The interaction of curriculum type and implementation method on 1-year smoking outcomes in a school-based prevention program

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Abstract

Studies have shown that the effectiveness of programs or curricula may depend in part on who delivers the material. In adolescent health education programs, peer leaders are often recruited to implement programs because they are more persuasive to other adolescents than adults. Teachers also systematically vary how groups are constructed in school-based health education programs. This study compared the effects of three leader and group selection methods within the context of two tobacco prevention programs. Eight schools received a social influences program (Chips) and eight received a program with a multicultural emphasis (Flavor). Within these 16 schools 84 classrooms consisting of 1486 students were randomly assigned to one of three leader and group creation conditions: (i) leaders defined as those who received the most nominations by students and groups created randomly (random group), (ii) same as (i) but groups created by assigning students to the leaders they nominated (network), and (iii) leaders and groups created by teachers (teacher). One year follow-up data showed that main effects of the curriculum and network assignments were non-significant on smoking initiation when entered alone. Interaction terms of curriculum and assignment methods, however, were significant such that the network and teacher conditions were less effective than the random group condition with Chips, and more effective than random group condition with Flavor. These data show that school-based prevention programs should be evaluated in light of who implements the program. Even a peer-led program will be differentially effective based on how leaders are selected and how groups are formed, and this effect may be curriculum dependent.

Introduction

Tobacco use has been well documented as the single most preventable cause of premature death and disability in the United States. School-based smoking and substance use prevention programs have been created to reduce tobacco and other substance use [1–5]. Several reviews [6–9] have shown that school-based programs can reduce tobacco use. Although most school-based tobacco prevention programs are based on a social influences model, they have not been structured to take full advantage of the possible positive aspects of peer influence.

One way that programs address social influence is by using peer leaders. Peer led, interactive programs seem to be more effective than teacher led programs and more effective when compared with controls. Meta-analyses of substance use prevention programs [9, 10] have shown that interactive programs, those that incorporate student-to-student exercises, are more effective than lecture style...
programs. Current guidelines for implementing school-based tobacco prevention programs recommend that peer leaders be used to assist them [11] and a number of studies have found peer leaders to be effective implementers of tobacco prevention programs [12–18].

There is considerable variation, however, in how peer leaders are selected. Peer leaders for middle-school programs have ranged in age from college students [14, 16] to high school [13] to those of the same age [12, 17]. Sometimes leaders are self-selected, and in some cases student nominations are used to identify same age peer leaders. Many school-based tobacco prevention programs that have used peer leaders have reported some success in reducing smoking or changing mediators to smoking.

Using peer leaders to assist in curriculum implementation has thus been standard practice in school-based health education programs. Little research, however, has been conducted on the composition of groups used during program delivery. It has been assumed that the specific construction of the groups is not important, yet because peer influence is one of the strongest correlates of smoking [19] the peer context of program delivery warrants study.

One of the most common methods for constructing groups in classrooms is randomization. Teachers typically assign students to numbered groups by having each student, in turn, count one number in a repeated series (1, 2, 3, 1, 2, 3, ...). Randomization has numerous advantages including ease of implementation, controlling for teacher and student biases and being objective. Teachers may also assign students to groups based on their knowledge of who works well with whom (e.g. not putting several disruptive students in the same group). Another strategy is to construct heterogeneous groups of students with a wide range of abilities and skills, so that the weaker students can learn from the stronger ones. For tobacco use prevention and most health promotion programs, assigning students to groups based on different abilities or experiences may be impractical since it requires pairing students who engage in a behavior (smoking) with those who do not, raising ethical concerns. However, most other group assignment strategies also would result in groups containing smokers and non-smokers, so this strategy would not impose additional risk to non-smoking students over and above the risk they would experience from participating in completely random groups.

In sum, considerable research points to the need for including peers in the delivery of school-based health education programs, yet few studies assess the impact of different peer delivery methods. In this study, we test the effectiveness of peer leader selection strategies and group creation within a school-based tobacco use prevention program. A comparison of three conditions was conducted: (i) leaders defined as those who received the most nominations by students and groups created by randomly assigning students to leaders (random), (ii) leaders defined as those who received the most nominations by students and groups created by assigning students to the leaders they nominated (network) and (iii) leaders and groups created by teachers (teacher).

The rationale for the network condition comes from research which has shown that social networks are important influences on tobacco use [20–25]. Given that peers have been shown to influence tobacco use, teaching resistance skills within the context of these peer relationships seems a promising approach. The network condition identifies opinion leaders through peer nominations, but extends the logic of peer influences by matching students to those leaders they nominated or are one or two steps from (one step means they nominated the leader, two steps means the student is assigned to a leader who was nominated by one of his/her nominees and so on). In this manner, students are assigned to the leaders they nominated, thus recognizing that opinion leadership is a localized phenomenon; opinion leaders are not leaders for everyone, but rather are leaders for those who nominate them as leaders [26].

The teacher condition was implemented for practical reasons. The easiest method to implement logistically is to have teachers identify leaders and construct groups. Teacher identification can be
done independent of curriculum staff and requires little additional time for data collection or analysis. Indeed, most prevention programs recommend that teachers identify leaders with the ballot method, but they do not specify how groups are to be constructed.

The random condition acted as the reference group since this is considered the standard in school-based health promotion programs. Identifying peer leaders via ballot, the sociometric method, is a validated means to locate those students considered the best leaders in the class. No studies, however, have assessed whether the effectiveness of using sociometrically defined leaders depends on how they are assigned to groups.

**Intervention/curricula**

A second way that school-based prevention programs can improve their efficacy is to include multicultural references, particularly in multicultural contexts [27]. We developed Project Flavor (Fun Learning About Vitality, Origins and Respect), a multicultural school-based smoking prevention program. The curriculum included cultural referents such as a Wheel of Life collage about health using the Asian yin-yang concept of health as a balanced body, mind and spirit. In another activity, students act out a *telenovela* (soap opera) about the effects of a son’s smoking on a Mexican-American family. The comparison curriculum (Chips) presented the same information and theoretically derived prevention messages, but without these cultural referents.

Both curricula, Chips and Flavor, are social influence–based smoking prevention curricula for middle school students, consist of eight 50-min sessions, and include an initial session for peer leader training. The curricula were taught by college-age, trained health educators with the teacher in attendance. The curricula include Socratic discussions, role-plays and games. The classroom sessions occurred once per week for eight consecutive weeks. In both programs, students worked in their groups in every session and were asked to work on a group project outside of class. The group project was the culminating event in both curricula where students perform skits in their assigned groups on the last day of the curriculum. They are given time during class and are encouraged to work during lunchtime and after school on creating their skits. The programs aimed to change psychosocial mediators of tobacco use such as attitudes toward smoking, self-efficacy, refusal skills, coping skills and intention to smoke [28].

Peer leaders in both Chips and Flavor were trained in a separate 45-min session on how to be a peer leader prior to the start of the curriculum. Peer leaders were taught about the importance of being a leader, about ways to encourage discussion in their group and were asked to prepare to lead their group in the creation of a final project. Peer leaders were taught to encourage open mindedness, communication, group participation, active listening and to reduce critical comments within the group. During their initial training, peer leaders role played being a good leader and practiced encouraging communication. During the curriculum, peer leaders assisted the health educator with materials, role-plays and certain activities. For example, during a refusal skills demonstration leaders were asked to enact a scenario in which the health educator pretended to offer a cigarette. Leaders then demonstrated different ways to refuse the offer. Peer leaders were also asked to lead discussions within their group of curricular components during the sessions.

Earlier analyses of these data reported that the multicultural program was effective among Latinos, but not among non-Latinos [27, 29]. Immediately after the completion of the program, students matched to the peer leaders they selected liked the program more and reduced their susceptibility to smoking more than those who were assigned to leaders randomly [30]. We combine these two prior analyses to determine whether curriculum effects on smoking over a 1-year period vary by implementation condition. The central research questions are does the effectiveness of a smoking prevention program vary by implementation condition (defined as the leader selection and group composition methods) and is this effect consistent across types of curricula?
Methods

Design
The three implementation methods were randomly assigned by classroom to the 84 classes in 16 schools. We ordered classrooms by period within school and simply counted 1, 2 and 3 with numbering continuing repeatedly in series of 3 to the next school (i.e. if we assigned a value of 1 to the last class in a school, a value of 2 was assigned to the first class in the next school). For schools with multiple classes, different implementation conditions were assigned within the same school. Assignment was blind to the students, teachers and health educators. Every teacher and every student regardless of assignment provided nominations.

Table 1 provides a schematic of the study design. Participating schools (comparisons between participating schools and those who refused to participate showed no differences on socio-economic status (SES) or academic performance) were matched on ethnic composition and randomly assigned to three conditions: control (no curriculum), Chips (standard social influences program) and Flavor (culturally tailored curriculum). Because the control schools did not implement either programs (and therefore did not create groups), they were dropped from this analysis.

Sample
Sixteen southern California middle schools with at least 25% Hispanic/Latino and/or Asian/Pacific Islander students were recruited. Of the 1961 students who completed sixth-grade baseline surveys, 1652 completed 1-year follow-up surveys in seventh grade (84% retention). Of these, 166 were missing some data on specific survey items leaving a final analytical sample of 1486 who had complete data at sixth and seventh grades.

Measures
We used lifetime ever smoking as the outcome measure because the prevalence of daily smoking is low among sixth graders. Students who indicated that they had ever tried smoking cigarettes, even a few puffs, and/or reported smoking in the past month were coded as smoking. We chose this measure because it has been shown to be linked to progression to regular smoking [31]. We also used this measure because it provided enough power for analysis to prevent having cells with too few smokers (six cells in this analysis, two curricula by three implementation methods). The rate of any smoking increased by 6.0 percentage points from 10.1% at baseline to 16.1% at follow-up.

To identify leaders, we asked students to ‘Think about the five people in this class who would make the best leaders for working on group projects. Write up to 5 names on the lines below, starting with the best leader on the first line’. We then instructed them to write the person’s roster number next to their name.

Measures for smoking and all other variables were identical at baseline (March 2001) and 1-year follow-up (March 2002).

Table 1. Study design: two smoking prevention curricula were assigned to eight schools and with 84 classes within the schools being randomly assigned to three implementation conditions, random groups, networked groups and teacher chosen leaders and groups

<table>
<thead>
<tr>
<th>Schools</th>
<th>8</th>
<th>8</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Random</td>
<td>Network</td>
<td>Teacher</td>
</tr>
<tr>
<td>Classes</td>
<td>14</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Students</td>
<td>277</td>
<td>251</td>
<td>217</td>
</tr>
</tbody>
</table>

T. W. Valente et al.

318
Analysis

To test for implementation method effects, we used logistic regression with smoking at 1-year follow-up as the outcome variable. We tested a lagged regression model (including baseline smoking) and a smoking initiation model (including baseline non-smokers only). We included dummy variables for the FLAVOR (multicultural) curriculum and dummy variables for the network and teacher conditions. For controls, we included the many socio-demographic characteristics shown to be associated with smoking in past studies including age, sex, ethnicity, having one or both parents foreign born, having one or both parents as college graduates, parental smoking, SES (measured as rooms in the house) and academic performance [21]. To determine if implementation effects varied by curriculum, we constructed interaction terms of curriculum and implementation method.

All analyses controlled for intra-class correlation at the school level by using a multilevel model with individuals as Level 1 and schools as Level 2. We could not specify classroom as the clustering level (Level 2) because randomization was done at the class level. We replicate the analysis by aggregating data to the class level as a partial control for classroom level co-variation.

Results

Sample characteristics

Socio-demographic characteristics of the sample are reported in Table 2. At baseline, most students were 11 years or younger, with 30.7% being 12 or older. Slightly more girls than boys were included in the study (53.9 versus 46.1%). Because the initial sampling frame of schools had been selected to include schools with large numbers of Hispanic/Latino and Asian–American students, the sample was ethnically diverse. Most students were Hispanic/Latino (56.3%) with about a quarter being European–American (24.2%) or Asian–American (26.5%). Most had at least one parent foreign born (84.3%) and less than half had a parent who was a college graduate (40.6%). About a third had at least one parent who smoked (31.8%) and a majority reported getting mostly A’s and B’s on their report cards (69.4%). Finally, students reported an average of 3.79 rooms in their households (not including kitchen and bathrooms).

There were some differences in participant characteristics between those who stayed in the study and those lost to follow-up. There was a decrease in the percentage of Hispanic/Latinos at follow-up and an increase in Asian–Americans at follow-up. Those with fewer rooms in their household were

Table II. Comparison between respondents lost to follow-up, those with some missing, and those with complete data

<table>
<thead>
<tr>
<th></th>
<th>Baseline only $n = 309$</th>
<th>Missing data $n = 166$</th>
<th>Complete data $n = 1486$</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoked at baseline (%)</td>
<td>13.7</td>
<td>8.0</td>
<td>10.1</td>
<td>0.09</td>
</tr>
<tr>
<td>Smoked at follow-up (%)</td>
<td>—</td>
<td>17.7</td>
<td>16.1</td>
<td>0.61</td>
</tr>
<tr>
<td>Age 12+ years (%)</td>
<td>32.0</td>
<td>40.8</td>
<td>30.7</td>
<td>0.04</td>
</tr>
<tr>
<td>Male (%)</td>
<td>49.6</td>
<td>49.6</td>
<td>46.1</td>
<td>0.41</td>
</tr>
<tr>
<td>Whitea (%)</td>
<td>22.2</td>
<td>30.3</td>
<td>24.2</td>
<td>0.16</td>
</tr>
<tr>
<td>Hispanic/Latinoa (%)</td>
<td>60.0</td>
<td>48.0</td>
<td>56.3</td>
<td>0.05</td>
</tr>
<tr>
<td>Asian–Americana (%)</td>
<td>19.7</td>
<td>25.0</td>
<td>26.5</td>
<td>0.03</td>
</tr>
<tr>
<td>One parent foreign born (%)</td>
<td>81.3</td>
<td>83.2</td>
<td>84.3</td>
<td>0.39</td>
</tr>
<tr>
<td>One parent college graduate (%)</td>
<td>40.0</td>
<td>36.7</td>
<td>40.6</td>
<td>0.63</td>
</tr>
<tr>
<td>One or two parents smoke (%)</td>
<td>32.3</td>
<td>27.1</td>
<td>31.8</td>
<td>0.47</td>
</tr>
<tr>
<td>Strong academic performanceb (%)</td>
<td>66.3</td>
<td>65.0</td>
<td>69.4</td>
<td>0.33</td>
</tr>
<tr>
<td>SES (no. of rooms in household)</td>
<td>3.50</td>
<td>3.71</td>
<td>3.79</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*aStudents who reported multiple ethnicities were classified as both ethnicities, thus percents total to >100.

bOf the cases, 99 recoded to this modal category.
slightly more likely to be lost to follow-up than those with more rooms. Older students were more likely to have some missing data in their surveys. However, there was no difference in attrition across experimental conditions. Therefore, the attrition variations might affect the incidence and prevalence of smoking, but they should not affect estimates of the relative effectiveness of the interventions.

In terms of smoking, the smoking rate among students with baseline data only was higher than those retained in the study (13.7 versus 10.1%, \( P = 0.09 \)). There was little difference in smoking between those with some missing data and those with complete data (8.0 versus 10.1%, \( P = 0.48 \); 17.7 versus 16.1%, \( P = 0.98 \); at Years 1 and 2, respectively). Table 2 shows that smoking among those with complete data increased from 10.1 to 16.1% (\( P < 0.001 \)). These data are consistent with other data on smoking incidence and prevalence in California [32].

Figure 1 shows the percentage change in smoking from sixth to seventh grade by curriculum and implementation condition. The percentage increase in smoking was less in Flavor than in Chips but not statistically significant overall (4.7 versus 7.3%, \( P = 0.14 \)). Changes in smoking were similar in the three peer leader/group formation techniques (random, 6.6%; teacher, 5.6% and network, 5.9%; \( P = 0.88 \)). There was a curriculum by implementation condition interaction, such that the network and teacher conditions had lower smoking increases in Flavor than Chips. Specifically, smoking rates were lower in Flavor networked than Chips networked (3.5 versus 7.8%, \( P = 0.27 \)) and lower in Flavor teacher than Chips teacher (2.5 versus 9.6%, \( P < 0.05 \)).

Table 3 reports two logistic regression models to test the interaction between curriculum (Chips/Flavor) and implementation condition (random/network/teacher) while controlling for variation in socio-demographic characteristics and school-level clustering. Model 1 reports program effects on lifetime smoking among baseline non-smokers (smoking initiation) and Model 2 on Year 2 lifetime smoking controlling for Year 1 lifetime smoking (lagged regression [33]). In both models, control variables co-varied with outcomes as expected with older, male, students being more likely to become smokers, and Asian–American and those with a parent who graduated from college being less likely to do so.

The network condition in Chips (the reference curriculum) was associated with a higher smoking initiation rate in seventh grade among sixth-grade non-smokers [adjusted Odds Ratio (AOR) = 1.22; \( P < 0.01 \)], and the teacher condition in Chips was associated with increased smoking growth trajectory between sixth and seventh grades (AOR = 1.57; \( P < 0.001 \)) compared with the random condition. Both teacher and network conditions were associated with lower smoking initiation rates in Flavor (AOR = 0.41, \( P < 0.05 \) and AOR = 0.50, \( P < 0.05 \), respectively) and flatter smoking growth trajectory in Flavor (AOR = 0.38, \( P < 0.01 \) and AOR = 0.49, \( P < 0.05 \), respectively) compared with random. Although not presented, we ran three-way interaction terms including Hispanic/Latino ethnicity and found significant effects that indicated Latino students who received Flavor, implemented with teacher selection of leaders and groups yielded the most effective results.

Results were consistent when aggregated to the classroom level, but did not achieve statistical significance. Changes in the percentage of smokers per class were negatively associated with network and teacher assignments in Flavor (\( \beta = -0.22 \),
The empirical results showed that the teacher condition and network conditions were more strongly associated with lower smoking initiation rates and flatter smoking growth trajectory in Flavor than in Chips. These data suggest that school-based curriculum effects depend, to some extent, on who specifically implements the program and on the social network context within which it is implemented. A program using peers to deliver lessons still needs to consider how these peers will be selected, and curricula with group activities should consider how these groups are formed. Forming groups randomly, even when peer leaders were chosen by ballot, was the least effective delivery method.

Flavor was more effective overall and its effects were enhanced by the teacher and network methods. An important aspect of the Flavor program was its emphasis on gaining an understanding and appreciation of one’s own culture of origin and those of one’s classmates. The Flavor curriculum was intended to minimize stereotypes and use
cultural values from multiple cultures to illustrate positive, culturally appropriate reasons not to smoke. Because of the intense and non-superficial social interaction required for these activities, the Flavor curriculum may have been most effective when it was implemented in groups of students who were already somewhat familiar discussing personal topics with one another. This suggests that implementation modality may multiply program effects, making an effective program more effective, and a less effective one, less so. Students may participate in group activities more fully, and may internalize the messages conveyed in these activities, if they do the activities with classmates who are their friends and/or role models. Conversely, if students participate in activities with classmates who they do not like or respect, they may be more likely to reject the messages. Implementation modality alone probably does not fundamentally change the effectiveness of a curriculum, but it may magnify its impact.

Moreover, Flavor, the multicultural program was more effective among Hispanic/Latino boys [27, 29]. Because Flavor had many Hispanic/Latino references, it was expected to be more effective among Hispanic/Latinos. Flavor was less effective when groups were formed randomly, perhaps because these groups had more ethnic diversity and these cultural referents were less appealing in an ethnically diverse group. In contrast, Flavor was more effective in the network and teacher conditions perhaps because teachers and the network algorithm created more ethically homogenous groups. The cultural references of the curriculum among an all Hispanic/Latino group would be reinforced by the group thus making the program more appealing, engaging and more effective.

The teacher condition in Flavor was the most effective method. This may have been due, in part, to the study itself. Teachers in the teacher condition were given worksheets to indicate leaders and their groups. This may have prompted teachers to be more deliberate in their selection of leaders and formation of groups. Teacher selection of leaders and groups in general might not always be the most efficacious, but is more likely to be so when combined with tools that prompt teachers to use their knowledge of who works well with whom in a group (it should also be noted that the curricula were implemented in April and May, after teachers had taught their classes for 7 months). In this study, we did not ask the teachers what decision rules they used to assign students to groups. Some teachers may have assigned students to leaders whom they knew worked well together, mimicking the network condition. Other teachers may have constructed groups with the goal of separating problem-prone students from one another, encouraging students to work with classmates outside their usual friendship groups, or distributing high-performing and low-performing students evenly to groups. Further research is needed to understand the nature of teacher-formed groups.

The composition of peer groups may be critical. Social influences have been an important component of tobacco prevention programs [34] and current school-based prevention guidelines call for the use of peers [35]. Yet, social influence programing may not in itself be sufficient to deter tobacco use [36–38] and social influence programming effectiveness will clearly depend somewhat on the role models who perform skill demonstrations.

Research has shown that interactive, peer-led programs are the most effective at preventing tobacco and substance use [7, 9, 28, 39]. This study goes one step further by suggesting that who specifically leads those interactions, and how groups are formed for those interactions also makes a significant difference in program effectiveness. Different peer implementation methods, however, should not be evaluated without consideration of program content and curriculum design.

Acknowledgements

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