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# Using the Implicit Association Test to Assess Children's Implicit Attitudes toward Smoking

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## Abstract

The development and psychometric properties of an Implicit Association Test (IAT) measuring implicit attitude toward smoking among fifth 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 (versus non-smoking) and children who were high in sensation seeking (versus low) had a significantly more favorable implicit attitude toward smoking. Further, implicit attitudes became less favorable after engaging in tobacco prevention activities targeting risk perceptions of addiction. Results support the reliability and validity of this version of the IAT and illustrate its usefulness in assessing young children's implicit attitude toward smoking.

The Implicit Association Test (IAT) measures the strength of relatively automatic mental associations using a reaction-time paradigm (Greenwald, McGhee, & Schwartz, 1998). 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, 200l; Nosek, Greenwald & Banaji, 2007). Several previous studies have used the IAT to assess implicit attitudes towards smoking among adults (e.g., Huijding, de Jong, Wiers, & Verkooijen, 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 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 towards smoking, the target concept was of

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"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 initiation of 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 and Slovic and colleagues (Finucane, Alhakami, Slovic & Johnson, 2000; Slovic, Peters, Finucane & MacGregor, 2005) have demonstrated that increased positive affect associated with a behavior, such as 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 expected that implicit attitude would be more strongly related than 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 attitude toward smoking as an indicator of their affect toward smoking. Since the IAT had not been used previously to assess implicit attitude toward smoking among fifth graders, our goal was to develop a suitable IAT for this age group, and to assess the reliability and validity of this 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, 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, Gawronksi, Gschwender, Le, & Schmitt, 2005). Second, we assessed the internal consistency of each measure and 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 (1-week) test-retest reliability of each version of the IAT.

In Study 2, the validity of the IAT with 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 non-smokers (Swanson et al., 2001; Huijding et al., 2005). We expected that children who had previously experimented with smoking would have more favorable implicit attitudes than children who had not experimented with smoking, and that children from smoking families would have more favorable implicit attitudes than children from non-smoking 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 towards smoking (Zuckerman, Ball, & Black, 1990). Finally, we examined change in implicit

attitude as a function of engaging in tobacco prevention activities designed to change t 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, greater intention to smoke and have earlier onset (Andrews, Hampson, Barckley, Gerrard & Gibbons, 2008; Gerrard, Gibbons, Stock, Vande_Lune & Cleveland, 2005; Dinh, Sarason, Peterson, & Onstad, 1995). 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 and decreasing positive affect. Thus, activities targeting all three of these risk mechanisms were expected to also 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 this study was to select the contrast category for a version of the IAT to assess implicit attitude toward smoking among fifth graders. To do this, we examined the correlations of both versions with explicit attitude and examined the internal consistency and the stability of both versions over one week .

### Method

**Participants—**Ninety-three fifth-grade children (41 boys and 52 girls, all Caucasian; mean age = 12.07 years) 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 and 48 girls) participated in the second assessment. The first and second assessments were one week apart. Children received $25 per assessment, and their parents were compensated $10 for travel expenses.

**The 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 children use to describe smokers and non-smokers. Four “good” (popular, cool, exciting, smart) and four “bad” (ugly, boring, mean and dumb) adjectives were selected from those used by Dinh, Sarason, Peterson, & Onstad (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, such as cupcakes and cookies; and healthy foods, such as vegetables.

To keep the children's IAT as brief as possible, we limited the pictures per category to four, which Nosek, Greenwald, & Banaji (2005) considered as 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” (1 = Not so good, 2 = Okay, 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 (1 = Not at all, 2 = Okay, 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 Inc. (Version 2.0) and recommended by Greenwald and colleagues 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 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 versus bad); participants distinguished bad from good adjectives presented on the screen by pressing the designated keys (e.g., left for bad and 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 (compatible combinations) by pressing the designated keys (e.g., left for smoking or bad and right for eating or good). Block 4 repeats the Block 3 pairings. In Block 5, responses to the good and bad adjectives are reversed (e.g., left is good and right is bad). Both Block 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 (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 versus Blocks 6 and 7) was randomized.

Participants performed the IAT on Toshiba Satellite laptop computers. The subjects 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. by 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, Nosek and Banaji (2003, p. 213), 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 versus smoking and bad) divided by the “inclusive” standard deviation of subjects' response latencies in the two combined tasks. Prior to calculating *D*, trials greater than 10,000 milliseconds were deleted and subjects who responded extremely rapidly (<300 milliseconds) on more than 10% of the trials (i.e., those who were simply hitting keys as fast as possible) were not included in the analyses with that contrast category. At T1, 10 participants with the contrast category of healthy foods, and 6 with the contrast category of sweets were eliminated from analyses because they responded too rapidly; at T2, 22 with the contrast category of sweets, and 22 with contrast category healthy foods were dropped. This number of rapid responders is far greater than that typically found using the IAT, and was most likely due to 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 in Greenwald et al. (2003) and Lane, Banaji, Nosek & Greenwald (2007), to calculate *D*, the following steps were followed: (1) The “inclusive” standard deviation for trials in Blocks 3 and 6 and then in Blocks 4 and 7 was calculated; (2) The mean latency was calculated for each of the four trial blocks, Blocks 3, 4, 6 and 7; (3) The mean differences between Blocks 6 and 3 ($\text{Mean}_{\text{Block 6}} - \text{Mean}_{\text{Block 3)}}$ and between Blocks 7 and 4

(Mean $_{\text{block 7}}$ - Mean$_{\text{block4}}$) was calculated; (4) Each mean difference score was divided by its associated "inclusive" standard deviation; and (5) the equal-weight average was calculated from the two ratios (mean differences/standard deviation). 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 faster to the compatible combination (smoking and bad) than to the incompatible combination (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 (popular, cool, exciting, smart) 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". For this measure, Cronbach's alpha was .58 both at T1 and T2, 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 (dumb, dull, mean and ugly). For negative explicit attitude, Cronbach's alpha was .73 at T1 and .71 at T2, and the test-retest correlation was . 65.

**Family member smoking status:** Children were considered to be from families with smoking members if they responded positively to any of the following questions: "Do you have any brothers, sisters, step-brothers or step-sisters, who smoke?"; "Does your mother/ step mother smoke cigarettes?"; or "Does your father/step father smoke cigarettes?".

**Sensation seeking:** This trait was measured by a short form of the Sensation Seeking scale (Hoyle, Stephenson, Palmgreeen, Lorch, & Donohew; 2002). This scale includes four items such as liking to explore strange places and preferring friends who are exciting and unpredictable. Stephenson and colleagues (Stephenson, Hoyle, Palmgreen, & Slater, 2003) showed that this scale was reliable and was related to tobacco use. Cronbach's alpha for this scale was .73 at T1 and .85 at T2, and the stability coefficient was $r = .86$.

**Experimentation with smoking:** Participants' previous tobacco use was measured using a procedure recommended by Bush & Ianotti (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.

## Procedures

Children were tested in groups of eight to ten on two occasions (T1 and T2), one 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 T1 (n = 84, $p$ = .11) and .05 at T2 (n = 63, $p$ = .34), in the opposite direction of that expected. The correlation with negative explicit attitude was .12 at T1 (n = 34, $p$ =. 26) and .27 at T2 (n = 32, $p$ = .07) (in the expected direction), and the correlation with the difference between negative and positive explicit attitude was .01 at T1 (n = 34, $p$ = .47) and -.11 (n = 32, $p$ = .27) at T2. With sweets as the contrast category, the correlation of the IAT score with positive explicit attitude was - .05 at T1 (n = 81, $p$ = .35) and .09 at T2 (n = 59, $p$ = .26), the correlation of the IAT score with negative explicit attitude was .43 at T1 (n = 32, $p$ = .01) and .12 at T2 (n = 33, $p$ = .25), and the correlation between the IAT score and the difference between negative and positive explicit attitude was .32 at T1 (n = 32, $p$ = .04) and .05 at T2 (n = 33, $p$ = .38). In sum, correlations with positive explicit attitude were small and three were in the opposite direction than 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.

**Prediction of explicit attitude examining moderating effects of 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 backwards elimination of non-significant 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 T2 was significant, B = -.35, t(53) = -2,59, $p$ = .02. Decomposition of this interaction using the techniques proposed by Aiken and West (1991) showed 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 T1, 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 T2, 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 T1 was .54 (n = 91; $p$ < .001) and at T2 was .41 (n = 86; $p$ < .001). With sweets as the contrast category, the correlations were .37 at T1 (n = 92, $p$<.001) and .47 at T2 (n = 82, $p$<.001).

We assessed test-retest stability across a one-week period by correlating the *D* score from the T1 assessment with that of the T2 assessment. Correlations were moderate for both versions: healthy foods, $r$ = .20 (n = 82; $p$ = .07), sweets, $r$ = .29 (n = 91, $p$ = .01).

**Conclusion—**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 T1, with the difference between positive and negative explicit attitude at T1, and among those who had tried smoking, with positive explicit attitude at T2, were significant. In

addition, with sweets as the contrast category, the stability coefficient of the *D* score across a one-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 used in Study 2.

## Study 2: Assessment of Validity

The purpose of this study was 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 (playing computer pin ball). 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, Nosek, & Banaji (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, 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 (the control group and the activity group) was quasi-experimental because participants were not randomly assigned to the pinball versus the smoking prevention activity.

### Method

**Participants—**A total of 937 fifth graders, 459 girls (48.9%) and 468 boys, 88% of whom were Caucasian, each participated in one of 13 activity evaluation studies plus the control comparison study (53 to 82 participants per study). Participants were recruited through newspaper advertisements to take part in a study to help to develop a smoking prevention program. Children received $25, and their parents were compensated $10 for travel expenses.

**Design and Procedures—**Two activities were evaluated in a single evaluation study using a pre-post cross-over design. Half the participants viewed Activity A first and the other half view 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.[1]

### Measures

**The IAT:** 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. For details, and a description of the scoring procedure, see Study 1. Data from relatively few children (from 0 to 2 per activity evaluation) were not used due to extreme rapidity of responding (<300 milliseconds) on more than 10% of the trials.

**Questionnaire measures:** 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) combined across all 13 activity evaluation studies. To assess differences due to "known groups", we examined differences on the baseline IAT scores as function of family smoking status, the participant's 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; $M$ = .55; $SD$. = .32) were significantly less favorable than were the implicit attitudes of fifth graders who had family members who smoked ($n$ = 286; $M$ = .49; $SD$ = .49; $t$ (764) = 2.78, $p$<.01). The implicit attitudes of fifth graders who had tried smoking ($n$ = 34; $M$ = .53; $SD$ = .35) were not significantly different from the implicit attitudes of children who had never tried smoking ($n$ = 731; $M$ = .53, $SD$ = .32). The correlation between unfavorable implicit attitude and sensation seeking was .08. However, the implicit attitudes of children who were low in sensation seeking (below the median) were significantly more unfavorable ($n$ = 388, $M$ = .56, $SD$ = .31) than the implicit attitude of children who were high in sensation seeking ($n$ = 378; $M$ = .50, $SD$ = .33; $t$ (1,764) = 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 (four activities); social images of smokers (five activities); or risk perceptions of health consequences associated with smoking (four activities). Change in implicit attitude, as measured by $D$, was then evaluated in a two-step process. First, one-way, between-subjects, univariate analyses of covariance (ANCOVA) were conducted comparing the effect of activities targeting a specific risk factor and the control activity (the independent variables) on implicit attitude following the activity (the 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

[1]Data from only the first activity was 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 if 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.

(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 mean and standard deviation 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 average 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* was significant (Difference = .112; standard error = .056; 95% CI = .002; .222; $p < .05$, one-tailed). This significant difference justified 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 standard error = .071; 95% CI = -.049, .230) or comparing the activities targeting health consequences versus the control activity (Difference = .128; standard error = .082; 95% CI = -.034, .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 suitable for assessing fifth graders' implicit attitudes toward smoking, and evidence of reliability and validity of this IAT were presented. Results from Study 1 suggested 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, Gawronski, Gschwendner, Le & Schmitt, 2005). While the *D* score derived from the IAT with sweets as the contrast category was relatively stable across a one-week period, the stability coefficient was lower than that usually found in studies with adults across a one-week period. These stability coefficients generally ranged from about .5 to .7 (Nosek et al., 2007). However, as shown in Study 2, the stability coefficient of the *D* score before and after each activity was consistently higher than the stability coefficient over a one-week period, and much more consistent with data obtained from adults (Nosek et al., 2007).

Results from Study 2 provided validity for the version of the IAT supported in Study 1. As expected, implicit attitudes toward smoking were less favorable for children with non-smoking 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 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 towards 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 to less positive (Andrews, Gordon, Hampson & Christiansen, 2007). 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 believed 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., 2007), did not change implicit attitude.

The activities targeting health consequences also did not result in a change in implicit attitude. These activities showed 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 consequence activities did not induce frustration. Thus the addiction activities may have involved more experiential or implicit learning 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 needs to be examined in further research.

The version of the IAT developed here has 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 response 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 (e.g., 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 attitude 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 attitude

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 attitude and intentions. While this is commendable, change in a measure which 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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**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 & get feedback regarding classmates' actual responses. |
| Build Your Own Smoker | Attribute social images to smokers and non-smokers 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 second-hand smoke health effects of tobacco use. |
| Second-Hand Smoke 101/ Smoker Soaker | Observe health effects of second-hand smoke and play a game where they save non-smokers from SHS. |
| Time Machine | Use a time machine to see the cumulative effect 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. |

**Table 2**

Means and Standard Deviations of Implicit Attitude Following each Activity

| | | Post - test | | | |
|---|---|---|---|---|---|
| **Activity** | **Sample Size** | **Mean** | **SD** | **Pre/post Correlations** | **Comparison with Control Activity** |
| Control Activity (Pinball Game) | 37 | -.32 | .32 | .41 | |
| Risk of Addiction | | | | | |
| Wheel of Misfortune | 27 | -.42 | .44 | .58 | F(1,59) = 2.92, p<.05 |
| Camp Cravings | 36 | -.40 | .35 | .65 | F(1,70) = 1.94, p<.10 |
| Pong | 40 | -.44 | .37 | .56 | ns |
| Addiction Maze | 26 | -.48 | .33 | .70 | F(1,58) = 3.24, p<.05 |
| Social Images | | | | | |
| Personality | 28 | -.42 | .33 | .64 | ns |
| Classmates | 37 | -.40 | .38 | .58 | F(1,69) = 2.71, p<.10 |
| Build your own Smoker | 32 | -.31 | .26 | .38 | ns |
| Make a Video | 34 | -.34 | .34 | .40 | ns |
| Definition of a Smoker | 28 | -.34 | .27 | .33 | ns |
| Risk Perceptions of Health Consequences | | | | | |
| Kids Choice | 30 | -.37 | .29 | .56 | ns |
| Second Hand Smoke 101/Smoker Soaker | 44 | -.36 | .36 | .51 | ns |
| Time Machine | 24 | -.45 | .37 | .54 | F(1,56) = 2.02, p<.10 |
| Every Cigarette Does | 30 | -.33 | .38 | .59 | ns |

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