thus demonstrating that viral susceptibility is contextually moderated rather than absolute.

### The Impact of Environmental Context on Health Behavior

It has taken some time and accumulated experience, however, for behavior change researchers to begin including contextual variables into their conceptual models and empirical studies. The accumulation of a number of failed large-scale behavioral interventions (e.g., Multiple Risk Factor Intervention Trial Research Group [MRFIT], 1982; The COMMIT Research Group, 1995) has starkly illustrated how difficult it is to influence individual health behavior through interventions that ignore context. The MRFIT trial, for example,
delivered a resource-intensive lifestyle change program to high-risk men over 6 years. Despite the enormous effort put into helping the men change their behavior, little actual behavior change occurred, and at the end of the trial there was no statistical difference in heart disease rates between the intervention and the control groups.

The lessons learned from this and other disappointing efforts to target individual health behavior on a large scale have inspired a new wave of studies that highlight community and environmental influences on health and behavior (cf. Macintyre, 2003; Woods, Montgomery, Herring, Gardner, & Stokols, 2006; Yen & Syme, 1999). A recent study demonstrates the contextual approach and identifies neighborhood safety as a crucial intervention target for changing urban children’s health behavior (Wilson, Syme, Boyce, Battistich, & Selvin, 2005). Moreover, efforts to understand and address the low levels of physical activity characteristic of the majority of Americans have turned toward the pervasive and influential role of the built environment (cf. Frank, Engelke, & Schmid, 2003; Frumkin, Frank, & Jackson, 2004; Jackson & Kochtitzky, 2002; Killingsworth, 2003). This emphasis on the physical and social context within which behavioral choices are made is characteristic of the SEF.

Overview of Social Ecological Theory

Definition of Social Ecology

Social ecology is a *meta-theoretical perspective* that encompasses several interrelated themes and research strategies for understanding illness etiology, health behavior, and well-being: namely *contextualist, systems-oriented, interdisciplinary, multilevel action research* analyses incorporating both qualitative and quantitative research methods and a variety of experimental and nonexperimental research designs. In lay terms, social ecology is based on the assumption that the answer to questions such as “how do we get people to wear sunscreen?” is, in essence, “it depends” (cf. English et al., 2005; Milne, Johnston, Cross, Giles-Corti, & English, 2002). The answers to such questions depend upon the physical and social environment within which the target population lives and works, upon the genetic and phenotypic predispositions that individuals bring to the situation, upon the institutional, legislative, and economic constraints that envelop the persons we are interested in influencing, and even upon the disciplinary perspective of those who are trying to answer these questions. Finally, and perhaps most essential to the SEF the answers to these types of questions depend upon the ways in which all of these multiple factors interact with one another.

It is important to note that the SEF represents a heuristic device that is intended to stimulate the formation of specific models or theories of health behavior in which multiple levels of influence and interactions between theoretical components are considered. At each level, existing theories may be used or new theories posited to select salient variables. Many theories already exist to guide investigators in the identification of critical variables at the level of the individual. Far fewer models are available to inform variable selection at the environmental levels, and there is much more to be done in terms of coming up with conceptual and operational definitions of factors that operate at the meso

Historical Context

Baranowski and colleagues were the first to conduct a study that investigated the Theory of Planned Behavior as a predictor of vegetable consumption among children. As depicted in this study, the Theory of Planned Behavior highlights the behavioral intentions of the individual as the primary determinant of behavior. The theory predicts that behavior is determined by the individual’s beliefs about the consequences of the behavior and the perceived control over the behavior. These beliefs are formed through social cognitive processes, including exposure to social influences, modeling, and self-regulatory processes. The theory suggests that individuals will be more likely to perform a behavior if they believe it will have positive consequences and if they feel they have control over the situation.

Core Assumptions

Social ecological models have several key assumptions:

1. Social ecological models recognize the importance of the environment in shaping individual behavior. The environment is defined as the set of physical, social, and cultural influences that surround an individual and can affect their behavior. These influences can include factors such as the availability of healthy food options, access to safe play areas, and the presence of sidewalks or bike lanes.

2. Social ecological models recognize the interdependence of individuals and their environments. Changes in one aspect of the environment can have cascading effects on other aspects of the environment and on individual behavior. For example, the addition of a bike lane can encourage more people to ride bikes, which can lead to increased traffic safety and reduced air pollution.

3. Social ecological models recognize the importance of social influences on behavior. These influences can include social norms, peer pressure, and the influence of family and friends. Social ecological models suggest that to effectively prevent or reduce unhealthy behaviors, interventions must target both the individual and their social environment.
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and macro levels. Thus, one function of the SEF is to provide the impetus for researchers to measure, test, and compare alternative theories and influencing factors at the meso and macro levels.

Historical Context of Social Ecology

Baranowski and colleagues (2003) provide an overview of the evolution of behavior change models that places social ecology within an historical context. As depicted in this review, the SEF represents an attempt to respond to the inadequacy of explanatory power of primarily cognitive models of behavior change (e.g., the Knowledge-Attitude-Behavior model and the Health Belief Model) and social-cognitive models of behavior change (e.g., Social-Cognitive Theory, the Theory of Planned Behavior, and the Transtheoretical Model), all of which focus primarily on the individual as the unit of analysis and yield recommendations for intervention that are limited in scope and impact (Breslow, 1996; Glanz, Rimer, & Lewis, 2002; National Cancer Institute, 2005; Sallis & Owen, 1997). The innovation of the SEF lies in its attention to etiologic influences on health and behavior ranging from molecular and cellular to global levels, and on the interactions among these factors.

Core Assumptions of the SEF

Social ecological models of health and health behavior change are guided by a number of underlying assumptions (Stokols, 1992):

1. Social ecological models are multiplicative rather than simply additive. That is, they provide a conceptualization of interactions among variables situated at multiple analytic levels, from the micro to the macro. For instance, Rashad and Grossman’s (2004) analysis of the obesity epidemic in the United States highlights the synergistic influence of multiple physical and social environmental factors on levels of obesity in the population, including economic determinants of food supply in the United States, the increasing participation of women in the U.S. labor force, technological changes such as the advent of microwave ovens, the presence of fast-food restaurants in a family’s neighborhood, and the social characteristics of households, including the number of working adults residing at the same address.

2. The relative scale and complexity of environments that influence health behaviors and outcomes can be characterized in terms of their physical and social attributes, objective versus perceived qualities, and relative immediacy to individuals and groups (ranging from proximal to distal settings). Independent attributes of environments are relevant, such as lighting, temperature, noise, space arrangement, and group size. Furthermore, these independent attributes may combine to result in a characteristic behavior setting or social climate (cf. Barker, 1968; Moos, 1979). The impact of such a composite may go beyond a simple adding together of the independent effects of each attribute.

3. The SEF takes into account both the interdependencies that exist among immediate and more distant environments and the dynamic interrelations between people and their environments (Miller, 1978; Von Bertalanffy, 1950).

assess several interesting etiology, health mated, interdisciplin ary and particular the nonexperimental be assumption that are sunscreen?” is. In Cross, Giles-Corti, on the physical and minds work, upon the thing to the situation, to that envelop the so disciplinary per ficially, and perhaps actions depend upon one another distinctive device that is theories of health ions between theory theories may be used eories already exist at the level of the me selection at the terms of coming up operate at the meso
That is, people-environment transactions are characterized by cycles of mutual influence, whereby the physical and social features of settings directly influence their occupant’s behavior, and concurrently the participants modify the healthfulness of their surroundings through their individual and collective actions (Lazarus & Folkman, 1984; Stokols & Shumaker, 1981).

4. Elements of the micro-, meso-, exo-, and macrosystems facilitate and/or impede individual behaviors and, therefore, individuals’ ability to “choose” their behavior can be substantially determined by the social and environmental context. In the MRFIT trial (Multiple Risk Factor Intervention Trial Research Group, 1982), it was assumed that lifestyle behavior could be changed by providing individuals with skills training, such as instruction in how to prepare low-fat meals, combined with health education. This approach failed, perhaps because participants remained in the same environment that had shaped their original (unhealthy) behavior to begin with, and their ability to “choose” a healthier lifestyle was limited by this environment. Acknowledging the limited power of choice that individuals have over their own health behavior opens the door to interventions that are less focused on changing health behavior and more oriented toward facilitating healthful behavior. These interventions may include entirely passive approaches that require no decision making on the part of the individual, such as adding fluoride to the water supply (Williams, 1982). They may include regulatory approaches that make certain behavioral choices very costly, as when legislation is passed to increase the penalties for drunk driving or the cost of cigarettes (Breslow & Johnson, 1993; Siegel, 2002). There can also be a combination of behavioral restrictions plus opportunities for obtaining support in behavior change, as when companies establish worksite nonsmoking policies in conjunction with smoking cessation classes. All of these approaches have in common an acceptance of the premise that simply targeting the individual with persuasive communication is seldom an effective method for achieving health behavior change.

5. The wide range of individual behavioral responses that typically occur within a given physical and/or social environment are evidence for the importance of individual differences in physiology, personality, and cognitions as mediators of environmental influences on behavior. Taking these individual differences into account lays the foundation for more finely tuned designs of intervention programs or materials. In the area of tobacco use, social influences may play a significant role in determining the likelihood that an adolescent will experiment with smoking cigarettes (Brickey, Peterson, Sarason, Andersen, & Rajan, 2007), whereas individual genetic susceptibility to nicotine addiction may be instrumental in determining whether experimentation leads to regular smoking (Koopmans, Slutske, Heath, Neale, & Boomsma, 1999). Understanding individual differences can facilitate advances in creating tailored interventions that are targeted toward specific subgroups of a population (cf. Kreuter et al., 2006, Kreuter et al., 2005; Noar, Benac, & Harris, 2007; Strecher & McPhee, 2006). The SEF incorporates individual level differences along with contextual factors in order to identify the most promising avenues of intervention for a given population.

6. The SEF acknowledges the multifaceted and dynamic nature of behavior itself. At times, behaviors may cluster, so a change in one behavior may facilitate a change in another (e.g., adolescent smoking and drug use; Noar & Malcom, 2006). More generally, interventions designed to change one behavior may influence others (e.g., physician behaviors that influence smoking cessation; Benac, & Hart, 1999). Therefore, a multilevel approach may be necessary to facilitate change at the individual level.

These core structural components provide an important starting point for translating these ideas into practice and policy.
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facilitate a change in a related behavior. This may be the case for the association between drinking coffee and smoking cigarettes (Fernandez et al., 1997). Moreover, behavioral changes are played out in continuous interaction with and adaptation to a changing environment. Therefore, efforts to influence behavioral choices cannot be static or "one size fits all" (Noar, Benac, & Harris, 2007). Behaviors also cannot be described as all-or-none phenomena; an individual may pass through a series of "stages" or behavioral approximations on the way to adopting a new behavior (Prochaska & Velicer, 1997). A useful model of behavior change, then, must be flexible enough to reflect that the behavioral target is likely to be neither fixed nor isolated.

These core assumptions of the SEF provide a conceptual basis for constructing models of health behavior that feature diverse influencing factors spanning multiple levels as well as reciprocal lines of causation connecting the model components. Key principles that guide the translation of social ecological theory into health-enhancing policies and programs are summarized in the next section.

Translating Social Ecological Theory Into Effective Strategies for Health Promotion

A distinguishing feature of the SEF is its emphasis on identifying "high-leverage" intervention targets that have the greatest potential for bringing about positive health behavior change (Stokols, 1996). Beyond simply highlighting the great variety of influencing factors that should be considered in determining how best to intervene to promote healthful behavior, the SEF encourages researchers to examine the relative utility of targeting each of the variables in the model. In this emphasis, the SEF is consistent with "solution-oriented research" (Robinson & Sirard, 2005). Solution-oriented research is characterized by studies that have clear implications for intervention and are likely to lead to changes in clinical practice or public health policy. In the imagery of Krieger (1994), rather than being content with simply identifying the causative web, researchers should strive to unmask the spider behind its pattern.

The SEF also stresses the implementation of health-promotive interventions that involve the coordination of individuals and groups acting at different levels. Thus, leverage points at different levels of analysis should be targeted simultaneously in order to achieve a synergistic effect. School-based interventions are a good illustration of this point. A classroom-based educational program that teaches students the benefit of eating well is likely to have a much greater impact if it is accompanied by changes in the school food service at the same time. That is, an educational intervention may be effective if delivered in the context of environmental change that facilitates the targeted behavior.

It should be noted that in order to effectively identify the most salient influencing factors, appropriate assessment tools and analytic methods must be developed that enable investigators to examine not only the relative impact of individual factors but also their joint and/or interactive effects (Glass & McAtee, 2006). Currently available assessment tools are inadequate to describe potentially relevant dimensions of the social and physical environment.
Similarly, traditional linear analytic models are insufficient for capturing the nested relationships and complex interactions that may typify a fully elaborated model of any health behavior (Ockene et al., 2007).

Applications of the SEF to Contemporary Health Problems

An illustrative and timely example of a behavior-based health problem that calls out for multilevel, cross-disciplinary, and interactive explanatory models is childhood obesity. Childhood obesity has traditionally been depicted as the result of an imbalance between energy in and energy out. That is, excessive body fat accumulates when the calories burned are outnumbered by the calories ingested. This reductionist perspective results in attempts to correct the imbalance by engaging in health education, specifically, "planned learning experiences that facilitate voluntary changes in behavior" (Green, 1999). These attempts may be made clinically, as in the case of physician-based counseling interventions (cf. Patrick et al., 2006) or on a public health scale, as in the case of mass-media communication campaigns (e.g., Huhman, Potter, & Wong, 2005). Whether applied on an individual or a group level, however, the health education approach fails to address the contextual factors that to a large degree shape the behaviors that directly influence childhood obesity, namely dietary intake and physical activity.

More recent analyses of the factors contributing to the contemporary unprecedented increase in childhood obesity have emphasized environmental influences and have focused attention on facets of the "obesogenic environment" (Rashad & Grossman, 2004; Swinburn, Caterson, Seidell, & James, 2004). This relatively new term refers to the elements in the environment that contribute to the development or maintenance of obesity. While still acknowledging that individual behavior is at the crux of the obesity problem and is therefore central to its solution, many researchers are pointing out and finding evidence for the contextual factors that curtail both the likelihood that individuals will engage in recommended dietary and activity practices and their ability to do so. More specifically, recent reviews have highlighted physical environmental factors that are more distal from the target behavior, such as urban design and transportation infrastructure (Brug, van Lenthe, & Kremers, 2006; Papas et al., 2007), as well as social environmental influences that are more proximal to the target behavior, such as supportive home and school environments (Swinburn et al., 2004). These multilevel models of obesity identify promising intervention leverage points both in the political arena (e.g., modifying children’s food preferences by changing food marketing) and in the personal arena (e.g., reducing children’s sedentary behavior by removing TVs from their bedrooms) (Anderson & Butcher, 2006).

Encouraged by several theoretical articles published in the 1990s (Breslow, 1996; O’Donnell, 1996; Sallis & Owen, 1997; Stokols, 1996), the field of obesity prevention has embraced the SEF. Initially, this perspective was reflected in a wave of correlational studies examining the multilevel environmental and psychosocial influences on obesity (Blanchard et al., 2005; Fleury & Lee, 2006). That is, researchers have conducted cross-sectional studies in which they have shown that obesity (Sallis, Kraft, & Lint television watching utility of the SEF is been confirmed, ret the development of 2001; Nigg et al., 20 interventions target mination of educatio of living conducive intended to promot 2007) was designed that facilitate physi and provide the girl settings” (p. 162).

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This biochemical when described in t this metabolic imbal related to chron: (1) stress; (2) low that has emerged wi reliance on the autor ment); and (3) a food foods (i.e., foods th foods with significan multilevel, multisci frates the promise of by examining the co make behavioral cho SEF can be employe- tion that can be e Physical activity in response to the ri gain insight into wh past work in this are Body Mass Index or identification of a la been found to explai
health problem that explanatory models have been depicted as the ut. That is, excessive ambered by the caloric attempts to correct the planned learning ex- (Green, 1999). Theserian-based counseling a scale, as in the case Potter & Wong, 2005).er, the health education a large degree shape namely dietary intake the contemporary un-wed environmental in-ergogenic environment & James, 2004). This attention that contrib-ute still acknowledging stem and is therefore and finding evidence that individuals will nd their ability to do-ysional environmental as urban design and years, 2006; Papas et al., more proximal to the ing environments (Swinburn promising interven-ifying children's food sonal arena (e.g., room their bedrooms) in the 1990s (Breslow, ), the field of obesity tive was reflected in environmental and Fleury & Lee, 2006).es in which they have shown that obesity is related to a variety of influences, including urban design (Sallis, Kraft, & Linton, 2002), food marketing (Anderson & Butcher, 2006), and television watching (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004). As the utility of the SEF for identifying relevant sources of influence on obesity has been confirmed, recommendations and models for adopting this approach to the development of health promotive interventions have emerged (Best et al., 2003; Nigg et al., 2005; Whitemore, Melkus, & Grey, 2004). As a result, recent interventions targeting childhood obesity are more likely to employ a "combination of educational and environmental supports for action and conditions of living conducive to health" (Green, 1999). For example, an NIH-funded trial intended to promote physical activity among adolescent females (Elder et al., 2007) was designed to "create environments at school and in the community that facilitate physical activity, enhance social support in those environments, and provide the girls with the motivation and skills to seek out activity in all settings" (p. 162).

A provocative article addressing the causes of childhood obesity (Lustig, 2006) provides a clear illustration of the explanatory value that can be added by combining a biomedical understanding of a disease process with an appreciation for the environmental context. Lustig discusses a biochemical theory of obesity in which an individual's hormonal signaling may be inappropriately triggering a starvation response (see Figure 5.2). This response causes the body to move energy into adipose tissue and reduce energy expenditure while simultaneously stimulating an appetitive drive. Thus, a child may be gaining weight because of a biochemical imbalance that is causing her to experience hunger and sluggishness even though she is ingesting more calories than should be required to meet her metabolic needs.

This biochemical explanation for childhood obesity takes on new resonance when described in the context of the environmental factors that may trigger this metabolic imbalance. Lustig theorizes that the dysfunctional biochemistry is related to chronic hyperinsulinemia brought about by a combination of: (1) stress; (2) low physical activity (associated with the sedentary lifestyle that has emerged within the context of car-centered urban design, individual reliance on the automobile, and the popularity of sedentary forms of entertainment); and (3) a food environment that is characterized by high-energy-density foods (i.e., foods that contain relatively few essential nutrients per calorie), foods with significant fat and fructose, and foods low in fiber. As a model, this multilevel, multidisciplinary, and interactive theory of childhood obesity illustrates the promise of expanding upon a biomedical model of a disease process by examining the context within which people reside and within which people make behavioral choices. In this way, Lustig offers a demonstration of how the SEF can be employed to yield a number of potential leverage points for intervention that can be explored in future research.

Physical activity is one of the behaviors that has been extensively studied in response to the rise in obesity. Many different models have been applied to gain insight into why some people are more active than others. Much of the past work in this area has focused on characteristics of the individual, such as Body Mass Index or perceived self-efficacy. These studies have resulted in the identification of a large number of behavioral mediators that have generally been found to explain a small percentage of the variance in physical activity
5.2

Postulated algorithm describing the vicious cycle wherein stress, poor diet, and low physical activity all contribute to hyperinsulinemia and obesity, which then feeds back via impaired leptin sensitivity, to further exacerbate the cycle.

![Diagram of the vicious cycle](image)

Note: Adapted with permission from image originally from American Heart Association.

levels (King, Stokols, Talen, Brassington, & Killingsworth, 2002). The past decade has seen an increasingly contextual paradigm being adopted in this area, as researchers have looked to the environment to help explain physical activity behavior (cf. Sallis & Owen, 1999). One discipline that has emerged as a fruitful partner in this endeavor is that of urban planning (Dannenberg et al., 2003; Frank et al., 2003; Hoehner, Brennan, Brownson, Handy, & Killingsworth, 2003). Initial evidence supports an association between urban form (indexed in terms of residential density, intersection density, land use mix, commercial and recreational space, and urban sprawl) and physical activity (Frank, Kerr, Chapman, & Sallis, 2007; Frumkin et al., 2004; Saelens, Sallis, & Frank, 2003).

It is worth noting that an individual study may yet embody social ecological principles, even in the absence of environmental variables. Individual studies can contribute toward a social ecological analysis of behavior by examining a particular slice of what, in its more elaborated form, would be a model that included environmental influence. For instance, a recent study on the factors that influence voluntary exercise participation (Bryan, Hutchison, Seals, & Allen, 2007) exemplifies certain principles of social ecology even though it does not include the social or physical environment as measured variables. This study employs a multidisciplinary approach, combining psychological, social, and environmental factors, to understand the complex interplay of factors that influence exercise participation.

This multidisciplinary approach, the research spatio-temporal analysis, and the incorporation of diverse methods and perspectives are central to the SEF. Although this study recognizes the limitations of the current methods, it emphasizes the importance of comprehensive research and the need for a coherent framework that can guide future research and practice.

**Future Directions on Health Behavior**

In ecological studies of health behavior, it is important to consider the environmental context in which health behaviors occur. The environment can influence an individual's susceptibility to certain health behaviors, and understanding this influence is crucial for designing effective interventions.

Each category within the ecological framework can be expanded upon in terms of objective variables to reflect the environment's role in influencing health. For example, exposure to environmental factors such as pollution, urban design, and accessibility to green spaces can significantly impact health outcomes. By recognizing these influences, researchers and practitioners can develop more effective strategies to promote and sustain healthy behaviors.
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employs a multidisciplinary model that integrates genetic, physiological, and psychological correlates of voluntary exercise. The authors hypothesized that “the physiological effects (e.g., changes in body temperature, heart rate) of exercise influence the subjective experience of exercise (e.g., changes in mood, perceived exertion, perceived reward), which in turn are important determinants of motivation to exercise (e.g., higher self-efficacy for exercise behavior and higher intentions to exercise) and of future exercise behavior” (p. 30). The authors further explain that the model is “both circular and dynamic [and that] genetic factors are included in the model as potential mediators or determinants of the physiological effects of exercise as well as the subjective experience of exercise” (p. 30).

This multidisciplinary study, then, exemplifies several of the underlying principles of the social ecological approach. By incorporating a genetic component, the research speaks directly to the importance of understanding the etiology of a behavior and appreciating the importance of individual differences. If, in fact, there are certain genotypes that are associated with having a negative affective response to exercise, this dynamic could inform strategies designed to increase physical activity. Moreover, the investigators have incorporated concepts from systems theory in their depiction of the relationships between these different influencing factors as both iterative and interactive. The inclusion of factors derived from multiple levels (genetic, physiological, psychological) and the use of diverse methodologies (genetic analysis, experimental manipulation of mood and heart rate) further exemplifies some of the principles that are central to the SEF.

Although this study lacks the contextual component, it is important to recognize that pragmatic limits exist on the number and scope of variables that can be included in a single study and that the SEF can be applied to an entire field of study, such that the cumulative results of many studies will yield a more comprehensive model incorporating elements from the level of genetics to the level of global economic policy. Thus, the SEF can provide overarching guiding principles for a field of study which, if they are consistently applied, should reveal useful avenues for intervention in the quest to modify health behavior and promote well-being.

Future Directions of Social Ecological Research on Health Behavior Change

In ecological studies of health and health behavior change, a basic unit of analysis is the environment(E)-behavior(B)-physiology(P)-health outcomes(H) pathway.

Each category within the EBPH pathway can be further differentiated (e.g., in terms of objective vs. perceived, built vs. natural, micro vs. macro features of the environment; personal vs. other directed health behaviors). In some cases, the effects of environmental factors on health outcomes are direct (e.g., exposure to environmental asbestos induces pulmonary symptoms and increases one’s susceptibility to lung cancer), whereas, in other instances, environmental influences on health status are mediated or moderated by behavioral factors (e.g., exposure to environmental asbestos combined with smoking cigarettes
on a regular basis increases the individual's susceptibility to lung cancer in a
multiplicative fashion [Grunberg, 1991]). Moreover, behavioral influences on
health are sometimes direct, as in cases of lethal behavior directed toward one-
self (suicide) or toward others (homicide); in other cases, behavioral impacts
on health are mediated in a more gradual fashion through cumulative physi-
ological processes (e.g., high cholesterol intake precipitating atherosclerotic pro-
cesses that eventually lead to acute myocardial infarction).

Each individual's or group's ecology of health is uniquely made up of cer-
tain highly influential EBPH pathways. For instance, one family may live close
to exercise facilities and neighborhood parks, which enables them to engage
in physical activity regularly, whereas another may reside far from such facil-
ties or parks and, instead, live close to several fast-food restaurants, which may
encourage frequent consumption of high-fat, low-fiber meals [Corti, Donovan,
& Holman, 1997; Rashad & Grossman, 2004]. A particular challenge in eco-
logical analyses of health and health behavior is to identify the effective context
of health, or those EBPH pathways that exert the greatest influence on an individu-
al's or group's health behaviors and outcomes (cf. Stokols, 1987). An important
strength of the SEF is that it provides a broad conceptualization of environmen-
tal and behavioral factors, physiological processes, and health outcomes within
each segment of the EBPH pathway. At the same time, however, a major chal-
lenge facing ecological analyses of health is to pare down potentially lengthy
lists of etiologic factors within the E, B, P, and H categories and to develop more
parsimonious and powerful conceptualizations of high-leverage variables in
those categories (and situated at multiple levels of analysis) that have the greatest
bearing on important health behaviors and outcomes.

The EBPH pathway is a useful analytic tool for examining both the pro-
gress that has been made to date toward developing broad conceptualizations
of ecological influences on health, as well as the conceptual, methodological, and
translational challenges inherent in the SEF that remain to be addressed in
future research. These issues are outlined in the next sections.

Development of the SEF: Progress to Date

Important strides have been made in identifying and measuring environmental
influences on health behavior and outcomes at micro-, meso-, and macrosys-
tem levels.

At the macrosystem level, for example, operational measures of urban
sprawl have been developed and the impact of sprawl on levels of physical
activity and body mass index (BMI) in the population have been demonstrated
empirically [Frank, Kerr, Chapman, & Sallis, 2007; Frumkin, Frank, & Jackson,
2004]. Similarly, a recent study by O'Neill and colleagues (2007) indicates
that exposure to elevated levels of ambient air pollution exacerbates inflammatory
processes among diabetic individuals, thereby heightening their susceptibility
to cardiovascular events. Also, research by Jerrett and colleagues has linked
air pollution exposure to higher rates of cancer and atherosclerosis [Jerrett &
Burnett, 2007; Jerrett et al., 2005; Krewski et al., 2005; Künzli et al., 2005]. At the
micro- and mesosystem levels of analysis, as well, a wide range of environmen-
tal stressors and their effects on individuals' health risk behaviors and physiolo-
ogy have been documented [Evans, 1999].
At the same time, pivotal health risk behaviors have been identified and shown to exert significant impacts on disease etiology from Belloi & Breslow's (1972) early studies of healthy and unhealthy lifestyles to more recent reports identifying the major causes of chronic illness in developed countries (McGinnis & Foege, 1993; Mokdad et al., 2004). After several decades of research, poor nutrition, physical inactivity, consumption of alcohol and tobacco, and sleep disturbances have emerged as high-risk behaviors that exert a disproportionate impact on premature morbidity and mortality. What is distinctive about the more recent studies, however, is that we now know much more about the physiological processes that are triggered by these pivotal health risk behaviors. For instance, sleep deprivation in adolescents has been found to be associated with elevated levels of C-reactive protein and leptin, which are physiological precursors of inflammation and hyperinsulinemia (Larkin et al., 2005; Prinz, 2004). Moreover, it is becoming increasingly clear that chronic processes of inflammation, metabolic syndrome, and hyperinsulinemia are common precursors of multiple illnesses, including diabetes, heart disease, and cancer. Thus, in addition to classifying and measuring important environmental, behavioral, and physiological influences on health, ecologically oriented research is now beginning to document the empirical links between environmental and behavioral variables on the one hand, and physiological processes and health outcomes on the other.

Another indicator of progress in ecologically oriented research on health behavior and outcomes is the recent emphasis on identifying synergistic processes involving multiple environmental and behavioral factors that have a multiplicative or interactive impact on health outcomes. One example of this synergistic orientation is Evans's (2004) analysis of the “environment of childhood poverty,” which emphasizes multiple and closely interrelated environmental factors (e.g., poor housing quality, substandard school environments, frequent exposures to toxins and environmental stressors, food insecurity) that jointly undermine the health outcomes of children and their parents. Chronic exposure to these multiple contextual dimensions of poverty result in elevated levels of allostatic load—that is, cumulative environmental demands that jeopardize health status when experienced over an extended period (McEwen, 2006; Seeman et al., 2001).

A synergistic orientation also is reflected in recent studies of the interactive health impacts of multiple risky behaviors. For instance, the combination of sleep deprivation and unhealthy diet increases adolescents’ susceptibility to early-adult phase cardiovascular disease beyond the risks associated with poor nutrition and obesity alone (Larkin et al., 2005). Similarly, the synergistic influence of environmental and behavioral factors is reflected in a recent study of health outcomes in mice and primate populations, which demonstrated that chronic exposure to environmental stressors amplifies the obesogenic influence of a high fat, high sugar diet (Kuo, Abe, & Zukowska, 2007; Kuo, Kitzinska, et al., 2007).

Refinement of the SEF: Priorities for Future Research

Clearly, substantial progress has been made in recent decades toward identifying and measuring multiple environmental, behavioral, and physiological...
determinants of health and the interrelationships among them. At the same time, ecological research on health behaviors and outcomes face at least three kinds of challenges in the coming years: conceptual, methodological, and translational. At a conceptual level, analyses that are broad-gauged (i.e., span macroenvironmental through microphysiological levels) as well as parsimonious and powerful (i.e., identify the highest-leverage influences on health situated at each analytic level) are needed. The tradeoffs between broad conceptual scope and theoretical parsimony remain to be better balanced or resolved in future research. As well, ecological analyses of health must continue to identify and document the most powerful synergies among multiple environmental, behavioral, and physiological factors that have the greatest cumulative influence on personal and aggregate indicators of well-being.

At a methodological level, broader-gauged research designs are needed to document the empirical links among all segments of the EPH pathways for a particular individual or group. This is not to say that all ecological studies must encompass the full array of EPH categories and their interrelations. As noted earlier, studies focusing on the links among more limited subsets of E, B, P, and H factors have been instrumental in advancing the SEF. Nonetheless, a larger number of broad-gauged studies encompassing the full range of hypothesized variables within a particular EPH pathway should be designed and supported by health research funding agencies and foundations in the future. More expansive field-experimental studies that address all segments of the EPH pathway are essential for documenting their empirical links and for moving the study of ecology and health forward in future years.

A major translational challenge facing ecological research on health is the design and evaluation of multilevel, multicomponent programs and policies that explicitly modify high-leverage environmental, behavioral, and physiological precursors of health status among individuals and groups. To date, broadly conceived disease prevention and health promotion programs that target facets of the macro-, meso-, and microenvironment and their effects on health behaviors, physiological processes, and well-being are lacking, partly because these kinds of studies are notoriously labor- and time-intensive and financially costly to implement and sustain. Those constraints notwithstanding, the design, implementation, and evaluation of more comprehensive health improvement interventions that encompass the full range of factors within the EPH pathway remain as important and valuable goals for future research.

Finally, broad-gauged studies of health enhancement and disease prevention programs will require close collaboration among cross-disciplinary teams of scientists, clinicians, and community decision-makers (Abrams, 2006; Stokols, 2006). Earlier studies of team science suggest that the effectiveness of cross-disciplinary collaboration in health research, training, and the translation of scientific knowledge into clinical practices and policies is highly variable and depends on several contextual factors that either facilitate or constrain teamwork (Kessel & Rosenfield, 2006; Stokols, Harvey, Gress, Fuqua, & Phillips, 2005) and influence the impact and sustainability of evidence-based community interventions (Altman, 1995; Kernan, Rimer, & Emmons, 2005). Strategies for sustaining effective collaboration extending across multiple academic and professional fields will need to be implemented.

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and refined as a basis for advancing social ecological research on health outcomes and health behavior in future years.

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