CHAPTER

4

Conceptual Perspectives

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The rationale for increasing physical activity levels and reducing sedentary behaviors is well outlined in other chapters of this book (e.g., see chapter 2). Children benefit physically, mentally, emotionally, and socially from participating in physical activity (U.S. Department of Health and Human Services, 1996; SPARK, 2004). Physically, these outcomes in youth consist of increased bone mass, aerobic fitness, and high-density lipoproteins as well as reduced risk for hypertension, obesity, and diabetes (Myers et al., 1996). Studies have also shown that students who participate in physical activity programs experience improved psychological health, concentration, and academic achievement (Sallis et al., 1999; SPARK, 2004). Emotionally and socially, youth who participate in sport have higher levels of confidence, stronger self-images, reduced disruptive behavior, and lower levels of depression (Dowling, 2000).

Despite these benefits, less than one-half of young adults are sufficiently active; and the prevalence of overweight is at an all-time high among children and adolescents, reaching epidemic proportions (Centers for Disease Control and Prevention [CDC], 2004). Decreasing physical activity levels and increasing sedentary behavior levels have been declared a public health burden for our society (CDC, 2001; Dishman et al., 2002). There is a strong need for research that identifies correlates of physical activity levels and sedentary behavior and for theories and frameworks that logically combine the correlates to increase our understanding of, and our ability to effectively and efficiently augment, physical activity levels and reduce sedentary behaviors.

Inactivity is an independent contributor to chronic health issues (such as obesity and diabetes); however, we know little about how and why people decrease their inactivity levels. Theorists should devote time and effort to conceptualizing a theory or framework for inactivity, specifically focusing on reducing factors related to its prevalence. Despite the absence of theory or a conceptual

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framework to examine the nature of inactivity, there is evidence that interventions placing an emphasis on decreasing inactivity can result in positive health behavior change and may reduce obesity (DeMattia, Lemont, & Muerer, 2006). Because interventions that focus on reducing inactivity often stress increasing knowledge, physical activity, or healthy eating patterns, it becomes difficult to tease out the true magnitude of the impact that inactivity interventions have on weight (DeMattia et al., 2006). We need more research on these topics, including follow-up data on study participants six months or more beyond an intervention, in an effort to truly identify the causal relationships among inactivity messages and outcomes.

Necessity and Status of Theory

Although recently there has been much focus on child-centered health education, less attention has been paid to the theoretical underpinnings of interventions (Theunissen & Tates, 2004). Theory-based interventions have the potential to help identify factors related to specific populations and health behaviors, enabling the design of more effective interventions (Biddle & Nigg, 2000; Theunissen & Tates, 2004). Also, in spite of the potential usefulness of models applied in health behaviors, many of them have primarily been developed for adults (Theunissen & Tates, 2004). Caution is warranted as developmental issues like biological maturation, changing social influences (e.g., parents vs. peers), and life responsibilities may differentially influence behavior change. Therefore, it is recommended that researchers incorporate developmental factors when adapting an existing theory for adults to apply to children.

Definition of Theory

A *theory* is a proposed description or model that explains natural phenomena (what is known) and that can be used to make testable predictions of future occurrences or observations (Kerlinger, 1973; Wikipedia, 2006). In other words, a good theory of physical activity or inactivity should be able to organize facts into meaningful wholes and increase clarity about what is known. A good theory predicts relationships, mechanisms, or outcomes. The expected relationships also must be testable through experimentation or be able to be falsified through some empirical observation. Support for a specific theory should come from many strands of evidence rather than a single foundation (Wikipedia, 2006). Ultimately, a theory provides guidance for systematically collecting facts, formulating hypotheses, and extending knowledge (King, 1978). Although in psychology of physical activity and sport, distinctions are sometimes made between the terms theory and model, these distinctions are not consistently observed in the field. We have chosen to follow that convention by using the two terms interchangeably in this chapter.

Further components of theory quality are the following:

- **Parsimony—**the ability to explain things in as simple a fashion as possible while maintaining completeness
- **Generalizability (**a.k.a. **transferability)—**applicability from one situation to the next and from one population to the next
- **Productivity—**the ability to drive experimentation and produce knowledge

These three characteristics determine how useful a theory is; a theory or framework that is not characterized by these qualities is not useful. Physical activity and inactivity research should be grounded in theory, and each theory should be tested and revised through research. Use of theories in our field helps us to verify knowledge about decision making and provides a rationale for gathering reliable and valid data that are essential for effective decision making and implementation (King, 1978). In creating theories or conceptual models for physical activity, it is important to identify particular correlates of behavior change in the population being studied.

Correlates of Youth Activity and Inactivity

Sallis, Prochaska, and Taylor (2000) reviewed the literature and identified a set of consistent correlates of youth physical activity. In children ages 3 to 12 years, positive correlates were

- contextual variables (sex, ethnicity, parental overweight status, program and facility access, and time spent outdoors),
- psychological variables (physical activity preference, intention to be active, enjoyment, attitudes, confidence), and
- behavioral variables (previous physical activity behavior, diet).

In an example of a study using objectively measured physical activity, preadolescent youth (6th graders) with a mean age of 11.4 years were sampled (Trost et al., 1999). This study showed that for boys, physical activity self-efficacy, social norms related to physical activity, and involvement in community physical activity organizations were significant predictors of moderate-to-vigorous physical activity (MVPA). For girls, only physical activity self-efficacy was found to be a predictor of objectively measured physical activity. In contrast to the abundance of literature concerning the determinants of physical activity, less is known about the determinants of inactivity. This is an important, emerging area of research that is necessary for developing theory addressing inactivity.

The Developing Theoretical Foundation

Over the last three decades, the literature applying theory to the field of physical activity has grown substantially (Dishman, 1994; King et al., 2002). The most popular theories driving the field of physical activity to date have been the theory

of reasoned action/planned behavior (Ajzen, 1988, 1991; Hausenblas, Carron, & Mack, 1997), the transtheoretical model of behavior change (Prochaska & Marcus, 1994; Prochaska & DiClemente, 1983), social cognitive theory (Bandura, 1986), and more recently self-determination theory (Chatzisarantis & Biddle, 1998; Deci & Ryan, 1985) and the health action process approach (Schwarzer, 1999).

These theories can be placed in larger conceptual categories of belief-attitude, competence-based, control-based, and decision-making approaches (Biddle & Nigg, 2000). This categorization has evolved to belief-attitude, competence-based, control-based, stage-based, and hybrid models (Biddle et al., 2007; chapter 8). The conceptual categories make it evident that these approaches stem from understanding an individual's psychology, targeting motivation, intentions, and behavior. This is undertaken either within the psychological context by itself or within the social psychological context, the immediate or microlevel social environment (Biddle & Nigg, 2000; King et al., 2002). Each approach has directed the attention of the field to some very useful determinants and has provided guidance on how to develop programs and interventions (see preceding section on correlates of youth activity and inactivity).

Specific models and theories translated into the field of physical activity are described in various chapters of this book. For example, although the theory of planned behavior (TPB; Ajzen, 1991) is popular in adult physical activity work, it has been underutilized in examinations of youth physical activity and has not been used to address youth sedentary behavior at all. Existing results (Craig, Goldberg, & Dietz, 1996; Trost, Saunders, & Ward, 2002; Trost et al., 2002) provide promising evidence for use of the TPB as a model for child and adolescent physical activity interventions, but additions to the TPB or other approaches seem to be necessary with this population (e.g., enjoyment and environmental considerations). Only a small amount of variance in physical activity is accounted for by TPB, and similar results have been shown with other theories. Although there is some evidence that these theories account for a meaningful proportion of variance, there is much more to be explained.

A Health Behavior Change Model

In recent years only one conceptual model has been proposed to increase physical activity among youth: Welk's (1999) Youth Physical Activity Promotion Model. Based on an ecological framework (Green and Kreuter's 1991 Precede-Proceed Model), Welk's model suggests that multiple levels of the environment (e.g., institutional, physical, cultural, social) can directly and indirectly influence behavior. In addition, Welk's model provides a conceptual framework for determining how youth become predisposed to physical activity and how physical activity is enabled and reinforced.

Predisposing factors, which increase the likelihood that youth will be regularly active, include factors such as self-efficacy, perceived competence, enjoyment,

beliefs, and attitudes (Welk, 1999). Enabling factors include both biological and environmental elements that allow youth to be physically active. Examples of enabling factors include fitness, access to facilities, skill, and environmental supports for physical activity. Reinforcing factors increase the likelihood that youth will increase and maintain physical activity, and they influence behavior directly and indirectly. Such factors include family, peer, teacher, and coach influence (Kimiecik & Horn, 1998). Welk's model provides a bottom-up framework according to which demographics (e.g., age, gender, race, social-economic status) are considered prior to the establishment of a program. This framework takes into account a given population's specific characteristics and needs. Despite the holistic nature of Welk's model, there are no studies to date that apply its principles. Although the study of sedentary behavior has recently been brought to the forefront (Robinson, 1999), there are no theories or conceptual frameworks specifically designed to address sedentary behaviors. As noted earlier, further work on determinants of inactivity is also needed in order to generate such theory.

A Review of Theory-Based Interventions

We identified several physical activity interventions among children or adolescents. Synopses and results of the identified interventions are reported in table 4.1. We used two criteria for selecting an intervention study: The study had to have been published following the review by Stone and colleagues (1998) and to have been theory based. The majority of the studies were conducted in the school environment, with the remaining conducted in low-income areas, summer camps, subjects' households, and the primary care setting. Each intervention was designed either to increase MVPA, decrease inactivity, or reduce cardiovascular risk factors such as obesity. The most commonly cited theories driving the interventions were the social cognitive theory (Bandura, 1986) and the social ecological model (Stokols, 1996).

The school or after-school environment is particularly popular as a setting for the implementation of interventions because schools are cost-effective and efficient vehicles for providing physical activity instruction and programs that reach a large number of children and adolescents (CDC, 1997; Faucette et al., 1995). Youth who are not engaging in these activities in the school environment may also miss out on these opportunities during their leisure time or at home (Dale, Corbin, & Dale, 2000). Such activities and programs facilitate the skills and knowledge necessary to support an active and healthy lifestyle. Interventions within the school environment have been effective in enhancing students' physical activity–related knowledge (Arbeit et al., 1992; Bush et al., 1989a, 1989b), attitudes (Prokhorov et al., 1993), and level of physical fitness (Kelder, Perry, & Klepp, 1993; Kelder et al., 1995).

Table 4.1 Theory-Based Physical Activity Interventions Among Children and Adolescents

Author and year Experimental design Setting	Intervention name Theoretical components Measures Follow-up time	Demographic Sample size
Baranowski et al. (2003a) Randomized controlled trial Summer camp and Internet programs	Name: The Fun, Food, and Fitness project (Baylor GEMS pilot study)—designed to increase fruit and vegetable (FV) consumption by replacing dietary fat with FV, increase water intake, and increase moderate or vigorous physical activity (PA) to 60 min per day. Girls were trained to set goals, social support was advised, and fun activities were encouraged. Theory: social cognitive theory (SCT) Measures: body mass index (BMI), PA, sexual maturation, diet Follow-up: 12 weeks	8-year-old Black girls (n = 73) and their parents (n = 82)
Caballero et al. (2003); Stevens et al. (2003) For others see *Preventive Medicine, 37,* Suppl. l Randomized controlled trial Elementary schools	Name: Pathways—a multicomponent intervention for reducing body fat in American Indian children. Intervention components consisted of classroom curriculum, food service, physical education, and family involvement. Theory: social learning theory and relevant cultural practices (e.g., storytelling) Measures: body composition; PA; PA-related behaviors, attitudes, and knowledge; dietary intake Follow-up: 3 years	1704 American Indian children
Fitzgibbon et al. (2005) Randomized controlled trial Elementary schools	Name: Hip-Hop to Health Jr.—designed to promote healthy eating and PA of children enrolled in Head Start. Theory: SCT, self-determination theory, and the transtheoretical model that incorporates the stages of change Measures: dietary intake, BMI, and PA Follow-up: 2 years	420 primarily African American children (mean age = 4 years; parent mean age = 30)
Ford et al. (2002) Randomized controlled trial Low-income urban community clinic	Name: No name; an intervention to reduce television viewing among low-income urban African American children. Theory: SCT Measures: BMI ≥85th percentile; number of televisions in the home; number of families with television in child's bedroom; number of VCRs in home; number with video game player hooked to a television; hours children spent watching television or videotape and in video game play; overall household television use; days having breakfast with television on; days having dinner with television on; hours playing outside; hours of organized PA Follow-up: 4 weeks	28 families with 7- to 12-year-old children

RESULTS		
Evaluation presented (Yes/No)	**Summary**	**Litmus test to evaluate theory**
Yes, but reported elsewhere	BMI at the end of the summer camp did not vary between conditions; lower calories from fat and beverages reported by intervention group. No changes in PA were reported.	1. Yes 2. No, not reported 3. Yes 4. Yes 5. No, not reported 6. Yes 7. No, not reported 8. No
Yes	There were no significant differences between groups for body composition. Dietary intake was lower among intervention students. No significant differences were observed between the two groups for the PA motion sensor, but self-report revealed higher reported PA among intervention students. Knowledge and self-efficacy for PA increased in the intervention group.	1. Yes 2. No 3. No 4. No 5. No 6. Yes 7. No 8. No
No	At year 1 and year 2 postintervention, the increase in BMI was greater in control students relative to intervention students. No significant differences were observed postintervention for TV viewing or for exercise frequency or intensity.	1. Yes 2. No 3. No 4. No 5. No 6. No, not measured 7. No, not reported 8. Yes
No	Both groups reported differences in television/video watching, playing video games, and total household television use. The intervention group reported a statistically significant increase in organized game play and a nearly significant increase in outside activity. There was also evidence for a decrease in overall family television use and meals eaten in front of the television in the intervention group, although nonsignificant.	1. Yes 2. No 3. No, not reported 4. No, not reported 5. No, not reported 6. No, no independent variables 7. No mediators measured 8. Yes, but for both groups

(continued)

Table 4.1 *(continued)*

Author and year Experimental design Setting	Intervention name Theoretical components Measures Follow-up time	Demographic Sample size
Gortmaker et al. (1999a) Quasi-experimental field trial with matched control Public elementary schools	Name: Eat Well and Keep Moving—an intervention designed to enhance cognitive and behavioral skills and focused on four behavioral outcomes: reduced fat intake and TV viewing, increased PA and FV consumption. Theory: SCT and school-level change theories Measures: dietary intake, PA, TV viewing, FV intake, and dietary and PA knowledge Follow-up: 2 years	479 predominantly African American students
Gortmaker et al. (1999b) Randomized controlled trial Public middle schools	Name: Planet Health—designed to reduce obesity by reducing TV viewing and high-fat food and increasing moderate and vigorous PA and FV consumption. Theory: behavior choice and SCT Measures: BMI, TV viewing, FV intake, and PA Follow-up: 2 years	1560 middle school students
Jamner et al. (2004) Quasi-experimental trial with matched control High school physical education (PE) classes	Name: Project FAB—an intervention designed to modify variables related to PA such as enjoyment, self-efficacy, benefits, barriers, and social support. Theory: behavioral modification (e.g., goal setting, self-monitoring, problem solving) Measures: VO_2max, body composition, BMI, PA, lifestyle activities, self-efficacy, barriers, social support, enjoyment Follow-up: 4 months	58 sedentary adolescent females in grades 10 through 11
Kelder et al. (2003) Randomized controlled trial with delayed intervention for former control and recruitment of new control PE classes	Name: CATCH-PE and CATCH-ON—took place 5 years after the completion of the original CATCH intervention; 56 former intervention (FI), 20 former control (FC), and 12 unexposed control (UC) schools participated. Theory: SCT and organizational change (OC) Measures: SOFIT and in-depth interviews Follow-up: 1 year	645 3rd- to 5th-grade classes

RESULTS		
Evaluation presented (Yes/No)	**Summary**	**Litmus test to evaluate theory**
No	Dietary fat was reduced and FV consumption was increased among students within the intervention group relative to the control group. The reduction in TV viewing was lower in the intervention group but the difference was not statistically significant. No differences were observed for PA.	1. Yes 2. No 3. No 4. No 5. No 6. Yes 7. No 8. Yes for dietary fat and FV intake
Yes	The prevalence of obesity in girls increased for control schools but decreased for intervention schools. Among boys, no significant difference was observed for obesity; hence, both declined at the same rate in the two groups. The intervention effect for obesity was larger for Black girls. TV viewing decreased in intervention girls and boys compared to control.	1. Yes 2. No 3. No 4. No 5. No 6. No psychosocial variables to compare 7. No, not reported 8. Yes, but only for girls
No	*Physical fitness:* VO_2max remained constant in the intervention group but declined in the control group. *Physical activity recall:* The intervention had a significant effect on light, moderate, and total activity. Intervention group increased total energy expenditure while the control group showed a decline. Those in the intervention group were seven times more likely to report hard activity compared to the control group. *Lifestyle activity:* Lifestyle activity was significantly increased in the intervention group but not the control group. *Psychosocial variables:* No effect was observed.	1. Yes 2. No 3. No 4. No 5. No 6. Yes 7. No 8. Yes
Yes	Students in FI schools spent more time in moderate-to vigorous PA and vigorous PA, but these values were not significantly different from those in the FC or UC schools. FI and FC schools spent more time on general knowledge and skills, while UC schools spent more time on game and free play. More FI school teachers reported having the CATCH-PE materials and curriculum compared to FC teachers.	1. Yes 2. No for SCT, but yes for OC 3. No, not reported 4. No, not reported 5. No, not reported 6. Yes 7. No, not reported 8. Yes

(continued)

Table 4.1 *(continued)*

Author and year Experimental design Setting	Intervention name Theoretical components Measures Follow-up time	Demographic Sample size
Nader et al. (1999) Randomized controlled trial 5th- to 8th-grade students	Name: CATCH III—designed to determine whether the 5th-grade intervention resulted in changes in eating and activity attitudes and behaviors at grade 8 of the CATCH II cohort (56 intervention and 40 control schools). Theory: SCT and OC Measures: 24 h diet recall, food checklist, PA checklist, health behavior, blood pressure, lipid and cholesterol levels Follow-up: 3-year follow-up of the original CATCH II cohort	3714 8th-grade students
Neumark-Sztainer et al. (2003) Randomized controlled trial School based	Name: New Moves—a school-based obesity prevention intervention for adolescent girls. Theory: SCT Measures: stage of change, PA, sedentary behavior, BMI, diet-related behaviors (soda intake, breakfast, fast food, weight control behaviors, binge eating), self-acceptance, athletic competence, physical appearance, self-worth, media internalization, exercise benefits, eating benefits, exercise enjoyment, self-efficacy, parental support, peer support, staff support Follow-up: 16 weeks	201 high school adolescent girls
Nigg et al. (2006); Battista et al. (2005) Quasi-experimental study Elementary after-school programs	Name: Fun 5—a PA and FV intervention implemented in elementary after-school programs in Hawaii. Fun 5 offered a variety of organized, noncompetitive, non-gender–specific and fun activities in which children of all skill levels can participate and experience success. Theory: structural ecological model, SCT, theory of planned behavior, stages of change Measures: school-based and leisure-time PA, FV consumption, enjoyment, self-efficacy, intentions, social norms, attitudes, PA stage, perceived behavioral control Follow-up: 1 year	Pilot: n = 533 (48% female) Year 1: n = 453 (54% female). All participants were public elementary school students
Pate et al. (2003) Quasi-experimental trial with matched control Rural communities	Name: Active Winners—designed to increase PA and increase the hypothesized determinants of PA. Active Winners consisted of four parts: Active Home, Active School, Active Kids, and Active Community. Theory: SCT and Pender's health promotion model Measures: PA, self-efficacy, beliefs regarding PA, social influences on PA, intentions to be physically active Follow-up: 18 months	558 predominantly Black middle school students

RESULTS		
Evaluation presented (Yes/No)	**Summary**	**Litmus test to evaluate theory**
Yes	At the end of the trial, intervention students reported significantly lower energy intakes compared to control students. Intervention students reported more minutes of PA compared to control students (30.2 vs. 22.1 min). Health knowledge and healthy food choices were higher in the intervention group. No differences were observed for physiological measures.	1. Yes 2. No, not reported 3. No, not reported 4. No, not reported 5. No, not reported 6. Yes 7. No, not reported 8. Yes
Yes	Program participants rated the study favorably. The majority of the outcome variables did not significantly differ between groups. At postintervention, 31% of intervention students progressed in stage compared to 20% of control group participants, while 19% and 24% regressed in stage by postintervention. At follow-up no change in stage increase was observed among control students, while 38% overall in the intervention group progressed.	1. Yes 2. No 3. No 4. No 5. No 6. Yes 7. No 8. Yes, but only PA stage of change
Yes	Overall, there was a 21% decrease in time spent standing, sitting, and lying down and a 140% increase in moderate and vigorous PA during the after-school program. Results on self-reported leisure-time activity revealed a significant increase in moderate PA over the course of the program. During its pilot phase, Fun 5 did not appear to affect FV consumption. One year after the initial pilot study, Fun 5 resulted in an increase in moderate and vigorous PA and in FV consumption. No changes in psychosocial variables were observed 1 year after implementation (unpublished).	1. No, not reported 2. No 3. No 4. No 5. No 6. No 7. No 8. Yes
Yes	No significant differences were observed in moderate to vigorous PA or psychosocial variables between intervention and control conditions over time. The control group usually reported higher mean scores compared to the intervention group in both boys and girls for psychosocial variables.	1. Yes 2. No 3. No, not reported 4. No 5. No 6. Yes 7. No 8. No

(continued)

Table 4.1 *(continued)*

Author and year Experimental design Setting	Intervention name Theoretical components Measures Follow-up time	Demographic Sample size
Pate et al. (2005); Felton et al. (2005) Randomized cohort design High schools	Name: LEAP—designed to promote PA by changing the instructional practices in the school environment. LEAP, designed to enhance self-efficacy and enjoyment, consisted of two components: LEAP PE and LEAP education. Theory: social ecological model and the coordinated school health approach Measures: PA, BMI, self-efficacy, enjoyment Follow-up: 2 years, but this study provides only 1-year results.	2111 Black and White girls
Resnicow et al. (2000) Quasi-experimental (no control) Public housing units	Name: GO GIRLS—designed to increase FV consumption and PA behavior, reduce TV viewing, and decrease dietary fat, as well as to enhance skills, efficacy, and outcome expectations. Theory: SCT Measures: BMI, outcome expectation, social support, self-efficacy, health knowledge, perceived weight, PA Follow-up: 6 months	57 Black adolescent females
Robinson (1999) Randomized controlled trial Elementary schools	Name: no name; designed to reduce television, videotape, and video game, changes in adiposity, PA, and dietary intake. Theory: SCT Measures: BMI; tricep skinfold thickness; waist hip circumferences; waist-to-hip ratio; time watching TV, watching movies or videos on a VCR, and playing video games (before and after school, yesterday, and last Saturday). (Children's television/video viewing and game playing were validated by estimated parental reports. Children and parents estimated time spent in sedentary activity [homework, reading, computer use, listening to music, playing instruments, etc.].) Previous-day out-of-school activity, organized and nonorganized game play, 1-day food frequency recalls, 20 m shuttle run test, and meals in front of the TV. Follow-up: 7 months	198 4th-grade public elementary students

RESULTS		
Evaluation presented (Yes/No)	**Summary**	**Litmus test to evaluate theory**
Yes	The prevalence of regular vigorous PA was greater in intervention schools than control schools. Eighty percent of girls in both conditions were enrolled in PE classes as 9th-grade students. Previous studies provided evidence that the LEAP intervention influenced psychosocial variables (Dishman et al., 2004).	1. Yes 2. No 3. No 4. No 5. No 6. Yes 7. Not known 8. Yes
No	High attendees reported more social support for diet and exercise changes. No significant differences in physiological outcomes or behavioral measures.	1. Yes 2. No, not reported 3. No 4. No 5. No 6. Yes 7. No 8. No
Yes	BMI, skinfold thickness, waist circumference, and waist-to-hip ratio increased in both groups as expected, but this increase was significantly lower for those in the intervention. A significant difference in TV viewing and video game playing was observed among intervention students compared to controls. A significant reduction in eating in front of the TV was observed. No significant differences were observed for PA levels or 20 m shuttle run test. No significant sex differences were observed.	1. Yes 2. No 3. No 4. No 5. No 6. No, not reported 7. No, not reported 8. Yes

(continued)

Table 4.1 *(continued)*

Author and year Experimental design Setting	Intervention name Theoretical components Measures Follow-up time	Demographic Sample size
Robinson et al. (2003) Two-arm parallel group randomized trial Low-income neighborhoods	Name: Stanford GEMS Pilot Study—an after-school dance and family-based intervention to reduce obesity and sedentary behavior. Theory: SCT (i.e. attention, retention, production, and motivation) Measures: BMI, waist circumstance, sexual maturation, blood plasma, reported media use, TV viewing, eating while watching TV, 24 h dietary recalls, PA accelerometer, overconcerns with weight and shape, self-esteem Follow-up: 12 weeks	61 8- to 10-year-old African American girls
Roemmich et al. (2004) Randomized controlled trial Family based	Name: no name; evaluated the effect of open-loop feedback and reinforcement on PA and TV time in a sample of sedentary youth. Theory: Premack's theory of reinforcement Measures: BMI, objective daily PA, and a habit book used to record time spent in sedentary behaviors (TV time, recreational computer use, handheld video game play, reading, and telephone time) Follow-up: 6 weeks	21 families with children ages 8 to 12 years
Saelens et al. (2002) Randomized controlled trial Primary care setting	Name: Healthy Habits—a behaviorally based weight control intervention for overweight adolescents initiated in primary care. Theory: behavioral modification Measures: BMI, 2-day dietary recalls, 7-day PA recall, 7-day sedentary behavior self-report, problematic eating and weight-related behaviors and beliefs, physician counseling, behavioral skills use, and participant satisfaction Follow-up: 4 months	44 overweight adolescents aged 12 to 16 years

RESULTS		
Evaluation presented (Yes/No)	**Summary**	**Litmus test to evaluate theory**
Yes	Most of the results of the study were nonsignificant; however, evidence of a 7% (91 counts/min) increase in PA counts was observed in the intervention group relative to the control group. Significant differences were observed in total household TV use (20%) and eating dinner with TV on (10%). The treatment group reported 20% fewer hours of TV, videotape, and video game use and 10% fewer meals eaten with the TV on. A statistically significant decrease in the treatment group was observed for overconcerns with weight and shape.	1. Yes 2. No, but the four components are explained 3. No 4. No 5. No 6. Yes 7. No 8. Yes, but only household TV use
No	There were no group differences for BMI over the course of the study. The open-loop feedback group increased PA by 24%, which was greater increase than in the control group. Although TV time was not significantly different, subjects in the open-loop feedback group reduced TV time by 20 min per day while the control group increased TV time by 13 min.	1. Yes 2. No 3. No 4. No, not reported 5. No 6. No independent variables measured 7. No mediators measured 8. Yes
No	At posttreatment, there was a statistically significant difference in BMI over time between the healthy habits group and the typical care or control group. More healthy habits adolescents reduced their BMI when compared to the typical care adolescents (40% vs. 10.5%). No significant differences between conditions were observed at posttreatment for dietary fat intake, PA, sedentary behavior, or problematic eating- and weight-related behaviors or beliefs. At follow-up, the treatment-by-time interaction for BMI remained significant; however, linear contrasts for BMI from posttreatment to follow-up revealed no differential change in BMI scores. From baseline to follow-up, more healthy habits adolescents had decreased BMI scores from baseline values than typical care adolescents (55.6% vs. 15.8%). No significant interactions by conditions were observed among the remaining variables. Healthy habits participants reported higher rates of eating- and PA-specific behavioral skills compared to typical care students.	1. Yes 2. Yes 3. Yes 4. Yes 5. No 6. Yes, measured 7. Yes, use of skills changed 8. Yes, but only BMI

(continued)

Table 4.1 *(continued)*

Author and year Experimental design Setting	Intervention name Theoretical components Measures Follow-up time	Demographic Sample size
Sallis et al. (2003) Randomized controlled trial Public middle schools	Name: M-SPAN—a PA and nutrition intervention implemented in middle schools with the intent to influence the school environment and policies. Theory: structural ecologic model Measures: SOFIT, System for Observing Play and Leisure Activity in Youth (SOPLAY), PA, dietary fat Follow-up: 2 years	24 public middle schools, 1109 participants
Warren et al. (2003) Four-arm randomized controlled trial Oxford primary schools	Name: Be Smart—a school- and family-based intervention to prevent obesity of children in three primary schools in Oxford, U.K., randomized into four conditions (Be Smart [control], Eat Smart, Play Smart, and Eat Smart Play Smart). Theory: SCT Measures: anthropometry (BMI, skinfold thickness, and circumference from the waist, hip, upper arm, and head), nutrition knowledge, PA (transportation to school, playground activity, and lunchtime activities), 24 h recall, parental questionnaires (PA, nutrition knowledge, and social and medical history) Follow-up: 14 months	213 children ages 5 to 7 years selected from three primary schools

School Based

The interventions we identified that were conducted in schools often infused science-based health education within normal physical education classes and encouraged teachers to reduce management time (e.g., SPARK, CATCH, LEAP, Project FAB). Additional strategies included providing parents with newsletters regarding the program to build support for the students involved and encouraging the reduction of television viewing (e.g., HIP-HOP to Health Jr.). M-SPAN in particular promoted activity through media messages on bulletin boards throughout the school and encouraged structured activity before, during, and after school (Sallis et al., 2003).

Despite the level and magnitude of the interventions, several resulted in little or no change in physical activity. For example, no intervention effects were observed for activity or inactivity among the Baylor GEMS, Eat Well

RESULTS		
Evaluation presented (Yes/No)	**Summary**	**Litmus test to evaluate theory**
No	Intervention schools increased PA at a greater rate than control schools. Gender-specific results revealed that the increase was significant for boys but not girls. Boys increased PA in both PE and leisure time, while girls increased PA only during PE. No significant differences were observed for fat intake between groups.	1. Yes 2. No 3. Yes, but not described fully 4. Yes, but not described fully 5. No 6. Yes 7. No, not reported 8. Yes
Yes	There were no significant differences in overweight from baseline to follow-up. Nutrition knowledge increased in all groups. There was a small increase in number of children walking to school. An increase in activity in playground activities at morning break was reported in all groups, but was higher in all intervention groups. Overall there was a significant increase in FV consumption; however, this increase was even higher for the Be Smart and Eat Smart groups. No significant differences were observed in 24 h recalls between groups. Outcome evaluation suggested that children in the Eat Smart group scored significantly higher in nutrition knowledge compared to children in the Be Smart and Play Smart groups. No significant sex differences were observed.	1. Yes 2. No 3. No 4. No 5. No 6. Yes 7. No, no PA/inactivity mediators measured 8. Yes

and Keep Moving, and HIP-HOP to Health Jr. interventions. Conversely, interventions such as CATCH-PE, CATCH-ON, Project FAB, M-SPAN, Pathways, Be Smart, and Fun 5 resulted in positive behavioral outcomes. It is important to note that few studies reported changes in psychosocial variables as a result of the intervention. Interventions that successfully influence proposed mediators are more likely to have successful behavioral outcomes (Baranowski et al., 2003b). More research is needed in this area to determine the efficacy of school-based interventions.

Clinically Based

Clinically based physical activity and weight control interventions among children and adolescents have provided some evidence of long-term efficacy (Epstein et al., 1998). Pediatric primary care settings are ideal environments

for delivering theory-based research approaches to target manageable health risk behaviors, given the number of children and adolescents who see a doctor over the course of any given year (Epstein et al., 1998). Despite the practicality of the avenue, data are lacking on interventions in this area. Interventions in the primary care setting (Ford et al., 2002; Saelens et al., 2002) were plagued by small sample sizes and suffered from a lack of statistical power.

The Healthy Habits intervention was a multicomponent behavioral intervention for weight control among overweight adolescents in the primary care setting. The Healthy Habits intervention was based on concepts of behavioral modification (e.g., goal setting, problem solving, self-monitoring). Behavioral skills use among adolescents in the experimental condition was higher than in the typical care condition. In addition, the intervention resulted in an overall decrease in body mass index (BMI) among all participants (Saelens et al., 2002). Ford and colleagues (2002) conducted an intervention in a low-income urban community clinic in Atlanta, Georgia. The intervention was based on the social cognitive theory, with families receiving a brief counseling session. Decreases in children's television, videotape, and video game use were observed in the intervention condition. In addition, an increase in physical activity was observed among those in the behavioral intervention group.

A number of studies that were not reviewed because they were not theory based (e.g., Dennison et al., 2004; Faith et al., 2001; Simon et al., 2004) resulted in significant changes in physical activity, sedentary behavior, or obesity. Recent reviews have focused on interventions that target sedentary behavior and obesity among children and adolescents (DeMattia et al., 2006; Sharma, 2006). Although some of the approaches varied, there was evidence that programs targeting sedentary behaviors and obesity are quite effective (DeMattia et al., 2006). Sharma noted that television watching seems to be the most modifiable behavior, followed by physical activity. Most of the interventions we identified focused only on individual behavior change approaches that emphasize short-term changes. More longitudinal interventions are needed that include long-term follow-up data.

Critical Evaluation of Applied Theory

Current interventions often focus on psychosocial models within schools or community settings and have had modest success. However, limitations of these efforts are apparent. Few researchers have measured changes in the constructs of the theory inspiring their intervention; or, when they have done so, they measured only one construct to capture the totality of the theory. For example, researchers examining the effectiveness of school-based interventions grounded in the social cognitive theory commonly measure only the construct of self-efficacy, neglecting other components such as outcome expectations, reinforcement, and goal setting. In order to improve both theory and intervention, we must consider all concepts and constructs within a theory to find out what

components are really working (Sharma, 2006). In addition, some consensus is needed in the field regarding appropriate, psychometrically sound instruments for specific populations or environments.

Studies often produce weak results, if any at all, or may affect only one subset of the intended population. These problems often arise because researchers are not conducting preliminary research (e.g., qualitative inquiry, elicitation studies) in an effort to understand perspectives of the target population; this results in poor selection of the procedures used to influence potential mediators (e.g., psychosocial variables) in desired directions (Baranowski, Anderson, & Carmack, 1998). Similarly, selecting a theory for an intervention that is irrelevant to behavior change in a certain population will lead to nonsignificant findings. Hence, it is important to know relevant moderators (e.g., age, gender, and ethnicity) of one's intervention as well as the key mediators that influence behavioral change; this knowledge has a direct impact on the efficacy of an intervention (Baranowski & Jago, 2005).

In one example of evaluation of a theory-based intervention, investigators explored the intervening effects of the LEAP program on proposed social cognitive mediators (i.e., self-efficacy, goal setting, satisfaction, and outcome expectancy) in effort to increase self-reported physical activity (Dishman et al., 2004; Pate et al., 2005). The intervention successfully influenced self-efficacy, goal setting, and self-reported physical activity. In addition, self-efficacy partially mediated the effects of the intervention on physical activity, although no mediating effects were observed for goal setting, satisfaction, or outcome expectancy (Dishman et al., 2004). LEAP may have been effective because the mediating variables were related to physical activity and effective intervention strategies were in place to influence the variables in the desired direction.

Extensive process evaluations are needed to clearly assess how intervention components influence mediators. Baranowski and Stables (2000) outline a number of components relevant to successful process evaluations:

> *Recruitment* and *maintenance* of participants, *context* within which the program functions, *resources* available to the program and the participants, *implementation* of the program, *reach* of materials into (or receipt by) the target group, *barriers* to implementing the program, *initial use* of program activities, *continued use* of program-specified activities, and *contamination* of treatment and control groups. (p. 158)

Evaluating these components provides clear inferences about the effectiveness of the intervention, allowing one to determine successes and barriers to implementation. The implementation of process evaluation within youth physical activity research helps bridge the gap between research and practice, resulting in interventions that are transferable and that can produce significant effects on behavioral outcomes.

Studies employing process or formative evaluations that are described in table 4.1 include Active Winners, Pathways, CATCH, Fun 5, New Moves, LEAP,

Planet Health, Stanford GEMS, and Be Smart. The major limitation identified by Active Winners (Pate et al., 2003) was a lack of full implementation of all program elements. Relative to Pathways (Caballero et al., 2003; Stevens et al., 2003), though a positive intervention effect for physical activity was identified, the authors failed to relate changes in the psychosocial variables to elements of the evaluation. Baranowski and Jago (2005) also suggested that the family component of Pathways (Caballero et al., 2003; Stevens et al., 2003) might have had a limited reach. One of the more successful interventions implemented in recent years was CATCH (Kelder et al., 2003; Nader et al., 1999). Process measures indicated that the study was implemented as planned, but no associations among outcomes and psychosocial variables were ever reported. One year after its initial pilot study, Fun 5 (Battista et al., 2005; Nigg et al., 2006) replicated an increase in moderate and vigorous physical activity. Evaluation of Fun 5 suggested that the majority of the site coordinators and group leaders enjoyed implementing Fun 5 and perceived that enjoyment and enthusiasm among the kids increased with intervention implementation. Such belief in and support for a program usually result in successful implementation, which increases the probability of desired outcomes. For process evaluation information on the remaining interventions, see the related articles.

A Litmus Test for Evaluating the Use of a Theory

As we begin to evaluate theory as applied in youth physical activity interventions, it would be valuable to generate an evaluation protocol that outlines key considerations. Thus we offer the following "litmus test" comprising the factors to consider when one is evaluating the use of theory in this research area:

1. Is a theory identified? A theory may be explicitly stated or presented via a logic model. The chances are that if no theory is identified, the approach is not theory based or is based only on one or more parts of theories.

2. Is the theory described? If so, this suggests that the individuals doing the intervention understand how and why behavior change should come about. Lip service is provided too commonly in the literature: That is, a theory is named (e.g., health belief model, protection motivation theory), but no description or a limited description is given. This usually leads to problems with the next issue.

3. Are all components of the theory translated into the intervention or the components thereof? One should be able to discern what part of the intervention maps to the posited theoretical mediators. For illustrations of translating theory to intervention, we guide the reader to a special issue of *Health Education Research* (Nigg, Allegrante, & Ory, 2002).

4. Is there evidence that all of the intervention components were implemented? Such evidence is usually presented as part of the process evaluation. The process evaluation should provide information on the fidelity of the treatment or intervention for all the intervention components.

5. Are the components of the theory assessed? Frequently the major variable of a theory is assessed and then conclusions are made about its effectiveness or usefulness (e.g., self-efficacy—social cognitive theory; stages of change—transtheoretical model). Two major categories of variables should usually be evident:

- Moderators, which are preexisting conditions that influence the effectiveness of an intervention—by definition, moderator variables either exist prior to the intervention or program or are quantified at baseline
- Mediators, which are the mechanisms through which an intervention is expected to work—for a variable to qualify as a mediator, changes must occur *during* an intervention (Kraemer et al., 2002)

6. Are the theory variables and the outcome congruent? An intervention addressing the theory of planned behavior variables for overall physical activity may not be effective (may be too broad) to increase one specific behavior (e.g., swimming).

7. Did the mediators change during the intervention? This must occur in order to allow the claim that any change in the outcome is due to the mediator. If the mediators do not change, the reason may be faulty theory, and the validity of the theory being used needs to be questioned. For example, an intervention uses dramatic portrayals of heart attacks to motivate adolescents to be physically active but does not elicit a change in perceived severity, which is thought to lead to protective behavior (physical activity), might not be appropriate for this population. As another example, a participant may not interpret the intervention as expected. The intervention may have targeted social support (getting one's parents to go for a walk), but the participant may have interpreted it as removing a barrier (the barrier being not to go for a walk because the family wants to spend time together). A process evaluation usually does not address this issue. One way to obtain this information is to have qualitative or structured interviews with the participants once the program or intervention is over.

We caution, however, that if the mediators do not change during the intervention, the lack of change may also be due to a failure in the research. There may be several reasons for this. For one, the intervention may not have addressed the mediators appropriately. For example, the interventionist is trained to talk about obtaining social support, but does not talk about the sources of such support, how to ask for it, or how to capitalize on it. Another possible reason is that the participant did not attend to or understand what to do. The researcher may have created excellent expert reports that addressed all the theoretical components and sent them to the participant's home, but the participant did not look at the report and threw it away. Finally, measurement issues may be the culprit in that the instrument assessing the mediator may not have been sensitive enough to detect a change, the timing of the assessment may have been too late to detect the impact, or some kind of bias (e.g., social desirability) may have influenced the measurement.

8. Did the outcome change? This is (obviously) a necessary condition for any conclusions to be drawn that the intervention is indeed effective. In some instances the outcome changes, but the mediators do not. This can indicate that the theory does not address the right mechanisms. There are also cases in which the mediators change but the outcome does not. Here a careful examination is required before the theory is dismissed, as the measurement issues previously described relative to mediators also apply to outcomes.

This "litmus test," presented in abbreviated form in figure 4.1, not only is informative when one is evaluating interventions, but also is a useful guide for planning a program or intervention. The more affirmatively this set of questions is answered, the more likely it is that the theory has been used to best effect. Being aware of these items when planning programs or interventions will ensure a more thorough approach, decrease the likelihood of missing important components, and provide a more informative evaluation.

Applying the Litmus Test to Interventions

On the basis of the litmus test just presented, we evaluated 20 theory-based physical activity interventions in children and adolescents (see table 4.1 for study descriptions). None of the studies that we identified met all requirements of the proposed litmus test, suggesting that most youth physical activity intervention

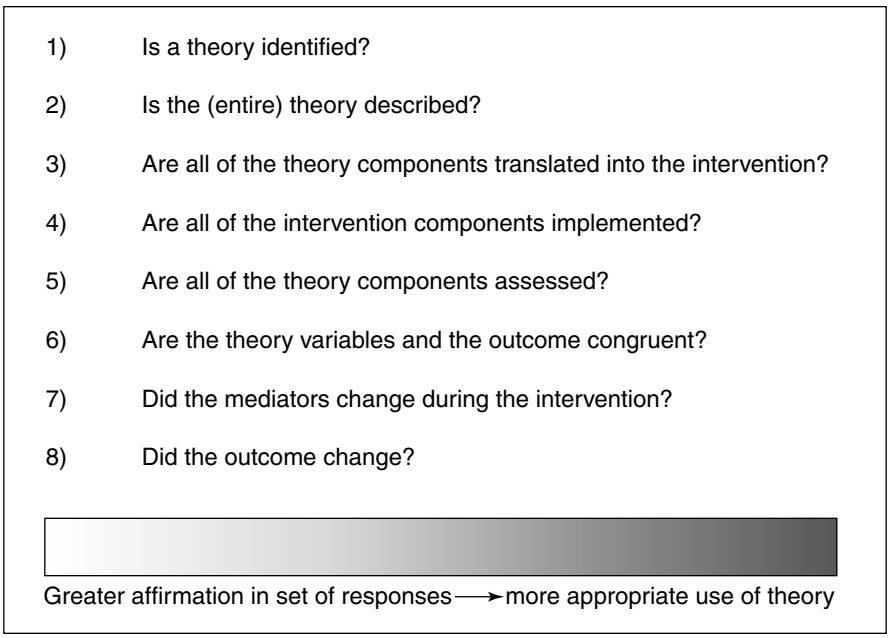

Figure 4.1 This abbreviated version of the litmus test can serve as a useful checklist for readers planning their own research or evaluating that of others.

research is not totally theory driven but may better be characterized as theory inspired. Most studies identified a specific theory as driving the intervention, with the exception of Fun 5 (Battista et al., 2005); however, we know that Fun 5 is based on a structural ecological model (Cohen, Scribner, & Farley, 2000). The bases of structural ecological models are to change behavior beyond the individual level and influence the social and physical environment in which the interventions are placed. Structural ecological models extend typical ecological models of health behavior change by specifying structures whereby population-level factors effect change in individual-level factors (Cohen et al., 2000). These interventions are usually conducted within existing structures, such as schools, communities, and organizations. Examples of other interventions that have applied such approaches include the Middle-School Physical Activity and Nutrition study (M-SPAN; Sallis et al., 2003) and the Sports, Play, and Active Recreation for Kids study (SPARK; Sallis et al., 1997).

With regard to items 2 through 5 of the litmus test, there was evidence that two studies met at least two of these requirements. These studies include the Baylor GEMS study and the Healthy Habits study (Baranowski et al., 2003a; Saelens et al., 2002). The Baylor GEMS study did not describe the entire theory (item 2) in detail or assess all theoretical components (item 5), but did translate and implement all components within the intervention (items 3 and 4). The Healthy Habits intervention (Saelens et al., 2002) involved several behavioral modification techniques including self-monitoring, goal setting, problem solving, stimulus control, self-reward, and preplanning, meeting requirements for items 2 and 3 of the litmus test. It also appears that all the intervention components were implemented within the intervention (item 4); however, Saelens and colleagues (2002) did not assess all components that were applied within the intervention (item 5).

Item 6 ("Are the theory variables and the outcome congruent?") was satisfied by most of the interventions reviewed, with the exception of those providing only follow-up data on behavioral measures (e.g., physical activity, obesity, sedentary behavior) (Fitzgibbon et al., 2005; Ford et al., 2002; Gortmaker et al., 1999b; Battista et al., 2005; Nigg et al., 2006; Robinson, 1999; Roemmich, Gurgol, & Epstein, 2004). Researchers less frequently report results related to the psychosocial variables. The only two interventions that successfully affected mediators (item 7) were Healthy Habits (Saelens et al., 2002) and LEAP (Dishman et al., 2004; Pate et al., 2003). Groups of studies were identified that successfully changed outcome measures (item 8) such as BMI or physical activity, including the CATCH studies (Kelder et al., 2003; Nader et al., 1999), Project FAB (Jamner et al., 2004), M-SPAN (Sallis et al., 2003), LEAP (Pate et al., 2005), Planet Health (Gortmaker et al, 1999b), Hip-Hop to Health Jr. (Fitzgibbon et al., 2005), Fun 5 (Battista et al., 2005; Nigg et al., 2006), Stanford GEMS (Robinson et al., 2003), Be Smart (Warren et al., 2003), Healthy Habits (Roemmich et al., 2004), and two other interventions (Robinson, 1999; Ford et al., 2002).

Overall, we notice that interventions designed to change activity or inactivity are producing significant results. However, a consistent trend in the interventions is that mediators are not changing. In addition, researchers are not adequately describing intervention components, evaluating entire theories, or measuring important theoretical components. More focus, attention, and research are needed in this area.

Improving Our Theoretical Understanding

A number of theory-based interventions focus on changing current levels of physical activity, but few if any address sedentary behavior. It has yet to be determined if the theories and models that are useful for physical activity promotion are also applicable to sedentary behavior. An important theoretical distinction between utilitarian (nonleisure) and disposable (leisure) inactive time needs to be made (Buckworth & Nigg, 2004). When attempting to decrease sedentary behavior, we should not be affecting homework time (which may include time in front of a computer or screen) but rather should decrease inactivity that is devoted to leisure pursuits such as computer games or watching TV for entertainment (which also includes time in front of a computer or screen). The effectiveness of these investigations can be maximized if we increase our efforts to develop a holistic approach to our work.

A Holistic Approach

Our field is developing by amassing information that can be integrated into what we already know and by identifying areas that have not received adequate attention (such as theories of reducing sedentary behaviors). It would be useful to study multiple theories to empirically integrate their salient components in an effort to create a more complete or holistic theory of health behavior change (Nigg et al., 2002). However, before theorists can begin to integrate multiple theories, we must first examine and assess existing theoretical models within the context of our interventions. Although these approaches can increase participant burden given the lengthiness of data collection, without complete approaches we risk the chance of not appropriately evaluating our theoretical models (Baranowski et al., 2003b). The success of this endeavor depends on the construction and use of valid measures of a range of mediators and outcomes (Traub, 1994).

Another effort to establish a more holistic understanding of youth physical activity is grounded within ecological conceptual frameworks. Individual psychology is just one element within ecological models and community interventions. This effort is reflected in the recognition of the importance of multilevel models and the impact of the environment in health promotion (e.g., McLeroy et al., 1988). Holistic approaches include the promotion of trails, pathways, and parks as means of increasing physical activity, decreasing inactivity, and reduc-

ing sedentary behavior in youth. Trails and pathways designed and created in local communities can be easily connected to local parks, open space areas, and school, library, and other public lands. The adoption of the Safe Routes to School programs encourages the connection of communities to schools. These programs promote safe and convenient exercise among children and adolescents. If we begin to implement these programs on a broader level, more children will be able to walk or ride their bikes to school, potentially decreasing inactivity and reducing sedentary behavior (Ege & Krag, 1999; Sallis, Bauman, & Pratt, 1998). Moreover, bicycles provide vital mobility for children; bicycles also represent fun, freedom, exercise, and fresh air—issues that matter to most children (Sallis et al., 1998).

The policy and environmental components from the social ecological approaches are understudied in the school environment (Sallis et al., 2003). However, they do appear to be effective approaches to changing the school environment and potentially transfer into the homes of many adolescents. Structural and social ecological approaches implemented at school encourage collaboration among various health professionals and individuals from other sectors of the population. Such sectors include principals, community agencies and organizations, legislators, and the mass media. However, implementing interventions based on ecological models (e.g., policy and environmental changes) in the school environment is not easy. These interventions often require a great deal of planning and collaboration with school officials, teachers, parents, and community leaders.

Finally, health behavior and physical activity theory has been discussed alongside health behavior and physical activity *change* theory without clear differentiation (Nigg & Jordan, 2005). There are clear distinctions between the two (e.g., Glanz & Rimer, 1997). Describing and understanding behavior are not the same as changing it. Behavior theories identify why a behavior exists. Behavior change theories explain why *and* how changes come about, and later guide the development of interventions. Of course, these two types of theories are symbiotic in nature, but we should not confuse their underlying ideologies.

Directions for Future Research

We propose two main research agendas:

- The appropriateness of theory for increasing physical activity and reducing inactivity should be further explored. Exploratory studies investigating why youth adopt physical activity and decrease inactivity are required immediately to allow us to judge whether the current theories address the correct constructs. Techniques from anthropology and sociology, along with qualitative methods, are recommended for the pursuit of this descriptive work. Depending on the outcomes of these efforts, it may be necessary to develop behavior-specific theories targeting physical activity or inactivity separately.

- The second agenda, related to the first, is theory testing using experimental designs to empirically provide understanding of the active components of increasing activity and decreasing inactivity. This may reveal that
  - existing theories and models are applicable;
  - revisions to existing theories and models are required; or
  - existing theories and models are not appropriate, and theories and models specific to youth activity, inactivity, or both need to be developed.

Jeffery (2004) argued that many theories fail to influence behavior because they focus on predictors of motivation and fail to address opportunities or capabilities to change. He then suggests returning to classic learning theories and emphasizing interactions between the person and her or his environment. Rothman (2004) suggested that theory often fails because current protocols that are in place to apply theoretical constructs within the framework of interventions are poorly developed, resulting in poor application of theory. This proposition was supported by Kremers and colleagues (2006). Our second proposal recommends expanding, refining, or rejecting existing theories based on intervention rather than observational studies (Brug, Oenema, & Ferreira, 2005; Rothman, 2004). Recommendations have also been made to address behavior change instead of motivation, and to focus more on hypothetical causal pathways rather than associations. Therefore, well-designed intervention studies of theoretically based interventions of behavior change are warranted.

The *International Journal of Behavioral Nutrition and Physical Activity* reported on several theoretical debates and related commentary(Baranowski, 2006; Brug, 2006; Resnicow & Vaughan, 2006). Perhaps a "chaotic view" of behavioral change should be considered. Resnicow and Vaughan propose that behavior change should be viewed as a chaotic system in which change is influenced by complex interactions and does not always necessarily follow a linear pattern. This perspective suggests that multiple interactions exist that may vary across individuals, and that random external and intrapsychic events can significantly affect the system. Gladwell (2000) agrees with Resnicow and Vaughan's proposed concept of a "tipping point," or a dramatic change in a person's behavior that is usually unexpected and arises quickly. They report that many decisions to change are not planned events but rather arise depending upon motivation. However, reactions from theorists have challenged the notion of chaos theory with a more ordered, linear approach to understanding behavior change (Brug, 2006).

In activity research, psychosocial, personality, and environmental variables are important determinants of behavior. If multiple factors are measured over time and the interactions among them are considered, mathematical algorithms of behavior can be created. Small changes in knowledge, efficacy, attitudes, social and physical environments, and other constructs may have a dramatic impact on a young person's motivation to be sedentary or active.

It is clear from research debate that there is little understanding of how to identify the "tipping point" of behavior change. However, as researchers we should do our best to understand and explain behavior change. Perhaps we should explore modeling techniques similar to those used in the molecular sciences (e.g., plant genetics). To succeed in this endeavor we also must improve our existing measurement methods. Baranowski (2006) proposes the use of Item Response Theory (Wilson, 2005) as a way to determine which variables are being poorly measured and, more specifically, in what demographic group(s). In addition, perhaps measurement models such as latent class analysis or latent transition analysis would be useful for examining the chaotic nature of health behavior; and growth mixture modeling could be used to capture the clustering of behaviors over time and to determine whether those clusters evolve over time (Muthen & Muthen, 2000).

Finally, we should assess the "big picture" of theory as applied to youth physical activity and sedentary behavior. In the fields of social and behavioral sciences, there is an overabundance of theories; and deciding which theory works and in what population is a significant challenge. Therefore, as researchers we should ask ourselves several questions:

- Are the current health behavior theories addressing behavior *change*?
- Are current health behavior theories too complicated?
- Should we consider revising, extending, integrating, or abandoning current theories?
- Are more complicated statistical designs needed to adequately test health behavior theories?
- Are there simple examples in nature that we can learn from?

Essentially, as Thomas Kuhn (1970) suggested, we are in the early stages of scientific development, or the preparadigm stage. We are in the preparadigm stage for research that relates to physical activity or inactivity because we are currently using theories from different fields to describe or interpret phenomena in our own field. Scientific knowledge develops slowly during these stages because there is often little agreement among scientists due to confusion, frustration, the defense of theory and research, and power struggles among factions within the discipline (Hardy, 1978). Nonetheless, despite the fact that we are in the early stages of scientific development, great strides have been made to identify determinants of physical activity in children and adolescents. We need much more high-quality research to better understand determinants and mechanisms of reducing inactivity and decreasing sedentary behaviors. If there is nothing as practical as a good theory, we must focus our efforts, intelligence, and creativity on bringing about the best theory.

APPLICATIONS FOR RESEARCHERS

The most general recommendation is that any physical activity and inactivity research addressing youth be grounded in theory. Care should be taken to use entire theories, not just individual constructs. Attention should also be paid to the appropriateness of the current theories and models in explaining physical activity and inactivity in youth. One area of inquiry that may need to be revisited is theory development and redevelopment in the physical activity or inactivity domains. New or hybrid theories unique to these specific behaviors may be necessary. We may also have to look at other disciplines (physics, biology, economics, etc.) for potentially salient frameworks. Both theory integration and theory comparison research are warranted at this time. Finally, one should evaluate any theory-based intervention research with the litmus test described in this chapter before concluding that the theory works or does not.

APPLICATIONS FOR PROFESSIONALS

Although the theoretical foundation for studying youth physical activity, inactivity, and (especially) sedentary behavior is not well developed, it is important that interventions be designed and implemented using the current theoretical understanding. The reason is that theory-based interventions tend to be more effective than non–theory-based interventions, and they provide guidance on how to intervene, evaluate, and explain why change occurs—all of which are essential for effective decision making. Based on our current understanding, these interventions should integrate the individual, social, and physical environments. Both physical activity levels and sedentary behaviors need to be targeted in youth because both are independently related to health; and current alarming chronic disease rates and quality of life issues appear to be related to not being physically active on a regular basis and engaging in sedentary leisure-time behaviors.

References

Ajzen, I. (1988). *Attitudes, personality and behavior*. Milton Keynes: Open University Press.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 57*, 179-211.

Arbeit, M.L., Johnson, C.C., Mott, D.S., Harsha, D.W., Nicklas, T.A., Webber, L.S., et al. (1992). The Heart Smart cardiovascular school health promotion: Behavior correlates of risk factor change. *Preventive Medicine, 21*, 18-32.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall.

Baranowski, T. (2006). Crisis and chaos in behavioral nutrition and physical activity. *International Journal of Behavioral Nutrition and Physical Activity*, *3*, 27.

Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions: How are we doing? how might we do better? *American Journal of Preventive Medicine*, *15*, 266-297.

Baranowski, T., Baranowski, J.C., Cullen, K.W., Thompson, D.I., Nichlas, T., Zakeri, I.F., et al. (2003a). The fun, food, and fitness project (FFFP): The Baylor GEMS pilot study. *Ethnicity and Disease*, *13*, S1-30-S1-39.

Baranowski, T., Cullen, K.W., Nicklas, T., Thompson, D., & Baranowski, J. (2003b). Are current health behavioral change models helpful in guiding prevention of weight gain efforts? *Obesity Research*, *11*, 23S-43S.

Baranowski, T., & Jago, R. (2005). Understanding the mechanisms of change in children's physical activity programs. *Exercise and Sport Sciences Reviews*, *33*, 163-168.

Baranowski, T., & Stables, G. (2000). Process evaluations of the 5-a-day projects. *Health Education and Behavior*, *27*, 157-166.

Battista, J., Nigg, C.R., Chang, J.A., Yamashita, M., & Chung, R. (2005). Elementary after school programs: An opportunity to promote physical activity for children. *California Journal of Health Promotion*, *3*, 108-118.

Biddle, S.J.H., Hagger, M.S., Chatzisarantis, N.L.D., & Lippke, S. (2007). Theoretical frameworks in exercise psychology. In G. Tenenbaum & R.C. Eklund (Eds.), *Handbook of sport psychology* (3rd ed., pp. 537-559). Hoboken, NJ: Wiley.

Biddle, S.J.H., & Nigg, C.R. (2000). Theories of exercise behavior. *International Journal of Sport Psychology*, *31*, 290-304.

Brug, J. (2006). Order is needed to promote linear or quantum changes in nutrition and physical activity behaviors: A reaction to "A chaotic view of behavior change" by Resnicow and Vaughan. *International Journal of Behavioral Nutrition and Physical Activity*, *3*, 29.

Brug, J., Oenema, A., & Ferreira, I. (2005). Theory, evidence and intervention mapping to improve behavioral nutrition and physical activity interventions. *International Journal of Behavioral Nutrition and Physical Activity*, *2*, 2.

Buckworth, J., & Nigg, C.R. (2004). Physical activity, exercise, and sedentary behavior in college students. *Journal of American College Health*, *53*, 28-34.

Bush, P.J., Zuckerman, A.E., Taggart, V.S., Theiss, P.K., Peleg, E.O., & Smith, S.A. (1989a). Cardiovascular risk factor prevention in black school children: The "Know Your Body" evaluation project. *Health Education Quarterly*, *16*, 215-227.

Bush, P.J., Zuckerman, A.E., Theiss, P.K., Taggart, V.S., Horowitz, C., Sheridan, M.J., et al. (1989b). Cardiovascular risk factor prevention in black schoolchildren: Two-year results of the "Know Your Body" program. *American Journal of Epidemiology*, *129*, 466-482.

Caballero, B., Clay, T., Davis, S.M., Ethelbah, B., Rock, B.H., Lohman, T., et al. (2003). Pathways: A school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *American Journal of Clinical Nutrition*, *78*, 1030-1038.

Centers for Disease Control and Prevention. (1997). Guidelines for school and community programs to promote lifelong physical activity among young people. *Morbidity and Mortality Weekly Report*, *46*(RR-6), 1-36.

Centers for Disease Control and Prevention. (2001). Increasing physical activity: A report on recommendations of the Task Force on Community Preventive Services. *Morbidity and Mortality Weekly Report*, *50*(RR18), 1-16.

Centers for Disease Control and Prevention. (2004). Physical activity and good nutrition: Essential elements to prevent chronic diseases and obesity. Retrieved March 1, 2005, from www.cdc.gov.

Chatzisarantis, N., & Biddle, S.J.H. (1998). Functional significance of psychological variables that are included in the Theory of Planned Behavior: A self-determination theory approach to the study of attitudes, subjective norms, perceptions of control, and intentions. *European Journal of Social Psychology*, *28*, 303-322.

Cohen, D.A., Scribner, R.A., & Farley, T.A. (2000). A structural model of health behavior: A pragmatic approach to explain and influence health behaviors at the population level. *Preventive Medicine*, *30*, 146-154.

Craig, S., Goldberg, J., & Dietz, W. (1996). Psychosocial correlates of physical activity among fifth and eighth graders. *Preventive Medicine*, *25*, 506-513.

Dale, D., Corbin, C.B., & Dale, K.S. (2000). Restricting opportunities to be active during school time: Do children compensate by increasing physical activity levels after school? *Research Quarterly for Exercise and Sport*, *71*, 240-248.

Deci, E.L., & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.

DeMattia, L., Lemont, L., & Muerer, M. (2006). Do interventions to limit sedentary behaviours change behaviour and reduce childhood obesity? A critical review of literature. *Obesity Reviews*, *7*, 111-136.

Dennison, B., Russo, T., Burdick, P., & Jenkins, P. (2004). An intervention to reduce television viewing by preschool children. *Archives of Pediatric and Adolescent Medicine*, *158*, 170-176.

Dishman, R.K. (Ed.). (1994). *Advances in exercise adherence*. Champaign, IL: Human Kinetics.

Dishman, R.K., Motl, R.W., Saunders, R.P., Dowda, M., Felton, G., Ward, D.S., et al. (2002). Factorial invariance and latent mean structure of questionnaires measuring social-cognitive determinants of physical activity among black and white adolescent girls. *Preventive Medicine*, *34*, 100-108.

Dishman, R.K., Motl, R.W., Saunders, R., Felton, G., Ward, D.S., Dowda, M., et al. (2004). Self-efficacy partially mediates the effect of a school-based physical activity intervention among adolescent girls. *Preventive Medicine*, *38*, 628-636.

Dowling, C. (2000). Getting them out of the doll corner. In *The frailty myth: Redefining the physical potential of women and girls* (pp. 84-112). New York: Random House.

Ege, C., & Krag, T. (1999). Cycling will improve environment and health. Retrieved June 3, 2003, from www.thomaskrag.com/Ege-Krag_Velo-city_2005_paper.pdf.

Epstein, L.H., Myers, M.D., Raynor, H.A., & Saelens, B.E. (1998). Treatment of pediatric obesity. *Pediatrics*, *101*, 554-570.

Faith, M.S., Berman, N., Heo, M., Peitrobelli, A., Gallagher, D., Epstein, L., et al. (2001). Effects of contingent television on physical activity and television viewing in obese children. *Pediatrics*, *107*, 1043-1048.

Faucette, N., Sallis, J.F., McKenzie, T., Alcaraz, J., Kolody, B., & Nugent, P. (1995). Comparison of fourth grade students' out-of-school physical activity levels and choices by gender: Project SPARK. *Journal of Health Education*, *26*, S82-S90.

Felton, G., Saunders, R., Ward, D., Dishman, R., Dowda, M., & Pate, R. (2005). Promoting physical activity in girls: A case study of one school's success. *Journal of School Health*, *75*, 57-62.

Fitzgibbon, M.L., Stolley, M.R., Schiffer, L., Van Horn, L., KauferChristoffel, K., & Dyer, A. (2005). Two-year follow-up results for Hip-Hop to Health Jr.: A randomized controlled trial for overweight prevention in preschool minority children. *Journal of Pediatrics*, *146*, 618-625.

Ford, B.S., McDonald, T.E., Owens, A.S., & Robinson, T.N. (2002). Primary care interventions to reduce television viewing in African American children. *American Journal of Preventive Medicine*, *22*, 106-109.

Gladwell, M. (2000). *The tipping point.* Boston: Little, Brown.

Glanz, K., & Rimer, B. (1997). Theory at a glance: A guide for health promotion practice. National Cancer Institute (NIH Pub. No. 92-3316, updated 27 February 2003). Retrieved June 3, 2004, from http://cancer.gov/cancerinformation/theory-at-a-glance.

Gortmaker, S.L., Cheung, L.W., Peterson, K.E., Chomitz, G., Cradle, J.H., Dart, H., et al. (1999a). Impact of a school-based interdisciplinary intervention on diet and physical activity among urban primary school children: Eat Well and Keep Moving. *Archives of Pediatric and Adolescent Medicine*, *153*, 975-983.

Gortmaker, S.L., Peterson, K., Wiecha, J., Sobol, A.M., Dixit, S., Fox, M.K., et al. (1999b). Reducing obesity via a school-based interdisciplinary intervention among youth. *Archives of Pediatric and Adolescent Medicine*, *153*, 409-418.

Green, L.W., & Kreuter, M.W. (1991). *Health promotion planning: An educational and environmental approach.* Toronto: Mayfield.

Hardy, M. (1978). Evaluating nursing theory. In *Theory development: What, why, how?* New York: National League for Nursing.

Hausenblas, H., Carron, A.V., & Mack, D.E. (1997). Application of the Theories of Reasoned Action and Planned Behavior to exercise behavior: A meta-analysis. *Journal of Sport and Exercise Psychology*, *19*, 36-51.

Jamner, M.S., Metz, D.S., Bassin, S., & Cooper, D.M. (2004). A controlled evaluation of a school-based intervention to promote physical activity among sedentary adolescent females: Project FAB. *Journal of Adolescent Health*, *34*, 279-289.

Jeffery, R.W. (2004). How can health behavior theory be made more useful for intervention research? *International Journal of Behavioral Nutrition and Physical Activity*, *1*,10.

Kelder, S.H., Mitchell, P., McKenzie, T.L., Derby, C., Strikmiller, P.K., Luepker, R., et al. (2003). Long-term implementation of CATCH physical education program. *Health Education and Behavior*, *30*, 463-475.

Kelder, S.H., Perry, C.L., & Klepp, K.I. (1993). Community-wide youth exercise promotion: Long-term outcomes of the Minnesota Heart Health Program and the Class of 1989 Study. *Journal of School Health*, *63*, 218-223.

Kelder, S.H., Perry, C.L., Peters, R., Lytle, L.L., & Klepp, K.I. (1995). Gender differences in the Class of 1989 Study: The school component of the Minnesota Heart Health Program. *Journal of Health Education*, *26*, S36-S44.

Kerlinger, F.H. (1973). *Foundations of behavioral research* (2nd ed.). New York: Holt, Rinehart and Winston.

Kimiecik, J.C., & Horn, T.S. (1998). Parental beliefs and children's moderate to vigorous physical activity. *Research Quarterly for Exercise and Sport*, *69*, 163-175.

King, A.C., Stokols, D., Talen, E., Brassington, G.S., & Killingsworth, R. (2002). Theoretical approaches to the promotion of physical activity: Forging a transdisciplinary paradigm. *American Journal of Preventive Medicine*, *23*(2S), 15-25.

King, I. (1978). The "why" of theory development. In *Theory development: What, why, how?* New York: National League for Nursing.

Kraemer, H.C., Wilson, G.T., Fairburn, C.G., & Agras, W.S. (2002). Mediators and moderators of treatment effects in randomized clinical trials. Archives of General Psychiatry, *59*, 877-883.

Kremers, S.P.J., de Bruijn, G.J., Visscher, T.L.S., van Mechelen, W., de Vries, N.K., & Brug, J. (2006). Environmental influences on energy balance-related behaviors: A dual-process view. *International Journal of Behavioral Nutrition and Physical Activity*, *3*, 9.

Kuhn, T.S. (1970). *The structure of scientific revolutions* (2nd ed.). Chicago: University of Chicago Press.

McLeroy, K.R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, *15*, 351-377.

Muthen, B., & Muthen, L. (2000). Integrating person-centered and variable-centered analysis: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research*, *24*, 882-891.

Myers, L., Strikmiller, P.K., Webber, L.S., & Berenson, G.S. (1996). Physical and sedentary activity in school children grades 5-8: The Bogalusa Heart Study. *Medicine and Science in Sports and Exercise*, *28*, 852-859.

Nader, P.R., Stone, E.J., Lytle, L.A., Perry, C.L., Osganian, S.K., Kelder, S.K., et al. (1999). Three-year maintenance of improved diet and physical activity. *Archives of Pediatric and Adolescent Medicine*, *153*, 695-704.

Neumark-Sztainer, D., Story, M., Hanna, P.J., & Rex, J. (2003). New Moves: A school-based obesity prevention program for adolescent girls. *Preventive Medicine*, *37*, 41-51.

Nigg, C.R., Allegrante, J.P., & Ory, M. (2002). Theory-comparison and multiple-behavior research: Common themes advancing health behavior research. *Health Education Research*, *17*, 670-679.

Nigg, C.R., & Jordan, P.J. (2005). It's a difference of opinion that makes a horserace. *Health Education Research*, *20*, 291-293.

Nigg, C.R., Kerr, N.A., Hottenstein, C., Yamashita, M., Inada, M., Paxton, R., et al. (2006). First year dissemination results: Fun 5—a physical activity and nutrition pro-

gram for elementary after school programs. *Annals of Behavioral Medicine*, *31*, S92.

Pate, R.R., Saunders, R., Ward, D., Felton, G., Trost, S., & Dowda, M. (2003). Evaluation of a community-based intervention to promote physical activity in youth: Lessons from active winners. *American Journal of Health Promotion*, *17*, 171-182.

Pate, R.R., Ward, D.S., Saunders, R.P., Felton, G., Dishman, R.K., & Dowda, M. (2005). Promotion of physical activity among high-school girls: A randomized controlled trial. *American Journal of Public Health*, *95*, 1582-1587.

Prochaska, J.O., & DiClemente, C.C. (1983). Stages and processes of self-change in smoking: Towards an integrative model of change. *Journal of Consulting and Clinical Psychology*, *51*, 390-395.

Prochaska, J.O., & Marcus, B.H. (1994). The transtheoretical model: Applications to exercise. In R.K. Dishman (Ed.), *Advances in exercise adherence* (pp. 161-180). Champaign, IL: Human Kinetics.

Prokhorov, A.V., Perry, C.L., Kelder, S.H., & Klepp, K.I. (1993). Lifestyle values of adolescents: Results from Minnesota heart health youth program. *Adolescence*, *28*(111), 637-647.

Resnicow, K., & Vaughan, R. (2006). A chaotic view of behavior change: A quantum leap for health promotion. *International Journal of Behavioral Nutrition and Physical Activity*, *3*, 25.

Resnicow, K., Yaroch, A.L., Davis, A., Wang, D.T., Carter, S., Slaughter, L., et al. (2000). GO GIRLS!: Results from a nutrition and physical activity program for low-income, overweight African American adolescent females. *Health Education and Behavior*, *27*, 616-631.

Robinson, T.N. (1999). Reducing children's television viewing to prevent obesity: A randomized controlled trial. *Journal of the American Medical Association*, *282*, 1561-1567.

Robinson, T.N., Killen, J.D., Kraemer, H.C., Wilson, D.M., Matheson, D.M., Haskell, W.L., et al. (2003). Dance and reducing television viewing to prevent weight gain in African-American girls: The Stanford GEMS pilot study. *Ethnicity and Dance*, *13*, S1-65-S1-77.

Roemmich, J.N., Gurgol, C.M., & Epstein, L.H. (2004). Open-loop feedback increases physical activity of youth. *Medicine and Science in Sports and Exercise*, *36*, 668-673.

Rothman, A.J. (2004). "Is there nothing more practical than a good theory?": Why innovations and advances in health behavior change will arise if interventions are used to test and refine theory. *International Journal of Behavioral Nutrition and Physical Activity*, *1*, 11.

Saelens, B.E., Sallis, J.S., Wilfley, D.E., Patrick, K., Cella, J.A., & Buchta, R. (2002). Behavioral weight control for overweight adolescents initiated in primary care. *Obesity Research*, *10*, 22-32.

Sallis, J.F., Bauman, A., & Pratt, M. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine*, *15*, 379-397.

Sallis, J.F., McKenzie, T.L., Alcaraz, J.E., Kolody, B., Faucette, N., & Hovell, M.F. (1997). Effects of a two-year health-related physical education program on physical activity and fitness in elementary school students: SPARK. *American Journal of Public Health*, *87*, 1328-1334.

Sallis, J.F., McKenzie, T.L., Conway, T.L., Elder, J.P., Prochaska, J.J., Brown, M., et al. (2003). Environmental interventions for eating and physical activity: A randomized controlled trial in middle schools. *American Journal of Preventive Medicine*, *24*, 209-217.

Sallis, J.F., McKenzie, T.L., Kolody, B., Lewis, M., Marshall, S., & Rosengard, P. (1999). Effects of health-related physical education on academic achievement: Project SPARK. *Research Quarterly for Exercise and Sport*, *70*, 127-134.

Sallis, J.F., Prochaska, J.J., & Taylor, W.C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise*, *32*, 963-975.

Schwarzer, R. (1999). Self-regulatory processes in the adoption and maintenance of health behaviors: The role of optimism, goals, and threats. *Journal of Health Psychology*, *4*, 115-127.

Sharma, M. (2006). School-based interventions for childhood and adolescent obesity. *Obesity Reviews*, *7*, 261-269.

Simon, C., Wagner, A., DiVita, C., Rauscher, E., Klein-Platat, C., Arveiler, D., et al. (2004). Intervention centered on adolescents' physical activity and sedentary behaviour (ICAPS): Concepts and 6-month results. *International Journal of Obesity*, *28*, S96-S103.

SPARK. (2004). SPARK coordinated health. Retrieved March 19, 2005, from www.sparkpe.org/csh.jsp.

Stevens, J., Story, M., Ring, K., Murray, D.M., Cornell, C.E., Juhaeri, et al. (2003). The impact of the Pathways intervention on psychosocial variables related to diet and physical activity in American Indian schoolchildren. *Preventive Medicine*, *37*(Suppl. 1), S70-S79.

Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion*, *10*, 282-298.

Stone, E.J., McKenzie, T.L., Welk, G.J., & Booth, M.L. (1998). Effects of physical activity interventions in youth: Review and synthesis. *American Journal of Preventive Medicine*, *15*, 298-315.

Theunissen, N.C.M., & Tates, K. (2004). Models and theories in studies on educating and counseling children about physical health: A systematic review. *Patient Education and Counseling*, *55*, 316-330.

Traub, R. (1994). *Reliability for the social sciences: Theory and applications.* Thousand Oaks, CA: Sage.

Trost, S.G., Pate, R.R., Dowda, M., Ward, D.S., Pelton, O., & Saunders, R. (2002). Psychosocial correlates of physical activity in white and African-American girls. *Journal of Adolescent Health*, *31*, 228-233.

Trost, S.G., Pate, R.R., Ward, S.S., Saunders, R., & Riner, W. (1999). Correlates of objectively measured physical activity in preadolescent youth. *American Journal of Preventive Medicine*, *17*, 120-126.

Trost, S.G., Saunders, R., & Ward, D.S. (2002). Determinants of physical activity in middle school children. *American Journal of Health Behavior*, *26*, 95-102.

U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General.* Atlanta: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

Warren, J.W., Henry, J.K., Lighttowler, H.J., Bradshaw, S.M., & Perwaiz, S. (2003). Evaluation of a pilot school programme aimed at the prevention of obesity in children. *Health Promotion International*, *18*, 287-296.

Welk, G.J. (1999). The youth physical activity promotion model: A conceptual bridge between theory and practice. *Quest*, *51*, 5-23.

Wikipedia, The free encyclopedia. (2006). Theory. Retrieved August 8, 2006, from http://en.wikipedia.org/wiki/Theory.

Wilson, M. (2005). *Constructing measures: An item response modeling approach*. Mahwah, NJ: Erlbaum.