

Validation of Susceptibility as a Predictor of Which Adolescents Take Up Smoking in the United States

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Smoking onset has 4 levels, with a “susceptibility” level preceding early experimentation. This study assessed the predictive validity of smoking susceptibility in a longitudinal study of a nationally representative sample of 4,500 adolescents who at baseline reported never having puffed on a cigarette. At follow-up 4 years later, 40% of the sample had experimented with smoking, and 8% had established a smoking habit. Baseline susceptibility to smoking, defined as the absence of a firm decision not to smoke, was a stronger independent predictor of experimentation than the presence of smokers among either family or the best friend network. However, susceptibility to smoking was not as important as exposure to smokers in distinguishing adolescents who progressed to established smoking from those who remained experimenters at follow-up.

Key words: smoking initiation, adolescents, exposure to smoking, susceptibility to smoking

Preventing the onset of smoking has been identified as essential to the public health priority of achieving a rapid reduction in smoking prevalence (Institute of Medicine, 1994; U.S. Department of Health and Human Services [USDHHS], 1989, 1994). Since the early 1950s, the proportion of adults who begin to smoke has declined markedly (Gilpin, Lee, & Pierce, 1994), so that by 1990, the onset of smoking could be defined as mainly an adolescent behavior (Centers for Disease Control and Prevention [CDC], 1991; Lee, Gilpin, & Pierce, 1993; USDHHS, 1994). Although adolescent smoking rates declined throughout the 1970s and early 1980s, there is little evidence for any decline since 1985 (Johnston, O’Malley, & Bachman, 1993; Nelson et al., 1995). However, there has been a significant decline in the smoking prevalence among Black adolescents, resulting in a widening of the Black–White difference in smoking prevalence (Nelson et al., 1995). Because lack of progress has been concurrent with some of the most extensive public health programs against tobacco (Bal, Kizer, Felten, Mozar, & Niemyer, 1990; Community Intervention Trial for Smoking Cessation Research Group, 1995; Pierce et al., 1994), the Institute of Medicine (1994) has led the call for research to develop a greater understanding of the natural history of adolescent addiction to nicotine.

Generally, scholars agree that the onset of smoking is a

time-dependent four-level process that includes (a) a preparation period, (b) early experimentation, (c) more advanced regular but nondaily smoking, and (d) a stable level of addiction (Elder et al., 1990; Flay, d’Avernas, Best, Kersell, & Ryan, 1983; Leventhal & Cleary, 1980; Schinke & Gilchrist, 1983; Stern, Prochaska, Velicer, & Elder, 1987; USDHHS, 1994). Progress through these levels is presumed to take at least 2 years, although the natural history of the smoking onset process has never been adequately defined (USDHHS, 1994).

Most measures of onset behavior rely on the report of recent smoking behavior. The preferred measure of adolescent smoking is the report of smoking within the past 30 days (USDHHS, 1994). Experimentation is generally inferred from responses to questions about ever smoking or age of first cigarette; however, there is no generally accepted method of identifying adolescents prior to experimentation. As most smoking prevention programs aim to prevent experimentation (USDHHS, 1994), such a measure is needed to facilitate both their design and evaluation. Smoking prevention programs should either prevent target groups from becoming susceptible to smoking or prevent susceptible adolescents from progressing to experimentation.

Having developed an algorithm for this preexperimentation phase of the smoking onset process (Pierce et al., 1993; Pierce, Farkas, Evans, & Gilpin, 1995), we hypothesized that such a measure should identify which “never smokers” are cognitively predisposed to smoking. It should include the participants’ intentions (Ajzen & Fishbein, 1980; Conrad, Flay, & Hill, 1992; McNeill et al., 1988; Sussman, Dent, Flay, Hansen, & Johnson, 1987) and expectations (Bandura, 1977; Bandura, 1986; Bauman, Fisher, Bryan, & Chenoweth, 1984) for future behavior. Demonstrating preliminary evidence of the validity of this preexperimentation measure, we noted an urgent need to test the predictive validity of this algorithm in a longitudinal study.

We used a nationally representative longitudinal study of

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adolescents to further evaluate the predictive validity of our measure of preexperimentation on a sample who reported that they were never smokers (or puffers) over 4 years. We examined the appropriateness of the susceptibility to smoking algorithm in this population and tested its ability to predict the next level in the smoking onset process (i.e., experimentation), taking into account other sociodemographic predictors of future smoking and exposure to other smokers. We also addressed the probability that never smokers progress through the onset process in the 4-year time period to the level defined as *established smoking* (having consumed at least 100 cigarettes, current or former smokers).

Method

Participants

The Teenage Attitudes and Practices Survey (TAPS) was designed to provide information on adolescent smoking behavior and was developed under the direction of the National Center for Health Statistics and the Office on Smoking and Health, Centers for Disease Control and Prevention (Allen, Moss, Giovino, Shopland, & Pierce, 1992). The TAPS interviewed adolescents who had responded to the 1989 National Health Interview Survey (NHIS), an annual household interview survey of the civilian, noninstitutionalized population of the United States. TAPS I was conducted in 1989, and the follow-up, TAPS II, was conducted in 1993.

Nine thousand nine hundred sixty-five adolescents aged 12–18 years were interviewed by TAPS I in 1989 by either telephone or mail questionnaire. This represented a response rate of 82% of the original sample of 12,097 adolescents who had responded to the NHIS in 1989. Of the 9,965 adolescents in TAPS I, only the respondents reached by telephone ($N = 9,135$) were eligible for follow-up in 1993. The 830 adolescents who were not reached by telephone responded through mail questionnaire and were not eligible for the follow-up in 1993.

The follow-up telephone survey, TAPS II, was completed in 1993 by 87% of the eligible TAPS I respondents ($N = 7,960$), who by that time were aged 15 to 22 years (CDC, 1994). This article focuses on the 4,500 participants from the longitudinal sample who, at baseline, reported never having experimented with smoking.

Measures of Smoking Onset

In both surveys we identified current smokers with the standard question, "Think about the last 30 days. On how many of these days did you smoke?" Experimentation with cigarettes was defined as a positive response to either of two questions: "Have you ever smoked a cigarette?" and "Have you ever tried or experimented with cigarette smoking, even a few puffs?" Two negative responses required classifying a respondent as a never smoker. Only those respondents so classified according to 1989 data were included in this analysis. A positive response to the any cigarette question led to an additional question about whether the individual had ever smoked 100 cigarettes. In 1993, we classified respondents who reported having smoked 100 cigarettes as meeting the criteria for established smoking (either current or former smokers).

The survey included all three questions on the algorithm (Pierce et al., 1995) for classifying a respondent as susceptible to smoking, although one question had slightly different wording from that of the previously published algorithm. To be classified as not susceptible to smoking, a respondent had to answer "no" to the question, "Do you think that you will try a cigarette soon?" and "Definitely not" to the questions, "If one of your best friends were to offer you a cigarette,

would you smoke it?" and "Do you think you will be smoking cigarettes 1 year from now?"

In our published question set, this last question was worded, "Do you think that you will smoke a cigarette in the next year?" Rewording appeared to reduce by about 7% the proportion of never smokers classified as susceptible. We obtained this estimate by analyzing the 1990 and 1993 Youth Attitudes and Practices Survey section of the California Tobacco Surveys, which contained the two different versions of the "smoking in the next year" question.

Other Predictors of Smoking Status

Sociodemographic information obtained for this study included date of birth, gender, and race or ethnicity (non-Hispanic White, Hispanic, Black, Asian, or other). The TAPS sample was drawn from households that had recently completed the NHIS, making adult-provided NHIS data available on family income and the educational attainment of the responsible adult who gave permission for the adolescent to be interviewed. Respondents reported family income in 27 income categories (from <\$1,000 to \$50,000+) that for the purposes of this analysis were reduced to four categories (<\$16,000, \$16,000–\$29,999, \$30,000–\$49,999, and \$50,000+). Because of the association between school performance and smoking prior to completion of formal education (Farrel & Fuchs, 1982), we analyzed how respondents thought they were performing at school, compared with the average student. We include this reported relative performance.

Exposure to smokers in the social network is a strong and consistent predictor of smoking initiation (Ary & Biglan, 1988; Bauman et al., 1984; Best, Thompson, Santi, Smith, & Brown, 1988; Flay et al., 1983). Both adolescent surveys sought detailed smoking status for each older member of the household and immediate family members not living at home. Respondents also reported the smoking status for each of their designated four best male and four best female friends. Prior detailed analysis of these exposure data led to the development of a single four-level variable that reflected minimal exposure to smoking (i.e., no exposure from family or best friends), exposure through family members only, exposure through best friends only, and exposure through both family and peer networks (Pierce et al., 1995).

Statistical Analysis

The NHIS uses a multistage sample design to provide national estimates of the civilian, noninstitutionalized population. It is a complex sample design that involves both clustering and stratification. The stratification variables were race (Black and non-Black), sex, and age categories (10–14 years, 15–17 years, 18–19 years, and 20–22 years). The multistage NHIS sample design requires a Taylor series approximation to estimate variance on the basis of the NHIS weighting procedures (Allen et al., 1991). We used the SUDAAN program for all statistical analyses (Research Triangle Institute, 1989). All percentages were weighted and adjusted for sampling design and nonresponse.

We used two nested logistic regressions to identify which specified variables predicted any change in use or experimentation with cigarettes in the interval between the two surveys and which predicted established smoking at follow-up. Both logistic regressions included only adolescents who were never smokers in 1989. All percentages (experimentation and established smoking) are based on the initial cohort of 4,500 never smokers at baseline.

The first logistic regression model attempted to separate adolescents who had experimented with smoking (both experimenters and established smokers; $N = 1,796$) from adolescents who remained never smokers ($N = 2,704$). The independent variables included age, sex, race or ethnicity, perceived school performance, adult education

level, household income, exposure to other smokers, and susceptibility to smoking. All independent variables were recoded and entered as categorical variables with appropriate design variables, which used referent groups within each independent variable. We also examined two-way interactions between susceptibility to smoking and all predictor variables.

The second logistic regression was performed to predict those adolescents who progressed to established smoking ($N = 351$) versus adolescents who remained experimenters ($N = 1,445$) at follow-up. This analysis used the same independent variables as those in the first logistic regression and tested similar two-way interactions with the susceptibility to smoking variable.

For both logistic regressions, we forced all demographic variables (age, sex, race or ethnicity, adult education level, and household income) into the model and examined the significance of the following variables: susceptibility to smoking, exposure to other smokers, and perceived school performance. Odds ratios and 95% confidence intervals were based on standard errors derived from the SUDAAN procedures.

Results

The Susceptibility to Smoking Measure

A strong univariate association was observed between each potential susceptibility to smoking question and later smoking behavior (Table 1). Approximately 17% of adolescent never smokers who in 1989 thought that they would try a cigarette soon had become established smokers by 1993, compared with only 7% of those who did not think that they would try a cigarette soon ($p = .0006$). Almost twice as many respondents had experimented with smoking in the interim (71% vs. 38%, $p < .0001$). The vast majority of never smokers indicated that they would definitely not smoke cigarettes if they were offered by friends. These respondents were less likely than others to be

Table 1
Never Smoker 1989 Susceptibility Responses as Predictors of 1993 Experimentation or Established Cigarette Smoking

Susceptibility responses, 1989	Cigarette smoking status, 1993		
	N	Experimentation ^a % (95% CI)	Established % (95% CI)
Do you think you will try a cigarette soon?			
Yes	199	71.2 (64.7, 77.6)	17.1 (11.9, 22.4)
No	4,301	38.4 (36.9, 39.8)	7.2 (6.5, 8.0)
<i>p</i> value		<.0001	.0006
If one of your best friends were to offer you a cigarette, would you smoke it?			
Definitely yes, probably yes, or probably not	501	60.3 (56.1, 64.5)	11.0 (8.4, 13.7)
Definitely not	3,999	37.2 (35.6, 38.8)	7.3 (6.4, 8.1)
<i>p</i> value		<.0001	.0105
Do you think you will be smoking cigarettes 1 year from now?			
Definitely yes, probably yes, or probably not	509	55.1 (50.6, 59.6)	13.3 (10.3, 16.3)
Definitely not	3,991	37.8 (36.3, 39.4)	7.0 (6.1, 7.8)
<i>p</i> value		<.0001	.0003

Note. $N = 4,500$. Weighted percentages, adjusted for sampling design and nonresponse. CI = confidence interval.

^aExperimentation group includes adolescents in the established group.

Table 2
Never Smokers' Rates of Experimentation and Established Smoking 1993 by 1989 Susceptibility Score

Susceptibility score, 1989 ^a	N	Smoking onset level, 1993	
		Experimentation ^b % (95% CI)	Established smoker % (95% CI)
0	3,610	35.6 (35.9, 37.2)	6.5 (5.7, 7.3)
1	623	52.8 (48.8, 56.8)	12.3 (9.7, 14.9)
2	215	64.6 (57.9, 71.4)	11.3 (6.9, 15.7)
3	52	74.6 (60.9, 88.3)	20.6 (9.4, 31.8)
2 + 3	267	66.5 (60.6, 72.5)	13.1 (8.9, 17.2)

Note. $N = 4,500$. Weighted percentages, adjusted for sampling design and nonresponse. CI = confidence interval.

^a0 = Not susceptible; 1 = one response indicating susceptibility; 2 + 3 = two or three responses indicating susceptibility. ^bExperimentation group includes adolescents in the established smoker group.

established smokers in 1993 (7% vs. 11%, $p = .0105$) or to have experimented with cigarettes (37% vs. 60%, $p < .0001$). Similarly, the vast majority of respondents indicated "definitely not" when asked if they thought they would be smoking 1 year later. Members of this group were also less likely to be established smokers in 1993 ($p = .0003$) or to have experimented ($p < .0001$).

To develop our a priori additive index of susceptibility to smoking, we dichotomized each of these questions. To be labeled "nonsusceptible" (a score of zero on the index), the respondent had to answer "No" or "Definitely not" to all three questions (Table 2; Pierce et al., 1993, 1995). The majority of the 1989 TAPS never smokers ($N = 3,610$) were in this nonsusceptible category and, by 4 years later, 35.6% had experimented with cigarettes and 6.5% were established smokers (i.e., had smoked more than 100 cigarettes). Only 1% ($N = 52$) of the 1989 never smokers answered all three questions in a way that was incompatible with the nonsusceptible definition; at follow-up three quarters of such respondents had experimented, and almost 21% were established smokers. Although these data suggest a strong relationship with later experimentation, the small sample sizes of the categories with a score of 2 or 3 on the index dictated their combination. The result is a three-level index of susceptibility to smoking in which each level has nonoverlapping 95% confidence intervals on the probability of experimentation by the 1993 follow-up (0 = 35.9%–37.2%; 1 = 48.8%–56.8%; 2 + 3 = 60.6%–72.5%).

The three-level susceptibility to smoking scores were inversely related to age and perceived school performance, positively related to exposure to other smokers, and were greater for Hispanics and for adolescents in the lowest adult education and family income categories.

Predictors of Experimentation With Smoking

Table 3 shows the multivariate analysis of which never smokers had experimented with smoking by 1993. Approximately 40% of those aged 12–16 years had experimented prior to the second survey. A lower experimentation rate was observed in those aged 17 (odds ratio [OR] = .80) and 18

Table 3
*Predictors of Experimentation Before 1993 Among
 1989 Never Smokers*

Independent variables, 1989	n	Experimentation before 1993	
		%	OR (95% CI)
Age (years)			
12	981	40.4	1.00
13	807	39.8	0.96 (0.79, 1.17)
14	741	41.4	1.02 (0.82, 1.27)
15	595	42.1	1.03 (0.81, 1.31)
16	504	41.1	0.98 (0.76, 1.26)
17	477	35.9	0.80 (0.63, 1.01)
18	395	35.5	0.81 (0.62, 1.07)
Sex			
Female	2,297	38.1	1.00
Male	2,203	41.6	1.17 (1.03, 1.33)
Race/ethnicity			
White	3,196	42.1	1.00
Black	769	31.6	0.64 (0.52, 0.78)
Hispanic	367	41.7	0.88 (0.68, 1.13)
Asian/other	168	33.1	0.69 (0.49, 0.98)
Adult education			
< 12 years	456	39.4	1.00
12 years	1,630	39.6	1.01 (0.78, 1.31)
13-15 years	1,092	40.6	1.07 (0.80, 1.42)
16+ years	1,322	39.5	1.05 (0.79, 1.41)
Family income (\$)			
< 16,000	760	39.7	1.00
16,000-29,999	1,191	37.7	0.89 (0.71, 1.11)
30,000-49,999	1,499	39.5	0.99 (0.79, 1.25)
50,000+	1,050	42.5	1.17 (0.91, 1.51)
Perceived school performance			
Much better than average	922	33.0	1.00
Better than average	1,781	37.7	1.16 (0.97, 1.39)
Average and below	1,797	45.4	1.56 (1.30, 1.87)
Exposure to other smokers			
Minimal	2,019	34.6	1.00
Family only	1,200	39.4	1.25 (1.05, 1.49)
Best friends only	685	46.8	1.60 (1.34, 1.90)
Both family and best friends	596	49.7	1.84 (1.49, 2.26)
Susceptibility			
Not susceptible	3,610	35.6	1.00
Susceptible level 1	623	52.8	1.92 (1.61, 2.30)
Susceptible level 2	267	66.5	3.15 (2.37, 4.17)

Note. $N = 4,500$. Weighted percentages, adjusted for sampling design and nonresponse. OR = odds ratios, adjusted for all the variables in the table; CI = confidence interval.

(OR = .81) years at baseline, although these were not statistically significant. Males were more likely to experiment than females. Blacks (OR = .64) and Asians (OR = .69) were significantly less likely to experiment than Whites or Hispanics.

The educational achievement of the responsible adult showed no association with experimentation, which was not the case for reported relative performance in school. Respondents who classified themselves as having school performance at an average or below-average level were significantly more likely to experiment than were those who responded that their performance was much better than average (45% vs. 33%).

A strong relationship was also seen for exposure to other smokers. Thirty-five percent of those respondents who at baseline reported no exposure by either family or best friends had experimented with smoking by follow-up. A higher percentage of those exposed to smokers only within their family had

experimented. Those who reported smoking by best friends had an even higher experimentation rate again. The rate of experimentation was highest in respondents exposed to smoking by both their family and their best friend network (OR = 1.84).

Both levels of susceptibility to smoking in 1989 were significant in predicting experimentation by 1993. Respondents with a lower level of susceptibility to smoking had an odds ratio of 1.92, whereas adolescents classified in the higher susceptibility to smoking level in 1989 had a slightly higher odds ratio, 3.15. This susceptibility-experimentation effect had a stronger association than all other predictor variables in the multivariate analysis. None of the two-way interactions between susceptibility to smoking and the other predictor variables were significant.

Predictors of Established Smoking

Table 4 presents the multivariate analysis of predictors of progress toward established smoking prior to the 1993 follow-up as compared with those adolescents who remained experimenters. There were no significant differences among those aged 12 years compared with those aged 13 to 17 years who had smoking rates that varied between 6.8% and 10.0%. However, a significantly lower smoking rate (3%) was observed for adolescents aged 18 years at the initial interview, compared with that of 12-year-olds. There were no significant gender differences in the progression to established smoking. Blacks (OR = .41) and Asians (OR = .35) were significantly less likely than Whites to have progressed to the extent of becoming established smokers at follow-up. Hispanics also appeared less likely than Whites to become established smokers.

Although the educational level of the responsible parent was not statistically significant in predicting who progressed to established smoking, there was some suggestion that adolescents from higher-educated households were more likely to be established smokers. Adults' reported family income level was not associated with progress toward established smoking at follow-up. However, reported relative school performance demonstrated a significant association: Respondents who perceived that they were average or below average in relative school performance were much more likely to progress to established smoking than were those who perceived that they were performing much better than their peers (OR = 1.79, 95% CI, 1.20-2.66).

Exposure to other smokers was an important predictor of whether adolescents progressed to established smoking or remained experimenters at follow-up. Approximately 5% of never smokers who at baseline had minimal exposure to other smokers had progressed to established smoking at follow-up. This rate increased among those exposed to smokers in either the family (OR = 1.85) or best friend network (OR = 1.66). Adolescents exposed to smokers in both their family and their best friend network had the highest rate of established smoking at follow-up, 13.8%.

Susceptibility to smoking was not significant in distinguishing adolescents who progressed to established smoking from those that remained experimenters during the 4-year study period.

Table 4
Predictors of Progress to Established Smoking Versus Experimentation

Independent variables, 1989	n	Established cigarette use, 1993	
		%	OR (95% CI)
Age (years)			
12	981	7.8	1.00
13	807	7.8	1.03 (0.70, 1.52)
14	741	8.1	1.05 (0.70, 1.57)
15	595	10.0	1.36 (0.89, 2.08)
16	504	8.8	1.07 (0.68, 1.67)
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Sex			
Female	2,297	7.0	1.00
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Race/ethnicity			
White	3,196	9.3	1.00
Black	769	3.4	0.41 (0.24, 0.69)
Hispanic	367	5.8	0.57 (0.35, 0.95)
Asian/other	168	2.9	0.35 (0.14, 0.88)
Adult education			
< 12 years	456	5.3	1.00
12 years	1,630	8.8	1.63 (0.98, 2.74)
13-15 years	1,092	7.7	1.41 (0.84, 2.40)
16+ years	1,322	7.2	1.55 (0.85, 2.81)
Family income (\$)			
< 16,000	760	7.2	1.00
16,000-29,999	1,191	7.3	0.76 (0.49, 1.17)
30,000-49,999	1,499	8.0	0.84 (0.57, 1.26)
50,000+	1,050	8.0	0.83 (0.51, 1.35)
Perceived school performance			
Much better than average	922	4.4	1.00
Better than average	1,781	6.9	1.39 (0.92, 2.10)
Average and below	1,797	10.2	1.79 (1.20, 2.66)
Exposure to other smokers			
Minimal	2,019	4.7	1.00
Family only	1,200	8.7	1.85 (1.34, 2.56)
Best friends only	685	9.3	1.66 (1.16, 2.38)
Both family and best friends	596	13.8	2.46 (1.73, 3.51)
Susceptibility			
Not susceptible	3,610	6.5	1.00
Susceptible level 1	623	12.3	1.34 (0.99, 1.82)
Susceptible level 2	267	13.1	0.97 (0.63, 1.49)

Note. $N = 4,500$. Weighted percentages, adjusted for sampling design and nonresponse. OR = odds ratios, adjusted for all the variables in the table; CI = confidence interval.

Again, no two-way interactions between susceptibility to smoking and the independent variables were significant.

Discussion

This article reports natural history information concerning smoking behavior in a large national sample of adolescents who reported in 1989 that they had never so much as puffed on a cigarette. By the follow-up survey 4 years later, approximately 40% of the sample reported having experimented with cigarettes, and nearly 8% had progressed so far as to be labeled as established smokers according to the common definition for defining adult ever smokers in the United States.

We looked for baseline evidence of cognitive susceptibility to smoking as an initial level in the process of starting to smoke and found evidence to support the use of both intention and

expectations to define this susceptibility period among never smokers, provided that nonsusceptibility was defined as the existence of a determined decision not to smoke (Pierce et al., 1993). Susceptibility to smoking at baseline was strongly associated with moving to the next step in the smoking onset process (defined as experimentation with cigarettes). This susceptibility to smoking measure was a more independent and stronger predictor of experimentation than was the existence of smokers among either the family or the best friend network, commonly regarded as the strongest predictor of smoking onset. However, because the majority of adolescents in absolute numbers who ultimately experimented with smoking came from the initially large and lowest susceptibility level group, efforts to deter subsequent smoking behavior in this group are still needed.

Our data suggest that the predictors of who will experiment with smoking and who will progress to become established smokers differ, indicating that different processes might be at work at various levels in the onset process. The strongest predictor of which individuals would make up the small group that progressed to become established smokers (i.e., consuming at least 100 cigarettes by 1993) was exposure to other smokers. The presence of smokers in the social environment may reinforce the adolescent who experiments, increasing the likelihood that he or she will become an established smoker. However, susceptibility to smoking at baseline was not predictive in distinguishing established smokers from experimenters at follow-up. The small sample size in the top susceptibility category may have contributed to the insignificant finding. The strong relationship between susceptibility to smoking and experimentation demonstrates the validity of the susceptibility to smoking measure in predicting which adolescents are at elevated risk for taking up smoking.

Another important predictor of established smoking was the level of parental education. Adolescents whose parents had not completed high school were less likely to become established smokers than were adolescents whose parents had more education. Analysis of national data on high school seniors and the prevalence of past-month smoking with respect to parental education yielded similar results (National Center for Health Statistics [NCHS], 1993). Among high school seniors whose parents did not graduate from high school, the prevalence of past-month smoking decreased from 33% in 1980 to 31% in 1991; among seniors whose parents graduated from high school, the prevalence of smoking decreased from 34% to 29% during the same time. However, for high school seniors whose parents had some postgraduate education, the prevalence of smoking increased from 24% in 1980 to 27% in 1991 (NCHS, 1993).

Several potential limitations of the current study should be considered. One is the reliance on self-reported data from telephone interviews of adolescents in their homes. Studies of adolescents have shown that there is stability of self-reported substance use in the adolescent population and that questionnaires provide highly reliable data (Barnea, Rahav, & Teichman, 1987).

Another possible bias may exist because of differences in reported smoking behavior between adolescents who were successfully followed up in TAPS II and nonrespondents. In

addition, adolescents who resided in nontelephone households in 1989 (who were excluded from the baseline sample in TAPS I) may have been more likely to be smokers. For these reasons, prevalence estimates from TAPS II may be lower than they would have been had the entire TAPS I cohort been successfully followed up, and therefore these results may include some bias that makes interpretation difficult.

This analysis provides evidence of the different levels involved in the process of taking up smoking. The positive move toward becoming a smoker appears to be the development of a cognitive susceptibility to smoking. During this "preparatory" period, the adolescent develops expectations and beliefs about smoking (Institute of Medicine, 1994). Further research is needed to identify the environmental variables associated with becoming susceptible to smoking. One obvious candidate is tobacco marketing. Over \$5 billion per year is being spent by tobacco companies on the advertising and promotion of cigarette smoking (Federal Trade Commission, 1995). Unfortunately, federally supported national surveys, such as TAPS, include no questions to measure adolescent response to tobacco marketing activities.

Other possible influences on susceptibility to smoking are parental influence, effective school smoking programs, an effective smoke-free learning environment, and community smoking norms. Further research may make it possible to identify what types of preventive efforts will be effective in preventing adolescents from becoming susceptible to smoking. Some of this research should focus on the period after experimentation. Many of the adolescents who experimented with cigarettes in this study did not progress further in the smoking onset process, but appeared to become nonsusceptible to future smoking. Identifying the factors that influence an adolescent to not progress beyond experimentation could also lead to the development of more powerful smoking prevention programs.

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