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Short-term Efficacy of *Click City*[®]: *Tobacco*: Changing Etiological Mechanisms Related to the Onset of Tobacco Use

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Abstract

This paper described the short-term results from an ongoing randomized controlled efficacy study of *Click City*[®]: *Tobacco*, a tobacco prevention program designed for 5th graders, with a booster in sixth grade. *Click City*[®]: *Tobacco* is an innovative school-based prevention program delivered via an intranet, a series of linked computers with a single server. The components of the program target theoretically based and empirically supported etiological mechanisms predictive of future willingness and intentions to use tobacco and initiation of tobacco use. Each component was designed to change one or more etiological mechanisms and was empirically evaluated in the laboratory prior to inclusion in the program. Short-term results from 47 elementary schools (24 schools who used *Click City*[®]: *Tobacco*, and 23 who continued with their usual curriculum) showed change in intentions and willingness to use tobacco from baseline to one-week following the completion of the 5th grade sessions. The results demonstrate the short-term efficacy of this program and suggest that experimentally evaluating components prior to including them in the program contributed to the efficacy of the program. The program was most efficacious for students who were most at risk.

Keywords

school-based prevention; tobacco prevention; component evaluation

Introduction

Although recent data from the 2008 Monitoring the Future Study (Johnston, O'Malley, Bachman, & Schulenberg, 2009), suggests that the prevalence of smoking among youth is decreasing, it is still substantial. In 2008, the 30-day prevalence of smoking for 8th graders was 6.8% and for 12th graders was 20.8%, indicating a clear need for tobacco prevention among youth. According to two earlier epidemiological studies (Harrell, Bangdiwala, Deng, Webb, & Bradley, 1998; Andrews, Tildesley, Hops, Duncan, & Severson, 2003), substantial increases in the onset of tobacco use occur between elementary (grades 4 & 5) and middle school (grades 6 & 7). For example, according to data from The Oregon Youth Substance Use Project (OYSUP; Andrews et al., 2003), the lifetime prevalence of cigarette use was

5.9% among 5th graders and 14.4% among 6th graders. In 5th grade, smoking is considered experimental. Among those who used cigarettes in the last year in 5th grade (1.4%), 91% smoked once or a couple of times (1.2% of all 5th graders) and only a small proportion (9%) smoked some each week (0.1% of all 5th graders; Andrews, 2010). The lifetime prevalence of using smokeless (chewing) tobacco remained low across both the 5th and 6th grade (2.9% among 5th graders and 3.2% among 6th graders). The increase in initiation in smoking between 5th and 6th grade suggested a clear need for a tobacco prevention program prior to 6th grade, emphasizing cigarette use. We designed the *Click City*[®]: *Tobacco* school-based prevention program to meet this need.

We designed *Click City*[®]: *Tobacco* to target theoretically derived and empirically supported mechanisms that were shown to be prospectively related to intentions and willingness to use tobacco in the future, and initiation of tobacco use among children or early adolescents. Although tobacco use among youth is influenced by a variety of mechanisms, including socioeconomic status (Gilman, Abrams, & Buka, 2003), personality (e.g., Hampson, Andrews, & Barckley, 2007), parental influences (e.g., parental tobacco use; Andrews, Hops & Duncan, 1997), and peer influences (Alexander, Piazza, Mekos & Valente, 2001), we chose mechanisms that were intra-individual and that were amenable to change. Thus we chose to target mechanisms that were based on the health cognition theories of Ajzen and Fishbein (Ajzen & Fishbein, 1980; Ajzen, 1988) and Gibbons and Gerrard (Gibbons & Gerrard, 1997; Gibbons, Houlihan, & Gerrard, 2009) and those based on the risk perception and decision research theories of Slovic (e.g., Slovic, Peters, Finucane, & MacGregor, 2005).

School-based substance use prevention programs have been in existence for several decades. Most of these programs focus on smoking, although some (e.g., Project towards No Tobacco Use; Sussman, et al., 1993) include smokeless (chewing) tobacco. Similar to *Click City*[®]: *Tobacco*, superior programs include ones targeting informational social influence mechanisms, focusing primarily on students' attitudes towards and evaluation of tobacco use (Sussman, 1989). Further, as noted by Botvin and Griffin (2007) and Sussman (2001), programs that include several components targeting diverse mediating mechanisms are more effective than those that focus only on one. Thus, *Click City*[®]: *Tobacco* was designed to target several mechanisms from diverse theoretical perspectives, including not only informational social influence mechanisms, but other mechanisms as described below.

Mechanisms Based on Cognitive Theories

The targeted mechanisms derived from cognitive theories were prototypes, normative social images and descriptive norms. Prototypes are a key component of Gibbons' and Gerrard's Prototype/Willingness model (Gibbons & Gerrard, 1997). Prototypes are the social images adolescents have of those who engage in risky health behaviors, such as their social image of a person their age who smokes cigarettes (e.g., they are "cool"). Adolescents are aware that if they engage in the behavior, they will be viewed by others as having the attributes of the prototype. According to the Prototype/Willingness model, the more favorable the social image (prototype or attitude), the more likely adolescents are willing to engage in the behavior (Gibbons & Gerrard, 1997).

Normative beliefs are a key component in the Theory of Reasoned Action and the Theory of Planned Behavior (Ajzen & Fishbein, 1980; Ajzen, 1988). Normative social images are a type of normative belief. As children develop cognitively, they are able to understand the perspective of others. As a result of this perspective-taking, children can be influenced by what they perceive as others' behaviors, thoughts and feelings. In our etiological research, we have shown that perception of friends' social images, which we refer to as "normative social images," prospectively predict smoking intention and initiation (Andrews, Hampson,

& Barckley, 2008). Further, this variable was a stronger prospective predictor of intention than the child's own social images of smokers. Normative beliefs also include descriptive norms, which are operationalized as beliefs about the extent to which other people are perceived to be engaging in the activity (Rivis & Sheeran, 2003). Our etiological research (e.g., Andrews, Hampson, Barckley, Gerrard, & Gibbons, 2008), and that of others (Marcoux & Shope, 1997), has shown that descriptive norms influence children's intentions to smoke cigarettes and their eventual use.

Mechanisms Based on Risk Perception Theories

Mechanisms derived from risk perception theories included perceptions of risks of long and short-term consequences from tobacco use, consequences of exposure to environmental tobacco smoke, and risk of addiction. Research by Paul Slovic and colleagues demonstrates that many individuals do not adequately understand and appreciate the risks associated with tobacco use and do not believe that they are at risk for addiction (Benthin, Slovic, & Severson, 1993; Slovic, 2000, Slovic, 2001). Development of components designed to change these risk perceptions were guided by the "affect heuristic" (Slovic et al., 2005). According to this heuristic, the more attractive a product or activity is, the more its perceived risks decline. Correspondingly, the less attractive the activity, the more its perceived risk increases. Therefore, we designed several components to induce negative affect regarding cigarette smoking in order to increase risk perceptions. For example, components showing the short and long term health effects of tobacco were quite graphic and affect arousing and components targeting addiction induced frustration.

Estimation of risk is also influenced by optimism bias. Optimism bias occurs when an individual's personal risk is estimated at less than the risk faced by others (Weinstein, 1998), and the optimism bias of adolescents is equal to that of adults (Quadrel, Fischhoff & Davis, 1993). Thus, many youth believe that others will get addicted from experimenting with cigarettes, but they will not. One of the components targeting the risk of addiction also targeted optimism bias, showing that the participant, similar to other smokers, will also get addicted from smoking.

Research conducted by Diamond (1990) suggests that people are more willing to expose themselves to cumulative risks than to independent but statistically equivalent risks. Slovic (2000) showed that young smokers are cumulative risk takers, and believe that smoking the "very next cigarette" poses little or no risk to their health or that smoking for only a few years poses negligible risk. Thus our components emphasized that every cigarette causes some harm, and that cumulative risk begins with the first cigarette smoked.

Description of *Click City*[®]: Tobacco

Click City[®]: Tobacco is an eight-session, school-based program, for 5th graders, with a two-session booster in 6th grade. The booster sessions were designed to maintain the effects of the 5th grade program. The 5th grade program consisted of 21 activities and 17 components and the 6th grade booster consisted of 5 components. The program was delivered over an intranet (i.e., networked computers linked to an internal server), which enabled students to interact individually with the program content, to share their thoughts and beliefs with classmates, using a screen name, and to receive feedback on classmates' beliefs based on their classmates' aggregated responses. The program began with a brief tutorial to ensure that those who had less experience with computers could easily navigate the program. The user interface was designed to be fun and engaging to students. Each activity took place in a specific location within *Click City*[®], a 3-D environment (e.g., the movie theater). A buddy, who was the same gender as the student but a few years older, provided an introduction to each activity which served as an advanced organizer (Ausubel, 1977) and, following each

activity, summarized the main points. The activities themselves were engaging and affect inducing. The activities and the mechanisms that they were designed to target are listed in Table 1.

Both the 5th and 6th grade programs were accompanied by a guide for teachers and a series of parent newsletters. The teachers' guide provided an overview of the entire program, national health content standards that were addressed by the program, and follow-up activities that reinforced the content and goals of each component. Newsletters included a description and purpose of the program and useful tips for parents.

Component Evaluation

Each component within the program was designed to change at least one etiological mechanism and all components were empirically evaluated to assure that they changed the etiological mechanisms that they were designed to change. The development of each component was iterative, consisting of formative evaluation of activities comprising the component, including feedback from both focus and user groups, and summative evaluation of each component. Focus groups provided feedback regarding initial ideas and concepts and user groups were observed as they tested activities in the computer lab. Following focus and user group feedback, components were formed from one to two activities targeting the same mediating mechanism. The development process culminated in an experimental evaluation of each in the laboratory to assess its effectiveness in changing the targeted mechanism, as recommended by MacKinnon and associates (MacKinnon, Taborga, & Morgan-Lopez, 2002).

Experimental Evaluation of Components

Two components were evaluated in a single study using a pre-post cross-over design. Each component of the pair (Component A and Component B) was chosen such that each targeted diverse mechanisms. Approximately 60 5th or 6th graders, who had not previously participated in an evaluation of the program, completed both of the two components. To control for potential order effects, half of the participants were randomized to complete Component A first, and the other half to complete Component B first. Each participant completed three assessments, prior to completing Component A, after completing Component A (and prior to viewing Component B), and after completing Component B. Component A was deemed effective if significantly more change occurred in the etiological mechanism targeted by Component A after completing Component A than in the same etiological mechanism after completing Component B. Similarly, Component B was deemed effective if significantly more change occurred in the mechanism targeted by Component B after completing Component B versus after completing Component A. For example, assume that Component A targets risk of addiction, and Component B targets normative social images. Using a cross-over design, following completion of Component A, we would expect an increase in perception of risk of addiction, but would not expect social images to become less favorable. Conversely, following completion of Component B, we would expect social images to become less favorable, with no change in perception of risk of addiction. This design is superior to testing one component at a time in a simple pre-post design because it controls for several threats to internal validity (Campbell & Stanley, 1966), including demand characteristics and Hawthorne effects.

Components were retained for use in *Click City*[®]: *Tobacco* if they significantly changed the mechanisms that they were designed to change for the entire sample or for those children who were most "at risk", as measured by a family member smoking, being high in sensation seeking, or having experimented with cigarettes. We also examined whether the component was effective for both genders, and retained only those that were. In addition, we used the

Implicit Association Test (IAT; Greenwald, McGhee & Schwartz, 1998) as part the component evaluation to assess change in implicit attitude, an indicator of affect. As shown in Andrews, Hampson, Greenwald, Gordon & Widdop (2010), compared to a control activity, components targeting addiction resulted in significantly less positive affect toward smoking. Although components targeting social images and negative health consequences changed affect in the expected direction, the changes were not significant due to small sample sizes ($n = 27 - 44$).

For the 5th grade program, we re-designed and re-evaluated five of the seventeen components (one was re-designed twice), and discarded two components. In sum, our component development process was successful, and only effective components, as indicated by the summative evaluation, were included in the final program.

Evaluation of Efficacy

The short-term efficacy of *Click City*[®]: *Tobacco* was evaluated by assessing change in intentions and willingness to use tobacco in the future among students in *Click City*[®] schools as compared to students in schools that continued with their usual tobacco education (Usual Curriculum schools). Most schools used a general health education program, which included components regarding tobacco education. The most common programs used were *The Great Body Shop* and *Michigan Model for Health*[®]. Behavioral Intentions are conceptualized as the first step in smoking initiation (Pierce, Choi, Gilpin, Farkas, & Merrit, 1996) and this conceptualization has been empirically supported. For example, Andrews and colleagues (Andrews et al., 2003) showed that intentions in the 1st through 5th grade were related to initiation of smoking two years later. Willingness to smoke measures openness to a risk-associated opportunity (Gibbons et al., 2009) and is less planful than intentions. Both intentions and willingness have been shown to be predictive of subsequent tobacco use (Andrews, Hampson, Barckley et al., 2008; Gerrard, Gibbons, Brody, Murry, Cleveland, & Wills, 2006). We hypothesized that students in *Click City*[®] schools would decrease their willingness and intentions to engage in tobacco use, as compared to students in Usual Curriculum schools. Change in these outcome measures was assessed from one-week prior to program implementation to one week following program implementation. We also assessed change in etiological mechanisms targeted by the program and hypothesized that these mechanisms would change more in the expected direction among students in the *Click City*[®] schools than among students in the Usual Curriculum schools.

We designed *Click City*[®]: *Tobacco* to be a universal prevention program, designed for all students in school, regardless of their level of risk. However, a major criticism of universal school based programs is that they may not meet the needs of all youth, particularly those who are at the most risk (Institute of Medicine, 1996) suggesting that at-risk youth may need a targeted intervention. Thus, following the recommendation of Griffin and colleagues (Griffin, Botvin, Nichols & Doyle, 2003), we evaluated the efficacy of the program for those students expected to be “at risk” as compared to those “not at risk”. Our definitions of “at risk” were based on the literature and consisted of having family members who smoked, being high in sensation seeking, or having experimented with smoking. Family members’ smoking is one of the primary predictors of initiation and the transition to more extensive smoking (Andrews et al., 1997; Bricker, Peterson, Andersen, Sarason, Rajan, & Leroux, 2007). Youth who are sensation seekers are more likely to smoke (Urbán, 2010), and trying tobacco at an early age is related to more extensive use in adolescence (Maggi, Hertzman, & Vaillancourt, 2007). We hypothesized that the program would be more efficacious, as measured by a decrease in intention and willingness, for those most “at risk”.

Gender was also assessed as a moderator to assure that short-term efficacy was similar across both genders. We did not predict that there would be effects of gender on the efficacy

of the program. However, there is some suggestion that girls' smoking may be more susceptible to social influence variables than boys'. For example, Andrews et al. (2008) found stronger effects of descriptive norms on willingness to smoke, and stronger effects of social images on intention to smoke for adolescent girls than for boys. Because several program components targeted mechanisms involving social influence, the moderating effects of gender was examined in the analyses to confirm that the program was equally effective for boys and girls.

Method

Design of Efficacy Trial

The *Click City*[®]: *Tobacco* efficacy trial took place in three counties in Western Oregon. In these counties, 5th graders typically attend elementary schools and 6th graders attend middle schools, although some schools in smaller towns served K - 8. Thus, both middle schools and the elementary schools that fed into those middle schools were recruited. Recruited middle schools were stratified according to school type (i.e., grades 6 – 8 or K – 8) and socioeconomic status of the population that the school served, then randomly assigned to receive either the intervention (*Click City*[®] schools) or to continue with their usual curriculum (Usual Curriculum schools). Elementary schools that fed into an assigned middle school (6 – 8), automatically were assigned to the same condition as the corresponding middle school. Intervention and control schools were yoked for the timing of assessments. Randomization resulted in 23 *Click City*[®] schools and 24 Usual Curriculum schools participating in the 5th grade evaluation.

Participants

The 47 elementary schools ranged in size from 63 to 593, with an average school size of 326. The population that schools served was primarily middle class, with 6 serving a more upper middle class population, as measured by free and reduced lunch (<20% on free or reduced lunch), and 16 serving a more lower middle class population (>60% on free or reduced lunch). Across the intervention schools, 1168 students participated in the study and across the Usual Curriculum schools, 1154 students participated in the study. Participants were 50.0% female, 5.0% had tried smoking, and 2.0% had tried using smokeless tobacco, 39.9% of students had parents or siblings in the home who smoked, and 24.5% had family members, in the home or not in the home, who used smokeless tobacco. Students were primarily White (78.3%) with 11.1% Hispanic, 3.3% African American, 3.1% American Indian, and 4.1% Asian. Students across the two conditions did not differ on gender, whether they had tried cigarettes or chewing tobacco, the proportion with family members who smoked or used smokeless tobacco, or sensation seeking. However, disproportionately more students in the *Click City*[®]: *Tobacco* condition were African American (4.1%) than in the Usual Curriculum condition (2.5%); $\chi^2(1, n = 2323) = 4.62, p < .05$.

Procedures

Since anonymity of students was assured, we used a passive consent procedure to recruit students within schools for the assessments. Parents of students in all participating schools were sent a passive consent letter along with a post-card to return if they did not want their child to participate in the evaluation. Across all 47 schools, the rate of passive consent was 98%. Students in *Click City*[®] schools completed a baseline assessment in the classroom the week prior to implementation of the prevention program and a short-term follow-up assessment one week following the implementation of the program. For purposes of the timing of assessment, students in Usual Curriculum schools were yoked to students in the *Click City*[®] schools. Thus, the pre and post assessments occurred approximately six weeks apart in both intervention and Usual Curriculum schools.

To implement the *Click City*[®]: *Tobacco prevention* program, research staff brought 25 to 30 laptops using a Microsoft Windows^c platform to the schools and set them up in a common setting (i.e., gym; empty classroom), hard-wired to a single server. Research staff assisted teachers and students during the first one to two lessons, then teachers facilitated the remaining lessons. Students accessed the program using their state-wide student identification number, which was used to track student participation, as well as to identify students on the assessments.

Measures

The measures were piloted three years prior to the implementation of the efficacy trial with a separate sample of 40 5th grade participants who completed each assessment two-weeks apart. Estimates of reliability are based on data from the pilot study and the first assessment in the efficacy trial and stability indices are based on the pilot study.

Behavioral intentions—Intention to smoke and use chewing tobacco in the future was measured by two items assessing the likelihood of smoking (or using chewing tobacco) as a teen and as an adult on a 5-point scale ranging from (1) “definitely not” to (5) “definitely will”. For intentions to smoke, Cronbach’s alpha was .86 at T1 and .89 at T2 (pilot) and .85 (trial). Stability was .69. For intentions to chew, alpha was .83 at T1 and .73 at T2 (pilot) and .84 (trial). Stability was .59. This measure of intentions has been correlated with subsequent use in numerous studies (e.g., Andrews et al., 2003; Andrews, Hampson, Barckley et al., 2008).

Willingness—Willingness assessed the likelihood of each of three behaviors in response to being “with a group of kids and some were smoking” and “kids are smoking and you want to be part of the crowd”. Responses to these scenarios are: “try a few puffs,” “smoke the whole cigarette,” and “smoke one and take one for later” with each rated on a five-point scale ranging from “not at all willing” (1) to “very willing” (5). Alpha was .90 at T1 and .95 at T2 (pilot) and .86 (trial). Stability was .80. This measure of willingness was prospectively related to tobacco use among youth (Andrews, Hampson, Barckley et al., 2008).

Descriptive norms—This measure consisted of two items assessing the number of kids at school in their grade that have tried smoking and the number of 5th graders in schools in their area that have tried smoking. It was used extensively in the OYSUP study and has been shown to be both reliable and valid. Alpha was .78 at T1 and .85 at T2 (pilot) and .84 (trial). Stability was .80.

Social images—Students endorsed five positive adjectives describing what they “think kids who smoke are like” on a five-point scale ranging from “not at all like this” to “very much like this”. The positive adjectives were “popular”, “smart”, “cool or neat”, “exciting” and “good-looking”. Alpha was .58 at T1 and T2 (pilot) and .79 (trial). Stability was .72. Previously, Andrews and Peterson (2006) showed that this scale had excellent Guttman properties for 5th graders (for boys, Coefficient of Reproducibility = .99; Minimum Marginal Reproducibility = .94; Coefficient of Scalability = .87; for girls, 1.00, .95, and .91, respectively).

Normative social images—Students endorsed the same five positive adjectives as those for the above scale describing what they “think other fifth grade kids think kids who smoke cigarettes are like”, on a five-point scale ranging from “not at all like this” to “very much like this”. Alpha was .74 at T1 and .76 at T2 (pilot) and .79 (trial). Stability was .78.

Risk of short-term consequences—This scale consisted of five items, each assessing risk of having a short-term consequence (e.g., shortness of breath, yellow teeth) as a result of smoking “a few cigarettes a day for 2 years”. Responses ranged from “no chance” (1) to “certain to happen” (5). Alpha was .83 at T1 and .79 at T2 (pilot) and .89 (trial). Stability was .63.

Perceived harm from smoking—This scale consisted of five items assessing agreement with statements, such as every cigarette “hurts their health”. Responses were on a Likert scale from strongly agree (1) to strongly disagree (5). This item was assessed at only one time in the pilot. Cronbach’s alpha was .73 in the pilot and .65 in the trial.

Risk of long-term consequences—The scale assessing risk of long-term consequences included four items for each of the following diseases: cancer, “breathing diseases” (e.g., emphysema), and “heart disease”. To decrease potential ceiling effects, items varied in terms of length of time and extent of smoking, ranging from “one cigarette” to “smoking a pack a day for 29 years”. Responses ranged from “no chance” (1) to “certain to happen” (5). As expected, the frequency of endorsing responses indicating more certainty increased as the length and extent of smoking increased, providing content validity for this measure. The scale was created by summing responses to all 12 items (across diseases). Alpha was .79 at both T1 and T2 (pilot) and .91 (trial). Stability was .66.

Risk of consequences from environment tobacco smoke—This measure consisted of five items assessing risk of health problems (e.g., asthma; ear infections) resulting from “being around a smoker a lot”. Responses range from “no chance” to “certain to happen”. Alpha was .94 at both T1 and T2 (pilot) and .87 (trial); Stability was .54.

Personal risk of addiction—This five-item scale assessed the cumulative risk of the student getting addicted from smoking varying quantities of cigarettes. Items range from smoking “one cigarette” to “a pack of cigarettes a day for 5 years”. Responses range from “No chance” (1) to “Certain to happen” (5). Alpha was .83 at T1 and .81 at T2 (pilot) and .93 (trial). Stability was .45.

Optimism bias regarding risk of addiction—A similar five-item measure to that assessing personal risk of addiction was used to assess perception of a teen getting addicted. Alpha was .81 at both T1 and T2 (pilot) and .84 (trial). Stability was .56. Optimism bias was measured by subtracting perception of own addiction from perception of teen addiction.

Perceived difficulty in quitting tobacco—This scale consisted of five items assessing ease of quitting after smoking “one cigarette” to a “pack of cigarettes a day for 5 years”. Responses ranged from very easy (1) to very difficult (5). Alpha was .77 at T1 and .86 at T2 (pilot) and .84 (trial). Stability was .61.

Perception of personal control over smoking—This variable was measured by five items assessing the student’s perceived control over quitting after smoking “a cigarette” to “a pack a day for 5 years”. The sum of these items was compared to two supposedly uncontrollable events: “getting injured in a car accident” and “getting struck by lightning” using a four-point response scale ranging from “no control” to “total control”. Cronbach’s alpha for the 5 control items was .89 at T1 and .91 at T2 (pilot) and .89 (trial). Stability was .72.

Sensation seeking—This variable was measured by four items from the Brief Sensation Seeking Scale (BSSS-4; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002).

Examples of items were “liking to explore strange places” and “preferring friends who are exciting and unpredictable”. Alpha was .73 at T1 and .85 at T2 (pilot) and .74 (trial). Stability was .76.

Family smoking—This variable was assessed by three items, “Do any of your brothers, sisters, step brothers or step sisters smoke? Does your mother/step-mother smoke? Does your father/step-father smoke?” If the participant answered in the affirmative to any of the three items, they were considered to come from a smoking family. In the pilot study, stability between assessments of this measure was .81.

Family chewing—This variable was assessed by one item, “Does anyone in your family chew tobacco or use stuff?”. Responses were “yes” and “no”. In the pilot, the phi coefficient assessing stability was .51.

Trying smoking—Trying a cigarette was assessed by one item: “How old were you when you first tried a cigarette, even a few puffs?” If students answered any response other than “Never tried”, they were considered “triers”. From the pilot study, stability of trying a cigarette was .75.

Results

Analysis Strategy

To control for the design effect (randomization by school), data were analyzed using a general linear mixed model, with participants nested within schools and schools nested within condition. Both students and schools were random effects. Among the 2,322 fifth grade students who completed either the baseline assessment or the assessment six weeks later, 149 students ($n = 82$ in intervention, 7.0%; $n = 67$ in UC, 5.8%) missed the baseline assessment, and 174 students ($n = 97$ in intervention, 8.3%; $n = 77$ in UC, 6.7%) missed the follow-up assessment. Missing data were imputed using full information maximum likelihood methods. Repeated measures analyses, with participants nested within schools, were conducted using a SAS procedure, Proc Mixed. Due to differences in Race/Ethnicity across conditions, Race/Ethnicity (Being African American versus not) was included as a covariate in all analyses.

The moderating effect of gender, having tried a cigarette, family smoking and sensation seeking on the effect of the intervention on intentions to smoke and use of smokeless tobacco and on willingness to smoke were examined by including these four variables as interactions with condition and time in the model. For this analysis, sensation seeking was categorized into three groups: (1) high sensation seekers (+1 standard deviation above the mean); (2) low sensation seekers (−1 standard deviation below the mean); and (3) moderate sensation seekers (between +1 and −1 standard deviations from the mean). For reasons of parsimony, if the three-way interaction was not significant, this interaction and the two-way interactions (with condition and time) were dropped from the model along with the main effect, and the model was reevaluated. Significant three-way interactions were decomposed using simple interactions. The effect of interest was the interaction of condition with time for each risk group.

Program Completion

Of the 1168 students who completed either the baseline or follow-up assessment in the intervention schools, 90.3% completed the entire *Click City*[®]: *Tobacco* program. Another 7.2% completed a major portion of the program.

Correlation of Mechanisms with Outcome Variables

The correlations between outcome variables were high. The correlation between intention to smoke and willingness to smoke was .56; the correlation between intention to smoke and intention to use smokeless tobacco was .52; and the correlation between intention to use smokeless tobacco and willingness to smoke was .40. The correlations of mechanisms with outcome variables are displayed in Table 2. As shown, the majority of the correlations were small, $<.20$. However, the mechanisms together explained a large proportion of the variance in intention to smoke at both T1 and T2 (T1: Multiple $R = .39$, $R^2 = .15$; T2: Multiple $R = .39$, $R^2 = .15$), a moderate proportion of the variance in willingness to smoke (T1: Multiple $R = .32$, $R^2 = .10$; T2: Multiple $R = .36$, $R^2 = .13$), and moderate to low proportions of variance in intention to use smokeless tobacco (Multiple $R = .25$; $R^2 = .06$; Multiple $R = .10$, $R^2 = .01$).

Short-term Results

Short-term results are based on change from baseline to one-week following the 5th grade program. With the exception of descriptive norms, all intraclass correlations (ICC's) of the variables in Table 3 ranged from .001 to .03 at both the pre- and post-program assessments. The ICC for descriptive norms was .10. As shown in Table 3, all univariate effects were in the expected direction. To maintain an experimentwise error rate of .05 across all analyses, univariate comparisons must be significant at .0005. All variables, with the exception of intention to use smokeless tobacco, met this criterion for significance.

Changes in the primary outcomes were in the hypothesized direction. As noted in Table 3, students who used the *Click City*[®]: *Tobacco* program, as compared to students in the Usual Curriculum control condition, significantly decreased their intentions to smoke and chew tobacco in the future and significantly decreased their willingness to smoke if given the opportunity. However, effect sizes, as measured by Cohen's d (Cohen, 1988), were small. Change in the targeted etiological mechanisms was in the expected direction and, for most mechanisms, these effect sizes were moderate. As compared to students in the Usual Curriculum schools, for students in the *Click City*[®] schools: (1) Social images and normative social images of smokers and smoking became less favorable; (2) Perception of descriptive norms for tobacco use decreased; (3) Risk perceptions regarding short- and long-term consequences of using tobacco increased; (4) Perception of harm from tobacco use and exposure to secondhand smoke increased; (5) Risk perceptions associated with addiction, including personal risk of getting addicted and perceived difficulty in quitting and perception of personal control increased; and (6) Optimism bias regarding getting addicted (i.e., their perception that other kids will get addicted from smoking, but they will not) was reduced.

Examination of Moderators of Short-term Results

Using this same analytical strategy, we examined the moderating effect of gender, trying smoking, having a family member (parent or sibling) who smoked, and level of sensation seeking on short-term changes in intentions and willingness. For intention to chew, we also evaluated the moderating effect of having a family member who chewed. No hypothesized variables moderated the effect of the intervention on intention to chew. Previous experimentation with cigarettes, $F(1,46) = 5.21$, $p < .05$, having a family member who smoked, $F(1, 46) = 5.68$, $p < .05$, and level of sensation seeking, $F(1,46) = 7.19$, $p < .05$, moderated the effect of the program on intentions to smoke in the future. Previous experimentation with cigarettes, $F(1,46) = 92.55$, $p < .0001$, and level of sensation seeking, $F(1,46) = 5.36$, $p < .05$, but not having a family member who smoked moderated the effect of the program on willingness to smoke. As shown in Table 4, the program was most effective at changing intentions to smoke in the future and willingness to smoke for those most at risk,

those students who had previously experimented with cigarettes or who were highest in sensation seeking. It was also most effective in changing intentions to smoke for those with a family member who smoked. As shown, those who were most at risk had higher initial intentions and willingness than those not at risk. Among those at risk who used *Click City*[®]: *Tobacco*, intentions and willingness decreased to become more similar to those who were not at risk.

Discussion

The short-term results presented here suggest that the 5th grade program of *Click City*[®]: *Tobacco* is efficacious in reducing students' intentions and willingness to smoke. This is particularly important since both intentions and willingness are precursors to and are predictive of initiation of tobacco use (Andrews, Hampson, Barckley et al., 2008). Thus *Click City*[®]: *Tobacco* has the potential to postpone or prevent initiation of cigarette use. In addition, findings suggest that the program is efficacious at reducing all etiological risk factors associated with cigarette use, significantly lowering the risk of initiation. The findings that the program was particularly effective at decreasing intentions and willingness for those students who were particularly at risk further adds to the efficacy of *Click City*[®]: *Tobacco*. For these at-risk students, measures at baseline on intentions and willingness were higher than those of students not at-risk.

Click City[®]: *Tobacco* reduced intentions and willingness closer to levels that were characteristic of those students who were not at risk. *Click City*[®]: *Tobacco* was only moderately effective at changing intentions to use smokeless tobacco in the future. Dent and colleagues (Dent, Sussman, Stacy, Craig, Burton & Flay, 1995) showed that while components of Project TNT (Sussman et al., 1993) targeting physical consequences decreased initiation of smokeless tobacco, components targeting social influence mechanisms did not affect initiation. Thus, we incorporated smokeless tobacco only in our components targeting the health effects of tobacco use. We expected that these components alone would be effective at reducing intentions to use smokeless tobacco. However, in contrast to Project TNT, *Click City*[®]: *Tobacco* did not reduce children's intentions. These aberrant findings could be due to the age of the child. Project TNT was implemented in the 7th grade, whereas *Click City*[®]: *Tobacco* was implemented in the 5th grade. Children's intentions to use smokeless tobacco is comparatively low in the 5th grade, as compared to intentions to smoke cigarettes (3.7% vs 15.6%), but increases to 5.3% by 7th grade (Andrews et al., 2003).

Evaluation of program components prior to including them in the program is a relatively novel method of program design. Although evaluations of component effectiveness are recommended by methodologists interested in the design of interventions (Flay, 2000), most occur after the program has already been implemented. Meta-analyses of school-based tobacco prevention programs have shown mixed results regarding the long-term effectiveness of these programs (Wiehe, Garrison, Christakis, Ebel, & Rivara, 2005; Skara & Sussman, 2003). We are optimistic that the systematic evaluation of components to assure that each changes the targeted mechanism that it is designed to change prior to including that component in the program will impact not only the short-term, but the long-term efficacy of *Click City*[®]: *Tobacco*.

Click City[®]: *Tobacco* has additional advantages over more traditional school-based prevention programs. First, it is translational, translating theory into practice as the mechanisms targeted in *Click City*[®]: *Tobacco* are theoretically based. Targeted mechanisms are guided by health cognition theories including The Theory of Planned Behavior of Ajzen and Fishbein (Ajzen, 1988) and the Prototype/Willingness Model of Gibbons and Gerrard

(1997) and by the risk perception and decision research theories of Slovic and colleagues (2005).

Second, the method of delivery via the intranet, a local area computer-based network within the school, encourages teacher fidelity. The program is designed so that all students must progress through it in step-wise fashion, going from one lesson to the next in the same order. Whereas efficacy evaluations can suggest that a given prevention program is efficacious, adoption of the program and implementation are often not successful. For example, an evaluation of the implementation of the Life Skills Training Program showed that 60% of the students did not receive all components of the program (Botvin, Baker, Dusenbury, Botvin, & Diaz, 1995). Further, Rohrbach, Graham and Hansen (1993) showed that although 80% of trained teachers implemented a school-based program immediately after training, only 25% of teachers maintained implementation in the following year. The standardized delivery of the *Click City*[®]: *Tobacco* program avoids these pitfalls of lack of adherence to program specifications.

Third, the method of delivery encourages active engagement with the program as well as interactions with other students. In a meta-analysis of 120 school-based drug prevention programs, Tobler & Stratton (1997) identified interactive (versus didactic) teaching formats as being the more effective of the two classroom processes. Interactive teaching formats engage students in the instruction process and give students direct feedback about other students' behavior and attitudes. Using the intranet, the program provides feedback about classmates behaviors and attitudes either in group form (e.g. "two of your classmates have tried smoking") or with anonymity preserved by self-ascribed "screen names" (e.g., "Baseball Girl says, "I will never smoke"). The *Click City*[®]: *Tobacco* program also provides an ideal environment for children to engage in "experiential learning", an important method of behavior change (Slovic, 2001). For example, in one activity, students experienced that they could not escape addiction, and were repeatedly held up in a timed task while they "smoked" a cigarette.

While it would be informative to relate engagement in the program to outcomes, within this efficacy trial, it was not practical. Since 91% of the students completed the entire program, the variability in time spent in the program, a typical measure of engagement, is limited. However, based on observing students in the classroom and feedback from teachers, students were interested in *Click City*[®] and found it engaging. For example, as an indicator of student interest, students who participated in the efficacy trial for *Click City*[®]: *Tobacco* looked forward to "*Click City*[®] days" and wanted to purchase the program for home use.

Limitations

There are three major limitations to this study. First, *Click City*[®]: *Tobacco* does not include components targeting refusal skill efficacy, which are commonly included in social influence prevention programs. Refusal skill efficacy can be conceptualized as related to perceived behavioral control, or the perception of a person's ability to perform (or not to perform) a given behavior, an integral part of the Theory of Planned Behavior (Ajzen, 1988). Although we attempted to design a component targeting refusal skill efficacy, we found that the component decreased the participants' favorable social images, rather than changing their refusal skill efficacy. Since social images are theoretically and empirically related to willingness to use tobacco (i.e., willingness not to refuse), social images are a key factor in implementing refusal skills (Plumridge, Fitzgerald & Abel, 2002). Therefore, if youth perceive a behavior as not "cool", then they may be more willing to refuse an offer to engage in that behavior.

Second, our findings are limited to short-term results. Although it is important to show short-term change as a function of the intervention, it is central to the efficacy of the program to show that change continues through the adolescent years. We plan to follow the sample until the 7th grade, to assess initiation of smoking among those who have not yet tried in 5th grade, and to evaluate whether change in intention and willingness is maintained over time. We also are planning an effectiveness trial to assure that the program is effective when using the school's computers linked to a website via the internet.

Third, a concern is that not all schools may have computers with internet access, and those in primarily low socio-economic schools will have less access. According to a 2005 survey of schools conducted by the National Center for Education Statistics (2006), 93% of all elementary schools had access to the internet and the majority of classrooms (95%) in these schools had internet access. This survey found no differences as a function of school characteristics including the proportion of minority students and the percent of students eligible for free or reduced lunch (an indicator of the income of families) suggesting that a large majority of students will have access to the program, once it is disseminated.

Summary and Conclusions

Findings from the present analysis of short-term outcomes are encouraging and suggest that the method proposed herein for the construction of prevention programs is efficacious. If long-term results replicate the short-term findings presented herein, *Click City[®]: Tobacco*, once disseminated, could prevent millions of children from initiating tobacco use and prevent the health consequences of tobacco use.

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Table 1

Activities Included in the *Click City*[®]: Tobacco 5th Grade Program

Activity Mechanism	Description
Classmates Descriptive norms; normative social images	Students estimate their classmates' responses to a confidential survey asking about tobacco use, intentions and social images. They compare their estimates with how their classmates actually responded to counteract overestimation bias.
Tobacco Tour Risk of short- and long-term physical consequences	Students travel inside cigarettes and smokeless tobacco products to learn about the chemical ingredients and associated health effects.
Kid's Choice Risk of short- and long- term physical consequences	Students watch affect-arousing movies on the short- and long- term health effects of smoking and second hand smoke. They vote for their favorite, and see their classmates' favorites.
Make Your Own Smoker Social images; normative social images	In a "Mr. Potato-head" game, students choose between attributes (e.g. smart/dumb) to portray their social images of smokers. During the next lesson, they see a composite of their classmates "potato heads" and can change theirs to agree with the consensus.
Addiction 101 Risk of addiction	Students watch science experiments demonstrating the physiological, psychological, and social aspects of addiction, craving and withdrawal.
Addiction Pong Risk of addiction; lack of control; difficulty in quitting	Students play a "pong-like" game in which they bat away cigarettes. They find it hard to avoid cigarettes and not get addicted. They see their classmates' scores and learn that most became addicted.
Wheel of Misfortune Risk of addiction; lack of control	In a smoking roulette game, students can win points but eventually lose when the wheel stops on "addicted." They compare their scores with their classmates and learn that everyone gets addicted to smoking.
Camp Cravings Addiction; Power of cravings; social images	Students play a board game in which campers who smoke miss out on fun activities and are dull and boring, because they must stop and smoke cigarettes to calm their cravings.
Second Hand Smoke Lab Risk of consequences	Students see the negative health effects that happen over time to people who are exposed to secondhand smoke.
Smoker Soaker Risk of consequences	Students rescue restaurant patrons from secondhand smoke by extinguishing smokers' cigarettes. They can compare their best score with their classmates'.
Personality Quiz Social images	Students, acting as newspaper reporters, take a personality quiz and then interview someone similar to them to find about what they think about tobacco. They write an article based on the interview that is viewed by other students.
Time Machine Cumulative risk	Students use a time machine to virtually travel through time to see what happens to parts of the body when someone uses tobacco, even a little bit, over 1, 5 & 10 years.
Choose to Refuse Perceived behavior control/social images	Students choose an ending for scenarios in which they are tempted to use tobacco. Social images are more favorable for endings where tobacco is not chosen. At the end of each scenario they choose from different ways to refuse tobacco and see what other students chose.
Truth or Dare Descriptive norms	Students play "Truth or Dare" to estimate the number of kids who use tobacco, and other drugs. Their estimates are compared to national prevalence estimates. They are told that most kids overestimate these behaviors.
Make a Video Social images	Students create a music video that shows how smoking negatively affects one teen's life. All scenes depict unfavorable social images. Students' finished videos are available to view.
Definition of a Smoker Normative social images	Students view images of smokers, and find out that most kids think people who smoke are not cool, popular, smart, good looking or exciting.
Addiction Maze Optimism bias; addiction	Students navigate a maze, and encounter cigarettes along the way. They cannot escape the maze, and learn that they, just like everyone else, can get addicted.
Every Cigarette Does Cumulative risk	Students view affectively powerful videos that show what cigarette smoke does over time to the brain, eyes, heart, and lungs. They vote for the "grossest" video and later find out how their classmates voted.
Classmates Redux Descriptive norms	Students re-estimate their classmates' reports of tobacco- related behaviors/cognitions, and then view their classmates' actual reports.
Get a Clue A review activity	Students play a hidden objects game that reinforces all concepts from the previous lessons.
Playground Making a commitment ¹	Students post an anti-tobacco commitment, and then view theirs and their classmates' commitments.

¹ Making a commitment is an integral component of many intervention and prevention programs, but does not target a mechanism which we measured. It is based on cognitive dissonance theory: to avoid the undesirable state of cognitive dissonance, people's behavior should be consistent with their commitments. In addition, the accountability of making a public commitment is believed to increase the likelihood of adherence.

Table 2

Correlation Between Outcome Variables and Potential Mechanism at T1

Mechanism	Intention to Smoke	Willingness	Intention to Chew
Descriptive norms	.25**	.21**	.18**
Positive social images	.17**	.13**	.09**
Positive normative social images	.16**	.12**	.08**
Risk of short-term consequences	-.06**	-.05*	-.03
Perceived harm from tobacco use	-.15**	-.13**	-.12*
Risk of long-term consequences	-.14**	-.10**	-.05**
Risk of consequences from ETS exposure/	-.09**	-.05*	-.04
Optimism bias regarding probability of addiction	-.22**	-.19**	-.12**
Personal risk of getting addicted	.23**	.18**	-.13**
Perceived difficulty in quitting	-.06**	-.05*	-.04
Perception of control over smoking	-.08**	-.02	-.03

*
p<.01;**
p<.05

Table 3
Means of Primary Outcomes and Mediating Mechanisms by Intervention Condition and Assessment; Effect Size and F Value for the Condition X Time Interaction

Risk Factors	Usual Curriculum				Click City®				F(1,46)
	Pre	Post	Pre	Post	Pre	Post	Cohen's d		
Primary outcomes									
Intention to smoke in the future	2.61	2.68	2.58	2.46	.17	23.69	****		
Intention to chew in the future	2.26	2.31	2.25	2.20	.16	7.75	*		
Willingness to smoke (if given the opportunity)	6.48	6.82	6.56	6.51	.19	25.78	****		
Health cognitions									
Descriptive norms regarding smoking	7.17	7.05	7.37	6.77	.15	23.45	****		
Positive social images of smokers	7.78	7.63	7.84	6.98	.35	53.32	****		
Positive normative social images of smokers	8.19	8.11	8.39	7.35	.40	76.19	****		
Risk perceptions of health consequences									
Risk of short-term consequences from tobacco use	19.20	19.28	19.54	20.79	.27	38.81	****		
Perceived harm from smoking	21.15	20.49	20.98	21.19	.28	38.14	****		
Risk of long-term consequences from tobacco use	42.05	41.20	42.31	43.32	.25	34.18	****		
Risk of consequences from ETS exposure	16.33	16.26	16.25	18.92	.62	208.84	****		
Risk associated with addiction									
Optimism bias regarding probability of addiction	8.51	4.93	8.84	3.26	.30	39.93	****		
Personal risk of getting addicted	10.06	12.88	9.89	15.59	.46	104.61	****		
Perceived difficulty in quitting tobacco use	17.89	17.09	17.76	18.43	.41	100.55	****		
Perception of personal control over smoking	11.35	11.10	11.36	9.54	.39	96.26	****		

* p<.05;

**** p<.0001

Table 4

Means of Outcomes by Intervention Condition, Assessment, and Moderator; Effect Size and F Value for the Condition X Time Interaction

Outcome	Moderator	Usual Curriculum				Click City®				F(1,46)
		Pre	Post	Pre	Post	Pre	Post	Cohen's d		
Intention to smoke	Family member smokes	3.06	3.20	3.03	2.83	.24	17.77	****		
	Family member doesn't smoke	2.32	2.34	2.29	2.22	.12	6.13	*		
Willingness to smoke	Tried smoking	4.44	4.63	4.21	3.66	.39	7.25	**		
	Haven't tried Smoking	2.52	2.58	2.50	2.40	.15	17.75	****		
Moderate sensation seeking	High sensation seeking	3.47	3.43	3.11	2.72	.22	7.01	*		
	Moderate sensation seeking	2.57	2.67	2.53	2.43	.19	19.53	****		
Low sensation seeking	High sensation seeking	2.12	2.18	2.26	2.33	.03	.76			
	Moderate sensation seeking	9.46	12.09	10.10	9.03	.72	17.30	****		
Tried smoking	High sensation seeking	6.32	6.55	6.38	6.38	.15	11.63	****		
	Moderate sensation seeking	7.56	8.33	7.49	7.20	.28	9.24	**		
Haven't tried smoking	High sensation seeking	6.37	6.69	6.43	6.43	.21	17.55	****		
	Moderate sensation seeking	6.03	6.12	6.20	6.17	.13	.32			

* p<.05;

** p<.01;

** p<.001;

**** p<.0001