

Using the Implicit Association Test to Assess Children's Implicit Attitudes Toward Smoking¹

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The development and psychometric properties of the Implicit Association Test (IAT) measuring implicit attitudes toward smoking among 5th-grade children were described. The IAT with *sweets* as the contrast category resulted in higher correlations with explicit attitudes than did the IAT with *healthy foods* as the contrast category. Children with family members who smoked (vs. nonsmoking) and children who were high in sensation seeking (vs. low) had significantly more favorable implicit attitudes toward smoking. Further, implicit attitudes became less favorable after engaging in tobacco-prevention activities targeting risk perceptions of addiction. The results support the reliability and validity of this version of the IAT and illustrate its usefulness in assessing young children's implicit attitudes toward smoking.

The Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) measures the strength of relatively automatic mental associations using a reaction-time paradigm. It is one of a number of techniques to measure attitudes without using direct self-report, thereby avoiding social-desirability response bias (Fazio & Olson, 2003). There is a large body of evidence for the validity of the IAT as a measure of both children's (e.g., Baron & Banaji, 2006; Craeynest et al., 2005; Dunham, Baron, & Banaji, 2006; Skowronski & Lawrence, 2001) and adults' implicit attitudes (Greenwald & Nosek, 2001; Nosek, Greenwald, & Banaji, 2007). Several previous studies have used the IAT to assess implicit attitudes toward smoking among adults (e.g.,

¹This research was supported by a grant from the National Cancer Institute (CA#98555). The authors thank Steve Christianson, Widya Kok, and Tim Wooley for the production of the activities within Click City, the tobacco-prevention program; Christine Lorenz for her insightful contributions to the development of the program and for manuscript preparation; and Martha Hardwick for coordinating all activity evaluations.

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Huijding, de Jong, Wiers, & Verkooyen, 2005; Sherman, Rose, Koch, Presson, & Chassin, 2003; Swanson, Rudman, & Greenwald, 2001), but to our knowledge, implicit attitudes toward smoking have not been previously assessed among children.

The IAT (Greenwald et al., 1998) measures implicit attitudes by assessing the strength of mental associations between a target concept (e.g., smoking) and one pole of an evaluative dimension (e.g., *good*), as compared to a contrast concept and the opposite pole of the evaluative dimension (e.g., *bad*). For example, in the version of the IAT developed by Sherman et al. (2003) to assess adults' implicit attitudes toward smoking, the target concept was *smoking*, and the contrast concept was *babies*. The opposite poles of the evaluative dimension were *good* versus *bad* words. The critical difference was the time taken to respond when pictures of smoking and bad words were paired, and pictures of babies and good words were paired (normatively perceived as the compatible combinations) versus when pictures of smoking and good words were paired, and pictures of babies and bad words were paired (normatively perceived as the incompatible combinations). The same response key is assigned to the compatible combination in one block of trials and to the incompatible combination in another block of trials. The IAT score is based on the difference in mean response latency between the compatible and the incompatible combinations.

As part of the development of a smoking-prevention program for fifth graders, we developed activities, each of which was designed to change a specific etiological factor related to an increase in intention or willingness to use tobacco or to initiate smoking. Prior to including each activity in the program, we conducted an empirical evaluation to assess if the activity affected the specific risk factor it was designed to change. In addition, all activities were expected to increase children's negative affect and decrease children's positive affect toward cigarette smoking.

Finucane, Slovic, and colleagues (Finucane, Alhakami, Slovic, & Johnson, 2000; Slovic, Peters, Finucane, & MacGregor, 2005) have demonstrated that increased positive affect associated with a behavior (e.g., smoking) is related to decline in its perceived risk, whereas increased negative affect is related to increased perceived risk (known as the *affect heuristic*). Since smoking is stigmatized in our culture, and a negative explicit attitude toward smoking is socially desirable, we expect that implicit attitude will be more strongly related than will explicit attitude to children's true affective response (i.e., positive or negative) toward smoking. We chose to use the IAT to assess fifth graders' implicit attitudes toward smoking as an indicator of their affect toward smoking. Since the IAT had not been used previously to assess implicit attitudes toward smoking among fifth graders, our goal is to develop a suitable IAT for this age group, and to assess the reliability and validity of the measure.

In Study 1, we compared two versions of the IAT, each using different contrast categories. In one version, smoking was paired with sweet foods; and in the other version, smoking was paired with healthy foods. First, we compared the size of the correlations between explicit attitude and implicit attitude, which were measured using each version of the IAT. We anticipated that explicit measures would uniformly indicate unfavorable beliefs. However, at the implicit level, we expected slightly more favorable responses. However, we expected restriction of range on both measures. Therefore, we predicted low to moderate correlations between explicit and implicit measures (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). Second, we assessed the internal consistency of each measure. Third, because stability is a desirable psychometric property for a measure intended to be sensitive to deliberate attempts to produce change, we also examined short-term (i.e., 1-week) test–retest reliability of each version of the IAT.

In Study 2, the validity of the IAT with sweet foods as the contrast category was examined in several ways. Previous research examining the validity of the IAT using the known-groups method (i.e., comparing groups expected to differ on implicit attitudes), has shown that adult smokers' implicit attitudes were less negative than those of nonsmokers (Huijding et al., 2005; Swanson et al., 2001). We expected that children who had previously experimented with smoking would have more favorable implicit attitudes than would children who had not experimented with smoking, and that children from smoking families would have more favorable implicit attitudes than would children from nonsmoking families. In addition, we hypothesized that children with higher levels of sensation seeking (a trait associated with taking risks, including smoking) would have more favorable implicit attitudes toward smoking (Zuckerman, Ball, & Black, 1990).

Finally, we examined change in implicit attitude as a function of engaging in tobacco-prevention activities designed to change three risk factors: social images of smokers, risk perceptions associated with getting addicted as a result of experimenting with cigarettes, and risk perceptions of health consequences associated with smoking. According to the prototype/willingness model (Gibbons & Gerrard, 1995), favorable social images or prototypes of individuals who engage in a health-risk activity (e.g., smoking) are related to willingness to engage in this activity. Adolescents with more favorable images of smokers have expressed more willingness to smoke and greater intention to smoke, and have earlier onset (Andrews, Hampson, Barckley, Gerrard, & Gibbons, 2008; Dinh, Sarason, Peterson, & Onstad, 1995; Gerrard, Gibbons, Stock, Vande Lune, & Cleveland, 2005).

According to Slovic (2001), young smokers tend to underestimate the risk of becoming addicted to smoking and perceive themselves as able to stop at any time. They also fail to understand the health consequences of smoking,

particularly those associated with occasional smoking (Slovic, 2000). Based on the affect heuristic, activities were designed to increase risk perceptions associated with addiction and health consequences through increasing negative affect and decreasing positive affect. Thus, activities targeting all three of these risk mechanisms were also expected to change fifth graders' affective response to tobacco, decreasing positive affect and increasing negative affect toward smoking.

Study 1: Selection of Contrast Category and Test–Retest Stability

The purpose of Study 1 is to select the contrast category for a version of the IAT to assess implicit attitudes toward smoking among fifth graders. To do this, we examined the correlations of both versions with explicit attitude and examined internal consistency and the stability of both versions over 1 week.

Method

Participants

Study participants were 93 fifth-grade children (41 boys, 52 girls; all Caucasian; *M* age = 12.1 years) who were recruited through newspaper advertisements to take part in a study of attitudes toward smoking. All children participated in the first assessment, and 87 children (39 boys, 48 girls) participated in the second assessment. The first and second assessments were 1 week apart. The children received \$25 per assessment, and their parents were compensated \$10 for travel expenses.

Implicit Association Test

A version of the IAT was developed using IAT software from Inquisit with pictures and words as stimuli. The target concepts were smoking and eating, since both behaviors reflect consumption, and the attributes were evaluative adjectives that children use to describe smokers and nonsmokers. Four good adjectives (*popular, cool, exciting, smart*) and four bad adjectives (*ugly, boring, mean, dumb*) were selected from those used by Dinh et al. (1995) in their study of children's perceptions of smokers. We tested two contrast categories that children were expected to view more favorably than smoking: sweets (e.g., cupcakes, cookies) and healthy foods (e.g., vegetables).

To keep the children's IAT as brief as possible, we limited the pictures per category to four, which Nosek, Greenwald, and Banaji (2005) considered to be minimally acceptable. In preliminary pilot work, 33 fifth-graders rated photographs of smoking (e.g., a hand holding a lit cigarette, an ashtray full of cigarette butts) for how good they were as "examples of smoking." The items were rated on a 3-point scale of 1 (*not so good*), 2 (*okay*), or 3 (*very good*). Participants were also asked to name the foods in photographs of healthy foods (e.g., broccoli, peas) and sweets (e.g., ice cream cone, cupcakes, chocolate cakes). We asked how much they liked each food on a 3-point scale of 1 (*not at all*), 2 (*okay*), or 3 (*very much*). Based on these ratings, the four best examples of smoking, healthy foods, and sweets were selected.

The standard IAT currently available from Inquisit (Version 2.0) and recommended by Greenwald and colleagues (Greenwald, Nosek, & Banaji, 2003; Nosek et al., 2007) consists of seven blocks or sets of stimuli. Each block consisted of 16 trials. Participants responded by pressing the designated keys on the right or left side of the computer keyboard.

Block 1 is used to practice the two categories; participants distinguished between the target categories of smoking and eating. The eight pictures of smoking or food were presented in a random order and were distinguished by designated keys on the left or right side of the keyboard (e.g., left for smoking, right for eating). Block 2 is used to practice the attributes (good vs. bad); participants distinguished bad adjectives from good adjectives presented on the screen by pressing the designated keys (e.g., left for bad, right for good). Block 3 is the first pairing of categories and attributes; participants distinguished between smoking pictures and bad adjectives versus eating pictures and good adjectives (i.e., compatible combinations) by pressing the designated keys (e.g., left for smoking or bad, right for eating or good). Block 4 repeats the Block 3 pairings. In Block 5, responses to the good adjectives and bad adjectives are reversed (e.g., left is good, right is bad). Both Blocks 6 and 7 are test blocks that consist of the second category and attribute pairing; participants distinguished between smoking pictures and good adjectives versus eating pictures and bad adjectives (i.e., incompatible combinations) by pressing the designated keys (e.g., left is smoking and good, right is eating and bad). The order in which each pairing was presented and associated with the key on the right or left side of the keyboard (Blocks 3 and 4 vs. Blocks 6 and 7) was randomized.

Participants performed the IAT on Toshiba Satellite laptop computers. The participants used their left and right index fingers on the "D" and "K" keys, respectively, to respond to the IAT stimuli. The research assistant established that children knew their index fingers and could locate the correct response keys. The word stimuli were centered on the screen against a white background in all capital, green 45-point letters. The picture stimuli were

9 cm × 12 cm color photographs, centered on the screen against a white background. Participants sat approximately 35 cm from the screen. Detailed instructions adapted from the adult version of the IAT and previously pilot-tested with fifth-grade children appeared at the top of the screen before each block of trials.

Scoring procedures. We used the scoring procedures recommended by Greenwald et al. (2003) to calculate D , which Greenwald et al. showed was psychometrically sound. D is computed as the average difference response latency between the combined tasks (e.g., smoking and good vs. smoking and bad) divided by the inclusive standard deviation of participants' response latencies in the two combined tasks. Prior to calculating D , trials greater than 10,000 ms were deleted, and participants who responded extremely rapidly (< 300 ms) on more than 10% of the trials (i.e., those who were simply hitting keys as quickly as possible) were not included in the analyses with that contrast category. At Time 1, there were 10 participants with the contrast category of healthy foods, and 6 with the contrast category of sweets who were eliminated from analyses because they responded too rapidly. At Time 2, there were 22 with the contrast category of sweets and 22 with the contrast category of healthy foods who were dropped. This number of rapid responders is far greater than that typically found using the IAT, and was most likely a result of the instruction to "respond as rapidly as possible." Following the evaluation of the two contrast categories, we extended our instructions to emphasize the importance of not simply hitting the keys as quickly as possible.

As detailed by Greenwald and colleagues (Greenwald et al., 2003; Lane, Banaji, Nosek, & Greenwald, 2007), to calculate D , the following steps were followed: (a) the inclusive standard deviation for trials in Blocks 3 and 6 and then in Blocks 4 and 7 was calculated; (b) the mean latency was calculated for each of the four trial blocks (i.e., Blocks 3, 4, 6, and 7); (c) the mean differences between Blocks 6 and 3 ($M_{\text{Block 6}} - M_{\text{Block 3}}$) and between Blocks 7 and 4 ($M_{\text{Block 7}} - M_{\text{Block 4}}$) was calculated; (d) each mean difference score was divided by its associated inclusive standard deviation; and (e) the equal-weight average was calculated from the two ratios (M differences/ SD). Since children typically associate negative images with smoking (Andrews & Peterson, 2006), and smoking is viewed by almost all children as unhealthy (Andrews, 2003), children were expected to respond more quickly to the compatible combination (i.e., smoking and bad) than to the incompatible combination (i.e., smoking and good). Since compatible responses (Blocks 3 and 4; smoking and bad, eating and good) are subtracted from incompatible responses (Blocks 6 and 7; smoking and good, eating and bad), a larger D score indicates a less favorable implicit attitude toward smoking.

Assessment of explicit attitude. Explicit attitude was assessed using a written survey. To measure positive explicit attitude, all participants rated four positive attributes (i.e., *popular, cool, exciting, smart*) describing what they “think kids who smoke are like” on a 5-point scale ranging from 1 (*not at all like this*) to 5 (*very much like this*). For this measure, Cronbach’s alpha was .58 both at Time 1 and Time 2, and the test–retest correlation was .72. The measure of negative explicit attitude was added halfway through the study, and 34 children also rated four negative attributes (i.e., *dumb, dull, mean, ugly*). For negative explicit attitude, Cronbach’s alphas were .73 and .71 at Times 1 and 2, respectively, and the test–retest correlation was .65.

Family member smoking status. Family member smoking status was assessed using three questions. If the child responded positively to any of the following—“Do you have any brothers or sisters, stepbrothers or stepsisters who smoke?”; “Does your mother/stepmother smoke cigarettes?”; and “Does your father/stepfather smoke cigarettes?”—they were considered to be from families with members who smoked.

Sensation seeking. Sensation seeking was measured by a short form of the Sensation-Seeking Scale (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew; 2002). This scale includes four items, such as liking to explore strange places and preferring friends who are exciting and unpredictable. Stephenson, Hoyle, Palmgreen, and Slater (2003) showed that the scale was reliable and was related to tobacco use. Cronbach’s alphas for the present study were .73 and .85 at Times 1 and 2, respectively, and the stability coefficient was .86.

Experimentation with smoking. Participants’ previous tobacco use was measured using a procedure recommended by Bush and Iannotti (1992) to maximize the validity of responses by wording the question in a way that assumes children have tried smoking, “How old were you when you first tried a cigarette, even a few puffs?” All children who did not answer *never tried* were considered experimenters.

Procedure

Children were tested in groups of 8 to 10 on two occasions (Time 1 and Time 2), 1 week apart. On both occasions, they completed two versions of the IAT (smoking paired with sweets and smoking paired with healthy foods), followed by a paper-and-pencil survey. The order of the two IATs was randomly determined, such that half of the children completed the smoking/sweets IAT first on both occasions, and the other half completed the smoking/healthy foods IAT first. The questions on the survey were read aloud by a research assistant, while the children read silently and responded privately on their surveys.

Results

Correlation With Explicit Attitude

A higher *D* score on the IAT suggests a less favorable implicit attitude toward smoking (i.e., smoking is bad). Thus, one would expect a negative correlation of the IAT score with positive (favorable) explicit attitudes and a positive correlation with negative (unfavorable) explicit attitude. With healthy foods as the contrast category, the correlation between the IAT score and positive explicit attitudes was .14 at Time 1 ($n = 84, p = .11$) and .05 at Time 2 ($n = 63, p = .34$), which is opposite the direction of what we expected. The correlation with negative explicit attitude was .12 at Time 1 ($n = 34, p = .26$) and .27 at Time 2 ($n = 32, p = .07$; in the expected direction); and the correlation with the difference between negative and positive explicit attitude was .01 at Time 1 ($n = 34, p = .47$) and $-.11$ at Time 2 ($n = 32, p = .27$). With sweets as the contrast category, the correlation of the IAT score with positive explicit attitude was $-.05$ at Time 1 ($n = 81, p = .35$) and .09 at Time 2 ($n = 59, p = .26$); the correlation of the IAT score with negative explicit attitude was .43 at Time 1 ($n = 32, p = .01$) and .12 at Time 2 ($n = 33, p = .25$); and the correlation between the IAT score and the difference between negative and positive explicit attitude was .32 at Time 1 ($n = 32, p = .04$) and .05 at Time 2 ($n = 33, p = .38$). In sum, correlations with positive explicit attitude were small, and three were in the opposite direction than what we expected. Correlations with negative explicit attitude were all positive, as expected, and were higher for the version of the IAT with sweets as the contrast category than for the version with healthy foods as the contrast category.

Sensation Seeking, Experimental Use, and Family Smoking

We examined the moderating effects of sensation seeking, experimental use, and family smoking by evaluating the interaction of each of these variables with the IAT score in the prediction of explicit attitude, using backward elimination of nonsignificant interactions. With only one exception, none of the interactions were significantly related to explicit attitude. The interaction of the *D* score with sweets as the contrast category and experimental use in the prediction of positive explicit attitudes at Time 2 was significant ($B = -.35, t(53) = -2.59, p = .02$). Decomposition of this interaction using the techniques proposed by Aiken and West (1991) shows that the relation between the *D* score and positive explicit attitudes was significant and in the expected direction only for those who had experimented with cigarettes

($B = -2.68$), $t(53) = -2.47$, $p = .02$, but not for those who had not experimented with cigarettes ($B = .15$), $t(53) = 1.25$, $p = .22$.

Correlations Between the Two IAT D Scores

At Time 1, the correlation between the D score with the healthy food as the contrast category and the D score with sweets as the contrast category was .35 ($n = 89$, $p < .001$). At Time 2, this correlation was .37 ($n = 81$, $p < .001$).

Reliability

We assessed the internal consistency of each measure of the IAT by correlating the D score derived from Blocks 3 and 6 with the D score from Blocks 4 and 7. With healthy foods as the contrast category, the correlation at Time 1 was .54 ($n = 91$, $p < .001$) and at Time 2 was .41 ($n = 86$, $p < .001$). With sweets as the contrast category, the correlations were .37 at Time 1 ($n = 92$, $p < .001$) and .47 at Time 2 ($n = 82$, $p < .001$).

We assessed test-retest stability across a 1-week period by correlating the D score from the Time 1 assessment with that of the Time 2 assessment. Correlations were moderate for both versions (healthy foods, $r = .20$, $n = 82$, $p = .07$; sweets, $r = .29$, $n = 91$, $p = .01$).

The moderate correlations between the two D scores suggest that the two versions of the IAT are related, but also have unique variance associated with each. With sweets as the contrast category, the correlations between implicit and explicit attitude were higher, were primarily in the right direction, and some were significant. Specifically, with sweets as the contrast category, the correlation of the D score with negative explicit attitude at Time 1, with the difference between positive and negative explicit attitude at Time 1, and among those who had tried smoking with positive explicit attitude at Time 2 were significant. In addition, with sweets as the contrast category, the stability coefficient of the D score across a 1-week period was slightly higher than the stability coefficient with healthy food as the contrast category. These findings led us to select sweets as the contrast category for the version of the IAT that we used in Study 2.

Study 2: Assessment of Validity

The purpose of Study 2 is to assess the validity of the children's IAT with sweets as the contrast category by first comparing initial D scores between

groups of children expected on a priori grounds to have different implicit attitudes toward smoking; and second assessing the IAT's sensitivity to change as a function of engaging in a smoking-prevention activity targeting a specific risk factor. This validation study formed part of a process to evaluate the effectiveness of activities developed to include in the tobacco-prevention program.

Each activity was designed to change a theoretically derived and empirically supported risk factor related to smoking onset in youth, including risk of addiction, social images of smokers, and perceptions of health consequences associated with smoking. Two activities, targeting distinctly different risk factors, were examined in each evaluation study. Since all of the activities were expected to decrease favorable implicit attitude, change in implicit attitude following each activity was compared to change in implicit attitude following a control activity (i.e., playing computer pinball). Change following the control activity was assessed in a separate evaluation study, pairing the control activity with an activity already evaluated (one targeting perceived risk of addiction). A brief description of the activities and risk factors they are intended to change is provided in Table 1.

To demonstrate a measure's sensitivity to change, it is necessary to compare scores on the measure before and after the change-inducing intervention. However, as noted by Greenwald et al. (2003), effect magnitudes with the IAT tend to decline with repeated administrations. While use of the *D* score reduces the influence of repeated testing, this artifact is nonetheless present in any study using repeated IAT measures. Thus, the necessity of a comparison activity (i.e., playing a computer pinball game) was further supported to control for the effect of repeated administrations (Campbell & Stanley, 1966). The comparison of implicit attitude across the two groups (control group and activity group) was quasi-experimental because participants were not randomly assigned to the pinball activity versus the smoking-prevention activity.

Method

Participants

A total of 927 fifth graders (459 girls, 468 boys), 88% of whom were Caucasian, participated in 1 of 13 activity evaluation studies plus the control comparison study; there were between 53 and 82 participants per study. Participants were recruited through newspaper advertisements to take part in a study to help develop a smoking-prevention program. Children were each given \$25 for their participation, and their parents were compensated \$10 for travel expenses.

Table 1

Activities Evaluated in Study 2

Activity	Brief description
Risk of addiction	
Wheel of Misfortune	Learn that smoking is a losing game.
Camp Cravings	Play a virtual board game showing that smoking results in uncontrollable cravings that keep you smoking.
Pong	Block cigarettes from entering the mouth in a Pong-like game. Once you fail to block one cigarette, it's difficult to block others.
Addiction Maze	Learn that escaping a maze, like addiction, is more difficult than anticipated.
Social images	
Personality	Learn that "someone like them" has negative social images of tobacco users.
Classmates	Guess how classmates responded to confidential survey and get feedback regarding classmates' actual responses.
Build Your Own Smoker	Attribute social images to smokers and nonsmokers by creating and comparing "Mr. Potato Head" type figures.
Make a Video	Create a music video illustrating that smokers are not cool, popular, or exciting.
Definition of a Smoker	See positive images that kids might have of smokers, and then see the opposite negative image that most kids have.
Risk perceptions of health consequences	
Kids Choice	Watch and rate PSAs showing long- and short-term and secondhand smoke health effects of tobacco use.
Secondhand Smoke 101/Smoker Soaker	Observe health effects of secondhand smoke (SHS) and play a game where they save nonsmokers from SHS.
Time Machine	Use a time machine to see the cumulative effects of smoking or using chewing tobacco at 1, 5, and 10 years.
Every Cigarette Does	View parts of the body and the harm that each cigarette does.

Design and Procedure

Two activities were evaluated in a single evaluation study using a pre–post crossover design. Half of the participants viewed Activity A first, and the other half viewed Activity B first to control for order effects. The two activities targeted distinct risk factors. Change in the measure of a risk factor was expected following engagement in the activity targeting that factor, but not following engagement in the activity targeting the other risk factor. Both activities were expected to change implicit attitude. The control activity was playing pinball on the computer and was not expected to change implicit attitude.

Within each activity evaluation study, participants completed the IAT, followed by a paper-and-pencil assessment three times: immediately before the first smoking-prevention activity, immediately after the first activity (and before the second activity), and immediately after the second activity. Data for this study are from the first two assessments: the one prior to the first activity and the one following the first activity.³

Measures

The IAT selected for Study 2 used pictures of smoking and sweets as the two target categories, and good or bad adjectives as the attributes.⁴ Data from relatively few children (0 to 2 per activity evaluation) were not used because of their extreme rapidity of responding (< 300 ms) on more than 10% of the trials. The same measures as those used in Study 1 were used to assess family member smoking status, sensation seeking, and experimentation with smoking.

Results

Relations Between Implicit Attitude and Other Variables

For these analyses, we used data from the first administration of the IAT and the paper-and-pencil survey (i.e., prior to completing the first activity)

³Data from only the first activity were used to assess sensitivity to change, since the size of the effect of the IAT diminishes with repeated administration. Further, although using the data prior to and following each activity (regardless of order of the activity) would increase the sample size and, hence, the power, we were unable to control for potential order effects since change in IAT as a function of the control activity was assessed in a separate study.

⁴Details and a description of the scoring procedure are presented in Study 1.

combined across all 13 activity evaluation studies. To assess differences as a result of known groups, we examined differences on the baseline IAT scores as a function of family smoking status, the participants' smoking experience, and whether participants were high or low in sensation seeking (using a median split). The implicit attitudes of fifth graders who did not have family members who smoked ($n = 480$; $M = 0.55$, $SD = 0.32$) were significantly less favorable than were the implicit attitudes of fifth graders who had family members who smoked ($n = 286$; $M = 0.49$, $SD = .49$), $t(764) = 2.78$, $p < .01$. The implicit attitudes of fifth graders who had tried smoking ($n = 34$; $M = 0.53$, $SD = 0.35$) were not significantly different from the implicit attitudes of children who had never tried smoking ($n = 731$; $M = 0.53$, $SD = 0.32$). The correlation between unfavorable implicit attitude and sensation seeking was .08. However, the implicit attitudes of children who were low in sensation seeking (i.e., below the median) were significantly more unfavorable ($n = 388$; $M = 0.56$, $SD = 0.31$) than were the implicit attitudes of children who were high in sensation seeking ($n = 378$; $M = 0.50$, $SD = 0.33$), $t(764) = 2.73$, $p < .01$. Thus, children from families without a smoking member and children who were lower in sensation seeking had more unfavorable implicit attitudes toward smoking.

Change in Implicit Attitude as a Function of Engaging in Tobacco-Prevention Activities

Activities were grouped by the risk factor that they targeted: risk perceptions associated with getting addicted as a result of experimenting with cigarettes (4 activities); social images of smokers (5 activities); or risk perceptions of health consequences associated with smoking (4 activities). Change in implicit attitude, as measured by D , was then evaluated in a two-step process.

First, one-way, between-subjects, univariate ANCOVAs were conducted comparing the effect of activities targeting a specific risk factor and the control activity (i.e., independent variables) on implicit attitude following the activity (i.e., dependent variable). Covariates were D before the activity, sensation seeking, and family smoking status. The effect of interest was the contrast between the control activity and the combination of all the other levels of the independent variable (i.e., the combination of the smoking-prevention activities). A one-tailed significance test was used, as we expected an increase in unfavorable implicit attitude toward smoking after participating in a smoking-prevention activity, as compared to the control activity. If this contrast was significant, then in the second step, we evaluated the difference between the control activity and each individual activity.

The means and standard deviations of *D* scores assessing level of unfavorable implicit attitude toward smoking (larger scores are more unfavorable) after each activity are provided in Table 2. The correlations between *D* scores before and after the activities are also shown. These correlations indicate considerable stability, ranging from .41 for the control activity to .70 for Addiction Maze.

The mean implicit attitude following the activities targeting risk perceptions associated with addiction was significantly less favorable than was implicit attitude after the control activity, controlling for implicit attitude prior to the activity. The differences in post-activity *D* were significant (difference = .112; *SE* = .056; 95% confidence interval [CI] = .002 to .222, $p < .05$, one-tailed). This significant difference justifies examining the difference between each of the four activities targeting addiction and the control activity. Compared to the control activity, implicit attitudes were significantly less favorable following Wheel of Misfortune, $F(1, 59) = 2.92$, $p < .05$; and Addiction Maze, $F(1, 58) = 3.24$, $p < .05$. They were marginally less favorable following Camp Cravings, $F(1, 70) = 1.94$, $p < .10$; but they were not significantly different after Pong.

The specific contrasts were not significant in the ANCOVAs comparing the activities targeting social images versus the control activity (difference = .09; *SE* = .071; 95% CI = -.049 to .230) or comparing the activities targeting health consequences versus the control activity (difference = .128; *SE* = .082; 95% CI = -.034 to .290). Therefore, no further analyses were justified, although differences between each activity and the control activity are reported in Table 2.

Discussion

We developed a version of the IAT that is suitable for assessing fifth graders' implicit attitudes toward smoking, and evidence of reliability and validity of this IAT was presented. The results from Study 1 suggest that for fifth graders, an IAT using sweets as the contrast category (good) versus smoking (bad) was more suitable than one based on healthy foods (good) versus smoking (bad). The moderate correlation found between explicit attitude and implicit attitude replicates that shown in other studies (Hofmann et al., 2005).

While the *D* score derived from the IAT with sweets as the contrast category was relatively stable across a 1-week period, the stability coefficient was lower than that usually found in studies with adults across a 1-week period. These stability coefficients generally ranged from about .50 to .70 (Nosek et al., 2007). However, as shown in Study 2, the stability coefficient of

Table 2
Means of Implicit Attitudes Following Each Activity

Activity	<i>n</i>	Post-test		Pre-post correlations	Comparison with control activity
		<i>M</i>	<i>SD</i>		
Control activity (pinball game)	37	-0.32	0.32	.41	
Risk of addiction					
Wheel of Misfortune	27	-0.42	0.44	.58	$F(1, 59) = 2.92, p < .05$
Camp Cravings	36	-0.40	0.35	.65	$F(1, 70) = 1.94, p < .10$
Pong	40	-0.44	0.37	.56	<i>ns</i>
Addiction Maze	26	-0.48	0.33	.70	$F(1, 58) = 3.24, p < .05$
Social images					
Personality	28	-0.42	0.33	.64	<i>ns</i>
Classmates	37	-0.40	0.38	.58	$F(1, 69) = 2.71, p < .10$
Build Your Own Smoker	32	-0.31	0.26	.38	<i>ns</i>
Make a Video	34	-0.34	0.34	.40	<i>ns</i>
Definition of a Smoker	28	-0.34	0.27	.33	<i>ns</i>
Risk perceptions of health consequences					
Kids Choice	30	-0.37	0.29	.56	<i>ns</i>
Secondhand Smoke 101/Smoker Soaker	44	-0.36	0.36	.51	<i>ns</i>
Time Machine	24	-0.45	0.37	.54	$F(1, 56) = 2.02, p < .10$
Every Cigarette Does	30	-0.33	0.38	.59	<i>ns</i>

the *D* score before and after each activity was consistently higher than the stability coefficient over a 1-week period and was much more consistent with data obtained from adults (Nosek et al., 2007).

The results from Study 2 provide validity for the version of the IAT supported in Study 1. As expected, implicit attitudes toward smoking were less favorable for children with nonsmoking family members than for children with smoking family members. Implicit attitudes toward smoking were also less favorable for children who were low in sensation seeking than for those who were relatively high in sensation seeking. Moreover, compared to a control activity, participation in smoking-prevention activities targeting addiction resulted in less favorable implicit attitudes toward smoking, suggesting that the measure of implicit attitude using this version of the IAT may be sensitive to change.

Activities targeting risk perceptions associated with addiction were intended to induce frustration to simulate the experience of being caught up in an addictive process. In these activities, it appeared initially possible to smoke without becoming addicted, but, ultimately, no participant could escape addiction. The results of the IAT suggest that the frustrating feelings experienced while engaging in these activities increased implicit negative affect toward smoking.

The activities targeting social images did not result in changes to implicit attitudes, although they did change explicit attitudes from more positive to less positive (Andrews, Hampson, & Gordon, 2009). Social images are children's evaluative beliefs about kids who smoke (e.g., they are cool, exciting, popular). The activities targeting social images all incorporated explicit attitudes in the activity (e.g., children learned that fewer of their classmates than they had estimated actually believe that kids who smoke are "cool"). The moderate correlations between negative social images and implicit attitude shown in Study 1 suggest that these two measures share variance. However, the results of Study 2 suggest that activities targeting social images, which did change explicit attitude (Andrews et al., 2009), did not change implicit attitude.

The activities targeting health consequences also did not result in a change in implicit attitude. These activities show the user adverse effects of smoking on organs such as the lungs and blood vessels, with pictures and narration. Thus, in contrast to the addiction activities, health-consequences activities did not induce frustration. The addiction activities may have involved more experiential or implicit learning, as compared to the physical-consequences activities. However, given that we had hypothesized that the activities targeting all three mechanisms would change implicit attitude, this explanation must be examined in further research.

The version of the IAT that we developed here has the potential for use in applied research. A typical aim of smoking-prevention programs is to change

children's attitudes toward smoking. Attitudes have both an affective and a cognitive component. For smoking, the affective component is children's emotional responses to smoking and smokers, whereas the cognitive component includes such variables as knowledge of and risk associated with short- and long-term consequences of smoking. Evaluations of the affective component are typically based on traditional methods, such as asking individuals to rate the attitude object using semantic-differential scales. However, these direct methods are vulnerable to social desirability response bias and demand effects, particularly when attempting to assess favorable attitudes to socially undesirable and non-normative behavior, such as children's smoking. Moreover, they assume that individuals can accurately report on their attitudes. The IAT was developed to measure implicit attitudes, which are much less likely to be influenced by response bias (Greenwald & Banaji, 1995).

Previous studies have shown that implicit attitudes are sensitive to environmental influences, and one study with adults demonstrated sensitivity to change as a result of an intervention (Rudman, Ashmore, & Gary, 2001). The IAT offers the possibility of assessing the effectiveness of attitude-change interventions without the demand effects that endanger the validity of more explicit measures. Our results suggest that it may be useful in evaluating the effectiveness of interventions seeking to change implicit attitudes in children.

The relatively small number of participants in Study 1 and in each activity evaluation study within Study 2 limited the power to detect significant effects. Nonetheless, some effects were moderate, several approached significance, and most were in the right direction. In addition, the lack of random assignment in Study 2 to the control activity versus the intervention activity could potentially impact the validity of our findings. However, the results from both studies provide support for the use of the IAT to measure implicit attitudes toward smoking in fifth-grade children.

Youth smoking is a target of numerous prevention programs (Botvin, Baker, Dusenbury, Botvin & Diaz, 1995; Sussman, Sun, McCuller, & Dent, 2003), and effectiveness is often demonstrated through change in explicit attitudes and intentions. While this is commendable, change in a measure that has less demand associated with it would be even more impressive. The results from these studies suggest that a version of the IAT can be used for this purpose with fifth-grade children.

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