

## Improving Fruit and Vegetable Intake Among Children: A Review of Interventions Utilizing the Social Cognitive Theory

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### Abstract

Objectives of this review are to identify effective factors of interventions using the Social Cognitive Theory to increase fruit and vegetable (FV) intake among children and to develop strategies for program development based on the interventions reviewed. Articles were obtained from multiple databases; study inclusion criteria were publication in years 1998-2008 and utilization of Social Cognitive Theory to increase FV intake among children primarily 6-11 years old. Creative informational components delivered in non-traditional fashions, inclusion of role-models, and promotion of activities for bolstering self-management skills and self-efficacy were often incorporated in interventions. FV intake programs were child-focused, multi-component interventions utilizing SCT; such interventions have been modestly successful in increasing FV intake among children.

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*Keywords: fruit and vegetable (FV) intake, fruit and juice and vegetable intake (FJV), Social Cognitive Theory, Social Cognitive strategies*

The diet quality of many children in the United States (US) is suboptimal in several aspects, including excess energy consumption and imbalanced nutrient composition (Anderson & Butcher, 2006). The increased prevalence of overweight suggests many children are consuming excess energy (calories). Changes in the school food environment, parental work patterns, and food industry products contribute to increased consumption of sugar-sweetened beverages, snacks with low vitamin and mineral content, fast foods and other foods away from home, and increases in portion sizes. These factors increase energy intake among children (Anderson & Butcher, 2006). Also, many advances such as urban sprawl and computer and video game recreation limit calorie expenditure among youth. Equally concerning is the fact that large portions of energy intake are obtained from calorie-dense, nutrient-poor foods (Munoz, Krebs-Smith, Ballard-Barbash, & Cleveland, 1997).

Inadequate fruit and vegetable (FV) consumption also contributes considerably to the poor diet quality of children in the US (US General Accounting Office [USGAO], 2002).

Fruits and vegetables are typically lower-calorie, nutrient-dense foods considered to be critical components of healthy diets. Depending on age and gender, it is recommended children 6-11 years old consume approximately four to five servings of FV daily (US Department of Health and Human Services [USDHHS], 2006). Unfortunately, few children in the US meet recommendations for daily FV intake. The US Department of Agriculture estimates only 25% of children aged 6-11 years consume the minimum number of FV servings per day (US Department of Agriculture, 2007). A poor quality diet, including inadequate FV intake, is a risk factor for multiple chronic diseases (USGAO, 2002). Increasing FV consumption among children is also desirable because eating habits are established in childhood and are predictive of adult intake patterns. Therefore, early intervention can maximize health benefits (Wardle, Carnell, & Cooke, 2005).

Federally-funded nutrition programs have attempted to improve dietary quality among children. The Centers for Disease Control and Prevention, along with the Produce for Better Health Foundation, administers the Fruit and

Veggies – More Matters campaign (Produce for Better Health Foundation, 2009). Additionally, the Federal Government administers food assistance programs: the Special Supplemental Nutrition Program for Women, Infants, and Children; the National School Breakfast and Lunch Programs; the Supplemental Nutrition Assistance Program (previously known as the Food Stamp Program); and farmer’s market programs (USGAO, 2002). Data support limited benefits of federally-funded programs, such as school meals (CDC, 2008; USGAO, 2002).

Apart from Federal assistance, interventions to improve health and increase FV consumption among children have been conducted in communities and schools. Several school studies have targeted education, dietary habits, physical activity, and/or weight as opposed to FV intake alone (Budd & Volpe, 2006). Thomas (2006) concluded that only four of 57 school-based intervention trials could be considered successful. A common limitation was lack of stated theoretical basis, or lack of theoretical explanation of results. An understanding of health behavior theory allows for effective intervention design, the most effective use of generally limited resources, and better assessment and potential redesign (Glanz, Rimer, & Lewis, 2002). In fact, of the four successful interventions, three employed the Social Cognitive Theory (Thomas, 2006).

This literature review describes the use of a promising behavioral theory, the Social Cognitive Theory (SCT), and how it has been utilized in interventions designed to improve FV intake among children primarily 6-11 years old. Previous studies have described elements of SCT related to FV intake; however none have applied the SCT in detail. This article expands upon reviews conducted by Burchett (2003); French and Stables (2003); Blanchette and Brug (2005); and Knai, Pomerleau, Lock, and McKee (2005) by providing a practical focus—the purpose is to develop strategies for health professionals to design programs for improving FV intakes among children.

## Methods

Articles reviewed were obtained from a search of multiple databases including PubMed, Science Direct, Academic Search Premier, and Google Scholar. Searched keywords included: “fruit intake,” “vegetable intake,” “fruit and vegetable,” “children,” and “intervention.” Inclusion criteria were publication in the past ten years and utilization of SCT to increase FV intake among children primarily 6-12 years old. Eight studies with innovative approaches were chosen for this review in order to thoroughly highlight the use of SCT, and to provide a wider range of strategies for health educators with varying backgrounds and resources.

## Results

### The Social Cognitive Theory

The role of health behavior theory is to simplify the complexities of behavior (Green, Glanz, Hochbaum, Kok, Kreuter, Lewis, et al., 1994). Use of theory helps identify significant components of a complex health problem, thereby providing better focus for potential interventions. Theory should be involved in all stages of the intervention process, from investigation to evaluation.

Practitioners choose a behavioral theory based on familiarity with the health problem to be addressed and the aspects of the problem that each theory attempts to explain (Green et al., 1994). The SCT is an interpersonal behavior theory that addresses psychosocial effects on behavior and provides direction for behavior change methods (Bandura, 1986; Glanz et al., 2002). An overarching concept of SCT is reciprocal determinism, which states a constant interaction exists among the characteristics of a person, their behaviors, and their environment. FV intake among children is dependent on personal characteristics such as preference, and on external factors like FV availability. SCT encompasses individual and environmental influences on behavior and is therefore a fitting theory for investigation of, and interventions targeting FV intake in children.

SCT includes nine constructs: environment, behavioral capacity, expectations, expectancies, self-control, observational learning, reinforcements, self-efficacy, and emotional

coping. Combination of constructs allows the theory to be used predictively or prescriptively. Constructs are defined below and in Table 1.

Table 1. Utilization of Social Cognitive Theory Constructs to Increase Fruit and Vegetable Intake in Children

<b>Construct</b>	<b>Definition</b>	<b>Application for increasing fruit and vegetable intake</b>
<b>Environment</b>	Factors physically external to a person	Increase availability & accessibility at home and school; Parent focus; Sustainable changes in foodservice
<b>Behavioral Capacity</b>	Knowledge and skill to perform a given behavior	Participatory activities including skill development for preparing fruits and vegetables and asking skills; Use of peers or paraprofessionals; Tailored, reinforced messages; Repeated multimedia approach; Parental involvement
<b>Expectations</b>	Anticipated outcomes of a behavior	Multiple, repeated messages; Taste testing; Use of recognizable or relatable role models including parents
<b>Expectancies</b>	Values placed on a given outcome	Discussion of social impact, media influence; Use of recognizable or relatable role models; Focused messages highlighting fruit and vegetable benefits and alleviating concerns regarding peer acceptance
<b>Self-Control</b>	Self-regulation of a behavior	Goal-setting; monitoring using food journals; feedback; Role-playing; Problem-solving activities
<b>Observational Learning</b>	Behavioral acquisition by observing outcomes of others' behavior	Use of credible, recognizable or relatable role models; Participatory skill development activities
<b>Emotional Coping Responses</b>	Strategies used to manage emotional stimuli	Monitoring & feedback; Role-playing; Problem-solving activities
<b>Reinforcement</b>	Responses to behavior that will increase or decrease likelihood of behavior's occurrence	Monitoring & feedback; Regulated use of exterior incentives; Encourage self-initiated rewards and incentives
<b>Self-efficacy</b>	Confidence in the ability to perform the behavior	Clear, targeted messages; Role-playing for asking skills; Enhancing preparation skills; Use of recognizable or relatable role models; Approach behavior change in small steps to ensure success

Note. Adapted from Glanz, et al (2002).

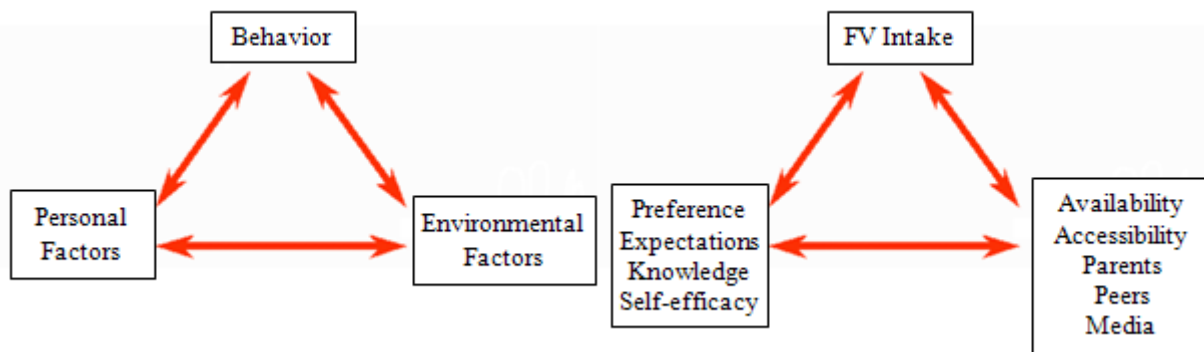
The construct of the environment refers to objective, physical surroundings that can impact behavior (Glanz et al., 2002). Behavioral capacity is the knowledge or skills needed to learn or unlearn the behavior of interest; the person must know what the behavior is and how to perform it. Expectations refer to anticipated outcomes of performing a behavior, while expectancies are values placed on the anticipated outcomes. The construct of self-control is defined as people regulating their own behaviors. Observational learning is behavioral acquisition through observation of peer coping, such as role modeling. Reinforcements are activities or responses, such as incentives or social pressure, that increase or decrease the likelihood of the individual to perform a health behavior. Self-efficacy is confidence in the ability to perform a behavior, making it a common target in behavior change programs. Finally, emotional coping responses are strategies used to cope with emotional situations.

SCT is a broad theory and including intervention components that address all constructs may not

be feasible (Glanz et al., 2002). Formative research using the theory as a guide should provide direction for intervention targets. Employing several, but not all constructs is common; therefore comprehensive testing of the theory has not been performed. However, individual constructs such as self-efficacy have been associated with target behaviors.

Understanding and explaining FV eating patterns is crucial in order to develop effective interventions (Reynolds, Hinton, Shewchuck, & Hickey, 1999). The SCT concept of reciprocal determinism is particularly useful because determinants of FV intake can be easily categorized. Illustrated in Figure 1, upon classifying FV intake as the health behavior of interest, interactions among personal factors and environmental factors can be examined and intervention targets determined. The design and implementation of interventions should reflect consideration of these determinants and should address SCT constructs to increase FV intake among children.

Figure 1. Application of the social cognitive theory to fruit and vegetable intake among children.



Note. Adapted from Pajares (2002). Overview of social cognitive theory and of self-efficacy. Available <http://www.emory.edu/EDUCATION/mfp/eff.html>. Accessed July 4, 2009.

These FV intake determinants, after being classified into environmental or personal domains, can then be associated with one or more SCT constructs, and components of interventions can be developed. Eight interventions designed to increase fruit, juice, and/or vegetable intake employing SCT constructs are described below and summarized in Table 2.

**Interventions**

Baranowski, Baranowski, Cullen, deMoor, Rittenberry, Herbert, et al. (2002) conducted the *5 a Day Achievement Badge* intervention with African-American boy scout troops in order to increase fruit, juice, and vegetable (FJV) intake. Formative evaluation revealed scouts had low preference for vegetables and low FJV preparation skills (Cullen, Baranowski,

Nwachokor, Baranowski, Hajek, & Jones, 1998).

The intervention consisted of lessons conducted by registered dietitians (behavioral capacity construct) and home-based activities (Baranowski et al., 2002). Activities incorporated use of role-playing for development of asking skills to increase FJV availability and accessibility at home (environment construct). Preference and skill expansion was accomplished through taste testing and snack preparation (behavioral capacity, expectations, and self-efficacy constructs). Home activities such as keeping food records (self-control construct), reading comic books (observational learning construct), and sharing family newsletters with recipes were included. Problem-solving was also embedded in at-home activities. If students met their goals, they received incentives and the Achievement Badge (reinforcement construct) (Baranowski et al., 2002). Overall, the intervention provided evidence for the ability to increase FJV intake, preferences for FJV, and asking skills among African-American boy scouts by addressing the majority of SCT constructs.

*Squire's Quest!* was a curriculum-only intervention designed to increase FJV consumption among multi-ethnic 4th grade students (Baranowski, Baranowski, Cullen, Marsh, Islam, Zakeri, et al., 2003). The intervention included interactive sessions with a computer game designed following focus groups (Cullen, Baranowski, Baranowski, 1998). Throughout a series of medieval challenges, meal- and behavior-specific skills and goals for increasing FJV intake were targeted (Baranowski et al., 2003). The curriculum included educational sessions (behavioral capacity construct), but also provided opportunities for application. For example, food selection and preparation skills were enhanced using virtual shopping trips and virtual recipe preparation (behavioral capacity and self-efficacy constructs). Students exercised problem-solving and decision-making skills, evaluated asking skills (behavioral capacity and environment constructs), set personal goals, and practiced self-regulation (self-control constructs) and self-reward (reinforcement construct) while

completing *Squire's Quest!* adventures (Baranowski et al., 2003; Cullen et al. 1998; Cullen, Zakeri, Pryor, Baranowski, Baranowski, & Watson, K., 2004). Post-intervention, children in treatment schools consumed approximately one serving of FJV more per day than did children in control schools (Baranowski et al., 2003).

The third intervention reviewed was *Gimme 5 Fruit, Juice, and Vegetables for Fun and Health (Gimme 5)* (Baranowski, Domel, & Gould, 1993; Kirby, Baranowski, Reynolds, Taylor, & Binkley, 1995). The initial *Gimme 5* curriculum was successful in changing dietary behaviors of elementary school children at school, but not at home. The revised program included activities designed to increase FJV consumption: role-playing and development of asking skills to increase FJV availability and accessibility at home (environment and behavioral capacity constructs), FJV preparation skill development (behavioral capacity and self-efficacy constructs), preference expansion via taste testing (expectancies construct), and problem-solving activities involving generation of advice for fellow students (Baranowski, Davis, Resnicow, Baranowski, Doyle, Lin, et al., 2000).

Students also kept food diaries for demonstration of self-monitoring and goal-setting skills (self-control construct) and analyzed media messages to assess social norms (expectations and expectancies constructs) (Baranowski et al., 2000). Videos using recognizable sports stars were included (observational learning construct), as well as recipes for snack preparation (behavioral capacity construct). Parents were involved using newsletters, and were invited to receive point of purchase education at local grocery stores. Significant differences favoring the treatment group were observed between treatment and control groups for FJV intake, asking skills, and knowledge (Baranowski et al., 2000).

*Every Day, Lots of Ways* (Blom-Hoffman, Kelleher, Power, & Leff; 2004) was a multi-component nutrition education program designed to increase FJV knowledge and vegetable consumption in African-American

kindergarteners and 1st graders of an under-served urban school. Students received ten lessons co-taught by regular classroom teachers and study staff. Incentives (reinforcement construct), FV samples (expectations construct), and preparation activities (behavioral capacity and self-efficacy constructs) were a few components included in the curriculum. Newsletters complimentary to the classroom lessons were sent home with students. During lunchtime, students were accompanied to the cafeteria by assistants responsible for asking the children to identify FV served (environment and behavioral capacity constructs), praising choice of FV (reinforcement construct), and distributing stickers for consuming FV (reinforcement construct). Intervention students demonstrated a significant increase in knowledge compared to control students, consistent with a prior study (Blom-Hoffman & DuPaul, 2003), but did not demonstrate increased vegetable consumption at lunchtime.

The *Cookshop* program was designed to increase consumption of whole grains and vegetables in urban, low income kindergarten-6th graders (Liquori, Koch, Contento, & Castle, 1998). Study investigators, parents, teachers, and university students were involved in administration of cooking workshops, which provided hands-on activities that enhanced learning (behavioral capacity, expectations, and self-efficacy constructs). Access to foods prepared in the cookshops increased as the same foods were later provided in the school cafeteria (environment and reinforcement constructs). Parental and community involvement was also encouraged through a series of newsletters and articles, and integration of local produce into cookshops (environment construct). Main effects results showed that Cookshop students exhibited increased grain and vegetable intake and preferences compared to students that received classroom education alone (Liquori et al., 1998). Attitudes were not impacted, but older Cookshop students reported increased cooking self-efficacy.

The goal of the *5-a-Day Power Plus* program was to increase FV consumption among multi-ethnic 4th grade children (Perry, Bishop, Taylor,

Murray, Mays, Dudovitz, et al., 1998; Story, Warren-Mays, Bishop, Perry, Taylor, Smyth, et al., 2000). Grade-appropriate curriculum (behavioral capacity constructs) consisted of team-building, skill-building, and problem-solving activities (Perry et al., 1998). Snack preparation and taste testing activities were offered (behavioral capacity and self-efficacy constructs). Role modeling was achieved through comic books (observational learning constructs), and incentives were provided for individual and team efforts (reinforcement constructs). Parental involvement was fostered through use of home activity packets and snack packs that included FV for recipe preparation (behavioral capacity and environment constructs). The food service component of the intervention was targeted to increase purchase of FV from the lunchroom using strategies such as enhancing attractiveness of FV offered and increasing variety of FV offered (environment construct). The program was successful in significantly increasing FV consumption at lunchtime (Perry et al., 1998).

The *5-a-Day Cafeteria Power Plus* program, an extension of the *5-a-Day Power Plus* program, used school cafeteria-based changes to increase FV consumption in 1st and 3rd grade students (Perry, Bishop, Taylor, Davis, Story, Gray, et al., 2004). The goal of the program was increased opportunity for FV consumption during lunchtime (environment construct). Recruiting the school district food service staff, daily activities such as increasing availability and attractiveness of FV in the lunchroom, and encouragement to choose FV in the lunch lines and at school stores were all performed (reinforcement and self-efficacy constructs). FV sampling was conducted as well (expectations construct); sampled items then became available in the cafeteria line. The study also sought to introduce FV consumption role modeling, achieved through life-sized posters of fruit and vegetable characters hung in the lunchroom, a theater production, and through “sampling helpers” (observational learning construct). Intervention students consumed significantly higher amounts of FV at lunchtime (Perry et al., 2004).

The *High 5* project was conducted with 4th grade students (Reynolds, Franklin, Binkley, Raczynski, Harrington, Kirk, et al., 2000). Learning processes involved taste testing (expectations construct), problem-solving exercises (behavioral capacity and self-efficacy constructs), modeling (observational learning constructs), self-monitoring activities (self-control construct), and reinforcement. Students were offered a challenge to eat five servings of FV and record dietary intake (self-control construct). A parental element of the program included an information night, and explicit requests that parents assist children in at-home assignments (environment construct). Parents could sign vouchers of completion that were returned for incentives (reinforcement construct). After the first year, students significantly increased FV intake by 1.6 servings; this is the highest serving per day increase reported in the literature (Reynolds et al., 2000). Intakes increased from 2.6 servings per day to 3.96 servings per day after the first year, and 3.2 servings after the second year. Additionally, intervention parents reported higher FV consumption than did control parents.

## **Conclusions**

### **Implications and Strategies for Health Educators**

The interventions reviewed represent efforts to increase fruit, juice, and/or vegetable intake in American children over the past decade utilizing constructs of SCT. Emerging patterns and trends in design among successful studies generated strategies for future research endeavors. A summary of strategies categorized by SCT construct is provided in Table 1.

Of the eight interventions discussed, seven were school-based; schools are attractive environments for behavioral interventions (Thomas, 2006). No other institution has as much contact with children in the United States as do schools (Story, Kaphingst, & French, 2006). In addition, Baranowski and others (2002) demonstrated success using a boy scout troop. Health educators may benefit from nesting interventions within such unique groups with utilizing built-in education mechanisms that

allow for use of formats similar to school-based interventions (Baranowski et al., 2002).

Impact of interventions varied from a 0.2 serving difference among treatment and control groups (Baranowski et al., 2000) to a 1.6 serving increase among participants (Reynolds et al., 2000). This seemingly low impact is typical of most interventions, with the 1.6 serving increase being the highest reported in the literature. Often following interventions, participants continued to receive less than five servings per day (Baranowski et al., 2002), reinforcing the need for multiple exposures to intervention messages and the need to prevent decline in FV intake. A pattern of change was observed in which there was less of a decline in highest quartiles of treatment groups versus highest quartiles of controls (Baranowski et al., 2000; Baranowski et al., 2003). This supports the need for identification of methods that prevent decline among children already consuming FV and promotion of “try it” approaches for children consuming low amounts of FV (Baranowski et al., 2000; Baranowski et al., 2003).

### **General Recommendations for Successful Programs**

To design and implement programs that are effective, researchers must incorporate specific theory-derived components as crucial elements of their programs (Huon, Wardle, Szabo, 1999). The majority of interventions producing positive behavior change were theory-driven and focused on specific food-related behaviors (Lytle & Achterberg, 1995; Sahay, Ashbury, Roberts, & Rootman, 2006; Thomas, 2006). Program planners should include intervention targets that focus on a specific health behavior rather than targeting several different behaviors (Liquori et al., 1998).

Using multiple components to address a clear target is recommended (Perry et al., 2004). Many successful programs have combined curricula, a parent or home component, and a school food service component (French & Stables, 2003); the synergism of environmental changes, curriculum or knowledge interventions, and parental or family involvement is the most effective way to increase FV consumption in children (Perry et al., 2004). The majority of

SCT constructs, including behavioral capacity and self-efficacy, can be addressed using such an approach.

Though positive changes were observed, sustainability of such changes was questionable in several studies (Baranowski et al., 2002; Baranowski et al., 2003). Duration of interventions reviewed varied from five months to three years, with the most successful program being two years long including multiple messages and booster sessions (Reynolds et al., 2000).

### **Discussion of Strategies by Social Cognitive Theory Construct**

*Environment construct.* A supportive environment can be created through changes at multiple levels. Involving school food service provides excellent opportunities to encourage environmental changes at school. The cafeteria is a place in which curriculum messages can be reinforced and social support fostered. A food service component can affect availability and accessibility and provide repeated exposures with reinforcement (Blanchette & Brug, 2005; Perry et al., 2004). Small, sustainable changes in the cafeteria, such as increasing attractiveness or altering marketing and pricing of FV are recommended. However, environmental changes alone may have little effect, as observed in *5-a-day Cafeteria Power Plus* (Perry et al., 2004).

Home and community environments may be targeted in addition to the school environment. Successful interventions foster development of asking skills to increase availability and accessibility of FV at home. Many include newsletters, point of purchase education for parents, recipes, collaborative cookbooks, and workbooks. The home impacts both environmental and personal determinants of FV intake. Involving the family provides the opportunity for family members to show support for change by creating a conducive home environment and providing alternate forms of support. Parents can reinforce messages children receive at school and impact family eating (Lytle & Achterburg, 1995; Sahay et al., 2006). Also, as demonstrated with the *High 5* program, children can be powerful conduits for delivery of

intervention messages to parents (Reynolds et al., 2000). Concentrated messages regarding availability and accessibility of FV, repeated exposure to a variety of foods, and parental modeling may affect the environment, behavioral capacity, expectations, and expectancies (Birch, 1999; Blanchette and Brug, 2005).

No interventions directly addressed community settings, but community environment is nonetheless important as it provides both opportunities and barriers to FV consumption, and influences social norms regarding food for its members (Lytle & Achterburg, 1995). Community involvement in school-based programs has been seen (Perry et al., 2004).

*Behavioral capacity construct.* Bandura (2004) notes that informational components are critical aspects of effective programs. Program planners will want to include an educational component in interventions to enhance knowledge and provide skill-building opportunities. Education should be simple, clear, direct, and transmitted frequently (Sahay et al., 2006). Complex nutrition advice should be broken down into easily understood, developmentally appropriate recommendations and activities.

Students receiving curriculum-only interventions demonstrated increased knowledge only, suggesting active learning or participatory experiences with peers to accompany classroom lessons is beneficial (Liquori et al., 1998). Also interesting in the *Cookshop* program was successful integration of an ecological focus in the curriculum, as opposed to common, health-only focused lessons regarding FV intake, providing another potential strategy for knowledge-based nutrition interventions.

Alternate methods of curricula delivery have been explored using non-traditional staff such as trained peers or paraprofessionals. Success of the *High 5* project was attributed, in part, to reliance on trained peers to deliver interventions, not teachers (Reynolds et al., 2000). Not only does this method ensure intervention implementation, but behavioral capacity and



observational learning may be enhanced if targets can better relate to the message deliverer. Another suggestion for those with access and funding is the use of computers for curricula delivery. Development and maintenance of a program like Squire's Quest! is costly, and may not be practical in all settings. However, the computer and the Internet provide an ability to reach a substantial audience. Also, the interactive approach engaged children and maintained their attention, thereby boosting behavioral capacity while eliminating reliance on teachers or researchers for intervention delivery (Baranowski et al., 2003). Several successful multimedia programs have been conducted with alternate populations. For example, adolescent users of the computer-based Body Awareness Resource Network, were overall less likely to engage in risky health behaviors such as alcohol use (Baranowski et al., 2003; Bosworth, Bustafson, Hawkins, Body Awareness Resource Network Research Group, 1994).

Adequate training and support for intervention sites should not be overlooked. Sahay and others suggest equal emphasis should be placed on initial training to develop knowledge, skills, and support in order to enable staff to work effectively (Sahay et al., 2006) Monthly follow-up with food service staff was performed in the successful *High 5* intervention (Reynolds et al., 2000).

*Expectations and expectancies constructs.* Discussion of social norms and provision of social support has the ability to impact student expectations and expectancies regarding FV intake. Expectation involves the results that students expect to receive from the behavior. Expectancies are the values attached to an outcome. Evaluation of social impact or peer and media influence on health behaviors may also be beneficial, as expectancies may be altered. For example, *Gimme 5* included evaluation of media campaigns (Baranowski et al., 2000).

*Self-control, observational learning, emotional coping responses, self-efficacy constructs.*

These four constructs are closely related and so are presented together. Bandura (2004) suggests promotion of social and self-management skills and development of self-efficacy and social support as components of effective interventions. Frequent activities in interventions reviewed included development of asking skills to increase accessibility and availability of FV in out-of-school environments, taste testing to increase preferences, and cooking or preparation skills to increase self-efficacy and reinforce curricula messages. Other important components of the successful programs included problem-solving, goal-setting, monitoring, and feedback activities. Each of these activities has the potential to impact multiple SCT constructs, including self-control, emotional coping, and reinforcement.

Role modeling is also suggested using recognizable or relatable characters in printed media like comic books, or other media such as videos. Use of peers, students, or parents to demonstrate FV intake is another common role modeling strategy for enhancing observational learning, self-efficacy, and expectations and expectancies.

*Reinforcement construct.* Lastly, environmental changes and social support systems can positively reinforce FV behaviors, but caution should be exercised when using extrinsic rewards. Rewards can provide motivation, and are attractive components for interventions; however, too great an emphasis on reward systems may create only temporary behavior changes.

In conclusion, child-focused, multi-component interventions have been modestly successful in increasing FV intake among children in the United States. Given the importance of FV in prevention of chronic disease, continued research regarding use of Social Cognitive Theory to increase FV consumption among children is warranted.

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## Appendix A

Table 2. Summary of Interventions Reviewed

Intervention	Participants	Duration, design, and description	SCT constructs addressed	Outcome measure(s)	Results	Limitations
<b>Baranowski et al, 2002</b> <b>5 a Day Achievement Badge</b>	186 African American boy scouts aged 9-18 years from 14 troops in Houston, TX	8 week matched pair randomized, controlled trial with pre- and post-assessment; 8 troop meetings, 7 home activities, 8 comic books, 8 newsletters	Environment, behavioral capacity, expectations, self-control, observational learning, reinforcement, self-efficacy	24-hour recalls; questionnaire assessment of preferences and knowledge; parent telephone interviews	+0.8 FJV servings (p=.09) and +0.5 vegetable servings (p=.09); increased preferences and asking by scouts; increased availability and accessibility of FJV; 40% earned badges	Small sample; use of extrinsic rewards raises questions about maintenance of dietary changes; time-intensive and would need alteration for widespread adoption
<b>Baranowski et al, 2003</b> <b>Squires Quest!</b>	1578 multi-ethnic 4 <sup>th</sup> graders aged 9-10 years from 26 elementary schools in Houston, TX	5 week matched pair randomized, controlled trial with pre- and post-assessment; 10, 25 minute sessions with an interactive computer game	Environment, behavioral capacity, self-control, reinforcement, self-efficacy	4 computer-based 24-hour recalls	+0.52 fruit servings (p<.05), +0.24 vegetable servings (p<.05), +0.91 FJV servings (p<.05), +1.01 FJV servings (including high fat vegetables) (p<.05)	Expensive methods; limited completion of all computer sessions; inconsistent effects among meals; questionable effect after program discontinuation
<b>Baranowski et al, 2000</b> <b>Gimme 5</b>	1,253 multi-ethnic 4 <sup>th</sup> and 5 <sup>th</sup> graders from 16 elementary schools in Georgia	3 yr interventions; matched pair randomized, controlled trial with baseline, mid-intervention, post-assessment; 12, 45 minute lessons; newsletters and point of purchase parent education	Environment, behavioral capacity, expectations, self-control, observational learning, self-efficacy	7 day food record; student psychosocial questionnaires; parent telephone interviews	+0.2 FJV servings (p<.05) due to +0.1 vegetable serving (p<.01) and decreased control consumption; increased knowledge (p<.05) and asking behaviors (p<.05)	Less than 50% implementation by teachers and low family participation; questionable persistence of changes
<b>Blom-Hoffman et al, 2004</b>	91 African-American kindergarten	5 week pre-test, post-test control group design	Environment, behavioral capacity,	Multiple choice knowledge	Increase in intervention student	Sample size; unclear effect of home component

	and 1 <sup>st</sup> graders from 6 classes in 1 northeastern elementary school	with 1 month follow-up; 10 classroom lessons; home component; lunchroom behavior component	expectations, reinforcement, self-efficacy	assessment; visual plate waste assessments	knowledge (p<.0001) with gains maintained at follow-up; no significant increase in lunchtime vegetable consumption; increase in lunchtime vegetable consumption in former controls upon study replication (p<.001)	
<b>Liquori et al, 1998</b> <b>The Cookshop Program</b>	590 low-income kindergarten-6 <sup>th</sup> grade students from 2 elementary schools in Harlem, NY	5 month non-randomized pre-post intervention targeting grain and vegetable intake; 10 interactive cookshops supporting curriculum lessons; parental and community involvement; food exposures reinforced via lunchroom offerings	Environment, behavioral capacity, expectations, reinforcement, self-efficacy	Psychosocial questionnaire; visual plate waste assessments	Cookshop main effects: increased preferences in younger (p≤.001) and older children (p≤.001); increased knowledge in younger (p≤.05) and older students (p≤.001); increased cooking self-efficacy among older students (p≤.05); decreased plate waste in younger children (p≤.01)	Non-randomized design; contamination effects due assignment of classrooms to conditions within the same schools
<b>Perry et al, 1998</b> <b>5-a-Day Power Plus</b>	1612 multi-ethnic 4 <sup>th</sup> graders from 20 elementary schools in St. Paul, MN	1 year matched pair randomized, controlled trial; behavior curriculum implemented by teachers; parent-child activity kits; food service training; industry	Environment, behavioral capacity, observational learning, reinforcement, self-efficacy	24-hour food record and weighted plate waste in lunchroom observation for subsample; health behavior questionnaire; parent telephone	Lunchroom observation: +0.47 lunchtime FV servings(p<.05); +0.3 lunchtime fruit servings (p<.05); 24-hour records: +0.62 fruit servings only (p=.02); increased self-	Differences in 24-hour recalls and lunchroom observations; major changes at lunchtime, or with fruit alone, and in female participants

		involvement		interviews	reported FV intake; increased knowledge; increased asking	
<b>Perry et al, 2004</b> <b>5-a-Day Cafeteria Power Plus</b>	1668 1 <sup>st</sup> and 3 <sup>rd</sup> graders (6-7 years and 8-9 years) from 26 elementary schools	2 year randomized, controlled trial; cafeteria changes: increased availability, attractiveness, and verbal encouragement to choose FV at lunchtime; FV role modeling; social support	Environment, expectations, observational learning, reinforcement, self-efficacy	Lunchroom observations for subsample	Range of increase +0.14 (p=.03) to + 0.17 servings FV (p<.05)	Environmental-only focus may have weakened potential effect
<b>Reynolds et al, 2000</b> <b>High 5</b>	Multi-ethnic 4 <sup>th</sup> graders from 28 elementary schools in Alabama	2 year matched pair randomized, controlled trial; 14, 30-45 minute lessons with booster sessions during 2nd year; parental involvement; food service training and cafeteria modification	Environment, behavioral capacity, expectations, self-control, observational learning, reinforcement, self-efficacy	24-hour recalls; lunchroom observation and visual assessment of plate waste for subsample; psychosocial questionnaire; parent questionnaire including food frequency questions	+1.68 FV servings (p<.0001) for students at first follow-up and +1 FV serving (p<.0001) at second follow-up; positive effects on outcome expectations, self-efficacy, and knowledge; +0.29 FV (p<.0366) serving per day increase among treatment parents during year 1	No differences in observational FV intake