CHAPTER

16

THE THEORY OF TRIADIC INFLUENCE

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INFLUENCING HEALTH-ENHANCING BEHAVIOR

Anyone in the business of health promotion (HP) must know two things: what causes health-related behaviors (HRBs), and how to effectively promote health-enhancing behaviors (like wearing seatbelts) or deter health-compromising behaviors (like smoking cigarettes). This knowledge, however, has been evasive because (1) the causes of behavior are many and varied, each cause being just one piece in a complex puzzle of causes (Petraitis, Flay, and Miller, 1995); (2) different theories of behavior have focused on different aspects of the puzzle; (3) theories are difficult to confirm, clouding our understanding with uncertainty; and (4) the translation of any theory into HP programs is limited by the scope of the theory, such that narrowly focused theories lead to narrowly focused interventions. For example, some theories of health behavior (HB) focus on proximal affective/cognitive predictors of behavior like self-efficacy, social normative beliefs, attitudes and intentions (for example, Ajzen, 1991; Fishbein and Ajzen, 1975), while others focus on ultimate or underlying causes in the broad sociocultural environment (Biglan, 2004), social situations (Magnusson, 1981), or biology (for example, Frankenhaeuser, 1991; Sher, 1991) and personality (Digman, 1990; Zuckerman, Ball, and Black, 1990). Yet other theories focus on interpersonal situations, social support, and bonding processes (for example, Elliott, Huizinga, and Ageton, 1985; Hawkins and Weis, 1985; Oetting and Beauvais, 1986), or social learning processes (for example, Akers, Krohn, Lanza-Kaduce, and Radosevich, 1979; Bandura, 1977). Very few extant theories of HB incorporate several of these viewpoints (for example, Bandura, 1986; Jessor and Jessor, 1977; Jessor et al., 2003), and those that do are limited in various ways.

We believe that some new ideas about HRBs and HP can be found in our integrative theory, the theory of triadic influence (TTI) (Flay and Petraitis, 1994). The TTI provides a meta-theoretical orientation that suggests higher-order descriptions and explanations of HRB, offers a detailed ecological approach to HB change, and suggests that an increased focus on distal and ultimate levels of influence will produce greater and more sustainable HP effects than the traditional (at least in the United States) focus on affective/cognitive approaches. This chapter provides a brief explanation of why a comprehensive theory of HB is needed, a general overview of the TTI, examples of how it explains a variety of HRBs, empirical evidence for its propositions, a description, some examples of how it can be applied in HP, and some conclusions and comments about future developments.

GENESIS OF THE THEORY OF TRIADIC INFLUENCE

Before introducing the TTI, we explain the need for an integrative theory of HRBs. Scholars have proposed dozens of different theories of various HRBs. For example, Lettieri, Sayers, and Pearson (1980) identified forty-three different theories that attempted to explain the development of substance use. These theories spanned a broad range of disciplines (from neuroscience to political science) and an even

broader range of variables (from disorganized social institutions to the spur-of-the moment decision to use substances). Most of these forty-three theories were rather narrow in scope, simply because earlier attempts to develop health behavior theories had to focus on smaller, manageable, and measurable components that contribute to a specific HB. In the decades since the review by Lettieri et al. the number of theories and variables that contribute to HB has grown, leaving planners of HP programs with a puzzle that had scores of pieces (variables), different ways of putting the pieces together (theories) and different sections of the puzzle complete or incomplete. Unfortunately, this predicament leads to considerable confusion and little agreement about how to design HP programs.

After carefully reviewing theories of HB (Petraitis et al., 1995), we recognized that theories and variables could be organized along two dimensions (Table 16.1), levels of causation and streams of influence, and we proposed the TTI (Flay and Petraitis, 1994) to reduce confusion and to integrate the scores of potentially relevant variables and theories in a conceptually meaningful way. Our focus was on developing a more comprehensive theory that would provide a set of testable and practical guidelines for both understanding the causes of HRBs and developing effective HP programs. Thus, in the terms of Glanz, Rimer, and Lewis (2002, pp. 25–26), the TTI represents both (1) a theory of the problem, in which the focus is on explanation and prediction of HB, and (2) a change theory, or theory of action, in which the emphasis is on guiding the development of HP interventions.

The TTI proposes that theories and variables can be arranged by different *levels (or tiers) of causation* (see Table 16.1). Some variables (like intentions) have direct effects on behavior and are *causally proximal or immediate*; some variables (like motivation to comply with or please others) have effects that are mediated through other variables (like social normative beliefs) and are more *causally distal or predisposing*; other variables (like the style of parenting one experienced during childhood or taxes on cigarettes) are mediated by even more variables and are even more *causally distal*; and yet other variables (like ethnic culture, neighborhood poverty, or personality) represent the *underlying or ultimate causes* of behavior.

The TTI also proposes that theories and variables can be arranged into three relatively distinct types or *streams of influence* (see Table 16.1), corresponding to the Person, Situation, and Environment of other theorists (Bandura, 1986; Frankenhaeuser, 1991; Lewin, 1951; Magnusson, 1981; Sadava, 1987), each of which acts through the levels of causation:

1. Intra-PERSONAL Influences are intrapersonal characteristics that contribute to one's self-efficacy regarding specific behaviors;
2. Interpersonal SOCIAL Influences are the social situation/context or micro-environment that contribute to social normative beliefs about specific behaviors; and
3. Cultural-ENVIRONMENTAL Influences are multiple sociocultural macro-environmental factors that contribute to attitudes toward specific behaviors.

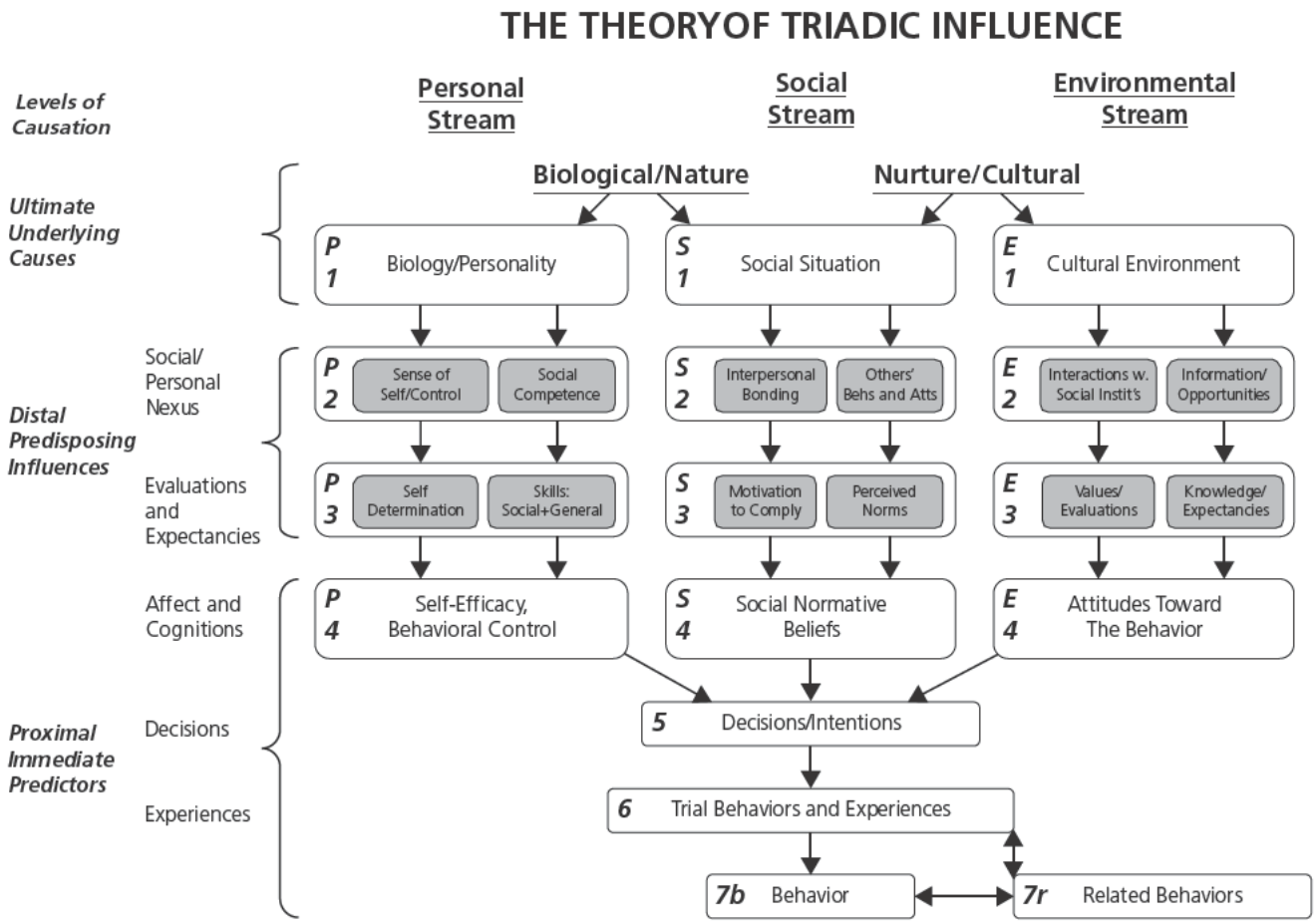
TABLE 16.1 A Matrix of Selected Theories of Social and Health Behavior: Streams of Influence and Levels of Causation.

	Streams of Influence		
Levels of Causation	Intrapersonal (Biological and **P**ersonality) →Self-efficacy	Interpersonal or **S**ocial Situation/Context →Normative Beliefs	Sociocultural **E**nvironment →Attitudinal
Ultimate causes	Biological Psychoanalytic Personality Resilience Self-control	Social control (Elliott) Family systems (Brook) Parenting styles Peer clustering (Oetting)	Class conflict Low SES Anomie Social Disorganization Strain (Merton) Radical theories
Distal influences	Personal competence Self-esteem Self-derogation (Kaplan) Personal control	Social attachment/ bonding Social development (Hawkins) Differential association Social learning	General knowledge Cultural identity Values theories Motivation theories
Proximal predictors	Social skills Self-regulation Self-efficacy	Conformity Social normative beliefs	Expectancy Subjective utility Attitude
	Theories of decision making and problem solving, Theory of Reasoned Action (Fishbein and Ajzen), Theory of Planned Behavior (Ajzen)		
Integrative	Social Cognitive Theory (Bandura), Problem Behavior Theory (Jessor), Feedback systems theories		

See text and reference list for references

The TTI then proposes that the effects of ultimate and distal causes of behavior flow predominantly within each stream (that is, *personal, social*, and *environmental* factors) and act through a small set of proximal predictors of behavior (self-efficacy, social normative beliefs, attitudes, and intentions), with multiple mediating factors between (Figure 16.1).

FIGURE 16.1 *Basic View of the Theory of Triadic Influence Showing Many Mediated Pathways*



Note: In this chapter, we consider the three streams and six substreams in the reverse order, or mirror image, compared to our previous presentations. This is in response to suggestions from others that it is a little easier for many people to think from persons outward to the environment and illustratively from left to right.

The TTI is one of the most comprehensive and integrative theories of HB to date and is actually relevant for all types of behavior (for example, saving money for retirement). As can be seen in Figure 16.1, the TTI begins with the simple but important assumption that the trial of a behavior is most immediately determined by one's decisions (Gerrard, Gibbons, Houlihan, Stock, and Pomery, 2008; Reyna and Rivers, 2008; Steinberg, 2008) or intentions (Fishbein and Ajzen, 1975). For example, a person's decisions precede the use of cigarettes, seat belts, or condoms. Consequently, the challenge for health promoters is to influence health decisions. Decisions are sometimes habitual (Wood, Quinn, and Kashy, 2002) and sometimes made in the heat of the moment (compare with hot cognition or emotionally influenced decision-making—Dahl, 2001, 2004); indeed, emotion is integral to both intuition and decision making (Gerrard et al., 2008; Mills, Reyna, and Estrada, 2008; Reyna and Farley, 2006a; Reyna and Rivers, 2008; Rivers, Reyna, and Mills, 2008; Steinberg, 2008; Sunstein, 2008). The TTI then asserts that three relatively independent paths—each ranging from ultimate, through distal, to proximal tiers of influences or causation—converge on health-related decisions/intentions that, in turn, lead to trial behaviors and then, depending on the experience, repeated or alternative behaviors.

The three major streams of influence each include *two sub-streams*. One sub-stream is more *cognitive and rational* in nature, based for example on an objective weighing of the perceived pros (for example, losing ten pounds) and cons (for example, giving up favorite foods) concerning a given behavior (for example, starting a diet). The other sub-stream that influences behavior is more *affective* or emotional and less rational (for example, wanting to look good for a high-school reunion, or no longer caring how one looks). Thus, decisions are not always entirely rational; they may include an affective or emotional component (compare with *hot cognition*) as well as a cognitive or rational component.

The theory also recognizes that influences in one path are often mediated by or moderate (or interact with) influences in another path. The TTI also recognizes that engaging in a behavior may have effects that feed back and alter the original causes of the behavior. Finally, the theory leads to implications for both understanding the causes of behavior and the development of effective forms of HP.

In summary, the TTI consists of multiple tiers/levels of causation, three major streams each with two sub-streams of influence, dozens of predictions about direct and indirect (mediated) pathways and interactions (moderation) between variables, and feedback loops. In the next section, we provide an in-depth overview of the TTI.

AN IN-DEPTH OVERVIEW OF THE THEORY OF TRIADIC INFLUENCE

Levels of Causation, Influence, and Prediction

As noted above, the TTI arranges the myriad causes of behavior into a set of tiers or levels that represent their causal distance from behavior. We use the term "cause" in

the probabilistic sense (Eells, 1991; Suppes, 1970), not in the deterministic sense of Galileo or Hume. Epidemiologists and some behavioral scientists use the terms "risk factors," "protective factors," or "risk regulators" (Glass and McAtee, 2006; Hawkins, Catalano, and Miller, 1992; Jessor et al., 2003; Jessor, Van Den Bos, Vabderryn, Costa, and Turbin, 1995; Rutter and Garmezy, 1983; Werner and Smith, 1992) instead of "causes" because they are not deterministic. However, we think it is appropriate to think in terms of *probabilistic causation*, whereby a cause increases the probability of a consequence. See Glass and McAtee (2006) for an extensive discussion of this issue. In addition, as we will describe below, these probabilistic causes occur at different levels of causation with regard to (1) the strength of the causal link, and (2) the distance between the cause and the behavior in terms of the number of mediating links that may exist between a particular cause and behavior. Thus, the causes of behavior within each stream are arranged from those causally most distant (ultimate or underlying causes), to those that are causally distal (predisposing influences), to those that are causally closest (proximal or immediate predictors).

Ultimate or underlying causes are the furthest removed from behavior (for example, biological susceptibility, rigid parenting style, poverty rates). They are largely beyond the easy control of any individual and are relatively stable (for example, cultural characteristics of a country or basic personality traits that do not change much). Their effects, however, are the most pervasive (having effects on multiple behaviors), the most mediated, and often the most difficult for any one person or program to change, but, if changed, are likely to have the greatest and longest-lasting influence on a broad array of behaviors. The well-known debate over the relative effects of nature and nurture on behavior usually focuses on ultimate causes (Institute of Medicine, 2006); thus, we place nature and nurture above the three streams of the TTI (Figure 16.1).

Distal influences are one step closer to behavior. The first level of distal causes is at the *social-personal nexus* (for example, rebelliousness, bonding to parents or deviant role models, religious participation), variables that reflect the quality and quantity of contact between individuals and their sociocultural environments, social situations or personality.

Second-order distal influences, another step closer to behavior, are a set of affective/cognitive influences, called *evaluations and expectancies*. They are general values and behavior-specific evaluations as well as general knowledge and specific beliefs that arise out of the contact between individuals and their surroundings. Compared to ultimate-level causes, distal-level influences are less removed from behavior, have effects on behavior that are less mediated, and usually more changeable. At the same time, however, when compared to ultimate-level influences, some distal-level influences are somewhat narrower and more behavior-specific. For instance, as an ultimate-level variable, the quality of healthcare options in a community might have diffuse and indirect effects on cancer screening; by contrast, as a distal-level variable, an individual's health locus of control (which might be influenced

by community health care options) probably has more targeted and less mediated effects on her attitudes towards cancer screening.

Proximal predictors of behavior are even closer to behavior and closer to the bottom of Figure 16.1. Self-efficacy, social normative beliefs, and attitudes are (1) less general than evaluations and expectancies on the previous tier, (2) are always specific to a targeted behavior, and (3) have direct effects on decisions/intentions to engage in that behavior.

The more proximal the predictor to a behavior, the more likely it is to be specific to that behavior. For example, attitudes toward cancer screening will be more predictive of cancer screening, but less predictive of hypertension screening or attempts at smoking cessation. Proximal predictors of behavior are also less stable, more likely to change (people's attitudes change, after all, more quickly than their personalities); they might be the easier targets of health programs in the short run, but might have the smallest or shortest-lasting influence and the least generalization to other behaviors.

Within any one level, the variables are usually correlated to some degree (not shown in Figure 16.1). For example, at the ultimate level, a child's personal development is correlated with family structure, which, in turn, is correlated with socioeconomic status (Krieger, 2007). Indeed, modern concepts from developmental psychology were derived from the fusion of biological and contextual levels of organization (Lerner, 1978; Overton, 1973). Similarly, at the proximal level, self-efficacy, social normative beliefs and attitudes regarding a specific behavior are usually correlated (Ajzen, 1988).

We distinguish between the three levels of influence not only by the ultimate, distal and proximal labels, but also by labels of differing degrees of causation—namely underlying causes (that are ultimate), predisposing influences (that are distal) and immediate predictors (that are proximal). Proximal or immediate predictors are usually the strongest predictors of particular behaviors because they are (1) causally closest (most proximal) to the behavior; (2) behavior specific; and (3) because they are behavior-specific, they usually correlate with the behavior being predicted more highly than the more distal influences or ultimate causes. Although ultimate causes often have lower correlations with any particular behavior, they have a causal relationship to many behaviors. In contrast, proximal predictors usually have higher correlations with a particular behavior and not with others. That is, proximal predictors are very specific to a behavior, while ultimate causes have more widespread effects. For example, attitudes toward smoking cigarettes will be highly predictive of cigarette smoking, but probably not of delinquency, whereas social disadvantage might be very predictive of both smoking and delinquency (see Figure 7 in Flay and Petraitis [1994] for one way of depicting this).

Streams of Influence

Figure 16.1 shows that causal effects flow primarily within three streams of influence, converging on behavioral intentions and behaviors. The TTI's intra-PERSONAL stream begins at the ultimate level with relatively stable biological predispositions (for example, testosterone levels) and personality characteristics (for example, the

Big Five: openness to experience, consciousness, extraversion, agreeableness, and neuroticism). The TTI predicts that these ultimate-level intrapersonal influences (labeled as P1 variables in Figure 16.1) have direct effects on social/personal nexus variables in the intrapersonal stream (labeled as P2 variables), including views of one's self (for example, self-esteem), and one's general competencies (for example, locus of control). These P2 variables then have, according to the TTI, direct effects on P3 variables. The P3 variables are more targeted to a specific behavior (for example, attempting to quit smoking), and include one's will or determination to engage in the behavior and one's perceived skills to succeed in the behavior. Rick Snyder (2002; Snyder, Feldman, Taylor, Schroeder, and Adams, 2000) calls this "hope"—the perceived capability (skill) to derive pathways to desired goals, and motivate oneself (will) via agency thinking to use those pathways. Finally, the TTI predicts that P3 variables converge on one's sense of self-efficacy regarding a particular behavior.

A similar flow exists within the TTI's SOCIAL stream. The social stream begins with S1 variables (ultimate-level characteristics of one's immediate social surroundings) that are largely outside the control of individuals (for example, parenting practices during their childhoods, or negative evaluations from family members). It continues through S2 variables (social/personal nexus variables in one's immediate social surroundings), including the strength of the interpersonal bonds with immediate role models, and the relevant behaviors of those role models (for example, whether older family members practice cancer screening). The flow then continues through S3 variables, including one's motivation to comply with various role models (for example, whether to comply more with family members or peers), and perceptions of what behaviors those role models are encouraging. Finally, social influences converge on one's social normative beliefs regarding the specific behavior, that is, the perceptions of social pressures to engage in that particular behavior.

The TTI's third stream, the cultural-ENVIRONMENT stream, follows the same pattern as the previous two streams. It begins with E1 variables—characteristics of one's broader culture that are largely beyond one's personal control, including political, economic, religious, legal, mass media, and policies environments (Minkler, Wallace, and McDonald, 1995). The third stream flows into E2 variables, including the nature of the interactions people have with social institutions (for example, the nature of their relationship with political, legal, religious, and governing systems) and the information they glean from their culture (for example, what they learn from exposure to mass media). The stream then flows through E3 variables, the consequences one expects from a behavior (for example, whether cancer screening is accurate, how much it will cost, and so on) and how one evaluates, favorably or unfavorably, the various consequences of a behavior. Finally, social influences converge on one's attitudes toward the specific behavior.

Affective and Cognitive Sub-Streams of Influence

Figure 16.1 shows obvious parallels in how each of the three major streams flow from ultimate-level influences, through distal-level influences and into proximal

influences that then converge on intentions. In addition, there are two sub-streams within each of the three major streams. Separately, these sub-streams represent affective and cognitive flows within the major streams. For example, the cultural-ENVIRONMENTAL stream consists of (1) the control/affective domain of the *values environment* (culture, religion, and so on) that informs values and evaluations of consequences, and (2) the cognitive domain of the *informational environment* (media, laws, politics, and so on) that informs knowledge and expectations of the consequences (or expectancies) of a behavior. Classic sociological theorists label the affective sub-stream as *control* (rather than affective), emphasizing how values-forming institutions (religions, laws, and so on), social bonding, and sense of self (and self-control) act as control mechanisms on, or reinforcers of, behavior. Both basic learning theories (Mowrer, 1960) and social learning theories (Akers, 1977; Bandura, 1977) also emphasize how behaviors are reinforced, shaped or controlled (Biglan, 1995; Glenn, 1988).

The affective and cognitive sub-streams both include ultimate causes that are common in multiple political-economy theories of subjective expected utilities (Bauman, 1980; Bauman and Fisher, 1985; Edwards, 1954, 1961) and the related distal and proximal influences common in expectancy-value theories (Atkinson, 1957; Eccles et al., 1983; Feather, 1982). The existence of so many related theories (subjective utility and expectancy-value) underlies the obvious importance of information/knowledge/expectancies and values/evaluations to our behaviors. However, the failure of so many educational campaigns designed to increase awareness of the dangers of health-compromising behaviors also points to the limitations of relying on just these theories or just the proximal levels of this one stream of the TTI for designing effective interventions.

For some readers, the proximal levels of all streams (self-efficacy, social normative beliefs and attitudes) may seem like they are intrapersonal factors. However, we distinguish these affective/cognitive factors that originate from social/interpersonal (social situation → social normative beliefs) or sociocultural (sociocultural environment → attitudes) factors from those that originate in the person (intrapersonal → self-efficacy). Within the TTI, each and every stream ends in affective/cognitive factors (self-efficacy, social normative beliefs and attitudes) that, in turn, influence the most proximal affective/cognitive predictor of behavior, intentions.

Both of the other streams of the TTI also include affective and cognitive sub-streams. For example, the SOCIAL stream includes social attachment or bonding and the desire to please others (or motivation to comply with others) as the affective sub-stream, and observations of others' behaviors (role models) and perceived norms as the cognitive sub-stream. Similarly, the PERSONAL stream includes the sense of self/control (Diamond, Barnett, Thomas, and Munro, 2007; Diamond and Kirkham, 2005) or self regulation (Csikszentmihalyi and Nakamura, 1999) and will or self-determination (Ryan and Deci, 2000) to behave in a certain way as the affective sub-stream, and general and social competence and skills as the cognitive sub-stream. Both the affective and cognitive sub-streams of all three streams of influence affect HBs.

Flows and Interactions between Streams of Influence

So far, much of our in-depth description of the TTI has focused on within-stream paths. Another very important assumption of the TTI concerns the causal connections between the three streams of influence. Although we believe that the three streams represent the major influences on behavior, we also recognize that factors in one stream can influence factors in another stream, and that Figure 16.1 oversimplifies matters in this respect. The TTI recognizes that many intra-PERSONAL factors contribute to more than just self-efficacy, many SOCIAL situational factors have influences that go beyond social normative beliefs, and many cultural-ENVIRONMENTAL factors affect more than just attitudes. These interactions between streams of influence are shown as paths *a–w* in Figure 16.2, a more complete representation of the TTI. The cross-stream interactions "explain" or account for the correlations between variables at the same level of causation mentioned above.

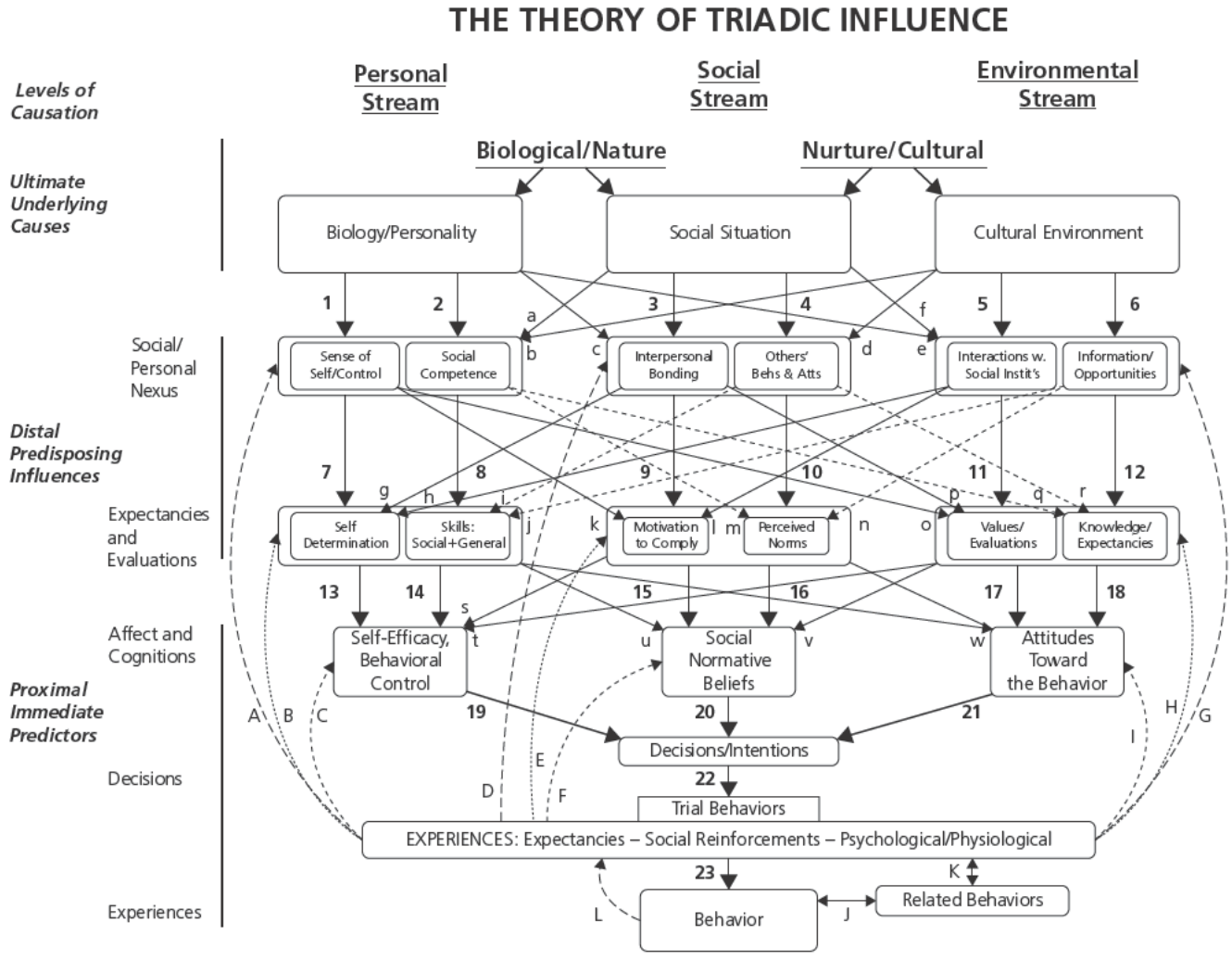
The interactions between streams at the upper levels (paths *a–f*) demonstrate the overpowering importance of characteristics of each of (1) a person's biological and personality dispositions, (2) the social situation/context in which the behaviors occur, and (3) the broader sociocultural environment in which an adolescent is raised and matures, in determining social and HRBs. The HP programs or policies that can address these ultimate causes will obviously have the greatest impact over the long term. Unfortunately, this is often easier said than done.

Many of the most important interactions for intervention purposes occur between the second and third levels of causation, between the social-personal nexus and expectancy-value levels (shown as paths *g–r* in Figure 16.2). For example, the TTI recognizes that adolescents who are impulsive, hyperactive or incapable of controlling their behaviors (all hypothesized sources of low self-efficacy) might place little value on their health (an attitudinal factor—see path *o* in Figure 16.2, from sense of self/control to values/evaluations) and might be motivated to please deviant peers who encourage risky behaviors (a social normative factor—see path *k* in Figure 16.2, sense of self/control to motivation to comply).

The TTI explicitly does not posit paths between an affective variable at one level and a cognitive variable at another level or vice versa. Accordingly, among paths *g–r*, those that are solid are between affective/control variables and those that are dotted are between cognitive variables.

For the analytically sophisticated, note that interactions between streams can be represented statistically as mediation or moderation (or, indeed, as mediated moderation), depending on the level at which it occurs (Baron and Kenny, 1986; MacKinnon and Lockwood, 2003; MacKinnon, Taborga, and Morgan-Lopez, 2002). Figure 16.2 also provides an answer to Nancy Krieger's (1994) question about the "web of causation," namely, "has anyone seen the spider?" Figure 16.2 shows that the causes of HB are, just like spider webs, remarkably complex and interwoven, yet ordered, systematic, and coherent, but that there is not a single causal agent or pathway.

FIGURE 16.2 *Formal View of the Theory of Triadic Influence Showing Cross-Stream and Feedback Influences*



THE ROLE OF BEHAVIORAL EXPERIENCE AND FEEDBACK

Once someone tries a behavior, her experience with it influences her future behavior. For example, an adolescent is more likely to repeat a behavior (like smoking) if she feels more accepted by her peers for trying it. The social reinforcement one receives will depend on the strength of social bonding one has with the person giving it. In turn, this reinforcement strengthens the bond with the person giving the reinforcement, and this increases the likelihood of pleasing that person again in the future by repeating the behavior. This is a feedback loop within the SOCIAL stream (path *D* in Figure 16.2). This feedback effect might occur all the way up to the ultimate level, as just described, or it might occur just to the expectancies/evaluation level (path *E*) or the affect/cognitions level (path *F*), depending on the specific context of the experience. For example, if an adolescent perceives that substantially more or substantially fewer of her peers smoke than she earlier believed, then the immediate feedback might be to the proximal (interpersonal bonding—path *F*) or distal (motivation to comply or desire to please—path *E*) levels.

There are also feedback loops in the cultural-ENVIRONMENTAL and intra-PERSONAL streams. The experience of many behaviors is accompanied by emotional or psychological consequences. The emotional or psychological feelings adolescents have from a behavior depend, to some extent, on their current sense of self (DuBois and Flay, 2004; DuBois, Flay, and Fagen, this volume). In turn, these feelings may feed back to alter how they feel about themselves (that is, their self-esteem). In addition, how one performs a new behavior is determined by one's skill; in turn, a good experience with the behavior will improve one's skill. These are the feedback loops in the intra-PERSONAL stream (paths *A, B* and *C*). The many theories of self-control, self-regulation, and self-monitoring rely on feedback loops to influence behavior change (Bandura, 2000, 2005; DiClemente, Marinilli, Singh, and Bellino, 2001; Gross, 2002; Karoly, 1993; Zimmerman, 2001).

How people experience a behavior depends, to some extent, on their expectations regarding it. In turn, performance of a behavior gives people immediate feedback of some of the consequences, both good and bad. Whether these experiences are the same as or different from those expected, the experience adds to firsthand knowledge about that behavior. This modified or reinforced knowledge then influences their future behavior. These are the feedback loops within the cultural-ENVIRONMENTAL stream (paths *G, H* and *I*).

Habitual Behaviors

Habitual behaviors are those for which the experiences of the behavior take on ever-increasing importance over time. Once they have been experienced a few times, habitual behaviors may be driven by social reinforcement (for example, sunbathing because all of one's friends are doing it and because having a tan increases acceptance by one's peers), psychological dependencies (the way it makes one feel), or physiological addictions (biochemical reactions within the body that are beyond one's control).

As a behavior becomes habitual, the relative strength of other factors weakens over time, and future behavior may be best predicted by past behavior (see path *L* in Figure 16.2) or affective-motivational processes. Most everyday behavior consists of routine activities (Hanson and Hanson, 1993) or is habitual, and does not involve active or conscious decision making or intentions—it essentially follows a very tight and well-worn feedback loop (defined by paths *L* and *23* in Figure 16.2) (Aarts and Dijksterhuis, 2000; Neal, Wood, and Quinn, 2006; Ouellette and Wood, 1998; Wood et al., 2002). It is important to remember, however, that habitual behaviors are intentional in the sense that they are goal-oriented (Aarts, 2007; Verplanken and Aarts, 1999).

Habitual behaviors (and dependencies and addictions) are the most difficult for health professionals to change, because one has to first "slow down the action," so as to make other determinants of behavior salient once again. One has to first motivate the person to want to change, then provide adequate positive social and personal skills (and reinforcement for using those skills) and engage the person in the changed behavior to overcome the strength of the habit.

The Role of Related Behaviors

Related behaviors influence or relate to each other in at least two ways. First, they have many of the same ultimate and distal causes. For example, youth who have high levels of sensation seeking or risk taking, or youth who are raised in disadvantaged communities or by unconventional parents, are more likely to engage in multiple problem behaviors (Biglan, Brennan, Foster, and Holder, 2004). Second, engaging in one problem behavior alters, through the feedback mechanisms described above (and through paths J, K and 23 in Figure 16.2), the causes of that behavior and closely related behaviors. For example, engaging in smoking cigarettes may change one's attitudes toward trying other substances (Kandel, Wu, and Davies, 1994).

The Role of Human Development

Adolescence provides its own unique developmental challenges. Besides integrating prominent theories of HB, another feature of the TTI is that its three streams of influence should remind health promoters and researchers that there are also three developmental features of adolescence that threaten adolescent health. It is clear that the *plasticity* of biological and social development plays an important role in determining behavior (Lerner, 2006; Lerner et al., in press; Merzenich, 2001). The multiple causes of behavior compose a *dynamic system* that changes as people develop and have new experiences with particular behaviors (Lerner, 1978, 2006).

The relative importance of self-efficacy, social normative beliefs, and attitudinal variables changes as children develop. Attitudinal influences are most important for younger children, social and normative processes become more important during adolescence, and self-efficacy becomes more important as youth gain more experience. First, adolescents begin to exert their independence from their parents, often by bonding more closely with their peers. Usually beginning at puberty, positive interactions between adolescents and parents diminish (Steinberg, 1991) and adolescents begin seeking independence from

their parents (Montemayor and Flannery, 1991). Their independence from parents is replaced by greater dependence on peers, and relations with peers "become more pervasive, more intense, and carry greater psychological importance" (Foster-Clark and Blyth, 1991, p. 786). Not too surprisingly, adolescents are more susceptible to and compliant with social pressures than are children or adults (Berndt, 1979; Landsbaum and Willis, 1971). This is especially true of pressures to engage in deviant acts like substance use (Brown, Clasen, and Eicher, 1986; Flay et al., 1994).

Second, during early adolescence, the delicate search for self-identity begins and adolescents start "trying out" different adult behaviors and roles. The search is not easy, and during it adolescents are psychologically vulnerable (Konopka, 1991), self-conscious, concerned about social appearances (Elkind and Bowen, 1979), and highly self-critical (Lowenthal, Thurner, and Chiriboga, 1975; Rosenberg, 1985), possibly because, for the first time, they can envision discrepancies between who they are and who they want to be or ought to be (Damon, 1991; Higgins, 1987). However, the finding about adolescents being highly self-critical might be a cohort effect. Compared to earlier generations, people born after the early 1970s (dubbed "Me Generation") seem less inclined toward self-criticism and higher in self-esteem; however, they often face a crisis in early adulthood when their high, but rarely tested/confirmed, self-esteem hits reality. As a result, self-esteem is at an all-time high, but so is anxiety (Twenge, 2006). Risky behaviors, such as substance use, might serve as a coping mechanism as adolescents search for an identity and feel vulnerable and self-conscious during this stage of intrapersonal flux (DuBois et al., this volume; Flammer, 1991).

Third, prior to adulthood, cognitive and affective skills are not fully developed and, to varying degrees, children and adolescents have difficulty understanding abstract information, appreciating events which might occur in the distant future (Orr and Ingersoll, 1991), or reacting calmly to emotional situations (Dahl, 2001, 2004; Reyna and Farley, 2006b; Steinberg et al., 2004). These, paired with generally good health (Brindis and Lee, 1991), might contribute to an adolescent's cavalier attitudes about health (Levenson, Marrow, and Pfefferbaum, 1984) and tendency to underestimate personal risks from health-compromising behaviors (Millstein, 1991), such as substance use.

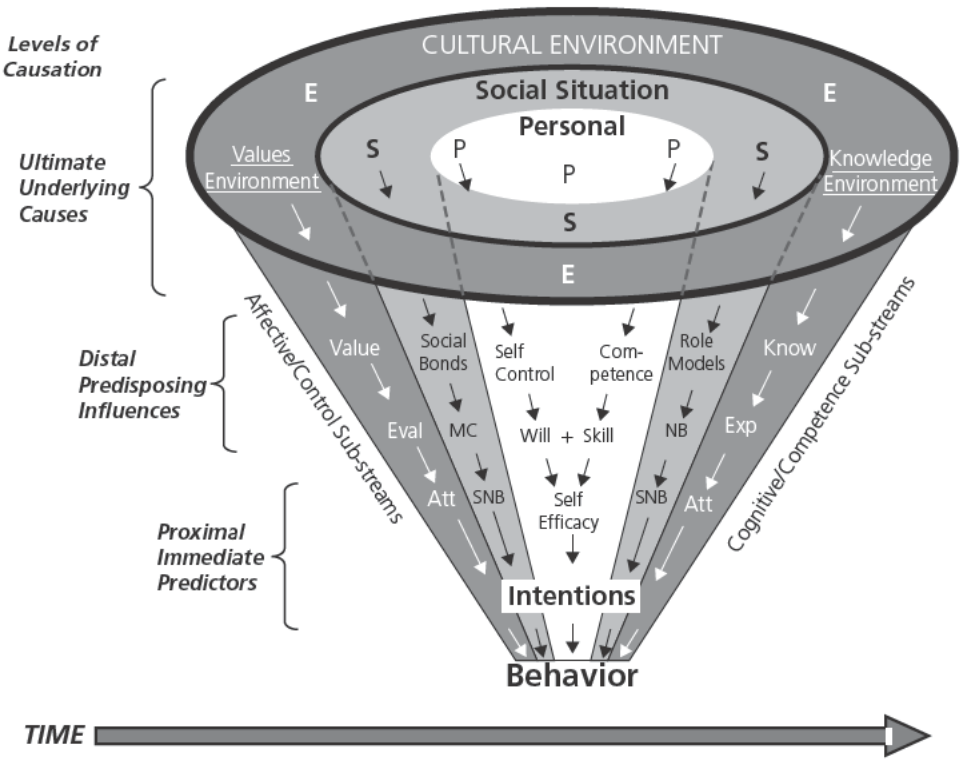
The absence of fully developed cognitive skills, the immature state of affective control, the desire to be "grown up," and deepening attachment to peers makes adolescence a period when adolescents are particularly susceptible to health risks. They may, for example, begin smoking cigarettes because they (1) feel anxious or insecure and want to look "mature"; (2) feel pressure to smoke from peers who smoke and want to feel like they "belong"; or (3) cannot fully appreciate the long-term dangers of smoking. Each of these developmental features of adolescence—personality, social and cognitive development—poses special challenges for health promoters.

An Ecological View of the Theory of Triadic Influence

The three streams of influence in the TTI and the notion of inter-related influences are similar to the rings of influence in Bronfrenbrenner's (1979, 1986, 2005) ecology

systems theory or social ecology model. However, most conceptions of the social ecology model, including those used in HP (Glass and McAtee, 2006; Hovell, Wahlgren, and Gehrman, 2002; King, Stokols, Talen, Brassington, and Killingsworth, 2002; McLeroy, Bibeau, and Glanz, 1988; Stokols, 1992), do not consider the levels/tiers of causation within its rings. In the TTI, intrapersonal factors can be seen to be nested within social factors that, in turn, are nested within broader sociocultural environmental factors, just as in the basic ecological models. However, within the TTI, all three rings/streams also have causal influences at multiple levels; ultimate/underlying, distal/predisposing, and proximal/immediate. See Figure 16.3 for a depiction of the TTI that emphasizes both the ecological rings and the levels of causation.

FIGURE 16.3 *The TTI Ecological System, showing how the intrapersonal factors lie inside the situation (contextual or interpersonal) factors that, in turn, lie inside the broad sociocultural environmental factors. Unlike most ecological systems, however, the TTI includes levels/tiers of causation within each circle.*



Note: For abbreviations in Figure 16.3: Value = Values, Eval = Evaluation, Att = Attitude towards the behavior, MC = Motivation to comply, SNB = Social Normative Beliefs, Know = Knowledge, Exp = Expectancies.

By incorporating both (1) levels of ecology and (2) levels of causation as independent dimensions, the TTI overcomes many of the problems of terminology and understanding about levels of causation outlined recently by Nancy Krieger (2008). We make it clear that levels of causation exist within every ecological domain; this is in contrast to some usages, that suggest that person-centered causes are proximal, social causes are distal and societal causes are ultimate or fundamental (Kuh and Yoav, 2004; McKinlay and Marceau, 2000). Note also that "level" is not a spatial or temporal dimension; rather, it is a "relational construct that organizes and distinguishes (conceptually or structurally) different orders of hierarchically linked systems and processes (including both nested and non-nested hierarchies)" (Krieger, 2008, page 226). Causal "distance" does not involve spatiotemporal separation; actually all levels co-occur simultaneously. However, space and time do matter for levels in the case of nested hierarchies, whereby processes at lower levels typically are smaller and involve faster processes than processes at higher levels. Whereas some usage of the proximal-distal terms "inherently cleaves levels rather than connects them, thereby obscuring the intermingling of ecosystems, economics, politics, history, and specific exposures and processes at *every* level, macro to micro, from societal to inside the body" (Krieger, 2008, page 227), the structure of the TTI separates levels of causation from ecological domains. As Krieger suggests, we need levels of causation as well as pathways that link them within and across ecological levels. This is achieved by the TTI.

Linking Ecologies, Development and Feedback —A Life-Course Perspective

Development, of course, does not end at adolescence; nor do the influences on and theories about health. An important third dimension of the TTI is time (shown with the large arrow from left to right in Figure 16.3) or development (Giddens, 1987; Glass and McAtee, 2006). Rather than solely focusing on the building blocks of social ecologies, Bronfrenbrenner's ecological model describes "the way in which these entities are related to each other and to the course of development" (1979, page 8). However, the developmental emphasis in Bronfenbrenner's model (and most other ecological models used) is missing from its application in HP (Li, 2008). A temporal (life-span and life-course) perspective can inform the timing of interventions regarding the needs, risks, and opportunities to change at a particular time in the life course, and the development of strategies at the individual, social, and sociocultural environmental levels that match the timing of interventions (Settersten, 2005). The meanings associated with life transitions are often socially constructed. Furthermore, life transitions typically encompass changes in social roles and responsibilities that may have transformational experiences that lead to major changes in an individual's life (Resnicow and Vaughan, 2006).

Extended from the ecological models that link an individual's life to the physical and social context, the life-course perspective connects the past to the present and

examines the social pathways in their historical context (George, 2004). Cumulative positive experiences with a behavior, with their feedback experiences, can lead into developmental trajectories and, eventually, to habituation. On the other hand, cumulative negative experiences with a behavior, new experiences or ecological transitions (Bronfrenbrenner, 1979), can lead to dropping a behavior, transitions in behavior (for example, post-marriage weight gain), teachable moments (McBride et al., 2008) or turning points (Baxter and Bullis, 1986; Graber and Brooks-Gunn, 1996; Kearney and O'Sullivan, 2003; Laub and Sampson, 1993; Wheaton and Gotlib, 1997).

EMPIRICAL SUPPORT FOR THE THEORY OF TRIADIC INFLUENCE

There are many components of the TTI for which we could review the empirical support. For this chapter, we chose to examine one of the most important of these, the mediated pathways included in the TTI. Mediated pathways are where the effects of an ultimate or underlying cause (for example, repeated exposure to a religious affiliation) or a distal or predisposing influence (for example, acceptance of Christian values) are mediated through some intervening variable (for example, attitudes toward substance use) on their way to influencing behavior (for example, substance use). The following is a review of the extant literature that (1) explicitly used the TTI and (2) empirically tested for mediation. Multivariate statistical analyses provide considerable support for the streams of influence and mediated pathways included in the TTI.

We reviewed findings from ten studies of various behavioral domains (that is, substance use, risk behavior, dietary behavior and physical activity, breast self-examination, and breast cancer screening) and, for the ease of discussion, we categorized each study in a particular stream based on the study's most distal variable (X). We classified studies that included variables that could be categorized in multiple streams (for example, ethnic group) or combined variables from several streams (for example, perceived behavioral control, social normative beliefs, and attitudes) as a single composite variable in the stream with the most outer ecological ring in the TTI Ecological System (see Figure 16.3). We created a separate category for studies that included feedback or past behavior as the most distal variable separately.

We coded mediation pathway findings from the ten studies using the construct labels (for example, P1) presented in the basic version of the TTI (Figure 16.1) and summarize them in Table 16.2. We classified mediation as complete, partial or non-significant as follows:

1. Complete mediation when the pathway from the more distal predictor (X) to the behavioral outcome (Z) was significantly mediated by a variable (Y), with no significant direct effect from the predictor (X) to the behavioral outcome (Z) remaining;
2. Partial mediation when the pathway from the most distal predictor (X) to the behavioral outcome (Z) was significantly mediated by an endogenous variable

TABLE 16.2 The TTI Mediation Literature.

					X		Y				Z	
	Study	**Behavioral Domain**	**Population**	**Design**	Variable Label[A]	Variable Name	Mediator 1: Label	Mediator 1: Name	Mediator 2: Label	Mediator 2: Name	Dependent Variable	**Mediation[B]**
Personal	Kear, 2002	Substance Use: Tobacco	224 U.S. college students	Cross-sectional	p3/s3/e3	Risk-taking tendency	s4	Social normative beliefs	p4	Resistance self-efficacy	Smoking	c
					p2	Depression	p4	Resistance self-efficacy			Smoking	c
					p2	Depression	s4	Social normative beliefs	p4	Resistance self-efficacy	Smoking	c
Social	Schofield et al., 2003	Substance Use: Tobacco	Over 1300 Australian Adolescents	Longitudinal	6	Experiences with smoking	e4	Attitudes	5	Intention	Smoking	p
					6	Experiences	5	Intention			Smoking	p
					6	Experiences	s4	Subjective norm	5	Intention	Smoking	p
					6	Experiences	p4	Self-efficacy	5	Intention	Smoking	p
					s4	Experiences	e4	Attitudes	5	Intention	Smoking	p
					s4	Peer-group norm	e4	Subjective norm	5	Intention	Smoking	p
					s4	Peer-group norm	5	Intention			Smoking	p
					s4	Peer-group norm	p4	Self-efficacy	5	Intention	Smoking	p

(Continued)

TABLE 16.2 (*Continued*)

	Study	Behavioral Domain	Population	Design	X		Y		Z	Mediation[B]
	Sieving et al., 2000	Substance Use: Alcohol Use	413 U.S. adolescent-parent dyads	Longitudinal	s1	Parent norms: Time 1	p4/e4/5	Alcohol-related cognitions: Time 1	p4/e4/5	Alcohol-related cognitions: Time 2	Alcohol use: Time 3	c
Environmental	Carvajal et al., 2004	Substance Use: Tobacco	2,004 U.S. middle school students	Cross-sectional	p1/s1/e1	Age	p3	Grade point average	p4/s4/e4/5	Self-efficacy, norms, attitudes, impediments, intention	Smoking	p
					p1/s1/e1	Age	p2/s2	Depression, parental relatedness, maladaptive coping, academic aspirations			Smoking susceptibility among nonsmoker	p
	Carvajal and Granillo, 2006	Substance Use: Tobacco	1137 U.S. Adolescents	Prospective cohort study	p1/s1/e1	Age, gender, ethnicity, SES	p3/s2/s3/e3	Depression, school connectedness, parent relatedness, global expectancies, coping, academic aspirations, GPA	p4/s4/e4/5	Intentions, perceived risk, attitudes, impediments, norms, self-efficacy	Smoking: Time 2	p

De Bruijn et al., 2005	Physical Activity and Diet	3,895 Dutch adolescents	Cross-sectional	p1/s1/e1 p2/p3/s2	Home situation, urbanization, school type, gender, self-esteem, relation with parents	p4/s4/e4	Perceived behavioral control, subjective norm (marginally significant), attitude	5		Intention	Snacking	p
				p1/s1/e1	Ethnicity, school type degree of urbanization	p4/s4/e4	Perceived behavioral control, subjective norm (marginally significant), attitude	5		Intention	Bicycle use	p

(Continued)

TABLE 16.2 (*Continued*)

	Study	Behavioral Domain	Population	Design		X		Y			Z	Mediation[B]
Feedback & Past Behavior	Carvajal et al., 2002	Substance Use	525 Adolescents	Prospective cohort study	f	Substance use: Time 1	e3	Global positive expectancies	p4 →5 (i.e., 5 is mediator 3)	Self-efficacy→ Intentions to avoid substance use	Substance use: Time 2	c
					f	Substance use: Time 1	p4	Self-efficacy	5	Intentions to avoid substance use	Substance use: Time 2	c
					f	Substance use: Time 1	e3	Global positive expectancies	e4 →5 (i.e., 5 is mediator 3)	Attitudes→ Intentions to avoid substance use	Substance use: Time 2	c
					f	Substance use: Time 1	e4	Attitudes	5	Intentions to avoid substance use	Substance use: Time 2	c
					f	Substance use: Time 1	5	Intentions to avoid Substance use			Substance use: Time 2	c

				f	Substance use: Time 1	p2	Self-esteem	p4 s4 e4	Self-efficacy Social norms Attitudes		ns
				f	Substance use: Time 1	e3	Global positive expectancies	s4 → 5	Social norms → Intentions to avoid substance use (i.e., 5 is mediator 3)		ns
Lechner et al., 1997	Breast cancer screening	395 Dutch women	Longitudinal	f	Past behavior	e4/p4	Perceived consequences, anticipated regret, modeling	5	Intention	Participation in second screening	c
Lechner et al., 2004	Breast-self examination	364 Dutch women	Longitudinal	f	Past behavior: Time 1	p4/s4/e4	Self-efficacy, social influence, attitude, intention	5	Intention: Time 2	Breast self-examination	p
				f	Past behavior: Time 1	p4/s4/e4	Self-efficacy, social influence, attitude, intention			Intention	p

[A]Variables are coded using the construct labels presented in Figure 1, f: feedback or past behavior.

[B]Mediation: c:complete, p: partial, ns: final pathway non-significant.

(Y), with a significant, but reduced, direct effect remaining from the predictor (X) to the outcome (Z); and
3. Nonsignificant when mediation was tested for and found to be nonsignificant.

See Baron and Kenny (1986) and MacKinnon and colleagues (2002) for more detailed discussions of mediation.

PERSONAL Stream: Intrapersonal Characteristics → Self-Efficacy

Only one study examined a model with the most distal variables from the TTI's PERSONAL stream. Kear (2002) explored psychosocial predictors of smoking among a cross-sectional sample of 224 college students. A Web-based survey assessed depression, risk-taking tendency, self-efficacy to resist smoking, and social normative beliefs. Depression and risk-taking tendency were the most distal variables examined. Results indicated that all four predictors of smoking behavior were significant, with self-efficacy to resist smoking being the strongest predictor. Self-efficacy (a proximal variable in the TTI) had the only direct effect on smoking behavior and completely mediated the effects of depression, risk-taking tendency (both more distal variables in the TTI), and social normative beliefs (a proximal variable in the TTI). Further, the study's model provided an example of cross-stream effects displayed in the TTI—social normative beliefs mediated the effects of depression on smoking behavior.

SOCIAL Stream: Interpersonal Situations/Contexts → Social Normative Beliefs

Two studies tested models with the most distal variables from the TTI's SOCIAL stream. In a longitudinal study of more than one thousand Australian adolescents, Schofield and colleagues (2003) investigated predictors of future smoking. They found that intentions (on a lower tier in the TTI) were predicted from attitudes and self-efficacy, and these, in turn, were predicted by peer-group norms (on the expectancies/evaluation tier of the TTI) and experiences with smoking (consistent with the TTI's feedback loops). Although the authors concluded that the addition of peer-group norms to the TTI model enhanced the model's performance, we note that peer group norms are already included in the TTI as part of subjective norms. Despite the study's limitations, support was provided for the mediated pathways included in the TTI from proximal predictors (for example, self-efficacy, social normative beliefs, and attitudes) through intentions to behavior. Additionally, the study provided an example of how past behavior (that is, personal experiences with smoking) can have a strong feedback effect.

A second study in the SOCIAL stream was conducted by Sieving and colleagues (2000) to examine parental influences on adolescent alcohol use. Participants were 413 adolescent-parent dyads who were participants in Project Northland, a multicomponent intervention designed to reduce adolescent alcohol use. A structural equation modeling approach was used to examine mediated pathways to adolescent alcohol use. Consistent with the TTI, parent norms (on the expectancies/evaluation

tier) had significant indirect relationships with alcohol use at one- and two-year follow-up. The relationships, in turn, were mediated by adolescents' alcohol-related cognitions (proximal predictors). Overall, the study emphasized the importance of adolescents' social situation and underscored the key role of parental influence on initial alcohol use.

ENVIRONMENTAL Stream: Sociocultural Environments → Attitudes

Several studies tested models with distal variables among the TTI's cultural-ENVIRONMENTAL stream. Using a cross-sectional sample of over two thousand middle-school students, Carvajal and colleagues (2004) found that ultimate causes, distal influences, and proximal predictors explained approximately 55 percent of the variance in smoking, with variables from each level significantly predicting current smoking. The researchers concluded that their model supported the TTI's structure of tiers and found adolescents were more likely to be current smokers if they had fewer impediments to smoking, greater positive attitudes toward smoking, lower self-efficacy, and a greater intention to smoke.

More recently, Carvajal and Granillo (2006) tested numerous predictors of smoking initiation among a sample of more than eleven hundred early adolescents (aged eleven to fourteen). The prospective cohort study examined an assortment of ultimate causes, such as ethnicity, as well as distal influences and proximal predictors. Within the ten-month follow-up period, in contrast to the previous cross-sectional analyses, more distal causes were more predictive of smoking than proximal predictors. However, consistent with TTI, relationships between ultimate causes and smoking initiation were mediated by distal influences and/or proximal predictors. The researchers, supporting the TTI's inclusion of multiple tiers of influence, highlight the importance of interventions not only targeting proximal predictors, but also targeting more ultimate causes and distal influences of behavior.

Similar analyses have been conducted by researchers in the Netherlands to investigate predictors of dietary behavior and physical activity (de Bruijn, Kremers, Schaalma, van Mechelen, and Brug, 2005). Using a cross-sectional sample of almost four thousand Dutch adolescents, the researchers examined predictors of bicycle use and snacking behavior. Paths from ultimate causes, such as degree of urbanization and type of school, along with paths from distal influences and proximal predictors were examined. Results indicated that more distal variables had associations with both bicycle use and snacking behavior that were partially mediated. The researchers concluded that there is a need to include more distal factors to fully understand dietary behaviors and physical activity.

Feedback and Past Behavior

Several studies included feedback or past behavior as the most distal variable. Carvajal and colleagues (2002) conducted a prospective cohort study of 525 adolescents in March (Time 1) and October (Time 2), 1995. Using substance use at Time 1 as the

more distal variable, they investigated a model that included self-esteem, self-efficacy, social norms, attitudes, global positive expectancies (general positive expectancies toward oneself and future outcomes), and intentions to avoid substance use. Results demonstrated that Time 1 substance use predicted all other endogenous variables in the model, with the exception of Time 2 substance use. That is, consistent with the TTI's feedback loops, the pathway from Time 1 to Time 2 substance use was completely mediated by variables on the TTI's several tiers. In addition, the relationship between global positive expectancies and substance use at Time 2 was mediated by self-efficacy, subjective normative beliefs, attitudes, and intentions.

Past breast cancer screening behavior (classified as the most distal variable) was examined by Lechner and colleagues (1997) in a study of participation in the Dutch national breast cancer screening program. The longitudinal study (at three time points over two years) of 395 women investigated the relationship between (1) past behavior, perceived consequences, anticipated regret (that is, not participating would cause feelings of regret), modeling (that is, female acquaintances received invitations to the screening or participated), and intention; and (2) breast cancer screening participation at a second screening. Results (Table 16.3) indicated intention and past behavior (that is, a feedback loop) were significant predictors of future screening participation. Further, using another model, the researchers concluded that self-efficacy, attitudes, and previous screening experiences significantly predicted intention to participate in future screening.

Subsequently, Lechner and colleagues (2004) conducted a longitudinal study (three time points over six months) to investigate the relationship between past breast self-examination, self-efficacy, social influence, attitude- and intention, on future breast self-exam behavior among 364 Dutch women. Consistent with the TTI's structure, they found that psychosocial determinants and past behavior directly predicted breast self-examination.

All three of these studies provided considerable support for the feedback loops of the TTI.

The Complete TTI Framework

Teena Willoughby and colleagues at Brock University in Ontario, Canada have provided the only attempt to date to test the complete TTI in one study (Busseri, Willoughby, Chalmers, and YLC-CURA, 2005, April; Willoughby et al., 2008). Using a longitudinal sample of almost sixteen hundred students from eight high schools, they used a twenty-eight-page questionnaire to assess: (1) six ultimate causes (neighborhood quality, school climate, parental education, difficult temperament, age, and gender); (2) ten distal influences (religiosity, parental relationships, curfew, friendship quality, peer victimization, sibling behavior, academic orientation, structured activities, unstructured activities, well-being); (3) six proximal predictors related to attitudes (tolerance of deviance), beliefs (how risky the behaviors were for oneself and for peers), expectations (how upset friends would be, how upset parents would be), and thoughts (how often youth think about risk behaviors concerning risk behavior involvement); to predict (4) a wide range of risk behaviors, including substance use, direct and indirect aggressive behaviors, and a variety of minor and major delinquent behaviors. All measures were collected on two occasions approximately eighteen months apart. Though

this list of variables does not cover all possible variables included in the TTI, it covers many of them and certainly more than any other single study. In both cross-sectional and longitudinal models of predictors of a composite of the risky behaviors, they found that: (1) most of the relationships between ultimate causes and a composite of proximal predictors were mediated by distal influences; (2) most of the relationships between ultimate causes and behavior were mediated by distal influences and/or proximal predictors; and (3) most of the relationships between distal influences and behavior were mediated by proximal predictors. This study presents a demonstration of the flow of causation from multiple ultimate causes through multiple distal influences and a composite of multiple proximal predictors to a composite of multiple behaviors.

The evidence from studies of pathways in the TTI consistently shows that more ultimate or distal variables are mediated by distal or proximal variables in the prediction of a range of HRBs across a range of populations (adult and adolescent) in several countries. Many other studies of the etiology of HBs that did not cite the TTI also support this pattern of findings.

APPLICATIONS OF THE THEORY OF TRIADIC INFLUENCE

By integrating and organizing so many risk and protective factors, hierarchical tiers, streams, sub-streams, mediated and moderated paths, and feedback loops, the TTI has utility for researchers who are studying the etiology of a HRB (like substance use or seat belt use) and for program planners who are designing and evaluating HP interventions. Etiology researchers and program planners might do well to study the TTI when designing their questionnaires, analyzing their data, and planning their interventions. With so many variables implicated in HRBs, the TTI can bring some order to the chaos that etiology researchers and program planners face.

Applications in Etiology Research

For etiology researchers, the TTI is designed to give insight into the multitude of causes of HRBs and how they relate to each other and to behavior. When compared to other theories of HB, the TTI's functionality for etiological research is apparent. With multiple hierarchical tiers, three thematic streams, and two sub-streams (affective and cognitive), the TTI has an explicit ability to organize coherently the factors influencing behavior. The TTI also offers a structured outline of multivariate hypotheses about how numerous predictor variables within a stream are linked to each other (through mediation) and to a behavioral outcome, as well as how numerous predictors between streams are linked to each other (through moderation) and to a behavioral outcome.

Since the introduction of the TTI (Flay and Petraitis, 1994; Petraitis et al., 1995), much of the etiological research regarding the TTI's tiers, streams, and sub-streams has focused on the etiology of substance use. However, in recent years, researchers from various disciplines have utilized the TTI in examining an assortment of behavioral domains including: dietary behaviors and physical activity; mental health; problem behaviors, such as violence and delinquency; positive youth development; and sexual behaviors (see Table 16.3, second column, for references).

TABLE 16.3 **Literature Referring to the TTI by Behavioral Domain and Type of Study.**

Behavioral Domain	Etiology	Intervention
Dietary Behaviors	Brug et al., 2006; Kamphuis et al., 2006	Brug et al., 2003; Klepp et al., 2005; McCall et al., 2005; Sandvik et al., 2005; Schols and Brug, 2003; te Velde et al., 2006; Wind, 2006; Wind et al., 2006
Dietary Behaviors and Physical Activity	Brug et al., 2006; de Bruijn et al., 2005; de Bruijn et al., 2005; Kremers et al., 2005	Wang et al., 2006
Health-Related Behaviors	Flay and Petraitis, 1994; Freudenberg et al., 1995; Perry, 2004	Brug et al., 2005
Mental Health	Fuemmeler, 2004; Mann et al., 2004	Bell and McKay, 2004; Breland-Noble et al., 2006
Multiple Risk Behaviors/Problem Behaviors	Busseri et al., 2007; Hirschberger et al., 2002; Willoughby et al., 2008	Browne et al., 2001; Flay and Collins, 2005; Flay et al., 2004
Physical Activity	Baranowski et al., 1998; Ferreira et al., 2007	
Positive Youth Development / Character Development	Flay, 2002	Flay and Allred, 2003; Flay et al., 2001; Ji et al., 2005
Sexual Behaviors	Bearinger and Resnick, 2003; Hellerstedt et al., 2006; Kocken et al., 2006; Sieving et al., 2007; Sieving et al., 2000	Bell et al., 2007; Kugler et al., 2007; Tortolero et al., 2005; Weeks et al., 1995

Substance Use	Abrams, 1999; Anderson, 1998; Carvajal and Granillo, 2006; Carvajal et al., 2002; Carvajal et al., 2004; DiRocco et al., 2007; Drobes, 2002; Ertas, 2007; Flay, 1993; Flay, 1999; Flay, 2000; Flay and Petraitis, 1991; Flay and Petraitis, 2003; Flay et al., 1994; Flay et al., 1995; Flay et al., 1999; Foshee et al., 2007; Haug, 2001; Holder et al., 1999; Hover et al., 2000; Karlsson, 2006; Kear, 2002; Kobus, 2003; Komro and Toomey, 2002; Kumar et al., 2002; Leatherdale and Manske, 2005; Leatherdale and Strath, 2007; Mohatt et al., 2004; Murnaghan, 2007; Nierkens et al., 2006; Petersen et al., 2005; Petraitis et al., 1995; Petraitis et al., 1998; Schofield et al., 2003; Schulenberg et al., 2001; Shadel et al., 2004a; Shadel et al., 2004b; Sieving et al., 2000; Sussman et al., 2000; Thorner et al., 2007; Turner et al., 2004; Victoir et al., 2007; Wiefferink et al., 2006; Wiefferink et al., 2008	Fogg and Borody, 2001; Komro et al., 2004; Midford et al., 2005; Perry et al., 2008; Perry et al., 2002; Scheier, 2001; Stigler et al., 2006
Violence	Botvin et al., 2006	Jagers et al., 2007; Komro et al., 2004
Other: (for example, gambling, skin cancer protection, colorectal cancer screening)	Biglan, 2003; Biglan, 2004; Commers et al., 2007; Chalmers and Willoughby 2006; de Vries and Lechner, 2000; DuBois and Flay, 2004; Kremers et al., 2000; Lechner et al., 2004; Lechner et al., 1997; Stanton et al., 2005; Wolf, 2002	Freudenberg et al., 2000

Applications in Health Promotion

The utility of the TTI might be even stronger for those who are developing HP programs. HB theory should provide a guide for the treatment or prevention of health-compromising or other risky behaviors, and the promotion of health-enhancing behaviors. The TTI has been referenced as helping guide the development of multiple HP programs designed to influence a variety of behavioral outcomes, such as: reducing substance use, reducing risky behaviors among adolescents, improving mental health, increasing healthy dietary behaviors and physical activity, and improving youths' academic achievement and behavior (see third column of Table 16.3). Presumably, the TTI has been useful to program planners because it is more comprehensive than other theories, addressing the myriad causes of a particular behavior or class of behaviors (see Table 16.1), providing coherent suggestions of how causal processes operate (mediating and moderating processes [Figure 16.2]), and providing program developers some guidelines when planning a program.

The TTI is useful for health promoters applying planning and evaluation models such as the PRECEDE-PROCEED model (Green, 1992; Green and Kreuter, 2005), Intervention Mapping (Bartholomew, Parcel, Kok, and Gottlieb, 2006) and the culturally appropriate PEN-3 planning approach (Airhihenbuwa, 1995). Specifically, the TTI is helpful in (1) identifying predisposing, enabling and reinforcing factors that influence behavior; (2) selecting, or including, strategies in an intervention; and (3) predicting and understanding a program's impact. We now review some of the ways the TTI can help in the development of interventions.

First, the TTI reminds program planners that they have options. Programs generally try to change a behavior by trying to alter variables that cause the behavior. By reminding program planners that any given HRB has multiple causes, the TTI reminds program planners that there are many different causes that they can alter. Beyond that, however, the TTI can help in the identification of modifiable risk and protective factors and help program planners decide what to provide. This is the first function of theory: to guide the development of interventions by helping identify protective factors (like knowledge about the dangers of substance use) and risk factors (like lack of adult supervision after school). It is no coincidence that substance use prevention programs only started teaching refusal skills after Bandura (1977) presented his theoretical work on self-efficacy. In this and countless other cases, theories have suggested the basic content that has gone into developing new and more effective approaches to prevention. By including so many risk and protective factors in one model, the TTI reminds program planners of more and more ways to affect HRB.

Table 16.4 provides another view of the TTI matrix, illustrating what we call the Big Three (the three streams) and the six (the six sub-streams) causes of behavior, and the parallel Big Three and six reasons for changing behavior. The table also shows the six parallel strategies for contextual change (that would lead to behavior change) and the six parallel strategies for individual-level behavior change, as well as the modes or channels that can be used to effect change. We elaborate on these ideas below.

TABLE 16.4 Causes of Behavior, Reasons for Behavior Change, and Strategies for Contextual and Behavior Change.

The Big three Causes of Behavior	**IntraPersonal Genetic/Biological, Personality**		**Social Situation/Context Family, School, Friends**		**Sociocultural Environment Culture/Ethnicity, SES, Media Exposure, Social (Dis)organization**	
The six Causes of Behavior	*Sense of self,* self determination, self control	General competence, *social skills*	*Social attachment* to (bonding with) family, friends, school	Observed (modeled) *behaviors and attitudes of others*	*Value* of expected consequences	*Knowledge* of expected consequences
Big three Reasons for Behavior Change	*Self-Efficacy:* "I have the behavioral skills and self-determination (Skill + Will)"		*Social Normative Behaviors* "Important others would like me to"		*Attitudes toward the behavior:* "It will be good for me"	
Six Reasons for Behavior Change	I really want to OR I can't help myself	I find it easier to do than not to	To please others—social acceptance	Because "everyone else is doing it"	To improve myself (or my health) in ways I value	To avoid negative consequences or gain positive ones
Six Classes of Strategies For Contextual Change*	**Improve group *empowerment***	**Improve general/ social competencies**	**Change sources and levels of *social support***	**Change *normative environment*, role models**	**Change the *sociocultural values environment***	**Change the *informational environment***
Six Classes of Strategies For *Behavioral Change*	Improve self control/image; Provide *cues and reminders*	Teach, learn, practice improved *(social) skills*	Increase social attachments; Provide/find sources of *social support*	*Model* desired behavior; Correct or alter normative expectations	Teach cultural values, clarify or (re)develop *values/evaluations* Teach problem solving and decision making	Provide *information*, change *expectations*
Modes or Channels of Change	Individual counseling, small groups, schools; media for modeling and cues		Modeling and increasing opportunities, in communities, schools, families and small groups, parent training, support groups,		Societal opportunities, legislation, policies, taxes, media (messages, counter advertising), communities, schools, health care systems	

* *Note*: The bolded row indicates our belief that future health promotion interventions need to focus on the distal and ultimate causes of health behavior, where they can influence multiple behaviors more efficiently and in a more sustained way than most of our current affectively/cognitively-focused interventions.

Each stream of the TTI suggests multiple approaches to HB change. For example, the TTI's PERSONAL stream suggests that there are two means by which health promoters can improve health-related self-efficacy (Figure 16.1 and Table 16.4). First, health promoters can teach self-regulation and self-management skills to adolescents and adults with weak self-concept or self-control, because they are otherwise at elevated risk for health-compromising behaviors (Bandura, 2005). Second, health promoters can improve people's skills and confidence so that they know how to handle situations where their health is at risk. For example, educators can help adolescents with their abilities to resist social pressures to use substances and engage in unsafe sexual activities.

The SOCIAL stream of the TTI suggests that health promoters can provide people with prominent role models who practice healthy lifestyles (Bandura, 1986; Jessor et al., 2003). Health promoters also can try to change the behaviors of peer and family members (and themselves) who serve as role models of health-compromising behavior (Flay, 2000). For example, by directly encouraging one employee or parent to quit smoking, educators can indirectly affect other coworkers' or children's perceptions that smoking is not normative. Health promoters can also help alleviate social pressure by correcting people's (1) distorted perceptions (knowledge or cognitions) about how people engage in health-compromising behaviors, and (2) their bonds and motivation to comply with or please people (an affective component) who engage in health-compromising behaviors. Finally, once an HRB has been changed, it can be maintained better if social support is available from important others (Duncan and McAuley, 1993; Gallant, 2003; Hurdle, 2001; Jessor et al., 2003; Verheijden, Bakx, Weel, Koelen, and Staveren, 2005).

The cultural-ENVIRONMENTAL stream of the TTI suggests several ways that health promoters can improve people's health. The most obvious way is to provide people with information and knowledge about the consequences of HRBs. Attempts at HP have often assumed that knowledge is power, and that the key to changing HRBs is to provide people with new information about health. It is widely assumed, for example, that if adolescents truly appreciate the dangers of cigarettes and unsafe sex, they would rationally decide to avoid smoking and use condoms. Similarly, it is assumed that if adults knew about the benefits of low-sodium diets they would reduce their salt consumption. The assumption that knowledge is power has shaped the foundation of many HP efforts (historically, the first approach to be used—Dusenbury and Botvin, 1990) and many well-known models of HB, such as the Health Belief Model (Janz and Becker, 1984; Rosenstock, 1974).

Knowledge, attitudes, decisions, and behaviors do not always fall into line with each other, and providing accurate information and expecting people to act in their best interests often fails to change them. However, as the TTI and expectancy-value theories (Feather, 1982) make clear, new knowledge is often worthless without new values. For example, teaching adolescents that smoking might cause cancer in decades to come will not deter them if they discount the value of their long-term health or if they place a higher value on getting along with peers now. Similarly, adults

might not heed warnings about high-sodium diets if they believe that low-sodium diets are bland and greatly reduce the quality of their lives. Consequently, the second means (and the second to be used historically in HP research—Dusenbury and Botvin, 1990) of boosting health-encouraging attitudes among people is to change their general health and social values. Historically, the third approach to prevention to heath promotion was to teach decision-making and problem-solving skills (Dusenbury and Botvin, 1990), which teaches people how to combine their values with their knowledge to reach informed decisions.

A second way that the TTI can help in the development of interventions is by encouraging developers to take advantage of multiple options. Looking at Figures 16.1 or 16.2 should make it clear to program developers that a program's effectiveness might be determined by its ability to affect more—rather than fewer—risk and protective factors. Therefore, the TTI reminds us that the most effective interventions are probably those that target a wide range of such factors.

For example, the TTI makes it clear that teaching about information, values and decision making may not be enough to change behavior, especially if people are exposed to multiple conflicting messages and the ultimate causes remain unchanged. Health promoters might do better by contributing to the sociocultural environment in which people mature and live day to day. As examples, health promoters might aim at (1) influencing health-related legislation, taxation, and public policy; (2) guiding selection of school curricula, food choices, and opportunities for physical activity; and (3) employing the mass media and popular public figures, as means of shaping the health-related values upon which people build their health-related attitudes, limiting or providing opportunities for behavioral choices (compare with Jessor et al., 2003), and reinforcing desired behaviors. One glance at Figure 16.1 reminds prevention planners that behaviors have their roots in all three streams, and reminds planners that simple interventions that target few risk or protective factors, or focus within only one stream, are likely to have modest effects. Moreover, Figure 16.1 reminds planners that among the three streams of influence, only a few factors probably affect a behavior fairly directly (such as attitudes toward the behavior) and that most factors probably have indirect effects (for example, religious involvement).

With such advice in mind, Bell and colleagues (Bell, Bhana, McKay, and Petersen, 2007; Bell et al., 2008) applied the TTI to guide the design of the Collaborative HIV Prevention and Adolescent Mental Health Project-South Africa (CHAMPSA). CHAMPSA is a South African version of the Collaborative HIV Prevention and Adolescent Project (CHAMP): a family-based HIV prevention research project originally conducted in Chicago (Bell and McKay, 2004). The TTI was used by these program developers to derive seven principles for interventions that CHAMPSA incorporated: individual, peer and family group, and community-based interventions, reflecting the TTI's PERSONAL, SOCIAL and cultural-ENVIRONMENTAL streams, respectively. Thus, CHAMPSA had a greater likelihood of success and could expect greater results by addressing more rather than fewer risk and protective factors.

Logically following the above two points, a third advantage of using the TTI in program planning is that it can help planners anticipate the size of their program's impact. Programs with modest resources that can only target one or two of the proximal causes of a behavior (like simply teaching kids about the dangers of drugs) should anticipate modest effects. At the same time, programs with many more resources and plans to target multiple causes, especially more distal and ultimate causes, should run long enough to produce larger and more lasting effects before being considered (un)successful. Therefore, program planners and funding agencies might do well to study Figure 16.1 before designing a program or approving of its funding to arrive at a more realistic estimate of their program's potential impact.

Fourth, not only can the TTI provide a preliminary estimate of the magnitude of a program's impact, the TTI's mediated pathways also point toward the location of a program's impact. Programs are designed to have an immediate effect on some variables that are expected to have subsequent effects on the targeted behavior. For instance, substance use prevention programs might try to correct perceptions about the extent of a behavior among peers in the hope that corrected social normative beliefs will change intentions toward substance use and, eventually, reduce substance use. By spelling out the intervening (mediating) variables, the TTI allows us to measure the appropriate variables and helps us locate the immediate, intermediate, and long-term effects of a program.

Fifth, whereas the TTI's within-stream mediated paths point toward the location of likely effects, the TTI's between-streams moderator paths should remind program planners about interactions and encourage careful thought about identifying appropriate target audiences for interventions. Not all people have the same level of risk or the same reaction to a program. For instance, a program that emphasizes the dangers of drug use might reduce the drug use of low risk takers but might promote drug use among high risk takers. Thus, the TTI, because it articulates moderating or interaction effects, encourages program planners to think about the populations for whom programs are more appropriate, and whether prevention efforts should be universal, selective, or indicated (Airhihenbuwa, 1995; Gordon, 1983, 1987).

Sixth, the TTI suggests to program developers that it is better, in the long term, to address ultimate or more distal factors rather than less distal or proximal factors. If a program focuses on proximal predictors rather than ultimate and more distal determinants of a behavior, the behavior might change temporarily but soon revert back to prior levels as underlying influences in the individuals' homes, schools, and broader sociocultural environments remain unaltered. For instance, a one-shot program that encourages adolescents to "just say 'no'" to offers of substances, although important, targets only proximal-level predictors, leaves unaltered more distal influences, and, therefore, is unlikely to have much long-term success. If program developers understand the short-term causal processes, the long-term causal processes, and intervening variables, they are in a better position to develop an effective program.

Theories, in conjunction with empirical support, explicitly articulate the intervening causal processes that link unmodifiable variables with behavior. Consequently,

the TTI gives program developers more than a list of risk and protective factors: it also gives developers a comprehensive list of those factors that can be modified by the program. Thus, to be long lasting, HP programs must not only be sustained, but they must also change the social ecologies in which people live. The influences in peoples' sociocultural environments to engage in health-compromising behavior do not go away, so programs must continue to influence or counteract them.

It is obvious by now that the many determinants of behavior need to be considered when planning a preventive or HP intervention. One cannot assume that information alone will do much to alter behavior. In many cases it has not, and in some cases has actually made things worse (Goodstadt, 1978, 1980). In part, information is usually not enough to change behavior because there are so many other determinants of the targeted behavior. Educational programs that address social skills (and self-efficacy) and norms, as well as information (and attitudes) are an improvement. However, given that the underlying/ultimate causes of behavior are at the level of families and neighborhoods (within the SOCIAL stream) and at the level of one's sociocultural heritage and macro-environment (within the cultural-ENVIRONMENTAL stream), one may need to consider educating parents as well as children, or using sociocultural environmental or legal interventions instead of, or in addition to, educational programs or campaigns. For behaviors for which the primary underlying causes are the physiological makeup or psychological adjustment of the person, clinical treatment programs will probably be more appropriate (Bierman et al., 2004; Greenberg, 2004).

A seventh and final way in which the TTI can help in the development of effective HP interventions is by providing a common framework with which to analyze the common elements of effective or evidence-based programs. In one example, Mary Jane Rotheram-Borus' laboratory (for example, Ingram, Flannery, Elkavich, and Rotheram-Borus, 2008) has analyzed the common components of AIDS prevention programs and found that they included structural features (agenda or goal setting), group management strategies (for example, active engagement), and content (for example, cognitive changes, skills/competence development and practice). Surprisingly, to them and us, they found little consistency in the application of positive reinforcement. A Behavior Change Consortium (Ory, Jordan, and Bazzarre, 2002) found the following common factors in interventions: decisional balance (pros and cons), goal setting, outcome expectations, self-determination/autonomy, (self-) efficacy, social support, and stress management. In another consensus exercise, Michie and colleagues (2005) identified twelve theoretical constructs for use in (1) studying the implementation of evidence-based practice; and (2) developing strategies for effective implementation, and to communicate these constructs to an interdisciplinary audience. The twelve constructs were: (1) knowledge; (2) skills; (3) social/professional role and identity; (4) beliefs about capabilities; (5) beliefs about consequences; (6) motivation and goals; (7) memory, attention and decision processes; (8) environmental context and resources; (9) social influences; (10) emotion regulation; (11) behavioral regulation; and (12) nature of the behavior.

Distinguishing core elements from optional elements of effective interventions could help program implementers to not undermine the program's effectiveness when they modify programs to meet the needs of their target population. The search for core elements in prevention interventions is parallel to the identification of "common factors" in a large body of psychotherapy research (Lambert and Oglesk, 2004) and other mental health interventions (for example, Arnold, Rice, Flannery, and Rotheram-Borus, 2008), as well as consistent with the study of levels of change by a National Institute of Mental Health task force (Bellack et al., 2001). A focus on the common elements in successful interventions, rather than on their theoretical explanations or idiosyncratic packaging, will make an empirically validated knowledge base more accessible to community interventionists (Ingram et al., 2008).

ABAN AYA: AN EXAMPLE OF THE APPLICATION OF THE THEORY OF TRIADIC INFLUENCE

It is clear from the TTI that interventions that (1) target multiple variables, (2) include the social context, and (3) address ultimate-level causes should have more and longer-lasting effects on more behaviors than interventions that target only a few variables, give less emphasis to social context, and/or do not address ultimate-level causes. In this section we describe how the TTI was used to design, implement, and evaluate the Aban Aya Youth Project. Aban Aya was an intervention designed to target the risk behaviors of violence, provoking behavior, substance use, school delinquency, and sexual practices (engaging in sexual intercourse and using condoms) among urban African American youth (Flay, Graumlich, Segawa, Burns, and Holliday, 2004). The culturally grounded project derived its name from two Ghanian symbols, Aban, a fence signifying double (social) protection, and Aya, an unfurling fern signifying standing up to the world, or self-determination.

Violence, substance use, delinquency, and risky sexual practices are major public health concerns confronting urban African American youth (Dahlberg, 1998; Herrenkohl et al., 2000). The Aban Aya Youth Project was a longitudinal randomized control trial of three interventions (two experimental interventions and one "attention-placebo" control) that were implemented in grades five through eight in twelve metropolitan Chicago schools between 1994 and 1998. More in-depth descriptions of research and intervention design, activities, implementation, and evaluation can be found elsewhere (Flay et al., 2004; Jagers, Morgan-Lopez, Howard, Browne, and Flay, 2007; Jagers, Sydnor, Mouttapa, and Flay, 2007; Ngwe, Liu, Flay, Segawa, and Aban Aya Co-Investigators, 2004; Segawa, Ngwe, Li, and Flay, 2005).

One of the Aban Aya experimental conditions was the social development curriculum (SDC), a four-year, classroom-based intervention consisting of sixteen to twenty-one lessons a year designed to: teach cognitive-behavioral skills to build self-esteem and empathy; manage stress and anxiety; develop interpersonal relationships; resist peer pressure; and develop decision-making, problem-solving, conflict-resolution and goal-setting skills. The SDC was structured to teach application of these skills to

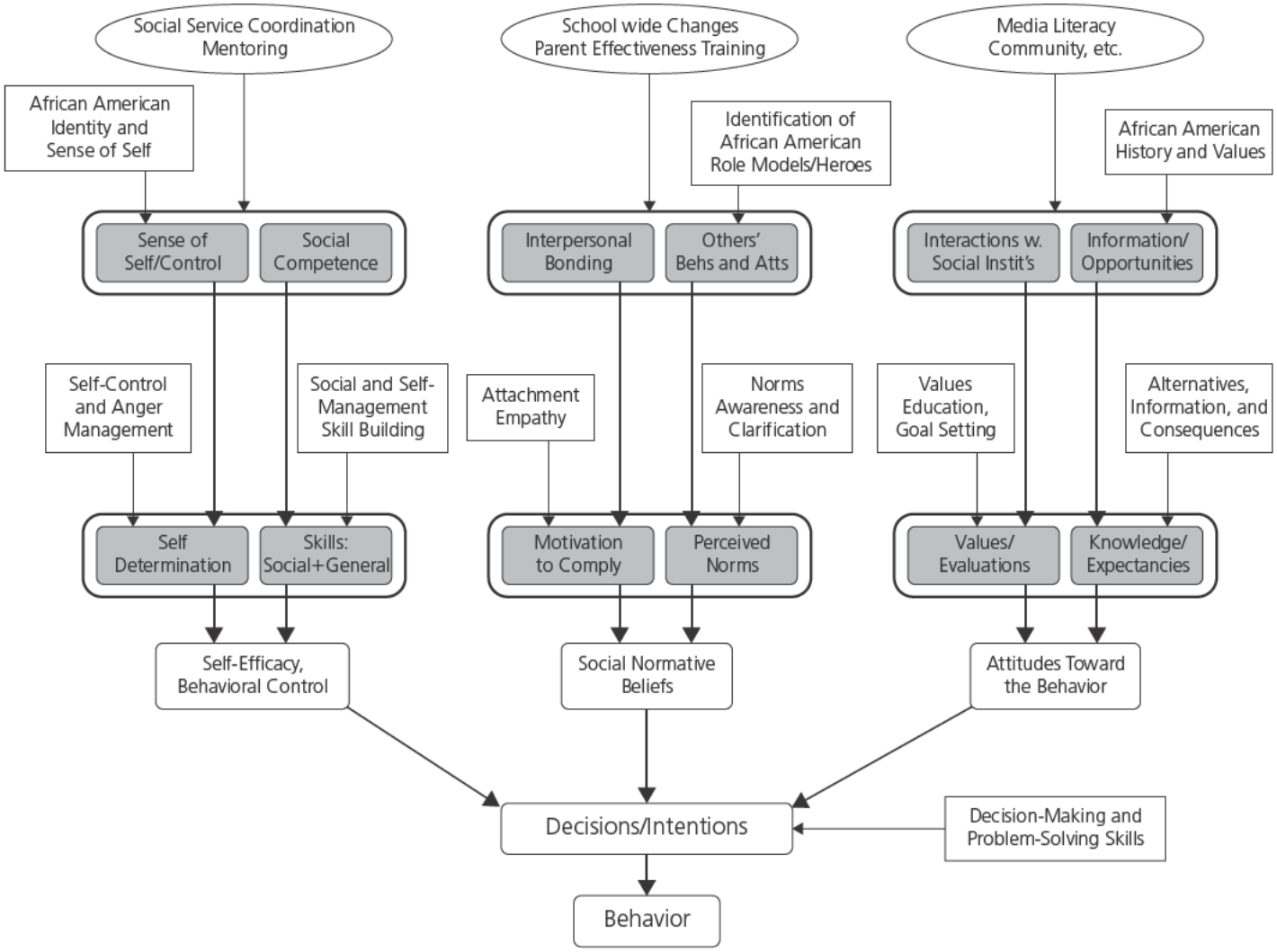
avoiding violence, drug use and, unsafe sex. The control condition was a health enhancement curriculum (HEC) that addressed physical HBs (for example, physical activity, nutrition, and sleep) rather than problem behaviors.

The second experimental condition was the school and community intervention (SCI). The SCI echoed the SDC's focus on community-specific issues (that is, violence, provocation, delinquency, drugs, and unsafe sex) but added parental support plus school climate and community components. The parent-support component reinforced the program's classroom lessons and promoted child/parent communication. The school staff and schoolwide youth-support component integrated programmatic skills into the school environment and provide reinforcement of appropriate behaviors. The community component forged linkages among parents, schools, and local businesses. Each SCI school formed a local school task force consisting of school personnel, students, parents, community advocates, and project staff to implement the program components (Comer, 1988), propose changes in school policy, develop other school/community liaisons supportive of school-based efforts, and solicit community organizations to conduct activities to support the SCI efforts. A goal of these linkages was to "rebuild the village" and create a "sense of ownership" by all stakeholders to promote sustainability of these efforts on completion of the project (Bell and Fink, 2000; Bell, Gamm, Vallas, and Jackson, 2001).

With the TTI as its conceptual foundation, Aban Aya included constructs from the PERSONAL, SOCIAL, and cultural-ENVIRONMENTAL streams (see Figure 16.4). For example, both the SDI and SCI incorporated skill building (for example, resistance, assertiveness, conflict resolution, and negotiation) from the PERSONAL stream, norms awareness and clarification from the SOCIAL stream, and values education from the cultural-ENVIRONMENTAL stream. Furthermore, the project included ultimate, distal, and proximal levels of causation. For example, the SCI incorporated more ultimate levels of causation and represented an ecological approach by including (1) a parental component, (2) a school climate component, and (3) a community component (see Figure 16.4). Thus, by addressing ultimate levels of causation, distal influences, and proximal predictors, we expected that the SCI would result in a greater reduction in the growth of negative behaviors than the SDC alone (Flay et al., 2004).

By including contextual components, the TTI would predict that both experimental conditions would improve behavior and that the SCI would have stronger effects than the SDC. Results supported this prediction. For boys in the SDC and SCI conditions, there were significant reductions in the rate of increase in negative behaviors from fifth to eighth grade compared to boys in the HEC condition: violence by 35 percent and 47 percent, from the SDC and SCI conditions, respectively; provoking behavior, 41 percent and 59 percent; school delinquency, 31 percent and 66 percent; drug use, 32 percent and 34 percent; and recent sexual intercourse, 44 percent and 65 percent. Among those who were sexually active, the relative improvements in condom use were 95 percent and 165 percent, respectively. A recent review of violence-prevention interventions (Limbos et al., 2007) indicated that Aban Aya was one of

FIGURE 16.4 *The Aban Aya Program Content Mapped onto the TTI*



only two primary-level interventions (that is, implemented universally to prevent inception of violence) that were evaluated with a randomized trial and that demonstrated a significant reduction in violence outcomes.

In addition to providing a framework for the Aban Aya interventions, the TTI also offered a framework to evaluate the interventions and test potential mediators. For example, Ngwe and colleagues (Ngwe et al., 2004) found that, as the TTI would predict, behavioral intentions, attitudes toward violence, estimates of peers' behaviors, and estimates of best friends' behaviors were complete mediators between the intervention and its preventive effects. Likewise, Jagers and colleagues (2007) investigated if Aban Aya produced differences in changes over time in communal value orientation, empathy, and violence avoidance self-efficacy beliefs. They found that both the SDC and SCI had significant effects on empathy; thereby reducing the likelihood of violent behavior over time. Moreover, they indicated that changes over time in violence avoidance self-efficacy were related to less violent behavior over time.

The TTI provided a ready source of mediation hypotheses for Ngwe et al. (2004) and Jagers et al. (2007). Consequently, other researchers can select the various constructs incorporated in the TTI to gain a greater understanding of the effects of a particular intervention. Additionally, the TTI provides researchers with a testable model and allows them to study many variables to understand their influence on a particular behavior, allowing researchers to better understand the etiology of behaviors and how to alter them.

STRENGTHS AND LIMITATIONS OF THE THEORY OF TRIADIC INFLUENCE

The TTI provides a single, unifying framework that organizes the constructs from many other theories. Indeed, the TTI is pan-theoretical in orientation and provides a "rapprochement" of competing theories (Flay, 2002) by bringing together constructs and processes from various multivariate theories of behavior, including, but not limited to the following:

- Theories of ultimate influences like social control theory (Hirschi, 1969) and its extensions (Elliott, Huizinga, and Menard, 1989), social development theory (Hawkins and Weis, 1985), biological vulnerability (Sher, 1991);
- Theories of distal influences like family attachment (Baumrind, 1985; Brook, Brook, Gordon, and Whiteman, 1990), peer clustering (Oetting and Beauvais, 1986), personality (Digman, 1990; Zuckerman, 1971; Zuckerman et al., 1990);
- Theories of proximal cognitive-affective predictors of behavior, such as the Health Beliefs Model (Becker, 1974; Janz and Becker, 1984), the theory of reasoned action (Fishbein and Ajzen, 1975), the theory of planned behavior (Ajzen, 1985, 1988, 1991), self-regulation, self-determination, and self-control theories (Aarts, 2007; Deci and Ryan, 1985; Hall and Fong, 2007), numerous expectancy-value theories (Atkinson, 1957; Feather, 1982), and self-efficacy theory (Bandura, 1977);

- Theories that cross levels and streams of influence like social learning (Akers, 1977; Akers et al., 1979), social cognitive theory (Bandura, 1986), social ecological systems (Bronfrenbrenner, 1979, 1986); and
- Other integrative theories (Huba and Bentler, 1982; Jessor and Jessor, 1977; Sadava, 1987).

See Petraitis, Flay, and Miller (1995) for a review of many of these theories.

One major strength of the TTI is that it provides dozens of testable hypotheses about causal processes, including mediation, moderation, and reciprocal effects. The TTI is useful not only for explaining behavior, but also for designing interventions for the treatment or prevention of health-compromising or other risky behaviors, the promotion of health-enhancing and other positive behaviors, and positive youth development (Catalano, Berglund, Ryan, Lonczak, and Hawkins, 2004; Flay, 2002; Lerner, 2006; Lerner et al., in press).

The TTI has major implications for understanding behavior and its change. The most obvious implication is that the determinants of any one behavior are many and varied. They range from proximal (decision/intentions and affective/cognitive predictors) to ultimate causes (those characteristics one brings into the world and the cultural and social environments within which one is raised and matures). These all act through three major streams and multiple levels of causation: (1) intra-PERSONAL characteristics, which are the major determinants of an adolescent's sense of self and competence (social and general) that, in turn, influence their self-esteem and self-efficacy; (2) the SOCIAL situations/contexts or micro-environments, which provide role models and are the major determinants of social bonding that, in turn, influence social normative beliefs; and (3) the cultural-ENVIRONMENTS, which are the major determinants of knowledge and values that, in turn, influence attitudes. There are important interactions between streams of influence, so that features within each stream affect features within others. Finally, feedback loops to and from behavioral experiences and both proximal predictors and the social-personal nexus influence both (1) how a behavior is experienced, and (2) the likelihood of future repetitions of the behavior. We have formalized all of these properties into ten postulates of the TTI as shown in Table 16.5.

IMPLICATIONS FOR BEHAVIOR CHANGE (PREVENTION OR PROMOTION)

The comprehensiveness of the TTI clarifies why informational or didactic educational approaches to prevention have usually failed. They focused toward the bottom of only the cultural-ENVIRONMENTAL stream of influence. Affective approaches have also failed because they also focused near the middle (values clarification) or the bottom (decision making) of only the cultural-ENVIRONMENTAL stream. Only more recent programs have added a focus on the intra-PERSONAL stream by addressing the need for social skills and self-efficacy; however, though some of these

TABLE 16.5 Postulates of the Theory of Triadic Influence.

1	The TTI provides a comprehensive, meta-theoretical view of behavior in which a symmetrical, higher-order system of description and explanation integrates multiple levels of organization. Certainly, no one variable can provide an adequate explanation of behavior—and there is no silver bullet for changing a behavior. In addition, no one existing theory can provide a satisfactory description of behavior. It requires the integration of numerous theories from many disciplines and subdisciplines to provide a full understanding of behavior. The TTI satisfies the requirements of a systems theory in that it is comprehensive, systematic, involves multiple levels and ecologies, includes feedback loops, and is symmetrical (Stewart and Cohen, 1997).
2	All behavioral choices are influenced by the interaction of genetic/nature and environmental/nurture factors.
3	Each behavioral choice is influenced by a complex system of PERSONAL (intrapersonal → self-efficacy), SOCIAL (interpersonal → social normative beliefs) and ENVIRONMENTAL (sociocultural → attitudes) factors.
4	All three (triadic) streams of influence each have two substreams: three control/values/affective/feelings sub-streams, and three information/cognitive substreams.
5	All (sub) streams of influence flow from causes most distant (ultimate) through distal influences to predictors closest (proximal) to the behavior of interest—a cascade of multiple and interacting influences. Proximal influences predict behavior while distal influences and ultimate causes help explain it.
6	Most influences, including all informative/cognitive influences, can have positive or negative values. The more positive influences there are, the more likely are positive behaviors. The more negative influences there are, the more likely are negative behaviors.
7	The most proximal control/affect predictors have values that range from zero to one (probabilities). The higher these probabilities, the more influence the corresponding information/cognitions will have on behavioral choices.
8	Interactions across streams can increase or reduce risks/protection; for example, positive sense of self can reduce risk in disorganized communities, negative sense of self can increase risk in protective families, positive community/family forces can protect against poor sense of self.
9	Once a behavior occurs, the resulting reactions and/or experiences (thoughts and feelings) feed back to change the original causes. For example, engaging in a behavior changes one's self-efficacy, relationships with parents and peers, and attitudes. Feedback changes the likelihood of engaging in the same or a similar behavior in the future. Thus, causes and effects are in a continuous cycle: with each action changing the causes, and the changed causes leading to the same, similar or different behavior over time, involving many mutually influential individual contextual relations and developmental regulation.
10	The reactions to certain behaviors feed back to influence the causes of related behaviors (for example, smoking and other drug use); that is, related behaviors have similar causes, with the more distal causes being the most similar. Less related behaviors (for example, smoking and skiing) have fewer causes in common. Even related behaviors may have some differences in proximal causes.

programs have demonstrated improvements in skills and self-efficacy, only weak linkages have been found between improved skills and subsequent behavior (MacKinnon et al., 1991). We suspect several reasons for this. First, many such programs minimized the informational and values components, so reducing the components that should motivate youth to *want* to behave differently. Second, the SOCIAL stream was still not addressed adequately. Though these programs included components to increase awareness of social influences, few of them deliberately altered social normative beliefs (or actual norms in the surrounding society). Recent studies demonstrate the importance of such components (Hansen and Graham, 1991; Kirby, Barth, Leland, and Fetro, 1991; MacKinnon et al., 1991). Few programs of any type addressed the upper levels of any of the streams of influence. Evidence from multiple studies suggests the power of altering influences on the upper levels of the SOCIAL and cultural-ENVIRONMENTAL streams (for example, school policies, increasing taxes, driving under the influence legislation, speed limits, legislating the wearing of seat belts, activism against billboards).

New interventions need to be broader, longer, and deeper; but we should not throw out all of the content of traditional approaches. We need to include family participation and parenting/communication skills, teach multiple relevant skills, consider special interventions for children in high-risk families, and consider how to impact broad sociocultural influences. Regarding the latter, perhaps we can train students to be advocates, reduce sales/access to minors (alcohol and tobacco), eliminate advertising of alcohol and tobacco on billboards and TV, increase taxes on tobacco and alcohol, change school lunches, reduce exposure to violence on TV and in movies, and so on. In short, the best interventions will use contextual and behavioral change strategies from all six sub-streams and from multiple causal levels (see Table 16.1).

Limitations

Comprehensiveness also leads to complexity—and complexity poses, perhaps, the biggest challenge to the TTI. Simply put, it is difficult to test the predictive power of the entire theory in one study (though Willoughby et al. [2008] made a good attempt) because that study would have to measure—and measure adequately—twenty-two different sets of variables (see Figure 16.1), the more proximal ones separately for each behavior of interest. Some sets of variables might be relatively easy to define and measure, especially TTI's proximal predictors; however, other sets of variables are considerably harder to define and measure. For instance, "cultural environment variables"—the ultimate causes in the cultural-ENVIRONMENTAL stream—need to be measured, but the TTI does not yet offer detailed guidance on which cultural environment variables need to be measured. Similarly, researchers should measure ultimate personality variables, but TTI does not yet say exactly which personality variables to measure. Starting with "the Big Five" (openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism) personality variables would be a good start, but the list could be much longer. As research advances in these twenty-two sets of variables, future versions of the TTI can provide a more complete

list of variables to measure. For now, however, the complexity of the TTI leads to piecemeal evidence: one study showing support for one set of paths, another study showing support for another set of paths.

It also may be difficult to incorporate all influences in one intervention. The Aban Aya program (Flay et al., 2004) and other programs such as the Positive Action program (Flay and Allred, 2003; Flay, Allred, and Ordway, 2001) demonstrate how it might be done. Future HP needs to focus less on the micro levels of causation and more on the distal and ultimate levels. A focus on distal and ultimate levels will lead to programs that are more efficient because they change multiple behaviors at once, and will lead to programs that are more sustainable because they change the cultural context. David Olds's home nursing program (1997) is an example of an intervention that has long-term effects on multiple youth behaviors. We need to focus more on the big picture, so that HP programs can socially infiltrate society, like fast food and TV have done!

Note that a focus on distal and ultimate levels is NOT the same as a focus on only the environment—it still includes interpersonal-social situations and the person. Some advocates of the focus on the environment leave out the ultimate or distal influences in the interpersonal and intrapersonal domains. We believe that there are distal and ultimate aspects of all three streams that should be focused on, not just of the environmental stream.

FUTURE DIRECTIONS

The TTI will be about fifteen years old when this book is published. The behavioral and health sciences have changed greatly during those years. One change has been the rapid growth in new technologies that can investigate the biological contributions to thoughts, feelings, and behaviors. Results from the Human Genome Project were published in 2001, providing a basis for researchers to look at the relationships between different genotypes and phenotypes. As a result, scientists are learning more about the biology of behavior, and advancing more detailed theory about such influences (Dodge and Pettit, 2003; Reiss and Leve, 2007). For instance, deBry and Tiffany (2008) recently proposed that early initiation of tobacco use has neurotoxic effects that alter the normal progress of neurodevelopment, particularly in the areas of executive functioning and control of inhibitions. In another example, a mediational study highlighted the importance of studying how program-influence variables at the distal level in the PERSONAL stream, namely, students' brain development and functional capabilities (Riggs, Greenberg, Kusché, and Pentz, 2006). In this study, improved neuropsychological functioning, in terms of increased inhibitory control and verbal fluency, partially mediated improvement in behavioral problems. Furthermore, neuroimaging research indicates that learning-oriented interventions can result in positive brain changes (Roffman, Marci, Glick, Dougherty, and Rauch, 2005).

Other research highlights the importance of other biological factors. For example, substance use tends to run in families (Sher, 1991) and is also linked to a variety

of biological factors (Cloninger, 1987; Phil, Peterson, and Finn, 1990; Tarter, Alterman, and Edwards, 1985). Along these lines, studies have shown that cigarette use among girls (but not boys) is positively related to testosterone levels (Bauman, Foshee, and Haley, 1992); the early onset of puberty predicts the onset of cigarette use (D. M. Wilson et al., 1994); and levels of serotonin and dopamine influence cocaine consumption among rats (White, 1997). In its original form, the TTI had little to say about such influences. The TTI does, however, have a structure and a location to place biological influences—among the ultimate-level intrapersonal influences. We hope that the future of the TTI will do more than have a place for biological influences; we hope that it spells out the biological mechanisms in more detail.

Another important change in the sciences since the TTI's inception is the rise in systematic research on evolutionary influences on human behavior and the recognition that many behaviors people do today might have genetic roots in behaviors that benefited ancestral humans 200,000 years ago. Evolutionary psychology might, for example, help explain unsafe sex practices, poor diets, and lack of exercise in today's modern world (Cosmides and Tooby, 2003). With hunter-gatherer humans facing a short and strenuous existence with frequent infant mortality and scarce food (especially calorie- and protein-rich foods), cautious sex, dieting, and forgoing opportunities for rest were costly behaviors of ancestral humans. Having inherited our genes from hunter-gatherer humans, modern humans might have inherited genetic inclinations towards unprotected sex; food cravings for fat, protein, and carbohydrates rather than vegetables; and a preference to be sedentary whenever possible. Originally, the TTI had little to say about these and other evolutionary influences (Petraitis, Lampman, and Falconer, 2008). Whereas the biological influences discussed in the previous paragraph might fit neatly into the TTI's PERSONAL influences stream, evolutionary influences also contribute to the SOCIAL and cultural-ENVIRONMENTAL streams (Richerson and Boyd, 2005; Sober and Wilson, 1998; D. S. Wilson, 2007; D. S Wilson and Csikszentmihalyi, 2008). We hope we can spell out the role of evolution in HRBs in more detail in future versions of the TTI.

We also hope that the future of the TTI spells out more specifically the roles of some key demographic factors such as gender, age, ethnic heritage, and socioeconomic status in greater detail. Each of these demographic factors probably affects variables in each of the TTI's streams. For example, being a female might affect one's rebelliousness and sense of self (variables in the PERSONAL stream), how one evaluates the various consequences of a behavior (a variable in the cultural-ENVIRONMENTAL stream) and the quantity and nature of one's social bonds (a variable in the SOCIAL stream). Future versions of the TTI should address the likely cross-stream influence of these key demographic variables.

Finally, we remind readers that the TTI is just as relevant to positive behaviors as to the negative ones on which HB researchers tend to focus. All of the same variables and pathways are involved in the prediction of positive behaviors. One of us has written elsewhere about the role of TTI in positive youth development (Flay, 2002). In the long term, however, the HP field needs to focus less on the micro levels, and more

on the common distal and ultimate levels. We need to focus more on the big picture so that our HP programs socially infiltrate society. It is for this reason that we bold one row of Table 16.4.

SUMMARY

The TTI is an ambitious theory: compared to other models of HRBs, the TTI aims to provide a more coherent structure for a more comprehensive set of variables. It should not be viewed, however, as finished. It is a work in progress and as scientists discover more pieces in the puzzle of HRB, we hope that the TTI will expand and will help show how the pieces fit together.

Everything in our biological/personal, social, and sociocultural (including physical) environments—from cells to society, from neurons to neighborhoods (Shonkoff and Phillips, 2000), from global warming to environmental contaminants, from national welfare policies to neighborhood poverty, from politics to religion, from international trade policies to the availability of healthy food and affordable energy—affects our health status both directly, and indirectly through affecting our behavior (Glass and McAtee, 2006). The TTI helps us understand the multiple determinants of our behavior and the complex webs of interacting and cascading linkages between the causes as they flow from ultimate to distal, and from distal to proximal, to ultimately influence multiple behaviors.

It is important to realize that each ultimate cause influences multiple behaviors. Indeed, they also influence many other aspects of human life besides the HRBs of interest in this text. They influence behavior in every realm of life as well as multiple health outcomes (Link and Phelan, 1995; Rose, 1985). For example, socioeconomic status (or education) predicts the risk of engaging in health-compromising behavior as well as morbidity and mortality. Further, socioeconomic status (SES) predicts health status in ways independent of its path through HRBs (Coburn, 2000, 2004); for example, by leading to chronic stress, which, in turn, leads to increased levels of cortisol and adrenalin in the body, leading to increased disease of diabetes, cardiovascular disease, and other morbidities (Adler and Newman, 2002; Coburn, 2000; House, 2002; Kawachi and Subramanian, 2007; Krieger, 2007; Marmot, 2001; Marmot and Wilkinson, 2006).

Ethnicity and culture also play important roles in both behavior and health status. Although the SES-health gradient exists for both whites and African Americans in the U.S. population, the overall level of health is lower for African Americans than it is for whites at every level of SES. This is, in part at least, because of the higher frequency of stressful experiences brought on by racism in the United States, leading to increases in cortisol and adrenalin flowing through the body more frequently for African Americans than whites (Morenoff et al., 2007; Williams and Earl, 2007). Another example concerns brain and language development—both are influenced by SES because of differing exposures to stimuli (Hart and Risley, 1995; Merzenich, 2001).

The point of the above two paragraphs is that the ultimate causes of HRB (biological/PERSONAL, SOCIAL situational or cultural-ENVIRONMENTAL) are also the ultimate or underling causes of many forms of morbidity and many other human developmental experiences. The TTI also makes it clear, however, that there are many pathways through which the effects of these underlying causal influences can be redirected so as to *not* have the influences addressed in these paragraphs! This is the critical work of HP. For example, any particular risk factor need not be predictive of bad outcomes because protective factors in youth's lives may counteract them. Using interventions derived from the TTI could place those protective factors in the lives of children in risky contexts in a strategic and intentional manner that actualizes the goals of HB change so essential to public health (Dodge and Pettit, 2003).

It is also important to understand that each behavior has multiple determinants (in addition to each ultimate cause influencing multiple behaviors). The complex relationships between causes and outcomes can be characterized as a "complex adaptive system" (Gell-Mann, 2003; Trochim, Cabrera, Milstein, Gallagher, and Leischow, 2006; Waldrop, 1992). One can view multiple pathways of influence coming into each behavior, the outcome-oriented view (Elder and Pellerin, 1998), or multiple pathways of influence emanating from each ultimate causal factor, the event-oriented view (Elder and Pellerin, 1998). The outcome-oriented model links multiple events, from proximal to distal, to the outcome of interest. Conversely, the event-oriented model links the events of interest to multiple proximal and distal outcomes. Both the outcome-oriented and event-oriented approaches can be applied to studies of HP. Somewhere in the middle is the complexity that is located between bottom-up and top-down explanations of nearly all behaviors and scientific phenomena. Biological systems theorists have called this region of complexity "the uncharted territory of ant country" after the phenomenon of ants using simple rules that lead to complex behavior (Stewart and Cohen, 1997). It is a bit like a chess game; at the beginning and end, the moves are all quite easy to understand, but in the middle, when you have a number of pieces on the board, even a chess master cannot work out your next move without knowing your overall plan.

Working upwards from intentions/decisions and other affective/cognitive factors, it is (just) possible to explain most behavior. However, the properties of affective/cognitive factors also need explanation, and these multiply upwards. In this sense, affect and cognitions, taken alone, cannot explain every behavior (or any of them!). On the other hand, simply moving to the ultimate levels and saying that nature or nurture explain everything is not very satisfying either (Institute of Medicine, 2006). Both extremes, by themselves, are almost useless as explanatory devices—we need to understand the influences on behavior (and our health) at both levels and the complexity of the linkages in between. The TTI is our attempt to understand "ant country"; to provide the linkages between the more traditional top-down and bottom-up approaches to understanding behavior.

Anyone in the business of HP must know two things: what causes HRBs, and how to effectively promote health-enhancing behaviors (like wearing seat belts) or deter health-compromising behaviors (like smoking cigarettes). This knowledge, however, has been evasive. We hope that those in the business of HP will benefit by pinning the TTI to their walls.

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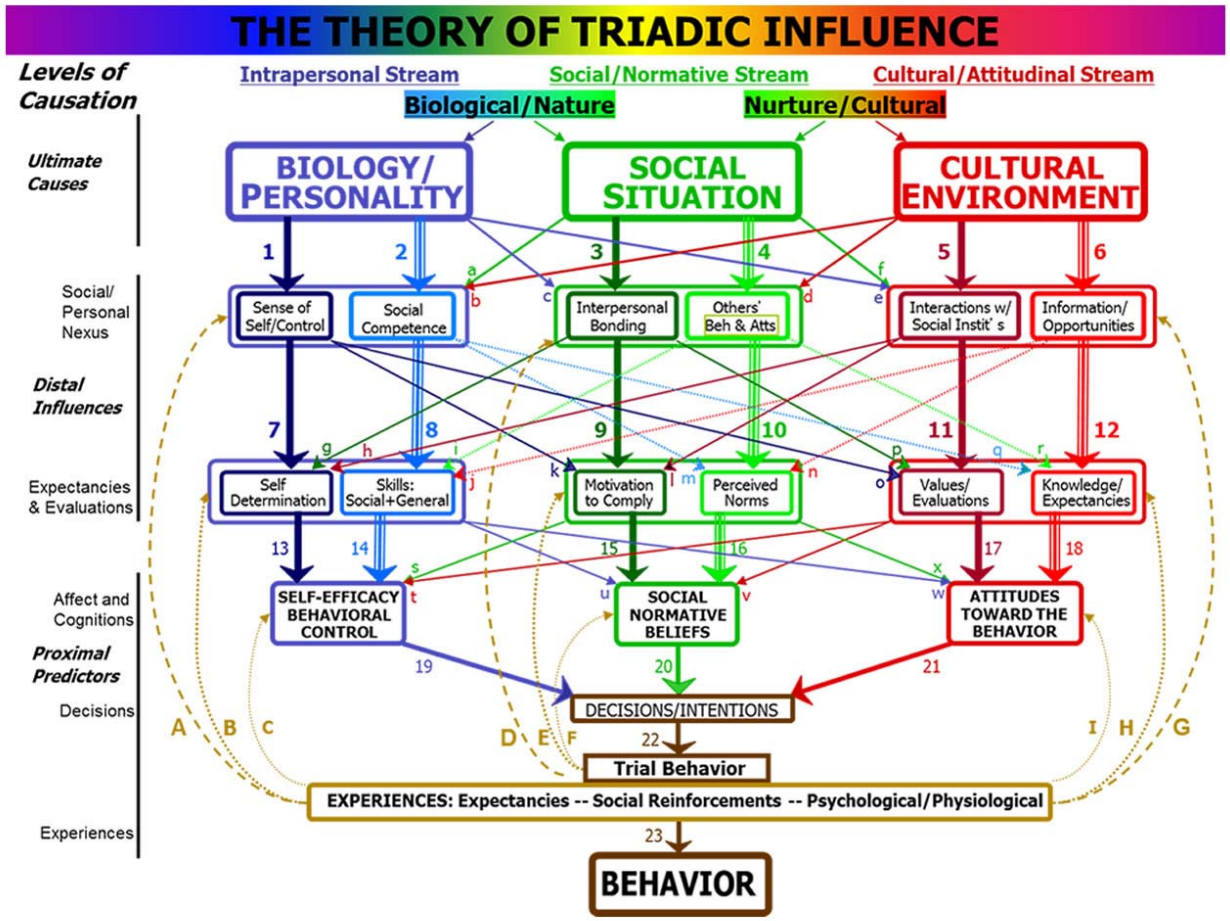
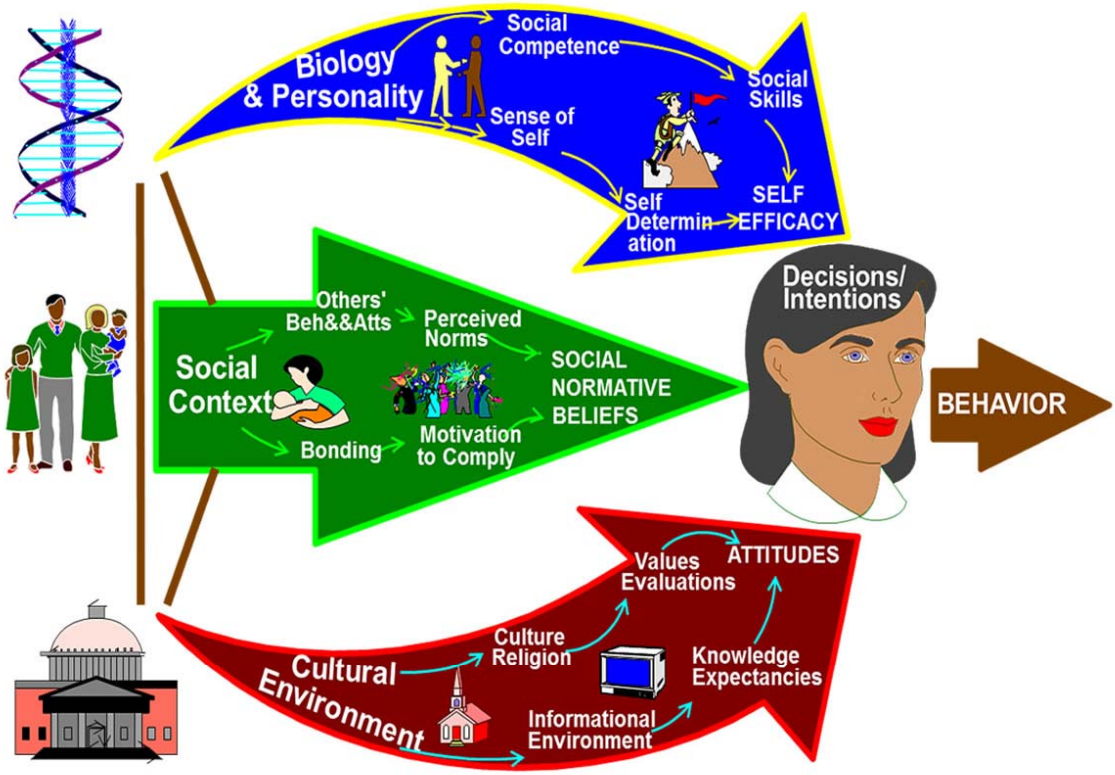
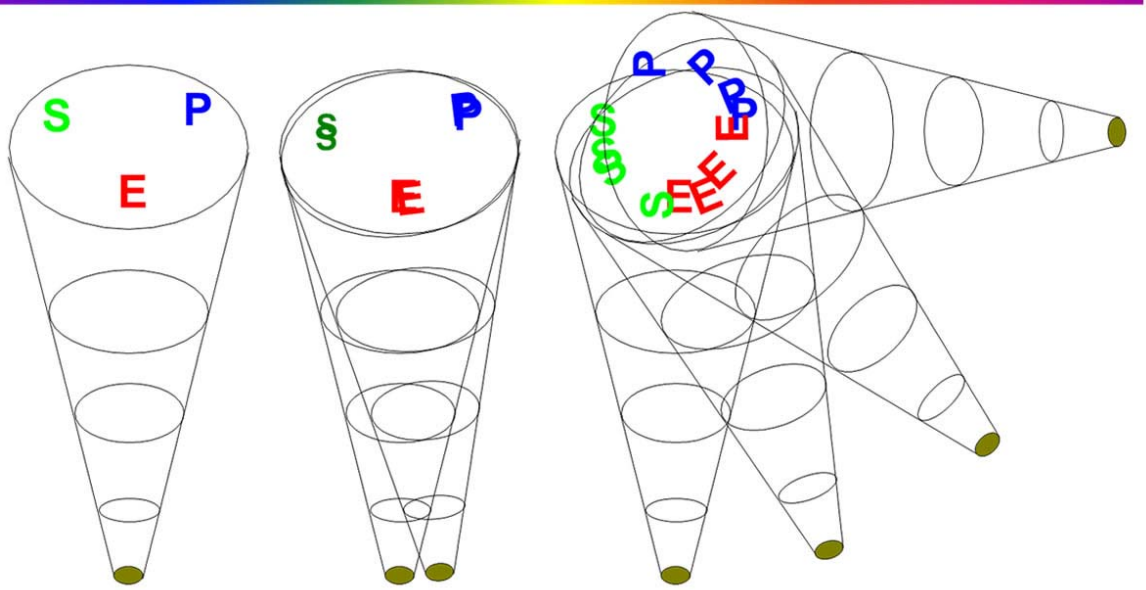

THE THEORY OF TRIADIC INFLUENCE
Levels of Causation
Intrapersonal Stream
Social/Normative Stream
Cultural/Attitudinal Stream
Biological/Nature
Nurture/Cultural
Ultimate Causes
BIOLOGY/ PERSONALITY
SOCIAL SITUATION
CULTURAL ENVIRONMENT
Social/ Personal Nexus
Sense of Self/Control
Social Competence
Interpersonal Bonding
Others' Beh & Atts
Interactions w/ Social Instit's
Information/ Opportunities
Distal Influences
Expectancies & Evaluations
Self Determination
Skills: Social+General
Motivation to Comply
Perceived Norms
Values/ Evaluations
Knowledge/ Expectancies
Affect and Cognitions
SELF-EFFICACY BEHAVIORAL CONTROL
SOCIAL NORMATIVE BELIEFS
ATTITUDES TOWARD THE BEHAVIOR
Proximal Predictors
Decisions
DECISIONS/INTENTIONS
Trial Behavior
Experiences
EXPERIENCES: Expectancies -- Social Reinforcements -- Psychological/Physiological
BEHAVIOR

THE BASICS OF THE THEORY OF TRIADIC INFLUENCE



Closely and less related behaviors:

Ultimate causes may be the same, distal predictors less so.



A single behavior Eg, smoking

Two closely related behaviors. Eg, smoking and drinking

Less and less related behaviors. Eg, smoking, drug abuse, sex, exercise.