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ORIGINAL PAPER

Modeling Structural, Dyadic, and Individual Factors: The Inclusion and Exclusion Model of HIV Related Behavior

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Abstract Changing HIV-related behaviors requires addressing the individual, dyadic, and structural influences that shape them. This supplement of *AIDS & Behavior* presents frameworks that integrate these three influences on behavior. Concepts from these frameworks were selected to model the processes by which structural factors affect individual HIV-related behavior. In the Inclusion/Exclusion Model, material and symbolic inclusions and exclusions (sharing versus denying resources) regulate individuals' ability and motivation to detect, prevent, and treat HIV. Structural interventions create inclusions that increase one's ability or motivation to perform these behaviors or exclusions that hinder one's ability or motivation to execute counterproductive behaviors. The need to expand research regarding multilevel influences on HIV-related behavior is also discussed, particularly concerning further understanding of sustained behavior change and effective dissemination of evidence-based intervention strategies.

Keywords Structural factors · Motivation · Behavioral skills · HIV prevention · Behavior determinants · Prediction · Change

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Approximately 33 million people worldwide are living with HIV and nearly three million new infections occur every year [1]. In the U.S., more than one million individuals are infected with the virus, with roughly 21% of HIV positive individuals unaware of their infection [2]. HIV is transmitted through direct contact with bodily fluids and does not survive for long outside of the body. Given the virus' fragility outside of the body, transmission depends on behaviors that are shaped by and take place within close interpersonal relationships. Once infection occurs, HIV diagnosis and treatment are initiated and maintained within interpersonal and social contexts as well. Therefore, understanding HIV diagnosis, prevention, and treatment requires an understanding of multilevel influences on behaviors in these complex social contexts.

To reduce HIV rates and promote diagnosis and treatment among those affected, researchers have developed theoretical frameworks upon which behavioral interventions were modeled. More than 25 years of HIV behavioral research has revealed that to achieve lasting and sustainable behavior change, interventions should address different levels of influences that interact to shape HIV-related behaviors. These include (a) an individual level that captures the motivations that affect behavioral decisions and the skills to enact such decisions; (b) an interpersonal level that captures the affective, normative, and cognitive processes that take place within the immediate social context where HIV-related behaviors occur; and (c) a structural level that captures the normative, material, and social conditions that facilitate or inhibit HIV-related behaviors within more immediate social spaces.

In this supplement of *AIDS & Behavior*, three teams of experts in HIV behavioral research present theoretical frameworks that address each of the three levels of influences on HIV-related behavior and examine its relation to

each of the other levels. In this paper, we summarize and compare the frameworks and present a model that highlights the dynamics of the relations between the structural and individual levels of influences and their implications for interventions in the HIV domain.

Multilevel Frameworks of HIV-Related Behavior

Benjamin Karney, Blair Johnson, and Carl Latkin led the teams that developed the multidimensional frameworks described in this supplement. Karney et al.'s framework emphasizes the dyadic and family context of HIV-related behavior [3]. The framework suggests that understanding the nature of potential dyadic relationships and increasing the dyad's capacity for successful coordination facilitate safer sex decision-making. According to Karney and colleagues, there are six elements of dyadic relationships that can impact HIV transmission: trust, intimacy, satisfaction, communication, commitment, and power. Partners will be more likely to engage in effective HIV prevention behavior if they trust each other, have a high level of intimacy, are satisfied with the relationship, communicate well, and are committed to each other. The power dynamics of a relationship may also impact the likelihood of engaging in HIV risk behavior. Whereas high-powered individuals retain more direct influence over dyadic decision-making and may be more effective at encouraging either safe or risky behavior, low-powered individuals could exert a more indirect influence (for example, by concealing relevant information such as HIV status) [3]. Furthermore, the factors that impact the decision to engage in HIV-risk behavior differ based on the quality of the relationship (e.g., the degree to which the partners demonstrate trust, intimacy, satisfaction, and communication within their relationship). Partners engaged in committed relationships exhibit stronger mutual influences than partners engaged in less committed relationships, such that the character of the relationship itself shapes the decision to engage in safe or unsafe behavior. In these dyads, the decision to engage in safe or unsafe behavior is determined by the personal motivations, abilities, and environments of both individuals [3]. Therefore, it is crucial to examine the quality of any existing dyadic relationships in an individual's life before choosing an appropriate course of action for HIV prevention. Although improving relationship quality and communication is likely to be beneficial in committed relationships, targeting personal motivation and ability is more likely to benefit individuals in uncommitted relationships.

Johnson et al.'s network-individual-resource framework [4] highlights the influence of the individual's network on his/her HIV-related behavior. A network is defined as two or more individuals who share a characteristic and momentarily or permanently interact. Networks may consist of dyads (such as sexual partners), families, peer groups, schools, neighborhoods, or entire communities. Networks contain actual or potential mental and physical resources that encourage risky or protective behaviors. Thus, healthy networks reduce risk for HIV by providing social support, medical care, financial resources, or secure, supportive partners. However, networks embodying hedonism may increase HIV risk by promoting risky behavior. As an example, hedonic network norms may endorse risky drug injection practices or unprotected sexual encounters with a variety of risky partners.

Because individuals cope with their environments by seeking and utilizing resources, the adequacy and availability of resources in a given network greatly impact the success of HIV-prevention efforts. As members of networks place the most value on resources that satisfy their most immediate needs, the intrinsic motivation for any given activity (such as drugs or sex) may outweigh the motivation for safety. Therefore, HIV-prevention efforts will be more effective to the degree to which they match the network's environment. Thus, network-level interventions can enhance HIV prevention efforts in multiple ways; for example, they could encourage students to sign up for intervention sessions with friends [5] or, conversely, separate students from their friends when the group engages in risky behaviors [6].

Latkin et al.'s framework of structural influences [7] describes how structural factors that are external to the individual and outside of their control can affect HIV-related behaviors. According to Latkin and colleagues, the social structural system is characterized by six dimensions that influence and are influenced by each other at various levels. These dimensions include four different forms of social and material power (technology, resources, formal, and informal social influence), as well as the physical and social settings in which power is produced and distributed. All dimensions can operate at different levels of breadth and distance from individual behavior. There are macro level factors such as culture, policy, and economic class, meso level factors such as communities and local service organizations, and micro level factors such as the environment in a particular clinic. Relationships among levels and dimensions can be reciprocal and all elements may function as a system of influences with emergent properties and feedback loops.

Structural factors can impact HIV-relevant behavior directly, via access to resources, or indirectly, through social interactions and motivational processes. Moreover, the different dimensions and levels of these factors may exert direct or indirect mutual influence. Thus, a meso-level factor such as a community organization might

impact a micro-level variable such as an individual's personal social network, whereas a macro-level factor such as societal gender definitions might directly impact the nature of a dyad's sexual practices.

According to Latkin and colleagues, investigators must examine how the six dimensions specified in their framework relate to specific problems, programs, behaviors, or populations and use that information to identify the appropriate level to target for intervention. For example, a macro-level intervention could work to deconstruct, critique, and replace existing belief systems about risk behavior, gender, or social norms. Interventionists could also lobby to change existing political structures, revise policies, or redistribute financial and technological resources. A meso-level intervention could work to diffuse risky networks (thereby discouraging the endorsement of unsafe behavioral norms) or create special housing developments for drug users or other risky populations. Finally, a micro-level intervention could target specific spaces or personal social networks with the objective of changing norms and increasing the safety of the surrounding environment.

A comparison of the three frameworks shows several similarities. Unsurprisingly, Latkin et al.'s structural level framework is the most comprehensive, integrating factors that range from the individual level to broad institutional structures. Although not as broad, Johnson et al.'s framework still incorporates dyads and larger networks in addition to individual-level factors. Karney et al.'s framework is the most focused of the three, primarily concentrating on the relationships between the individual and the dyadic level.

All of the frameworks described in this issue acknowledge that the social and environmental context of HIV transmission, whether it is proximal or distal, can facilitate or deter the detection, prevention, and treatment of HIV. In all cases, social and environmental influences can provide resources (either material or psychosocial) or constrain individual motivation and agency. For example, Latkin et al.'s framework proposes that social influences regulate the distribution of resources that affect HIV-related behaviors through physical access or psychological motivation to use those resources. Similarly, Johnson et al.'s framework posits that mental and material resources in a network can be aligned with or work against behaviors that either encourage or deter the detection, prevention, and treatment of HIV.

Both Latkin and Johnson propose complex bidirectional relationships among individuals and networks, although Latkin and colleagues also address relationships among networks and broader structures whose influence on individual behavior may be more indirect or uncertain. All of the frameworks suggest that influences among levels are multidirectional. Latkin et al.'s and Johnson et al.'s frameworks, in particular, underline the importance of observing contexts that are broader than individuals' close networks yet more immediate than macro-level policies and legislatures. These intermediate levels of influences may facilitate an integration of the processes by which more distal influences affect behavior, although, as in Latkin et al.'s framework, they may also have a more direct effect on health outcomes.

The frameworks in this supplement recognize the importance of proximal dyadic and close relationships that affect HIV-related behaviors. Karney et al.'s framework identifies how to improve relationship quality between partners and coordinate successful interactions to create positive HIV-related responses. Interestingly, all three frameworks emphasize trust as a moderator of the impact of the social context on behavior. On a dyadic level, trust within a relationship is an important determinant of HIV preventive measures. Within a broader social network, trust in the leadership and rules of the network can also influence the impact of these factors on HIV-related outcomes. On a structural level, trusting governmental policies, prevention messages, and local service providers predicts effective diagnosis, prevention, and treatment of HIV. Therefore, trust merits more focus in multilevel interventions to prevent HIV.

We now offer an integration that incorporates key elements from the described frameworks but represents an attempt to make dynamic directional predictions of the processes that occur at the individual and structural levels. The coming sections describe this perspective and are followed by a discussion about the importance of multilevel models in understanding sustainable behavior change and disseminating interventions to different settings and populations. A classification of HIV related interventions based on this model follows this presentation.

The Inclusion–Exclusion Model

The System Surrounding Human Behavior

Human behaviors, including those that are relevant to HIV infection and AIDS care, occur within a system [8, 9]. A system consists of inputs, processes, and outcomes, and is defined as an arrangement of elements (organizations, people, materials, and procedures) associated with a particular function or outcome. Systems vary in size and complexity (e.g., society, neighborhood, risk group), and these aspects are defined by the observer based on his or her goal. Interconnectedness and element diversity in a system also vary; more complex systems have a greater diversity of elements that become hierarchically organized,

as is the case with the systems that surround human behavior.

Elements and Hierarchy in the System

Identifying the elements of any system involves a construction in which aspects are selected based on a particular goal or point of view. In the case of HIV relevant behavior, for example, a common goal is to detect, prevent, or treat HIV in individuals. The system organized around this behavior can be defined as a hierarchy of elements, as in our *Social Inclusion and Exclusion Model* in Fig. 1. On top of this hierarchical chain are elements that are unlikely to be modified by individual behavior. On the bottom of the hierarchical chain is individual behavior, which is more likely to be influenced by the upper level factors than influence them. In our model, the relative position of the elements of a system is not an intrinsic property of the elements, but rather something that is unique to each system. For example, macro-level elements like the economy and climate are relatively independent of an individual's behavior and indirectly influence individual behavior. However, in a small village, an economic innovation by a single individual may potentially transform the village's economy. The economy is therefore less 'structural' when individuals control the economy than when they do not. This point illustrates that our model describes a *fluid continuum* in which elements are organized hierarchically but there are no fixed 'levels,' nor is it possible to produce a unique or complete list of the elements in such levels. Therefore,

Postulate 1. The system for detection, prevention, and treatment of HIV comprises a hierarchical chain of elements going from structural to individual. The position of an element in the hierarchy depends on the degree to which this element influences the other elements relative to the degree to which it is influenced by the other elements. More structural elements exert more influence than they receive, whereas individual elements receive more influence than they exert. Therefore, this continuum and the placement of elements are likely to be variable across systems.

In our fluid hierarchical chain displayed in Fig. 1, some elements are more structural whereas others are more individual. Examples of more structural factors are HIV prevalence, gender, race/ethnicity, policies, laws, economic conditions, science and technology (e.g., biomedical devices and electronic networking), physical spaces (e.g., bathhouses, crack houses/shooting galleries, sex-work establishments, drug-user apartments, deteriorated neighborhoods, etc.), social networks, and dyads, as well as politics and community mobilization. In terms of individual factors, we define individual behavior as actions determined by either ability or motivation or both, which are themselves determined by two sets of factors: actual and symbolic inclusion and exclusion. Actual inclusion/exclusion by other individuals, groups, or institutions entail the sharing or denial of material resources that can directly affect behavioral ability. For example, exclusion from valuable resources (e.g., condoms, money, and health care) or social contact (e.g., incarceration, geographic isolation) can directly impact the ability to detect, prevent, and treat HIV. Symbolic inclusion and exclusion comprise sharing or denial of intangible resources such acceptance, love, and recognition, as well as absence or presence of disapproval,

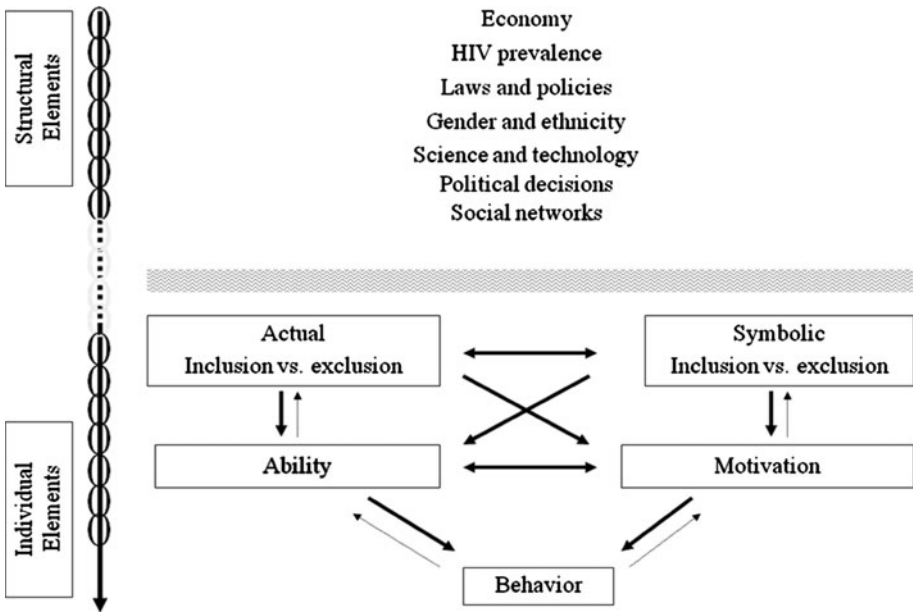

Fig. 1 Social inclusion and exclusion model

hate, or indifference. Symbolic exclusion and inclusion directly influence the motivation to detect, prevent, and treat HIV when, for example, proposing condom use triggers rejection from sexual partners. In addition, the perspective of receiving or losing valuable resources such as money or health care, or the perspective of being physically isolated or surrounded by others, can act as potent motivators. Therefore, in our model, actual exclusion and inclusion influence the ability to detect, prevent, and treat HIV.

Postulate 2. There are a variety of relatively structural factors that can influence individual behavior. Any such influence on behavior is mediated by actual and/or symbolic inclusion/exclusion, which themselves influence ability and/or motivation. No structural factor can influence behavior without going through either or both of these paths.

Note that the bottom portion of our model (see Fig. 1) shares characteristics of other psychological models such as the information-motivation-behavioral-skills model, the reasoned action approach, and the social cognitive theory. Overall, these include motivational elements (e.g., intentions associated with attitudes, norms, and beliefs) and a control element (control perceptions, self-efficacy, skills) [10–14]. In our model, ability entails the *actual* power to execute a behavior, which is determined by social inclusion (availability of information and behavioral skills, financial and instrumental resources, and access) and social exclusion (physical exclusion, exclusion from valuable resources and decision making processes). Motivation is the intention and commitment to perform a behavior; it overlaps with the motivational component of the information-motivation-behavioral-skills model and the attitudes, norms, intentions, and perceived control components of the reasoned action approach [11]. Thus, motivation in our model includes affective, cognitive, and normative determinants of behavior.

As we explain in the upcoming sections, not all interventions influence both ability and motivation, but many do. For example, community-based interventions designed to empower women to protect themselves from HIV [15, 16] may influence both ability and motivation to negotiate condom use [17, 18]. Moreover, increasing motivation can also increase the effort and persistence associated with somebody who is able to succeed at a goal. Increased motivation can also increase resource seeking, ultimately influencing ability. For example, a structural factor that influences exposure to HIV-prevention counseling could involve incorporating motivational videos into the waiting rooms of sexually-transmitted-infection clinics [19]. In this case, the motivation to prevent HIV may trigger a decision to seek out the necessary behavioral skills, which in turn facilitate prevention behavior.

Dynamics within the System

Any change or modification of the state of a system can be described in relation to the observer's goal (in this case, the detection, prevention, and treatment of HIV). The influence of a structural factor on a more individual factor can facilitate or hinder detection, prevention, and treatment of HIV. This notion is useful for classifying behavioral interventions and analyzing the plausibility of Postulate 2. As shown in Fig. 2, structural interventions can have an effect on behavior by increasing abilities that facilitate detection, prevention, and/or treatment or decreasing abilities that hinder detection, prevention, and/or treatment. In addition, structural interventions can have an effect on behavior by increasing motivation to engage in detection, prevention, and treatment (e.g., increasing the motivation to use condoms), or decreasing motivations to avoid detection, prevention, and treatment (e.g., reducing the motivation to maximize sexual pleasure).

Postulate 3. Individual behavior and the influence of more structural factors on individual factors can be in line with or opposed to the goal of HIV detection, prevention, and treatment. Therefore, interventions to increase detection, prevention, and treatment can either increase the ability and motivation for detection, prevention, and treatment, or decrease the ability and motivation to avoid detection, prevention, and treatment.

These outcomes are described in Fig. 2. The left column represents individuals' ability to detect, prevent, and treat HIV and the right column the motivation to detect, prevent, and treat HIV. The upper-left quadrant describes structural interventions designed to influence behavior by enhancing people's ability to detect, prevent, and treat HIV. Examples of these interventions involve increasing resources needed to conduct the desired behavior, including community and outreach HIV-testing interventions, condom distribution [17, 18, 20, 21], and implementation of routine HIV testing

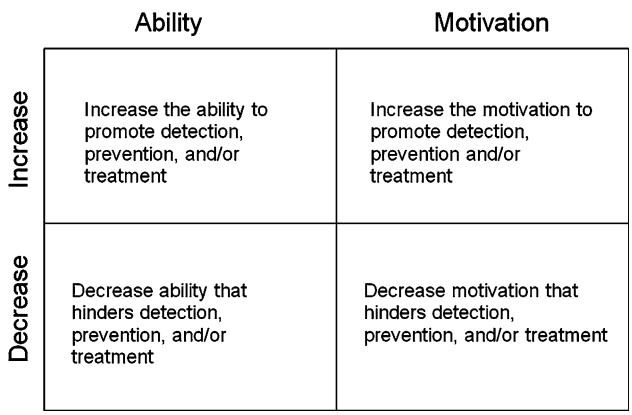

Fig. 2 Examples of interventions that address ability and motivation

in health care settings [22–27]. The lower-left quadrant includes interventions that influence behavior by reducing people's abilities to hinder the detection, prevention, and treatment of HIV. For instance, these interventions impede or constrain risk behavior by limiting or prohibiting the spaces and times in which people develop risky activities. Examples of these interventions include closing or modifying bathhouses or drug-injection sites [28–30].

The upper-right quadrant of Fig. 2 represents interventions that increase motivation to conduct desirable behaviors involving the detection, prevention, and treatment of HIV. These interventions often involve increasing the actual or perceived benefits of the desired behavior as well as removing actual or perceived barriers to the desired behavior [11]. Setting services for anonymous HIV testing [31], for example, addresses potent motivational barriers such as anticipated stigma by satisfying the need to maintain HIV testing private. Providing monetary incentives for HIV testing and HIV-prevention interventions can also be used to motivate reluctant individuals [32, 33].

Finally, structural interventions can decrease the motivation to conduct behaviors that are inconsistent with detection, prevention, and treatment of HIV. These interventions are represented in the lower-right quadrant of Fig. 2. Examples include interventions that create negative norms toward risky behavior, such as peer-led interventions delivered in schools [34] and 100% condom use campaigns [35, 36]. In essence, by operating on a social network, these interventions foster symbolic sanctions of risky behavior. Moreover, structural interventions that pose spatial or financial limits to a risky behavior (e.g., smoking) may limit not only the ability but also the motivation to pursue the risky behavior under the new set of conditions (e.g., higher price).

Describing the effects of an element on another element requires the concept of feedback. Feedback is defined by mutual influences between two elements, such that if *A* influences *B*, *B* also influences *A*. Positive feedback is defined as an element exerting an influence that amplifies a prior deviation. For example, if a symbolic sanction is effective at changing the behavior of a target person, the behavior change may stimulate stronger sanctions that are now known to be effective. Another example is how the promotion of HIV testing for pregnant women can reduce prenatal and natal care in an attempt to avoid the test and stigmatizing consequences of an HIV diagnosis [37]. Negative feedback is defined as an element exerting an influence that reduces a prior deviation. For instance, a neighborhood with an increase in teenage risk behavior may set up a condom-provision program that reduces teens' risky behavior to its baseline levels, without a further risk decrease as would be the case with positive feedback.

Following Fig. 2, structural interventions should seek to either amplify positive effects on motivation and ability to detect, prevent, and/or treat HIV, or amplify negative effects on motivations and abilities that hinder behaviors opposed to the detection, prevention, and/or treatment of HIV. Negative feedback should be particularly useful for interventions designed to reduce the motivation or ability to perform behaviors opposing detection, prevention, and/or treatment of HIV. However, many of the interventions aimed at correcting a deviation may also seek to maximize other outcomes such as increasing mental health. For example, opening an STI clinic can try to reduce infections but also function as a channel for ensuring mental-health treatment in at-risk populations. Therefore, most interventions probably target both positive and negative feedback effects.

Postulate 4. Feedback among the elements of the system can either amplify or correct a deviation in HIV detection, prevention, and/or treatment. Some interventions seek to amplify deviations whereas others seek to correct deviations.

The elements in the social inclusion and exclusion model can have connections that are sometimes random and that can be either loose or tight. Loose connections emerge when there is a higher number of mediating connections as well as weak connections [8]. In these cases, elements influence each other occasionally, negligibly, and/or eventually [38]. Connections can also be loose because of the independence of an element or group of elements within a whole (no mutual connections between a given part and the whole). In our fluid hierarchy, the upper, more structural elements are loosely connected to the mediating elements of actual and symbolic exclusion/inclusion as well as ability, motivation, and behavior. In contrast, the lower elements of actual and symbolic exclusion/inclusion, as well as ability and motivation, are tightly connected to behavior.

Postulate 5. Elements at the more structural level of our continuum are loosely connected to actual and symbolic exclusion/inclusion as well as detection, prevention, and treatment behavior. The looser the connection between a structural and individual element, the less likely that a structural intervention will ultimately influence behavior. However, a structural intervention with a defined mediational path to behavior can exert an influence on behavior.

The political and scientific literature is replete with examples of how tighter structural-individual connections can be an effective way to induce HIV detection, prevention, and treatments. For instance, interventions that increase availability of and accessibility to resources necessary to increase treatment (e.g., community HIV testing)

are highly effective [22], whereas simply allocating funds to an African country may never promote the desired outcomes [39]. As another example, areas of the country where the immigrant population grows rapidly are not prepared to serve large numbers of individuals with different cultural and linguistic needs. As a result, the immigrant behavior is loosely connected to economic and social factors in the region, and the disparities between acculturated and not acculturated immigrants are deeper [40]. Moreover, when local services exist but a group is isolated, those services may be loosely connected to behavior. Spanish-speaking Latinos with health insurance use health services only when surrounded by a large Spanish-speaking community who can alert them of the available services [41].

Irreversibility is an important aspect when one attempts to model change in HIV detection, prevention, and treatment. As a general principle, a property that develops in a system may become inaccessible to other properties that could 'undevelop' it [8]. This property generally applies to complex systems in which a single element would alter the entire system configuration [8]. For example, it is easy to imagine some beneficial behavioral effects could emerge from an intervention that promoted socially scorning risky behavior. However, increasing the financial resources of a group is likely to have fairly unpredictable effects on detection, prevention, and treatment of HIV, in part because many of the effects of poverty (e.g., low education, trauma, or poor mental and physical health) are difficult to reverse. Consider for example a program providing small loans to the poor in order to facilitate small commercial enterprises [42]. In this model, a group of women meets every week to make loan payments at commercial interest rates, critiques each other's business plans, and also pledges to use birth control, boil their water, and carry out other good health practices [42]. One unintended consequence of this program is that group members deny entrance to potential members who seem unable to fulfill repayment requirements (e.g., the poorest, less skilled, and less self-motivated), suggesting that not all social situations are reversible [43, 44]. Therefore, the additional economic resources entering the community cannot alter prior structural limitations to the lives of the more marginalized individuals [45].

Postulate 6. Not all changes in a system are reversible. The effect of many structural factors is irreversible.

Loose connections can produce uncertain effects of one system element on another, particularly within open systems. In fact, outside of artificial systems in which individuals are isolated and no outside input is allowed (e.g., a residential lab), all systems surrounding human behavior are open. The set of elements and processes an observer extracts are themselves being influenced by out-of-the-system elements. As a result, open systems have considerable uncertainty, and any loosely connected elements have particularly high uncertainty because more outside elements can influence a long chain of events than a short chain of events.

Postulate 7. By definition, open systems such as those surrounding human behavior have a degree of unpredictability. The unpredictability of the effect of an element on another element increases when the two are loosely connected. Therefore, the influence of structural interventions on individual behavior can have considerable uncertainty.

There are many cases in which a well-intended structural intervention has unintended consequences. HIV funding to African countries, for example, can increase corruption while having minimal if any impact on HIV detection, prevention, or treatment [39]. Also, the availability of efficacious treatments for HIV has been shown to diminish the perceived severity of AIDS and to increase risk behavior [46]. Luckily, however, some of the unintended outcomes are socially beneficial, as is the case when the availability of HIV treatment decreases HIV stigma [47].

Unpredictability often entails entropy, or the tendency for systems' outputs to decline when the inputs have remained the same. Entropy is a broad concept that has to be considered when forecasting the evolution of changes within a system. To begin, any analysis of the maintenance of behavioral changes or the sustainability of a structural intervention is curtailed by the system's unpredictability. Furthermore, the influence of an element that produces an initial change is not stable over time and some of the effect is lost over repeated occasions [48]. The effect of condom provision at the beginning of an epidemic, for example, may not be the same as it is after decades of the epidemic's progress, and any structural intervention probably needs to be regularly bolstered with new elements or changes in the elements that were initially manipulated. Just as booster sessions are now common in individual-level programs [5], booster-structural changes are likely to be necessary for structural interventions to be up to the challenge of modifying detection, prevention, and treatment of HIV.

Discussion

Theoretical models of health behavior provide a way to both organize what is currently known about the factors that shape people's health behaviors and specify new hypotheses regarding the processes that regulate behavior. The processes emphasized by theories in turn impact intervention practices because interventionists often turn to

theoretical models for guidance regarding the design and implementation of intervention strategies. The current state of research and practice in HIV detection, prevention, and treatment suggest the value of examining behavioral determinants at different levels of analysis (i.e., individual, dyadic, community/structural). To encourage the formulation of theoretical models that cross levels of analysis, structural, or higher-level, scientific interventions such as the conference that preceded this supplement of *AIDS & Behavior* are necessary to articulate how current research at one level of analysis engages with work conducted at a different level of analysis.

Sustained Behavioral and Health Outcomes

Intervention strategies must not only elicit initial changes in people's behavior and health, but also provide a framework that enables people to sustain those changes—in behavior and health—over time. To date, there has been a growth in individual-level models that examine factors that are important for sustained behavior change [49–53]. However, less consideration has been given to how processes that regulate the interactions between individuals and between people and their environments might be used to leverage initial changes in individual behavior. There has been a growing body of empirical findings suggesting that health states and health practices coalesce within social networks [54, 55], but little evidence for the processes through which individuals influence each other. To what extent is a person's behavioral decisions affected by another person's beliefs or practices? Dyadic models may help to examine this question as they provide a methodological and statistical framework for examining the influence of one's own beliefs on behavior (i.e., target effects) and the influence of another person's beliefs on behavior (i.e., partner effects). For example, whereas individual-level models of health behavior have assessed people's perceptions of other people's beliefs (i.e., social norms), a dyadic model [3] may provide a way to differentiate between two forms of interpersonal influence—one that operates through the indirect effect of perceived norms (a person's behavior is affected by what she/he believes another person thinks or feels) and the other that operates through the direct effect of another person's thoughts or feelings.

As dyadic models can capture the reciprocal influence that people have on each other, they may offer new insights into the factors that regulate sustained behavior change. In particular, the favorability of a partner or friend's psychological and behavioral response to a person's behavior may moderate the degree to which the behavior is sustained over time. The impact of these responses, especially negative reactions, may accrue over time such that someone might be resilient in the face of an initial negative reaction to the behavior, but have difficulty persisting with the behavior in the face of repeated criticism or complaints. Tracking these reactions over time may help to clarify the inconsistency sometimes observed in people's behavior, especially the observation that people who have successfully modified their behavior choose not to maintain the new pattern of behavior. What might appear to be a gap between a person's thoughts/feelings and behavior may seem less discrepant when a partner or friend's thoughts and feelings are taken into consideration.

More broadly, the integration of dyadic and individual level models affords investigators with several opportunities that are likely to have a favorable effect on theory and practice. First, the adoption of a dyadic framework provides a lens through which investigators may be more attentive to the manner in which individuals may influence each other, stimulating questions as to whether and how the thoughts and feelings of one's partners, friends, and co-workers might influence each other. Second, a dyadic approach provides a methodological and statistical framework that can be adapted to test the influence of a broad array of substantive predictors. Thus, it is not wedded to a particular theoretical perspective and provides a way to assess the relative contributions of different predictors. In fact, a dyadic model does not require a partner's effect, it merely provides a way to systematically examine the magnitude of this effect. If this magnitude is not significant, the dyadic model is simply supplanted by an individual level model.

The stability of the outcomes of HIV behavioral interventions also depends on an understanding of the processes that affect behaviors from the most distal to more proximal levels of influence. Whereas structural influences are assumed to regulate the actions of large numbers of individuals and can produce cost-effective, durable behavior changes [56–59], proximal influences, if unaddressed, can still alter the strength and stability of behavior changes stemming from structural efforts. To be sure, given the urgency of reducing new HIV infections, structural interventions are often implemented without consideration of other factors and regardless of psychological and social consequences that may offset the intervention benefits. For instance, programs may encourage women to protect themselves but fail to induce their partners to accept the women's initiatives. Likewise, circumcision campaigns may be implemented regardless of their effects on men's willingness to engage in risk behavior over time [60]. Intervention measures that do not consider the processes that may take place between the different levels of influence may backfire, have null effects on behavior, or result in unstable outcomes over time [60].

The paucity of multilevel approaches to behavior change in the domain of HIV stems in part from the difficulty of studying relations among very different levels of influences on behavior [7]. Integrating multiple-level influences requires methods that capture the processes that take place between distal and proximal antecedents of HIV-related behaviors and translate them into meaningful predictions. Observations of the trajectory of the AIDS epidemic and between-region comparisons have helped to identify the impact of several structural factors on the course of the HIV epidemic (e.g., increases in HIV prevalence during war [61] or higher HIV prevalence associated with income inequality [62, 63]). Prospective studies following structural changes could further discover how different levels of factors respond to new structural configurations. Whereas these studies may not have optimal internal validity, they may serve as a tool to develop hypotheses that can be examined in more rigorous trials at later times.

A multilevel approach to HIV-related behaviors can provide researchers and interventionists with insights on how structural factors affect interpersonal relationships and individuals' motivations and skills. Adjusting interventions, whether multilevel or not, with this knowledge can inform more sustainable behavior change strategies and allow for decisions about disseminating intervention efforts to different settings and situations.

Strategies for Intervention Dissemination

To date, investigators who have been working at the individual level have strived to generate a body of evidence that specific individual-level constructs (e.g., attitudes, self-efficacy) and intervention strategies that target those constructs are effective means to promote healthy behavior. Yet, when an evidence base has accumulated in support of a particular intervention strategy, how does an investigator determine the likelihood that the intervention would be effective when used with a different population or in a different setting? Individual-level models that specify the psychological processes that underlie people's behavioral decisions typically provide guidance as they explicitly or implicitly assume that the intra-psychic processes delineated in the model are robust across populations and settings. By forging connections between factors that operate at the structural and the interpersonal level, theoretical models can be developed that inform judgments regarding the applicability of a particular intervention strategy. For example, variability in the material resources available to members of community or the daily demands or stressors that must be dealt with might mitigate people's ability to prioritize health concerns or, even when health issues are deemed important, their ability to translate good intentions into behavior. With this information in hand, investigators may be better able to specify the intervention strategies that are and are not most likely to be effective under those conditions.

References

1. UNAIDS. AIDS epidemic update 2009. 2009. http://www.unaids.org/en/KnowledgeCentre/HIVData/EpiUpdate/EpiUpdArchive/2009/default.asp. Accessed 25 July 2010.
2. Campsmith M, Rhodes P, Hall H, Green T. HIV prevalence estimates—United States, 2006. Morb Mortal Wkly Rep. 2008; 57(39):1073–6.
3. Karney BR, Hops H, Redding CA, Reis HT, Rothman AJ, Simpson JA. A framework for incorporating dyads in models of HIV-prevention. AIDS Behav. doi:10.1007/s10461-010-9802-0.
4. Johnson BT, Redding CA, DiClemente RJ, et al. Toward a network-individual-resource framework for HIV prevention. AIDS Behav. (in press).
5. Wu Y, Stanton BF, Galbraith J, et al. Sustaining and broadening intervention impact: a longitudinal randomized trial of 3 adolescent risk reduction approaches. Pediatrics. 2003;111(1):e32–8.
6. Valente TW, Ritt-Olson A, Stacy A, Unger JB, Okamoto J, Sussman S. Peer acceleration: effects of a social network tailored substance abuse prevention program among high-risk adolescents. Addiction. 2007;102(11):1804–15.
7. Latkin C, Weeks M, Glasman L, Galletly C, Albarracin D. A dynamic social systems model for considering structural factors in HIV prevention and detection. AIDS Behav. doi:10.1007/s10461-010-9804-y.
8. Ashby WR. An introduction to cybernetics. Oxford: Wiley; 1956.
9. Von Bertalanffy L. General system theory: foundations, development, applications. New York: George Braziller; 1968.
10. Ajzen I, Fishbein M. Understanding attitudes and predicting social behavior. Englewood Cliffs: Prentice Hall; 1980.
11. Ajzen I, Fishbein M. The influence of attitudes on behavior. In: Albarracin D, Johnson BT, Zanna MP, editors. Handbook of attitudes and attitude change: basic principles. Mahwah: Erlbaum; 2005. p. 173–221.
12. Bandura A. Self-efficacy: the exercise of control. New York: Freeman; 1997.
13. Fisher JD, Fisher WA. Changing AIDS-risk behavior. Psychol Bull. 1992;111(3):455–74.
14. Fisher JD, FIsher WA. Theoretical approaches to individual-level change in HIV risk behavior. In: Peterson JL, DiClemente RJ, editors. Handbook of HIV prevention. New York: Kluwer Academic/Plenum Publishers; 2000. p. 3–55.
15. Reza-Paul S, Beattie T, Syed HUR, et al. Declines in risk behaviour and sexually transmitted infection prevalence following a community-led HIV preventive intervention among female sex workers in Mysore, India. AIDS. 2008;22(Suppl 5):S91–100.
16. Sherman SG, German D, Cheng Y, Marks M, Bailey-Kloche M. The evaluation of the JEWEL project: an innovative economic enhancement and HIV prevention intervention study targeting drug using women involved in prostitution. AIDS Care. 2006;18(1): 1–11.
17. Albarracin D, Gillette JC, Earl AN, Glasman LR, Durantini MR, Ho M-H. A test of major assumptions about behavior change: a comprehensive look at the effects of passive and active HIV-prevention interventions since the beginning of the epidemic. Psychol Bull. 2005;131(6):856–97.
18. Albarracin D, Ho RM, McNatt PS, et al. Structure of outcome beliefs in condom use. The Project RESPECT Study Group. Health Psychol. 2000;19(5):458–68.

19. Albarracin D, Leeper J, Earl A, Durantini MR. From brochures to videos to counseling: exposure to HIV-prevention programs. AIDS Behav. 2008;12(3):354–62.
20. Amass L, Bickel WK, Higgins ST, Budney AJ, Foerg FE. The taking of free condoms in a drug abuse treatment clinic: the effects of location and posters. Am J Public Health. 1993;83(10): 1466–8.
21. Frost LJ, Reich MR. Creating access to health technologies in poor countries. Health Aff. 2009;28(4):962–73.
22. Bozzette SA, Bozzette SA. Routine screening for HIV infection—timely and cost-effective. N Engl J Med. 2005;352(6):620–1.
23. Branson BM, Handsfield HH, Lampe MA, et al. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. MMWR Recomm Rep. 2006;55(RR-14):1–17 (quiz CE11-14).
24. Brown J, Shesser R, Simon G, et al. Routine HIV screening in the emergency department using the new US Centers for Disease Control and Prevention Guidelines: results from a high-prevalence area. J Acquir Immune Defic Syndr. 2007;46(4):395–401.
25. Cunningham CO, Doran B, DeLuca J, Dyksterhouse R, Asgary R, Sacajiu G. Routine opt-out HIV testing in an urban community health center. AIDS Patient Care STDS. 2009;23(8):619–23.
26. Haukoos JS, Hopkins E, Byyny RL, et al. Design and implementation of a controlled clinical trial to evaluate the effectiveness and efficiency of routine opt-out rapid human immunodeficiency virus screening in the emergency department. Acad Emerg Med. 2009;16(8):800–8.
27. Holtgrave DR, Holtgrave DR. Costs and consequences of the US Centers for Disease Control and Prevention's recommendations for opt-out HIV testing. PLoS Med. 2007;4(6):e194.
28. Burris S, Burris S. Legal aspects of regulating bathhouses: cases from 1984 to 1995. J Homosex. 2003;44(3–4):131–51.
29. Faissol DM, Griffin PM, Swann JL. Closing bathhouses unlikely to decrease number of sex acts and may reduce condom use: a response. J Acquir Immune Defic Syndr. 2008;47(2):266.
30. Woods WJ, Binson D, Pollack LM, et al. Closing bathhouses unlikely to decrease number of sex acts and may reduce condom use. J Acquir Immune Defic Syndr. 2008;47(2):264–6 (author reply 266).
31. Bindman AB, Osmond D, Hecht FM, et al. Multistate evaluation of anonymous HIV testing and access to medical care. Multistate Evaluation of Surveillance of HIV (MESH) Study Group. JAMA. 1998;280(16):1416–20.
32. Carey MP, Vanable PA, Senn TE, et al. Recruiting patients from a sexually transmitted disease clinic to sexual risk reduction workshops: are monetary incentives necessary? J Public Health Manag Pract. 2005;11(6):516–21.
33. Kamb ML, Rhodes F, Hoxworth T, et al. What about money? Effect of small monetary incentives on enrollment, retention, and motivation to change behaviour in an HIV/STD prevention counselling intervention. The Project RESPECT Study Group. Sex Transm Infect. 1998;74(4):253–5.
34. Fisher JD, Fisher WA, Bryan AD, et al. Information-motivation-behavioral skills model-based HIV risk behavior change intervention for inner-city high school youth. Health Psychol. 2002;21(2):177–86.
35. Rojanapithayakorn W, Rojanapithayakorn W. The 100% condom use programme in Asia. Reprod Health Matters. 2006;14(28): 41–52.
36. Sopheab H, Morineau G, Neal JJ, et al. Sustained high prevalence of sexually transmitted infections among female sex workers in Cambodia: high turnover seriously challenges the 100% Condom Use Programme. BMC Infect Dis. 2008;8:167.
37. Turan JM, Miller S, Bukusi EA, Sande J, Cohen CR. HIV/AIDS and maternity care in Kenya: how fears of stigma and discrimination affect uptake and provision of labor and delivery services. AIDS Care. 2008;20(8):938–45.
38. Weick KE. Management of organizational change among loosely coupled elements. In: Goodman P, editor. Change in organizations. San Francisco: Jossey-Bass; 1982. p. 375–408.
39. Crumplin G, Crumplin G. EU reimporting drugs meant for Africa is only part of story. BMJ. 2003;326(7383):285.
40. DuBard CA, Gizlice Z. Language spoken and differences in health status, access to care, and receipt of preventive services among US Hispanics. Am J Public Health. 2008;98(11):2021–8 (Epub Sep 2008)
41. Gresenz CR, Rogowski J, Escarce JJ. Health care markets, the safety net, and utilization of care among the uninsured. Health Serv Res. 2007;42(1 Pt 1):239–64.
42. Grameen Bank: Banking for the Poor. 2010. http://www.grameen-info.org/. Accessed July 2010.
43. Kabeer N. Safety nets and safety ropes: addressing vulnerability and enhancing productivity in South Asia. In: Cook S, Kabeer N, Suwannarat G, editors. Social protection in Asia. New Delhi: Har-Anand Publications; 2003.
44. Kay T. Empowering women through self-help microcredit programmes. Bulletin on Asia-Pacific Perspectives 2002/03. 2002. http://www.unescap.org/pdd/publications/bulletin2002/index.asp. Accessed 3 Sep 2009.
45. Hulme D, Mosley P. Finance against poverty. London: Routledge; 1996.
46. Ostrow DG, Silverberg MJ, Cook RL, et al. Prospective study of attitudinal and relationship predictors of sexual risk in the multicenter AIDS cohort study. AIDS Behav. 2008;12(1):127–38 (Epub April 2007).
47. Roura M, Urassa M, Busza J, Mbata D, Wringe A, Zaba B. Scaling up stigma? The effects of antiretroviral roll-out on stigma and HIV testing. Early evidence from rural Tanzania. Sex Transm Infect. 2009;85(4):308–12.
48. Kumkale GT, Albarracin D. The sleeper effect in persuasion: a meta-analytic review. Psychol Bull. 2004;130(1):143–72.
49. Albarracin D, Wallace HM, Glasman LR. Survival and change in judgments: a model of activation and comparison. In: Zanna MP, editor. Advances in experimental social psychology, vol. 36. San Diego: Elsevier Academic Press; 2004. p. 251–315.
50. Earl A, Albarracin D. Nature, decay, and spiraling of the effects of fear-inducing arguments and HIV counseling and testing: a meta-analysis of the short- and long-term outcomes of HIV-prevention interventions. Health Psychol. 2007;26(4): 496–506.
51. Rothman AJ, Baldwin A, Hertel A. Self-regulation and behavior change: disentangling behavioral initiation and behavioral maintenance. In: Vohs K, Baumeister R, editors. The handbook of self-regulation. New York: Guilford Press; 2004. p. 130–48.
52. Rothman AJ, Sheeran P, Wood W. Reflective and automatic processes in the initiation and maintenance of dietary change. Ann Behav Med. 2009;38(Suppl 1):S4–17.
53. Wood W, Neal DT. A new look at habits and the habit-goal interface. Psychol Rev. 2007;114(4):843–63.
54. Christakis NA, Fowler JH. (2007) The spread of obesity in a large social network over 32 years. N Engl J Med. 2007;357(4):370–9 (Epub July 2007).
55. Christakis NA, Fowler JH. The collective dynamics of smoking in a large social network. N Engl J Med. 2008;358(21):2249–58.
56. Coates TJ, Richter L, Caceres C. Behavioural strategies to reduce HIV transmission: how to make them work better. Lancet. 2008; 372(9639):669–84.
57. Cohen DA, Wu S-Y, Farley TA. Cost-effective allocation of government funds to prevent HIV infection. Health Aff. 2005; 24(4):915–26.

58. Latkin CA, Knowlton AR. Micro-social structural approaches to HIV prevention: a social ecological perspective. AIDS Care. 2005;17(Suppl 1):S102–13.
59. Sherman SG, Srikrishnan AK, Rivett KA, Liu SH, Solomon S, Celentano DD. Acceptability of a microenterprise intervention among female sex workers in Chennai, India. AIDS Behav. 2010;14(3):649–57.
60. Eaton LA, Kalichman S. Risk compensation in HIV prevention: implications for vaccines, microbicides, and other biomedical HIV prevention technologies. Curr HIV/AIDS Rep. 2007;4(4): 165–72.
61. Hankins CA, Friedman SR, Zafar T, Strathdee SA. Transmission and prevention of HIV and sexually transmitted infections in war settings: implications for current and future armed conflicts. AIDS. 2002;16(17):2245–52.
62. Moran D, Jordaan JA. HIV/AIDS in Russia: determinants of regional prevalence. Int J Health Geogr [Electron Resour]. 2007;6:22.
63. Tsafack TC. The role of income and gender inequalities in the spread of the HIV/AIDS epidemic: evidence from Sub-Saharan Africa: University d'Auvergne; 2008.