Abstract

This paper evaluates a smoking prevention intervention aimed at vocational school students, consisting of an existing Dutch in-school program (three lessons each lasting 50 min) and a computer-based tailored out-of-school program (three tailored letters with smoking prevention messages mailed to students’ homes). Nineteen schools that already participated in the in-school program were randomly assigned to the in-school or to the combined in-school and out-of-school condition. The remaining 17 schools were randomly assigned to the out-of-school condition or to the control group. Effect outcomes were assessed at 6, 12 and 18 months after a pre-test, and were based on initiation among never-smokers and continuation among ever-smokers. Twelve months after the pre-test (post-test 2), the in-school intervention was successful in preventing vocational school students from continuing to smoke, compared with students in the control condition (OR = 0.49; 95% CI = 0.29–0.84). The effect of the combined approach was not larger than the sum of the effects of the in-school and the out-of-school effects.

Introduction

Smoking causes 85% of lung cancer mortality, while 33% of mortality from other cancers is also attributed to smoking. About half of all smokers will eventually be killed by their habit (Doll et al., 1994). Many authors state that smoking prevention programs should be aimed at preventing or delaying the start of tobacco use [e.g. (Kelder et al., 1994)] and that such programs might be especially indicated for high-risk populations. In the Netherlands separate secondary school types exist. Vocational schools prepare one-third of the students (aged between 12 and 16 years) for specific vocations, while high schools (12–18 year olds) prepare the remaining students for follow-up education (Centraal Bureau voor Statistiek, 2002). Smoking rates among vocational school students aged from 12 to 16 year olds are generally higher than among high school students [e.g. (De Vries, 1995)]. In 1997, 66% of the Dutch vocational school students (aged between 12 and 16 years) had tried cigarettes, 45% of them being occasional or daily smokers. In contrast, 50% triers and 26% occasional or daily smokers were found among high school students in the same age category (Stivoro, 1998). These findings imply the need for effective prevention programs targeted at first-grade vocational school students aged 12–13 years old.
In the last decade, several smoking prevention programs have been developed, the most promising focusing on the development of social skills to resist social influences that encourage smoking (US Department of Health and Human Services, 2000). So far, most of these programs have been run in school settings, which is an obvious choice, since school-based smoking prevention programs can reach wide audiences. However, a potential drawback of these programs is, for example, that their implementation depends on limited time and untrained personnel (Murray et al., 1992). To overcome disadvantages of school-based interventions among (high-risk) vocational school students, an innovative computer-based out-of-school intervention was developed, consisting of personalized tailored letters mailed to the students’ homes. The idea of personalized tailored letters originated in the US [e.g. Velicer et al., 1993] and has been further developed and tested for several years in The Netherlands [e.g. (Dijkstra and De Vries, 1999)].

The goal of the present study was to compare the impacts on smoking rates of three programs: (1) a computer-based tailored out-of-school smoking prevention program, (2) a Dutch in-school smoking prevention program, and (3) a combined approach including the in-school and out-of-school intervention. The combined approach was included because research indicates that multiple prevention strategies produce better results in terms of the reduction of tobacco use (US Department of Health and Human Services, 2000).

Smoking rates, based on both smoking initiation among never-smokers and smoking continuation among ever-smokers, were assessed at 6, 12 and 18 months after the pre-test.

### Methods

#### Design and procedure

Table I presents a timeline following the sample from approach to the third post-test assessment. During springtime 1997, schools in The Netherlands were recruited with the assistance of six of the eight approached local health departments. All vocational schools within the six local health departments’ regions received an introductory letter, followed by a telephone call to the student counselor of the lowest grade vocational students, to discuss participation in the project. It was also checked whether schools were already participating in the ‘Healthy Schools and Stimulants Program’, which was selected as the in-school activity (Trimbos Institute, 1996). A sample size of 36 schools was estimated to be sufficient to demonstrate an effect size with an odds ratio (OR) of 2.0. Power calculation (80%) assumed a significance level of $\alpha = 0.05$ (two-sided), a cluster randomized control trial with 25 students on average per school and between school variance of 0.30, which implies an intraclass correlation of 0.08 [for binary data, intraclass correlation = school variance/(school variance + $B^2$) (Moerbeek et al., 2003)]. Thirty-six schools agreed to participate, of which 19 were already working with the in-school materials and, as a consequence, had been trained in the use of the program by The Netherlands Institute of Mental

<table>
<thead>
<tr>
<th>Approach</th>
<th>Timeline</th>
<th>I</th>
<th>O</th>
<th>I + O</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomization</td>
<td>June 97</td>
<td>9</td>
<td>8</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Pre-test</td>
<td>Sept 97</td>
<td>9 (525)</td>
<td>8 (513)</td>
<td>10 (829)</td>
<td>9 (509)</td>
</tr>
<tr>
<td>Intervention</td>
<td>Oct 97-Feb 98</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Post-test 1</td>
<td>Feb 98</td>
<td>9 (432)</td>
<td>7 (446)</td>
<td>10 (703)</td>
<td>8 (335)</td>
</tr>
<tr>
<td>Post-test 2</td>
<td>Sept 98</td>
<td>9 (434)</td>
<td>6 (349)</td>
<td>10 (580)</td>
<td>8 (362)</td>
</tr>
<tr>
<td>Post-test 3</td>
<td>March 99</td>
<td>5 (265)</td>
<td>10 (625)</td>
<td>7 (317)</td>
<td></td>
</tr>
</tbody>
</table>

I = in-school; O = out-of-school; I + O = in-school + out-of-school; C = control condition.
Health and Addiction, the ‘Trimbos Institute’, who had designed the program.

In June 1997, the schools already participating in the ‘Healthy Schools and Stimulants Program’ were randomly assigned within regionally defined blocks to the in-school (I) or to the in-school and out-of-school condition (I + O). The remaining 17 schools were randomly assigned to the out-of-school (O) or to the control group condition (C) in a similar manner. Schools participating in the O and I + O conditions distributed consent forms to students’ parents, as their children had been selected to receive educational materials sent to their home addresses. Forty out of 1342 (3%) parents refused participation. In-school materials (which were made available free of charge for this project), pre-test questionnaires and the assessment procedure were mailed to the schoolteacher who was responsible for this project. A letter with instructions on the assessment procedure was included, telling schools to schedule 1 hour for completing the pre-test questionnaires in September 1997 in the presence of the teacher, to collect the questionnaires after completion in the classroom, put them in a postage-paid envelope and—having sealed them—return the envelopes to the researchers.

Smoking behavior was assessed by means of self-reports. Objective smoking validation was not regarded as useful for this young age group because the available methods only detect very recent—at most weekly—smoking, while smoking family members may induce elevated readings (Sussman et al., 1995). Self-reported results are more accurate when confidentiality is assured and an identification coding system is used [e.g. (Dolcini et al., 1996)].

The interventions were implemented between October and early February 1998. Post-test 1 was in mid-February 1998. At the same time, students in the treatment conditions and teachers who implemented the in-school program completed a process evaluation questionnaire. Post-test 2 was in September 1998. The third post-test, March 1999, was restricted to long-term effects of the out-of-school intervention only, the in-school condition no longer being included in the sample at that time.

**Interventions**

The two interventions used in the present study were both based on essential components for successful social influence programs (Sussman et al., 1993). Topics included were the short-term physical and social consequences of smoking, pressure to smoke, other people’s smoking behavior, and refusal skills.

**The in-school intervention**

This consisted of three lessons, each lasting about 50 min, for which student and teacher manuals were available. Each lesson comprised a general introduction by the teacher, a reading text in the workbook, a classroom discussion, a workbook task and an additional task that summarized the main points of the lesson. The first lesson explained the ingredients of tobacco, and the physical and mental reactions of smoking, while the second discussed norms concerning smoking, and the third emphasized the pressures to smoke and the skills that are helpful in resisting cigarettes.

**The out-of-school intervention**

This consisted of three tailored letters with smoking prevention messages, which were sealed in envelopes and mailed to students’ homes at 3-week intervals. This procedure was used to ensure optimal confidentiality. The researchers signed the letters and telephone numbers were added. We deliberately did not disclose the students’ pre-test smoking behavior in the letters, to prevent arguments in the students’ families. The contents of the letters, however, were tailored to individual characteristics. The pre-test questionnaire on attitudes, social norms, self-efficacy, smoking intention and smoking behavior was used to create a database file containing personal information. Pilot testing and revision of concepts resulted in the creation of a message file. A computer program combined the database file with the message file using decision rules that linked students’ answers to personal messages. All messages thus selected
were combined in a letter format. The letters were illustrated with a picture puzzle and several cartoons, and a competition was included in which students could win one of two CD vouchers. The first letter (eight versions) contained information regarding students’ beliefs about smoking in general, and short-term and social consequences of smoking. The second letter (32 versions) discussed the influence of the social environment (with a description of the Dutch smoking prevalence) and intentions not to smoke in the future. Boys and girls received different messages and cartoons. The third letter (two versions) described refusal techniques and included an exercise about cigarette refusal. For instance, if students had indicated doubtful cigarette refusal capacities in the pre-test questionnaire, the message selected by the computer program explained that they could improve their cigarette refusal capacity by doing a simulation exercise. The letter then described an exercise in which students were stimulated to practice cigarette refusal step by step. Students already equipped with sufficient refusal capacities received a message reinforcing their capacities, followed by the simulation exercise and an explanation that cigarette refusal capacity might be improved even further through practice.

**Measurements**

**Process measurement for students**

The process evaluation assessed exposure and appreciation. Exposure to the in-school condition was measured by 15 questions on a two-point scale: ‘yes’ (1) or ‘no’ (0), assessing for each of the three lessons whether students had had the introductory talk, performed the reading assignment, engaged in the class discussion, and had done the workbook and additional task. Appreciation of each lesson had to be rated from ‘very bad’ (0) to ‘excellent’ (10). Exposure to the out-of-school condition was recorded by asking whether students had received each of the three letters, possible answers being ‘yes’ (1) or ‘no’ (0), and by asking to what extent they had read each letter: ‘completely’ (4) to ‘not at all’ (1). Students also indicated how many times they had read the letters. Appreciation of the letters was scored on a four-point scale: ‘liked reading it very much’ (4) to ‘not’ (1) and students judged the visual appearance of the letters on a scale ranging from ‘very attractive’ (4) to ‘unattractive’ (1). To find out how students perceived the essence of tailoring, their impression of the degree of personal approach was assessed: ‘completely personally directed’ (4) to ‘not personally directed’ (1). Lastly, students could indicate which of their parents, siblings or friends they had allowed to read the letters.

**Process assessment for teachers**

The teachers’ questionnaire assessed whether they had implemented the above five elements in the three lessons, using a two-point scale of ‘yes’ (1) or ‘no’ (0). In addition, teachers indicated their appreciation of each lesson from ‘very bad’ (0) to ‘excellent’ (10).

**Outcome measurements for students**

An updated version of the Attitude–Social influence–self Efficacy (ASE) questionnaire was used to assess the proximal factors of smoking: attitudinal beliefs, social influences, self-efficacy expectations and intentions, as well as the outcome measures of smoking behavior [e.g. (Dijkstra et al., 1999)]. Distal factors like age, gender, self-esteem, religion, family composition, pocket money and parents’ jobs and origin were also included as predictors, although they are assumed to influence smoking via attitudes, social influences and self-efficacy expectations.

Factor analyses confirmed four attitude subscales:

1. Disadvantages ‘immediate’: eight items (Cronbach’s α = 0.80) ranging from ‘negative’ (1) to ‘very positive towards non-smoking’ (5), reflecting immediate consequences (nausea, coughing, irritated eyes, breathing problems, unwise, bad for your health, disturbing others and regret).

2. Advantages ‘adult’: four items (Cronbach’s α = 0.54) ranging from ‘positive’ (1) to ‘very negative towards non-smoking’ (5), reflecting the perceptions of adult beliefs (growing up,
relieving boredom, relieving tension and tasting good).

(3) Disadvantages ‘long-term’: four items (Cronbach’s $\alpha = 0.64$) ranging from ‘very negative’ (−3) to ‘very positive’ towards non-smoking (3), reflecting the long-term consequences (risks of cancer and heart diseases, disapproval of oneself, and bad smell).

(4) Advantages ‘self-confidence’: eight items (Cronbach’s $\alpha = 0.77$) ranging from ‘very negative’ (±3) to ‘very positive’ towards non-smoking (3), reflecting consequences in terms of self-confidence (receiving attention from friends, acceptance by friends, making contacts, striking an attitude, feeling relaxed, being bullied, feeling cozy and enjoying it).

Social influence was measured by four indices:

(1) Modeling ‘nuclear’: four items ranging from ‘smoking’ (−2), ‘absent’ (−1) to ‘not smoking’ (0), referring to perceived smoking behavior of the student’s father, mother, brother/sister and best friend.

(2) Modeling ‘diffuse’: four items ranging from ‘almost all’ (−4) to ‘almost none are smokers’ (0), measuring the number of smoking friends, peers, teachers and family members.

(3) Social norms: six items ranging from ‘very negative’ (−3) to ‘very positive towards non-smoking’ (3), measuring the perceived beliefs of the student’s father, mother, brother, sister, best friend and friends.

(4) Social pressure: 10 items ranging from ‘very often’ (−5) to ‘never’ (0), measuring the perceived pressure to smoke from the student’s father, mother, brother, sister, best friend, friends, peers, teacher, family and advertisements.

Self-efficacy was measured by five items (Cronbach’s $\alpha = 0.89$) ranging from ‘very uncertain’ (−3) to ‘very certain’ (3), each item referring to the students’ expectations about refraining from smoking in different situations of increasing magnitude (when others smoke, when friends smoke, when a cigarette is offered by someone or by parents, or when you are called a coward).

Intention to smoke was measured by one item ranging from ‘definitely do’ (−3) to ‘definitely do not intent to smoke’ (3).

Self-esteem questions were derived from questions originally developed by Harter (Harter, 1985) and Minagawa and Charlton (Minagawa and Charlton, 1993). Factor analysis confirmed two self-esteem subscales:

(1) Self-esteem ‘general’: seven items (Cronbach’s $\alpha = 0.84$), ranging from ‘very positive’ (1) to ‘very negative’ (4), reflecting students’ feelings about their general image (looking good, satisfaction with performance, appearance or with oneself, opinion towards oneself as a person, personal affection and personal satisfaction).

(2) Self-esteem ‘physical’: 4 items (Cronbach’s $\alpha = 0.78$), ranging from ‘very positive’ (1) to ‘very negative’ (4), reflecting students’ feelings about their physical appearance (satisfaction with height and weight, satisfaction with their own body, desiring a different appearance, and satisfaction with face and hair).

Smoking behavior was based on self-reports, categorizing students as: (1) never-smokers: students who have never smoked even one cigarette or a puff of one; (2) non-current smokers: students who have smoked in the past, but not during the past month; and (3) current smokers: students who have smoked during the past month.

As outcome effects on smoking initiation, we assessed the percentage of pre-test never-smoking students (category 1) who indicated to have started smoking at post-test 1, post-test 2 or post-test 3 (categories 2–3). As outcome effects on smoking continuation, we assessed the percentage of pre-test ever-smokers (categories 2–3) who indicated at post-tests 1–2–3 to have smoked during the past month (category 3).

Analyses

The results of the process measurements were first calculated for each student and teacher, averaging across letters and lessons, respectively, and subse-
sequently for each school, averaging across students and teachers, respectively.

Students were nested within schools and schools were randomly assigned to treatment conditions. Since ignoring this nesting may lead to type I errors and too narrow confidence intervals (CI) for treatment effects (Flay et al., 1995), most analyses were carried out using multilevel regression modeling by the MIXREG (linear regression) program for continuous outcomes (Hedeker and Gibbons, 1996b) and the MIXOR (logistic regression) program for dichotomous outcomes (Hedeker and Gibbons, 1996a).

To check whether the randomization had been successful, the treatment conditions were compared for age, gender, pre-test ever-smoking and pre-test psychosocial variables. To check if those who dropped out differed from those who did not, we performed dropout analyses with attrition at post-tests 1–2–3 as the outcome, and pre-test demographics, pre-test ever-smoking, and psychosocial variables and treatment conditions as predictors.

With regard to program effects, in view of the two-way design of the study, the treatment factor was dummy coded. The in-school intervention effects were tested by computing the in-school factor: both in-school conditions (1) versus both not in-school conditions (0). The out-of-school intervention effects were tested by computing the out-of-school factor: both out-of-school conditions (1) versus both not out-of-school conditions (0). To test the additional effects of the in-school intervention on the out-of-school intervention, the interaction term ‘in × out-of-school’ was included in the analyses. If a significant interaction ‘in × out-of-school’ was found, the sample was stratified according to the scheme presented in Table II.

Table II. Stratification scheme in case a significant ‘in × out-of-school’ interaction was found

<table>
<thead>
<tr>
<th>In-school factor</th>
<th>Out-of-school factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>control</td>
</tr>
<tr>
<td>1</td>
<td>in-school</td>
</tr>
</tbody>
</table>

Note: ‘out’ factor = 1, comparing combined with out-of-school; ‘out’ factor = 0, comparing in-school with control; ‘in’ factor = 1, comparing combined with in-school; ‘in’ factor = 0, comparing out-of-school with control.

Results

Sample characteristics and randomization

Table III presents the sample characteristics (averaged at school level) of the pre-test sample. Students in the out-of-school conditions were more often from one-parent families (OR = 0.76; 95% CI = 0.67–0.97). Since the randomization check of age showed a significant ‘in × out’ interaction, different models were tested to check the randomization in terms of age (Table II). Students in the out-of-school condition were found to be older than those in the control condition (OR = 1.27; 95% CI = 1.03–1.57).
Attrition

Attrition at school level was 5.6% (two schools) at the first post-test and 8.3% (three schools) at post-test 2. At post-test 3, schools from the in-school condition were no longer participating in the study and were therefore excluded from the calculation of post-test 3 attrition analyses. At post-test 3, attrition was 18.5% (five schools out of 27, excluding the in-schools).

Absenteeism and difficulties in matching pre-test and post-test data mainly caused attrition at the student level. We calculated the attrition rates (student level) without the dropout schools, because we assumed that the students in these schools were not personally responsible for their dropout. Attrition at student level was 17.3% at post-test 1, 25.4% at post-test 2 and 24.6% at post-test 3.

Logistic regression analysis with post-test 1 attrition as the dependent variable suggested that dropout students were older (OR = 1.29; 95% CI = 1.10–1.51) and less likely to have participated in the out-of-school program (OR = 0.39; 95% CI = 0.18–0.86).

Post-test 2 attrition was less likely for students living with two parents instead of one (OR = 0.63; 95% CI = 0.44–0.89) and for students who were relatively less ‘diffusely’ surrounded by smokers (OR = 0.93; 95% CI = 0.91–0.95).

Post-test 3 attrition was less likely for students living with two instead of one parent (OR = 0.53; 95% CI = 0.37–0.77), for students with two Dutch parents (OR = 0.63; 95% CI = 0.47–0.84) and for students who were relatively less ‘diffusely’ surrounded by smokers (OR = 0.87; 95% CI = 0.84–0.90). Students in the combined condition were

<table>
<thead>
<tr>
<th>Table III. The pre-test sample (school averages): smoking behavior, distal and proximal factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking behavior</td>
</tr>
<tr>
<td>ever smoking (%)</td>
</tr>
<tr>
<td>current smoking (%)</td>
</tr>
<tr>
<td>Distal factors</td>
</tr>
<tr>
<td>age (years)</td>
</tr>
<tr>
<td>gender (% male)</td>
</tr>
<tr>
<td>origin (% with both parents Dutch)</td>
</tr>
<tr>
<td>religious (% adhering to a religion)</td>
</tr>
<tr>
<td>family composition (% with two parents)</td>
</tr>
<tr>
<td>father’s occupation (% paid job)</td>
</tr>
<tr>
<td>pocket money (% &gt;6.8 euro)</td>
</tr>
<tr>
<td>self-esteem ‘general’</td>
</tr>
<tr>
<td>self-esteem ‘physical’</td>
</tr>
<tr>
<td>Proximal factors</td>
</tr>
<tr>
<td>disadvantages ‘immediate’</td>
</tr>
<tr>
<td>advantages ‘adult’</td>
</tr>
<tr>
<td>disadvantages ‘long-term’</td>
</tr>
<tr>
<td>advantages ‘confidence’</td>
</tr>
<tr>
<td>modeling ‘nuclear’</td>
</tr>
<tr>
<td>modeling ‘diffuse’</td>
</tr>
<tr>
<td>social norms</td>
</tr>
<tr>
<td>pressure</td>
</tr>
<tr>
<td>self-efficacy</td>
</tr>
<tr>
<td>Intention</td>
</tr>
</tbody>
</table>

Note: ‘neg’ = negative towards non-smoking, ‘pos’ = positive towards non-smoking.
less likely to drop out than those in the out-of-school condition (OR = 0.37; 95% CI = 0.23–0.59).

**Process evaluation**

Fifty-eight percent of the intervention schools \((n = 11)\) returned the teacher process questionnaires. Response rates to the students’ process questionnaire were identical to those of the outcome measurement post-test 1 questionnaire, as data collection was combined.

With regard to the in-school exposure, all the teachers (100%) gave the introductory talk, and implemented the reading part and workbook task in all three lessons. The class discussion was used by 94% of the teachers, while the additional task was completed by 64% of the teachers. The students generally reported lower rates of exposure than the teachers’ rates of completing the lesson tasks. Teachers evaluated the three lessons as 7.5 (95% CI, 6.9–8.1) on a scale from bad (0) to excellent (10), while students rated them as 6.6 (95% CI, 6.3–6.9).

With regard to out-of-school exposure, 65% of the students received the letters and read them an average of 1.1 times, while 63% read them (almost) completely, 54% liked reading the letters and 54% liked the appearance of the letters. Forty-seven percent of the students felt more or less personally addressed by the letters. Forty-seven percent of students’ mothers, 38% of students’ fathers, 13% of students’ siblings and 7% of the friends had read the letters. Twenty percent of the students sent back their answers for the competition.

**Program effects**

Table IV presents the percentages of smoking initiation among pre-test never-smokers and the percentages of smoking continuation among pre-test ever-smokers at post-tests 1–2–3.

Post-test 1 showed that smoking initiation among pre-test never-smokers was lowest in the out-of-school condition (16.8%) and highest in the in-school condition (27.4%). In the pre-test ever-smoking sample, the lowest level of smoking continuation was found in the control condition (26.8%) and the highest in the in-school condition (34.6%).

At post-test 2, smoking initiation among pre-test never-smokers was lowest in the out-of-school smoking sample (25%) and highest in the control
condition (40.9%). The lowest level of smoking continuation was found in the in-school condition (29.4%), while the highest continuation level occurred in the in + out condition (45.0%).

At post-test 3, smoking initiation among pre-test never-smokers was lowest in the out-of-school condition (27.2%) and highest in the control condition (47.9%). In the pre-test ever-smoking
sample, the lowest level of smoking continuation was found in the out-of-school condition (37.0%) and the highest in the control group (46.9%).

The results of the MIXOR analyses of post-test 1 are presented in Table V. Interactions between the in-school and out-of-school factors were found neither for smoking initiation nor for continuation, implying that the effect of ‘in × out’ was not larger than the sum of the effects of the in-school and the out-of-school program. The in-school and the out-of-school programs did not show a significant effect on either smoking initiation or continuation.

The intraclass correlation at post-test 1, as obtained with the regression models in Table V, was 0.08 for smoking initiation, and 0.06 for smoking continuation.

At post-test 2 (Table VI), significant ‘in × out’ interactions were found, so four pairwise comparisons were tested (Table II). Since MIXOR failed to run some of the models (probably because of the reduced sample size), these specific models were run with the SPSS program (i.e. without random effects). With regard to smoking initiation, no significant treatment effects were found. With regard to smoking continuation, positive in-school effects were found: pre-test ever-smoking students in the in-school condition were less likely to have continued smoking at post-test 2 than students in the control condition.

The intraclass correlation at post-test 2, as obtained with the regression models in Table VI, ranged from 0.001 to 0.04 for smoking initiation and from 0.01 to 0.09 for smoking continuation.

Table VII presents the results of post-test 3. Data collection for the in-school population was not continued after post-test 2, therefore only three of the four treatments groups were observed at post-test 3 and so the regression model contained only two dummies for treatments: Out (1 for O and I + O, but 0 for C) and In (1 for I + O, but 0 for O and C). Their two regression weights estimate the difference between O and C, and between I + O and O, respectively. With regard to smoking initiation, students in the out-of-school condition were less likely to have initiated smoking at post-test 3 than students in the control condition. With regard to smoking continuation, no significant out-of-school effects were found.

At post-test 3, the intraclass correlation for smoking initiation was 0.07, for smoking continuation it was 0.05.

During all three post-tests, intention (students with a negative intention towards non-smoking being at higher risk) turned up as a consistent predictor for smoking initiation (Tables V–VII). Age (older students being at higher risk), intention (students with a negative intention towards non-smoking being at higher risk), disadvantages

### Table VII. Program effects at post-test 3: OR with 95% CI; smoking initiation (1 = ever-smoking, 0 = never-smoking) and smoking continuation (1 = smoking, 0 = not smoking)

<table>
<thead>
<tr>
<th></th>
<th>Pre-test never-smokers: smoking initiation ($n_{students} = 523$, $n_{schools} = 22$)</th>
<th>Pre-test ever-smokers: smoking continuation ($n_{students} = 676$, $n_{schools} = 22$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>CI</td>
</tr>
<tr>
<td>Combined (1) versus out-of-school (0)</td>
<td>1.85</td>
<td>0.71–4.83</td>
</tr>
<tr>
<td>Out-of-school (1) versus control (0)</td>
<td>0.42</td>
<td>0.18–0.96</td>
</tr>
<tr>
<td>Self-esteem general: 7 (pos) to 28 (neg)</td>
<td>0.86</td>
<td>0.73–1.01</td>
</tr>
<tr>
<td>Modeling nuclear: –8 (neg) to 0 (pos)</td>
<td>0.89</td>
<td>0.81–0.99</td>
</tr>
<tr>
<td>Modeling diffuse: –16 (neg) to 0 (pos)</td>
<td>0.90</td>
<td>0.81–1.01</td>
</tr>
<tr>
<td>Pressure: –50 (neg) to 0 (pos)</td>
<td>0.96</td>
<td>0.92–1.01</td>
</tr>
<tr>
<td>Intention: –3 (neg) to +3 (pos)</td>
<td>0.68</td>
<td>0.56–0.76</td>
</tr>
</tbody>
</table>

Note: ‘neg’ = negative towards non-smoking, ‘pos’ = positive towards non-smoking.
immediate’ (students perceiving fewer disadvantages being at higher risk), modeling ‘nuclear’ (students with more smokers in their immediate environment being at higher risk), modeling ‘diffuse’ (students with more smokers in their extended environment tending to be at higher risk) and pressure (students perceiving more pressure to smoke being at higher risk) were fairly consistent predictors for smoking continuation (Tables V–VII).

Because attrition at post-tests could be predicted by several proximal and distal pre-test characteristics, and possibly also by treatment, selective dropout might have influenced the results. To check for this effect, analyses were repeated in two ways (Heyting et al., 1992). First, missing data of dropouts were replaced by their previous observation, the so-called ‘last observation carried forward’ analysis. Second, dropouts were treated as smokers, the so-called ‘extreme case’ analysis. Both analyses were performed for all students and ‘extreme case’ analyses yielded some divergent results compared with the effect analyses presented above. With regard to first post-test, the ‘extreme case’ analyses in the never-smoking sample resulted in significant positive effects of the out-of-school program. For post-test 2, the extreme case analysis for the never-smoking sample showed that students in the combined condition were more likely to start smoking than students in the in-school condition. With regard to post-test 3, the positive effects of the out-of-school program (compared with the control condition) disappeared in the ‘extreme case’ analysis.

**Discussion and conclusions**

We compared the effects on smoking prevention among Dutch first grade vocational schoolchildren of a newly developed computer-tailored out-of-school program, an existing in-school program and a combined approach including both the in-school and out-of-school programs. The two treatments were not effective immediately after the implementation of the programs. However, at 12 months after pre-test, students in the in-school program were better able to discontinue smoking, compared with those in the control condition. Students in the out-of-school program tended to be more successful in not having initiated smoking after 18 months, compared with those in the control condition. In contrast to what was expected, the effect of a combined approach (in + out) was not larger than the sum of the effects of the in-school and the out-of-school program. Apparently, comprehensiveness does not mean doing everything at the same time or doing everything (Bell et al., 1999). Simultaneous combination of interventions might cause an overload of information, which might produce back to the front effects. To our knowledge, there have been two more or less comparable out-of-school smoking prevention interventions based on the Transtheoretical Model (TTM), targeting secondary school students. Pallonen et al. (Pallonen et al., 1998) implemented a computer-based smoking prevention and cessation intervention in a vocational school sample (mean age 16.5 years) and reported 6-month follow-up findings. Unfortunately, their sample size was too small to test the efficacy of the intervention. Aveyard et al. (Aveyard et al., 2001) used an expert system computer program in a larger sample of 13- to 14-year-old British schoolchildren, and reported 1- and 2-year follow-up findings. No evidence of effectiveness for smoking prevention was found. An explanation of the promising effects of our tailored program might be the use of a different theory (ASE versus TTM) and/or the use of the out-of-school context. Unfortunately, we could not single out whether the positive effects resulted from the presentation of the information in a letter format or from the fact that the letters were delivered by mail.

Previous evaluation of the in-school program reported positive short-term results (ResCon, 1999). The results of the 1999 in-school study and our in-school evaluation can hardly be compared, however, because smoking was defined in the 1999 report as ‘smoking once in a while’, which did not correspond with our definitions of ‘ever-smoking’ and ‘smoking in the past month’.
There were also differences in the research samples: secondary school students in general versus high-risk vocational school students.

Results comparable to those of our in-school program have also been found in an earlier Dutch study by De Vries et al. (De Vries et al., 1994) about the implementation of a smoking prevention program for Dutch vocational school students based on social influence (‘No smoking, your choice’). This program resulted in a decrease in regular smoking, but no effects on experimental smoking were found.

Process evaluation results of both our in-school and out-of-school programs indicated that there is room for implementation improvements. First, about 65% of the students indicated that they had received the letters. It was unclear whether the remaining 35% had really not received the letters. The students had been asked to fill in their names and addresses at the pre-test questionnaire, and in some cases these were not clearly written. An improved registration system might increase the exposure to the out-of-school intervention. Second, almost half of the students felt personally addressed by the letters. The degree of perceived personalization would undoubtedly have been improved if the information in the letters could have been tailored to students’ smoking behavior. However, this option was not used in the present study, to prevent arguments in the students’ families. Finally, the attractiveness of the out-of-school intervention in terms of content and appearance can be further refined.

Attrition in the present study roughly equals that in similar Dutch studies [e.g. (De Vries et al., 1994; Dijkstra et al., 1999)]. Analyses including all dropouts, either as post-test smokers or using their pre-test smoking scores, resulted in adjustment of some effects. Analyses including all dropouts as smokers (‘extreme case’) resulted in positive effects of the out-of-school program on smoking initiation and continuation at post-test 1, but the post-test 3 out-of-school effects disappeared. These results are in line with the attrition analyses; lower attrition rates are related with positive extreme cases results.

In conclusion, tailored out-of-school interventions offer protection to smoking initiation among vocational school students. Special attention should be paid to the registration system, to the improvement of personal relevance and attractiveness in terms of content and appearance, and to dropout prevention. In contrast, in-school interventions are recommended to prevent vocational school students from continuing to smoke. Furthermore, it is not necessary to implement in-school and out-of-school programs simultaneously.

In view of the development of smoking behavior, it is recommended to leave a sufficient interval between the out-of-school smoking prevention and the in-school smoking prevention. Booster interventions may be needed for long-term success.

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