

Adolescent Smoking: Research and Health Policy

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IN THE PERIOD SINCE THE 1979 U.S. SURGEON General's report on smoking and health, adolescent smoking behavior has received as much research attention as almost any other health-risk behavior. We know a great deal about the prevalence and natural history of adolescent smoking as well as the correlates and predictors of smoking behavior. In addition, there have been a series of well-designed, theoretically based experiments to evaluate adolescent smoking-prevention programs that match or exceed, in number and quality, program evaluation in any other area of health behavior.

In spite of this attention, smoking behavior among adolescents has not decreased appreciably over the past five years, and the most intensive intervention efforts have been judged to be of only modest success. Varied intervention approaches have been attempted, but the most commonly evaluated programs have placed a heavy emphasis on primary prevention through the modification of peer influences and other social/psychological correlates of smoking. We reexamine the appropriateness of these foci in light of the available theory and

research results and make recommendations for research on adolescent smoking.

Specifically, we suggest that it is inappropriate to focus almost exclusively on the prevention of smoking using programs that primarily deal with peer influence. In addition, we think that programs should be developed with barriers to dissemination in mind. Education budgets for smoking-cessation programs are extremely limited, and it might be easier to fund and implement programs integrated with basic health education techniques and focused on a range of health behaviors. Furthermore, a wide array of intervention strategies, including the use of public media and policies that discourage or restrict smoking, should be considered.

Natural History of Smoking

A majority of adolescents at least experiment with smoking, and experimentation now begins at younger ages than previously. Until very recently however, age-specific rates had been declining. Johnston, O'Malley, and Bachman (1984, 1985) have collected and analyzed trends in the proportion of high school seniors who have smoked a half pack or more a day in the preceding thirty days. Between 1975 and 1977, there was a small increase in the reported prevalence of smoking, but, after that, the prevalence of smoking declined steadily until 1981, and has remained approximately the same since then. Trends in the number of students reporting any daily use appear to rise slightly after 1981 and then begin dropping again, but the differences are small and it is not clear whether these trends will persist. The data from 1985, for example, indicate a slight rise in rates of daily smoking over the previous year (Johnston, O'Malley, and Bachman 1986).

Mirroring adult trends (Harris 1983), the rate of smoking among male high school seniors fell earlier than among females. Since about 1979, senior girls have been more likely to smoke a half a pack or more a day than senior boys. These data have resulted in the widespread impression that girls are increasing their smoking. Fortunately, senior girls have been decreasing their smoking, but later, and at a slightly slower rate than boys, although it is not clear whether this trend will continue. For the past five years or so, rates have been relatively

stable, with more girls than boys smoking on a regular basis (see also Green 1979).

These data are limited because they do not include high school dropouts, and those who do not complete high school are likely to have much higher rates of smoking than those who do finish. Thus, if the proportion of students not completing high school changed over the period studied, these trends might not accurately reflect changes among all school-aged adolescents. Another factor that complicates interpretation of these gender differences is the increasing use of smokeless tobacco among adolescents, especially among males (Marty, McDermott, and Williams 1986; Hunter et al. 1986; Guggenheimer et al. 1986). The interplay between the use of smokeless tobacco and cigarette smoking is not fully known and it is possible that when levels of smokeless tobacco use are taken into account, total tobacco use and nicotine consumption by boys and girls are more similar than smoking statistics would indicate.

The available data also indicate a correlation between early smoking and later use of cigarettes. Kandel and Logan (1984) have been conducting longitudinal studies of substance use among adolescents for many years and recently analyzed results from a ten-year follow-up study of 1,325 people who were in the 10th and 11th grades in the fall of 1971. They calculated hazard functions for various substances and found that the period of major risk for initiation of cigarette use was for the most part complete by age 20. They found that 90 percent of persons who eventually smoked cigarettes were initiated to it by the age of 19.

O'Malley, Bachman, and Johnston (1984) have analyzed data from an annual study of high school seniors. They estimated age, period, and cohort effects, and found a jump of about 5 percent in the number of students smoking at the rate of a half pack or more per day in the year after high school. The increase in heavy smokers, however, is largely due to an increased amount of smoking among respondents who were active smokers when they were high school seniors. Another important finding is that differences between graduating classes tend to endure. That is, cohort effects in smoking prevalence persist. This finding is extremely important because it suggests that if one can lower the prevalence of smoking among high school students, fewer of them will smoke as adults.

Recent data also indicate that age of onset may be related to the

persistence of smoking. Ershler et al. (1988) studied the adoption of smoking by school children and found that children who start younger are less likely to quit. Those who are older when they begin smoking are more likely than students who start at younger ages to try to quit within a year of starting.

These data indicate that most smokers start as adolescents, that many start at a young age, and that there is some persistence of rates among high school classes over time. These findings support a strategy of primary prevention among adolescents if one accepts the assumption that the most appropriate intervention point in the natural history among young people is prior to initiation—that is, a child's first direct experience with cigarette smoking. It is often easier to prevent a disease or unhealthy behavior than to cure the disease or change the behavior once it has been learned (c.f. Johnson 1982), unless the incidence in the target population is low or the preventive measures don't have a lasting effect. Most intervention programs are based on this assumption and have focused on "preventing" smoking rather than on modifying smoking habits or encouraging change among those who already smoke. There is sufficient complexity in the early development of smoking behavior, however, to warrant an examination of subsequent transition points in behavior as opportunities for interventions with young smokers.

Leventhal and Cleary (1980) suggested that the adoption of smoking consists of several distinct stages. The first of these is the preparation stage during which a person observes smokers and anticipates the experience of smoking. The next stage is the initiation stage, which is marked by the use of the first cigarette. The third stage is the experimentation stage, during which adolescents begin to use cigarettes on a more frequent basis but have not yet become strongly addicted to nicotine and are able to stop without much difficulty. Next is the maintenance stage, which is reached when a person becomes a regular user of cigarettes. Leventhal and Cleary (1980) speculated that social factors may be of primary importance in the beginning stages of cigarette use, while other factors, such as conditioning and nicotine dependence, will be more important determinants of later use patterns. Flay et al. (1983) have elaborated on these ideas and suggest that in the early stages family socialization and peer influences are most important, whereas knowledge, beliefs, and intentions are related to decisions to smoke. They suggest that the most important determinants

of continued experimentation are peer influences, self-image, and physiological reinforcement.

These theoretical models seem to support the appropriateness of an emphasis on the role of social models and early intervention to ameliorate the impact of those influences among young people who have not yet "initiated" smoking. An extremely important point, however, is usually not mentioned by prevention experts: most adolescents at least experiment with smoking. Thinking of early stages in the natural history of smoking as initiation is useful for helping to differentiate the mechanisms motivating and maintaining smoking, but "initiation" often has been viewed as equivalent to the initiation of a long career of smoking behavior. Such an interpretation is not supported by the data. For example, National Institute of Education data show that only 13.1 percent of the longitudinal sample studied reported never smoking at both waves of data collection (Green 1979). Furthermore, smoking status during the adolescent years is not always stable, and many adolescents attempt to stop at very young ages. In a five-year follow-up study of the 1974 national sample of high school students, 27 percent of those aged 12 to 18 who had smoked regularly at the first survey reported that they had quit at the time of the follow-up (Green 1979). In addition, over 60 percent of those young people between the ages of 17 and 23 still smoking in 1979 reported that they had made one or more attempts to quit since the time of the first survey (Green 1979; Fisher, Gritz, and Johnson 1982).

Hansen et al. (1985) also report data on smoking cessation during adolescence. Four months after a baseline survey, 33 percent of their sample of 392 smokers, aged 15 to 17, had quit; among those who quit and participated in the one-year follow-up study, 73 percent had remained abstinent. O'Rourke, Nolte, and Smith (1985) report that over 25 percent of 5,393 seventh to twelfth grade students who they interviewed in 1980 and 1981 considered themselves to be "exsmokers." Chassin, Presson, and Sherman (1984) found that in their sample of 178 smokers in sixth through eleventh grade, 18.5 percent had quit over the course of one year.

In a study of German school children, Semmer et al. (1986) analyzed transitions between different smoking behaviors over a two-year period. They found that there was relatively little change in behavior among nonsmokers and among regular smokers (at least one cigarette per week), but that among those smoking less than a cigarette a week,

there was a great deal of flux. Between the fall of 1983 and of 1984, 81 percent of the students who had never smoked at the first survey were also nonsmokers at the second survey. Similarly, 84 percent of the students who reported smoking at least a cigarette per week at the first survey were regular smokers at the second survey. In contrast, there was much more change in smoking status among children who were occasional smokers in the fall of 1983. Overall, about 49 percent reported that they were regular smokers a year later, but 28 percent said they were nonsmokers. Only 22 percent were still classified as occasional smokers. Rates also varied greatly among students in different types of schools with different college plans.

In addition to the evidence that experimentation with cigarettes does not lead inevitably to the establishment of regular smoking, there is evidence of other factors, occurring later in adolescence, that contribute to the establishment of regular smoking. The data on post-high school smoking reported by O'Malley, Bachman, and Johnston (1984) suggest that pre-existing patterns of light smoking may be intensified after high school graduation. Thus, although the stage model of smoking proposed by researchers such as Leventhal and Cleary (1980) and Flay *et al.* (1983) is a useful heuristic device for analyzing different types of smoking behavior, one stage does not necessarily lead to the next. Adolescents may go through several cycles of experimentation, regular smoking, and cessation (Semmer *et al.* 1986).

The data from the German school study suggest that prevention of any smoking may be futile, but preventing the transition from experimental smoking to regular smoking may be an attainable and important goal. It is important to think carefully about exactly what it is that we should try to prevent. The preliminary data that are available suggest that we should focus our energies on the prevention of regular smoking and help those who have begun to smoke to quit, in addition to discouraging experimentation.

Prevention Programs

Originally, smoking programs were similar to general health curricula and were based on a simple communication model: use a credible communicator to present a well-structured message about the dangers of smoking, children's attitudes toward smoking will change, and

they will be less likely to smoke (Goodstadt 1978; Thompson 1978). The limitations of such a simplistic model are well known (e.g., Leventhal and Cleary 1980; Leventhal, Safer, and Panagis 1983), and in the 1970s Richard Evans and colleagues (Evans 1976; Evans et al. 1978; Evans et al. 1981) developed more sophisticated interventions based on social psychological theories such as social-learning theory. Social-learning theory (Bandura 1977) describes the importance of vicarious and symbolic learning. That is, adolescents "learn" about smoking and the positive and negative consequences of smoking by watching peers and adults smoke. According to social-learning theory, there are four central processes that determine learning: attention (e.g., watching friends smoke), retention, motor reproduction (e.g., actually trying a cigarette), and motivation or incentive (e.g., peer pressure). Evans (1976) was the first researcher explicitly to apply principles of social-learning theory to intervention strategies.

Flay (1985a) describes a number of smoking studies conducted subsequent to Evans' work that added certain program elements (Jones et al. 1972; Kiesler 1971) such as having students make a public commitment to stop smoking and having them role play resisting pressures to smoke. Schinke, Gilchrist, and colleagues (Schinke and Gilchrist 1983) and Botvin and colleagues (Botvin and Eng 1980; 1982; Botvin, Eng, and Williams 1980; Wills 1985; Spitzhoff, Ramirez, and Wills 1980; Botvin and Wills 1985) conducted several studies of smoking prevention programs that attempted to develop more general personal and social skills.

Flay (1985a) reviewed twelve subsequent intervention studies that differed from these earlier studies in terms of content, length, and delivery, and typically involved several classes or schools randomly assigned to each study condition. These studies varied in terms of the types of programs tested and they included many planned variations in specific aspects of the programs. Fisher (1980) reviewed the evaluations of these programs and concluded that the interventions are efficacious, but Flay is not as sanguine about the results. Citing a number of methodological limitations, he concludes that "given the generally low internal validity and uninterpretable nature of these studies, none of the findings from these comparisons can be accepted without further replication" (Flay, 1985b, 81). Similarly, Moskowitz (1983) has stated that it is premature to conclude that these programs are effective in reducing cigarette smoking. He points out that the studies have yet

to demonstrate effects on the more established habitual smoking that generally does not occur until the high school years.

Subsequent studies consisted of large-scale trials typically involving five or more units per condition. All of these evaluations were based on the programs that teach adolescents to resist social pressure to smoke. Botvin, Renick, and Baker (1983) have asserted that psychosocial smoking-prevention strategies are capable of producing initial reductions in smoking behaviors of about 50 percent and that longer-term results look promising. Flay (1985b) concludes that the data from these studies suggest that programs to help adolescents resist pressure to smoke can be effective some of the time. He warns, however, that this conclusion is a tentative one because of the inconsistencies in the patterns of results.

A review of one of the apparently more-successful programs, the Waterloo Study, emphasizes the importance of viewing some of these results as tentative (Best *et al.* 1984; Flay *et al.* 1985). Flay (1985b) asserts that the results of the Waterloo study represent one of the most rigorous tests of the social-influences approach to smoking prevention. Flay interprets these results as suggesting reasonably good maintenance of long-term effects and notes the importance of the finding that the program was most effective for students who had parents, siblings, and friends who smoked. At the end of grade seven, 77.8 percent of those students in the experimental group still had never smoked, while the figure was only 44.4 percent for those in the control group.

These results appear to suggest that teaching children to resist social pressures can reduce the onset of smoking. From a public health perspective, however, it is important to consider not only the relative differences, but also the total number of students affected and the robustness of the effects. For example, only 44 percent of the students in the Waterloo study were nonsmokers at the beginning of the study and 33 percent were regular smokers. Furthermore, there were only 36 students in the high social-risk group (parents, siblings, and friends who smoked) who were nonsmokers at the beginning of the study. Thus, the difference of 78 percent versus 44 percent reported by Best *et al.* (1984) reflects the fact that 14 students in the experimental group versus 8 in the control group remained nonsmokers—a difference of 6 students. As Flay *et al.* (1985) assert, these results are “fragile.” This is especially true if one takes into account how unstable these

reported patterns at the end of grades seven and eight are likely to be.

Most adolescent smoking-program evaluations have been concerned primarily with the efficacy of specific programs. In an efficacy trial, it is appropriate to focus only on persons at risk. Before preventive measures are implemented, however, it is necessary to ask what the impact on the entire population will be (i.e., their effectiveness). In the case of adolescent smoking, this means that instead of asking how many nonsmokers are prevented from smoking in a six-month period of a specific trial, we should try to estimate what proportion of all adolescents in a school will be prevented from smoking. We have calculated two statistics for a number of representative intervention studies. The statistic that may be of most interest to public health officials is "attributable prevention in the population." This refers to the proportion of all students affected by the program who would not otherwise have changed their behavior. For example, if two schools were comparable in terms of size, and baseline rates of smoking and the proportion of all students who became new smokers in the experimental school was 5 percent, and the proportion of new smokers in the other was 10 percent, we would say that the "attributable prevention in the population" was 5 percent (10 percent - 5 percent).

Data are sometimes reported only for a subgroup of students. For example, if 70 percent of both schools already have experimented with smoking, one might analyze data for only nonsmokers. In the example given above, if only the data from the 30 percent of students who were nonsmokers were analyzed, the results would indicate a difference of 17 percent ($.05/.30$). To facilitate comparisons among studies, if data are presented only for a "risk group" we calculate what the "attributable prevention in the population" would be. There are many methods available for adjusting for pre-existing differences between experimental and control groups (Cleary 1983), but for simplicity we simply subtract base rates from rates at the end of the study. These figures, along with some description of the studies, are presented in table 1. These studies were drawn from the list compiled and reviewed by Flay (1985a, table 1).

The data in table 1 convey a slightly different picture than that presented by many researchers in the area. McCaul and Glasgow (1985) point out that most reviews of adolescent prevention programs conclude that they have a sizable impact on smoking behavior (Botvin and

TABLE 1
Comparison of Selected U.S. School Smoking-prevention Programs

Study	Grade(s)	Sample size [complete data]	Attrition at last follow-up	Criteria	Attributable prevention		
					Follow-up Period	Risk Group	Total Sample
Houston I	7th	374	27.7%	nonsmoking	10 wks ¹	8.7%	6.0%
Houston II	7th	1,352/3,296		2 or more cigarettes per day	9 mos 1 yr 21 mos 2 yrs 33 mos		0.2 1.8 3.1 0.6 2.1
CLASP RASP	7th	526		smoking in past week	9 mos	4.3	
	7th	1,526	18.4	never-smoker	7 mos 3 yrs	8.5 4.0	
				nonsmoker	7 mos	3.6	
			0.0	amount smoked	6 mos	7 cigs in past wk ²	
Washington I	6th	28				29.5 ³	
Washington II	6th	56	0.0	smoked in past month	6 mos		8.1
New York I	8th-10th	281	0.0	nonsmoking	12 wks	11.9	5.2
			23.0	nonsmoking	6 mos	11.2	7.8
New York II	7th	426		nonsmoking	1 mo	10.5	6.2
				nonsmoking	1 yr	8.4	7.1 ⁴
Minn II	7th	1,955	11.1	nonsmoking	8 mos	13.0	2.5 ⁵
New York IV	7th	1,185	9.6	smoking past month	4 mos		3.0
				past week	4 mos	6.6	6.0
				smoking	4 mos	6.3	5.8
				past month	16 mos	3.4	3.2
				smoking	4 mos		
New York V	7th	902	27.2	past week	16 mos	7.5	6.9

Washington III	6th	689 (original sample)	6%—9%	smoking past week	2 yrs	4.0 ⁶
Tennessee	6th—9th	1,472 (original sample)			2 yrs	NA ⁷
Stanford I	10th	871	2.9%	smoking past week	6 mos	3.5
Stanford II	10th	583		past month	6 mos	9.7
Waterloo	6th	439 (original sample)	20.0%	cessation	3 mos	0.9
				never smoked	30 mos	12.9
				quit		5.7 ⁸
				regular smoking	30 mos	18.0
				(among triers)		
Australia	7th	1,964	18.3%	smoking initiation	16 mos	5.9
				smoking cessation	16 mos	— 1.1
						— 0.4

¹ Evans included students who were only exposed to repeated testing in the experimental group. If those students are considered part of the control group the attributable prevention statistics are 5.2% and 3.6% respectively.

² Estimated from a published bar graph (Schinke and Blythe 1982).

³ Assumes that control and experimental groups were equal at baseline. Only post-test results were reported.

⁴ Numbers are based on data reported by Arkin et al. 1981. It is important to note, however, that the change in the control group occurred over a 32-month period. Data for a second study are reported in Murray et al., 1984. The results are presented in bar graph form, but the experimental effect appears to be similar to or smaller than for the first study.

⁵ Results from two experimental groups were pooled, assuming that they were of equal size. Number of students in each group was not reported.

⁶ Estimated from a line graph. Results from information-only group combined with results from control group.

⁷ Pentz (1983, 1985) presents only tests of significance for treatment effects on cigarette use.

⁸ Experimental and control groups assumed to be equal at baseline.

Sources: Houston I: Evans et al. 1978. Houston II: Evans et al. 1981. CLASP: Perry, Killen, and Slinkard 1980; McAlister, Perry, and MacCoby 1979; McAlister et al. 1980. RASP: Hurd et al. 1980; Luepker et al. 1983. Washington I: Schinke and Blythe 1982. Washington II: Schinke and Gilchrist 1983. New York I: Borvin and Eng 1980; Borvin, Eng, and Williams 1980. New York II: Borvin and Eng 1982. Minnesota II: Arkin et al. 1981; Murray et al. 1984. New York IV: Borvin et al. 1984. New York V: Borvin, Renick, and Baker 1983. Washington III: Schinke, Gilchrist, and Snow 1985. Tennessee: Pentz 1983, 1985. Stanford I: Perry et al. 1980. Stanford II: Perry et al. 1983. Waterloo: Best et al. 1983. Australia: Fisher, Armstrong, and de Klerk 1983.

McAlister 1982; Botvin and Wills 1985; Coates, Perry, Killen, and Slinkard 1981; Evans, Smith, and Raines 1984; Johnson 1982; McAlister, Perry, and Macoby 1979; Pechacek and McAlister 1980). It is true, as Botvin, Renick, and Baker (1983) have asserted, that these programs are capable of producing 50 percent relative reductions in smoking behaviors. If one looks at the actual proportion of students affected, however, the results are not as encouraging. The only study with results indicating an effect on at least 10 percent of all students involved only 56 students. A typical effect is in the 5 to 8 percent range, although a couple of programs report slightly better success rates. It is also important to note the attrition rate, or proportion of students that did not complete a study, in column 4 of table 1. Some studies have been able to follow up almost all of the students originally contacted, but may have attrition rates that are larger than the experimental effect. Almost none of the studies cited report sensitivity analyses in which the results are recalculated assuming varying proportions of success rates among students not completing the study. In addition, many of the follow-up periods were short, and virtually all of the statistics presented were based on single, cross-sectional measurements. Thus, almost none of the studies presented data on students who had consistently been nonsmokers at several points in time. Given what we know about the propensity of adolescents to change their smoking status, it is difficult to have a great deal of enthusiasm about the success rates of these studies.

There are a number of detailed reviews of the methodological limitations of these studies (Biglan and Ary 1985; Battjes and Bell 1985; Flay 1985a, 1985b; Lando 1985; Moskowitz 1983; Snow, Gilchrist, and Schinke 1985) and it is not necessary to repeat that material here. Suffice it to say that even the most recent studies suffered problems associated with unit of assignment to experimental conditions, integrity and strength of the treatment as delivered, unit of analysis, attrition, failure to assess treatment interactions, reactive effects of repeated measurements, lack of attention to the differential impact of program in different subsets of students, restricted study populations (e.g., never smokers), and Hawthorne effects. (For reviews of similar problems with drug abuse program evaluations see Schaps *et al.* 1981; and Moskowitz 1983.)

The methodological shortcomings pointed out by the various reviews cited are important, but these are to be expected given the complexity

of the research (Lando 1985). The experiments reviewed by Flay (1985a) have been carefully developed from sound theoretical work. They have been implemented with great care by some of the best researchers in the field, and the results have been carefully and honestly reported. It is our opinion that evaluations of adolescent smoking-prevention programs are among the best evaluation work done on changing health behavior, and that the results are definitive and obvious: the types of programs reviewed can have small effects of uncertain duration on smoking behavior.

We think that no matter how much we improve the internal validity of studies to be conducted, the conclusions will still be the same: these programs are complex, they will be implemented with varying degrees of enthusiasm even if fully funded, only a subset of the intended target population will participate, there will be high drop-out rates, and the results will be "modest" at best, and "fragile." Thus, although we think that many of the methodological critiques of these studies have been overly critical, we also feel that much of the optimism about their potential impact is unwarranted.

Theoretical Assumptions

In the face of these modest findings, why is there so much interest in developing better programs based on social-learning theory that deals almost exclusively with primary prevention? There appear to be two main reasons for these foci. One assumption apparently motivating much of the current research concerns the relation between adolescent experimentation with smoking and the adoption of other problematic behaviors such as alcohol and/or drug abuse. For example, Kandel (1975) and colleagues view the use of various substances as links in a chain of progressively more serious use and abuse. If this is true, then the limited impact of smoking programs on smoking behavior is not as troubling because there may be an effect on many types of substance use. It is important, we think, to critically re-examine some of the research that is used to justify these positions.

Another factor apparently motivating the focus on social learning is the data indicating that people who smoke are more likely to have parents, classmates, and friends who smoke than do nonsmokers, leading many to assume that there is a direct causal link between

social models and smoking behavior (cf. Krosnick and Judd 1982; McAlister, Krosnick, and Milburn 1984). Furthermore, there is a tendency to assume, at least implicitly, that these processes are the most important determinants of smoking behavior. The association between smoking by adolescents and the smoking behavior of friends and relatives is so striking and persistent that this seems like a logical focus of intervention efforts.

A key theoretical perspective used to explain the association between peer smoking and adolescents' smoking is social-learning theory. This perspective has received a great deal of attention partially because of the consistency of the findings that smoking by people in the immediate social environment strongly predict whether or not an adolescent smokes. There are alternative interpretations of these associations and other correlates of smoking, however, that are not consistent with this perspective. We review some of these data in the next section.

Social Correlates of Smoking

Smoking by Peers and Parents

Social-learning theory predicts that irrespective of the pharmacological effects or other functions of smoking, adolescents will anticipate, initiate, and adopt smoking as part of the socialization process. Consistent with this premise, numerous researchers have found that young people are more likely to experiment with smoking if their friends or parents smoke, and that they are most likely to try their first cigarette with friends (Hirschman, Leventhal, and Glynn 1984; Green 1979; Murray et al. 1983; Croft et al. 1985; Gordon 1986; U.S. Public Health Service 1979; Flay et al. 1983; Banks et al. 1978).

These studies appear to provide compelling support for the argument that social models "cause" adolescents to start smoking. It is important to emphasize, however, that an association between the smoking behavior of an individual and that of friends and relatives does not mean that one caused the other (see also Hitchcock and Schelling 1986). If both smoking by adults and smoking by adolescents are influenced by similar and related environmental factors, then the associations noted above may be spurious. For example, if the use of smoking as an emotional management strategy is related to social

class, then it may be true that adolescents who smoke are more likely to have friends and parents who smoke because they come from similar backgrounds.

Another possibility is that the associations are causal, but in a direction opposite to what is usually assumed. Chassin, Presson, and Sherman (1984) have referred to this phenomenon as "bidirectional" influence in their analysis of smoking cessation among older adolescents. Friends' attitudes and behaviors can play an important role in the adolescent's adoption or cessation of behaviors. Once an adolescent makes the decision to quit, however, she/he may tend to associate more with nonsmokers (social selection; see also Kandel 1978). Fisher and Bauman (1986) examined data from longitudinal research on adolescent smoking to determine the relative importance of influence and selection processes. Their findings provide support for the social-learning model; social selection processes, however, accounted for substantially more of the association between the behavior of subjects and their friends.

Similarly, the data on transition between types of substance abuse may be due to spurious associations. Social conditions contribute to the factors that cause smoking. Those same social conditions may predispose an individual to alcohol or drug abuse. Those behaviors tend to occur at different points in the developmental process, and so the sequential patterns of use are consistent with a transition model. If this is the case, then a social-influences intervention will have little impact on subsequent substance abuse. A program that addresses the underlying causes of different types of substance use, however, will have broader impact.

Socioeconomic Factors

There are numerous other research findings that are not easily explained by a social-learning model and which suggest a number of other mechanisms underlying smoking behaviors. A robust and provocative finding from research on smoking among adolescents is that the incidence and prevalence of smoking appear to be related to socioeconomic status. In general, children from lower socioeconomic families are more apt to smoke (U.S. Public Health Service 1979), although the trend has not been so clear for girls (Flay et al. 1983; Bachman, O'Malley, and Johnston 1980; Covington and D'Onfrio 1985). There

also appears to be a relation between educational aspirations and smoking behavior. Self-described college-bound students are far less apt to smoke (Bachman, O'Malley, and Johnston 1980; Green 1979; Semmer et al. 1986).

Best et al. (1985) report data on the associations between characteristics of schools and student smoking. The prevalence of smoking among sixth-grade students was significantly related to a composite "school risk" score based on the average socioeconomic status, the prevalence of smoking among the school's eighth graders, and the proportion of grade-six teachers who smoked. These findings are not inconsistent with transmission of smoking behaviors via modeling. The persistence and strength of these associations, however, suggest that other factors are necessary to explain the patterns in smoking.

Other Correlates

There are a number of other findings that are not easily explained by viewing smoking among adolescents solely as a socially learned behavior. For example, there appear to be rather substantial variations in smoking rates by region and race (Bachman, O'Malley, and Johnston 1980; Johnston, O'Malley, and Bachman 1984; Hunter, Webber, and Berenson 1980; Covington and D'Onfrio 1985). Also, children from "broken homes" smoke more than children from intact two-parent homes (Green 1979; Bachman, O'Malley, and Johnston 1980, 12). The Monitoring the Future Study has also found greater drug and cigarette use among the high school seniors who worked a substantial number of hours at a job, dated more often, and spent more evenings out of their families' home (Bachman, O'Malley, and Johnston 1980; see also Banks et al. 1978; Murray et al. 1983; Green 1979.)

Other Theoretical Perspectives

There are a number of important behavioral theories other than social learning relevant for adolescent smoking. For example, although smoking is almost normative among adolescents, it can be considered a "deviant behavior" from an adult perspective, and there is a large amount of theory and empirical research to explain why adolescents adopt deviant behaviors. Another major research paradigm is that developed by Jessor

and Jessor (1977). Their work is especially interesting because they hypothesize that there are behavior syndromes that consist of groups of behavior with a common social genesis. To the extent that general social factors are operative, specific interventions focused on smoking behavior will not be very effective.

Skinner et al. (1985) and Krohn et al. (1983) have tested the hypothesis that social-bonding theory and differential-association theory explain smoking behavior. Social-bonding theory (Hirschi 1969) posits that individuals will tend to behave in individualistic and "deviant" ways unless constrained by ties to conventional society. This theoretical perspective does not focus on the learning of behavior, but rather on the mechanisms of social control. Skinner et al. (1985) and Krohn et al. (1983) tested this theory using data from a two-wave panel study of 1,405 students in 7th through 12th grade. The findings generally supported the hypothesis that adolescents' ties to conventional society are important in constraining deviant behavior. Commitment to education, attachment to father and mother, and less association with female smoking friends were the variables most strongly associated with lower rates of smoking initiation, whereas attachment to father, beliefs about smoking, and association with both male and female smoking friends were important for cessation.

Although we tend to assume that adolescents smoke for reasons that are different from the reasons that motivate adults, this may not be the case. A good example of this is regulation of emotional states. Recent analyses of data from the West German study of adolescent smoking indicate that beliefs about the effect of smoking on affective states are predictors of changes in smoking behavior (Semmer et al. 1986). Similarly, Wills (1985) found that stress was related to an increased probability of cigarette use among two cohorts of public school students who were in the seventh grade when first interviewed. Castro et al. (1987) also suggest that adolescent smoking-prevention programs should do more than teach resistance to social influences.

These various findings do not imply that social learning is not important. For example, regional or racial differences could simply be a function of the salience of different models. Social learning could be a major mechanism for maintaining these differentials and is undoubtedly extremely important in influencing the anticipation of, the experimentation with, and the adoption of smoking. Social influence

models, however, explain transmission and cannot account for the origin of important class, race, and regional differentials that have been observed.

Program Dissemination

Regardless of the relative effectiveness of any prevention model, it must be "marketable" in the sense that it can be easily and rapidly disseminated and implemented throughout the nation's schools. If these programs reduced smoking among adolescents by only 5 percent, but were widely implemented, the impact on smoking behavior, morbidity, and eventual mortality would be enormous (Flay 1987). We doubt, however, that the types of programs reviewed here will achieve widespread acceptance. Given the current emphasis in American elementary and secondary education on a return to the "basics" (Governali 1983), all programs must compete for limited funds, teacher and staff resources, and classroom time. Thus, prevention models also must be inexpensive, simple to use, easy to implement, and should address the specific needs of school districts.

We find it striking that there are no data in the literature on the overall costs of smoking-intervention programs. These programs typically include the following central elements that are likely to place substantial demands on classroom time: (1) media material derived from the studies originally conducted by Evans et al. (1981); (2) behavioral learning techniques, such as role playing; (3) information on the physiological effects of smoking; (4) public commitments made by students about intended smoking behavior; (5) teaching about the prevalence of smoking among peers; (6) discussion of ways of dealing with family and media influences on smoking; and (7) extended duration (Flay 1985b). These programs require from 3 to 23 hours of classroom sessions to deliver these elements (a "session" most often being one hour long).

Total implementation costs would include the costs of instruction or classroom time, materials acquisition and equipment costs, teacher training costs, and the cost to the school or school system of added classroom time, as well as opportunity costs. That is, one of the costs of these programs is that they reduce the amount of time available for other subjects. For purposes of comparison, in the area of general

health education implementation costs varied greatly across the four programs included in the School Health Education Evaluation. The average cost per student for full program implementation was \$56 per student, with a range of \$23 to \$84. That evaluation concluded that over 90 percent of the total costs were directly associated with classroom time: 40 to 50 hours of classroom time were required for stable effects on knowledge, attitudes, and actual practices (Connell, Turner, and Mason 1985).

There is nothing in the published literature to indicate whether the smoking-prevention models are simple to use and easy to implement in a school or school system. While there are several past and current demonstration projects from which experience and data might be drawn, there is a fundamental problem inherent in drawing on such projects for experience relevant to the broader questions of diffusion: demonstration projects are generally well funded and staffed by highly knowledgeable, highly motivated researchers.

A condition for success of a prevention strategy based on schools is the receptiveness of the market—the degree to which teachers, school administrators, and policy makers are motivated to assign a high priority to prevention programs and allocate the necessary resources. There are indications from the education literature that the market may need more preparation before a broad strategy can be expected to take hold. For example, in a survey of 451 students, Reed (1981) found that only 58 percent of the students surveyed reported that their school discouraged smoking. Chen and Winder (1983) interviewed Massachusetts teachers in 1982 and found that they tended to think they should *not* be more active in speaking to their students about smoking. There is still a substantial amount of work to be done to educate teachers about basic facts concerning smoking. Higgens, Dunn, and Warmack (1983) interviewed 253 teachers in Kentucky in 1981. They found that the majority of respondents agreed that smoking education should be included in the school curriculum, but did not express a strong opinion that teachers were responsible for convincing students not to start to smoke. The most discouraging finding was that only 46.9 percent of teachers who smoked strongly agreed that there is an association between smoking and lung cancer. Even among nonsmokers, only 79.1 percent agreed that there was such an association. These results are not representative because they were collected in a tobacco-producing state, but they are suggestive of the types of problems

that would be encountered in distributing and implementing smoking-prevention programs.

Finally, to be effective a public health strategy must take into account the size of the target. In 1982 there were 15,517 operating school districts, 59,326 elementary schools, 1,743 combined elementary-secondary schools, and 22,619 junior and senior high schools in the United States (Grant and Snyder 1985). A strategy that envisions motivating a large percentage of these schools and districts to adopt marginally effective, complex, and potentially costly prevention models without the benefit of massive dollar incentives will lack credibility and risk failure.

We have found no published review and integration of data on the content, cost, and actual dissemination of available smoking prevention programs, but current databases such as the National Institute of Education's National Diffusion Network, and the Centers for Disease Control's Health Education Database may be resources for the compilation of such information. The National Cancer Institute's recent call for projects on the integration of tobacco education in the school system encourages further new work in this area. It will be interesting to see how informative this program is.

Summary Assessment and Suggestions for Future Research

Rigorous evaluation studies have demonstrated that the programs reviewed can have an impact on the incidence and prevalence of smoking among adolescents. Thus, if certain schools place a high priority on smoking prevention and have the necessary resources, the types of programs reviewed may help reduce adolescent smoking in those schools.

Data and theory reviewed above suggest, however, that the impact of school-based programs focusing almost exclusively on social learning and primary prevention are likely to have only a modest impact of uncertain duration. Furthermore, behavioral theories and data on adolescent smoking behavior suggest that there are numerous factors, other than those that are emphasized in the programs evaluated to date, that influence smoking behavior among adolescents. Programs with limited efficacy can have a substantial impact if they can be widely disseminated, but the nature of the programs reviewed and

constraints on education resources lead us to believe that these programs will not gain wide acceptance.

Because of the limitations of existing programs it is important to continue research that is likely to result in programs that are more efficacious, and that are more likely to have broad impact. Our review of the literature suggests a need for more basic research on the processes motivating and maintaining smoking, and the development and evaluation of programs for specific subgroups. Most smoking researchers concur with these needs, and there is currently a substantial amount of research in these areas. Other important areas are relatively neglected, however. Specifically, we recommend more research focused on: (a) development of programs that address different stages in the natural history of smoking among adolescents, including quitting; (b) research on the priorities and need of educators and the development of general health education curricula that include components of smoking prevention programs; and (c) research on the impact of policy initiatives and the effect of media on smoking attitudes and behavior.

Basic Research

The limited success of the tested programs emphasizes the need for continued research on the basic processes involved in smoking acquisition. Small, focused projects (e.g., Glynn, Leventhal, and Hirshman 1985; Hirschman, Leventhal, and Glynn 1984) should be complemented by careful, prospective epidemiologic studies that focus on the different determinants of smoking. Such studies have been conducted, but they tend to focus on one class of determinants of adolescent smoking (e.g., attitudes and beliefs) rather than on a full range of influences. For example, the work of Wills (1985) suggests that stress and stress-coping skills should be elements of smoking programs. Similarly, Gordon (1986) showed that adolescents who have tried smoking are significantly different from those who have never smoked on a number of factors theoretically important for smoking onset. Such knowledge, however, is not incorporated often enough when designing intervention programs.

McCaul and Glasgow (1985) have reviewed the literature on adolescent smoking-prevention programs and conclude that, partly because there has been so little emphasis on process assessment, not much is presently known about the construct validity of successful programs. They

suggest that it is unclear which specific information or combination of information and method of presentation is responsible for reducing smoking initiation. There is still a need for smaller, less costly studies that focus on process analysis and that attempt to elucidate our understanding of the physiological, psychological, and social factors influencing adolescent smoking. Without this type of research we will soon reach an intellectual dead end. The emerging data suggest that there are few, if any, consistent differences in efficacy among different approaches to smoking intervention. Without careful research on the process of change we will not know the best direction for future research.

Specific Groups

Social contexts may also have a significant impact on adolescent smoking, and interventions that are limited to the classroom are likely to have limited influence (Lando 1985). For reasons that are not well understood, there has been a dramatic shift in social norms and attitudes toward smoking in the United States over the past decade. Social pressure used to encourage smoking; it now encourages people not to smoke or to stop smoking. Whereas in earlier periods, prevention programs were working against the trend, current programs may act to reinforce ongoing trends.

One implication of these observations is that it may be inappropriate to compare programs that were conducted in different social climates. A more general observation is that smoking-prevention programs may contribute to a changing social environment as well as producing changes at the individual level. That is, calculating an effect in a particular study may not adequately reflect the cumulative, long-term impact of that study or of the many other prevention programs on the population.

Another implication of this change in environment is that our attention should be directed at those groups which are not so easily affected by changes in national norms. One of the most important findings in smoking research is that there are large and persistent racial and class differences in smoking rates. It is unfortunate that the majority of smoking research has been conducted in predominantly white schools. The populations most in need of help are the ones least often being reached. Fortunately, there has been increasing attention

focused on these groups, stimulated largely by grant initiatives by the National Cancer Institute and other federal agencies.

Cessation Programs

Another important area of needed research is in the development of programs to help adolescents quit (Ershler et al. 1988). Even if primary prevention programs were more efficacious than they are, there would be an important logistical problem related to their implementation. Such programs would be most effective if provided shortly before the period during which most adolescents are influenced to smoke. This period varies among adolescents, from the early elementary grades to the end of high school. Thus, to target the entire population, they would have to be provided almost continuously during this time.

There are perhaps a hundred different types of programs that adults can choose from if they decide to quit. Little effort has been directed at helping adolescents quit, however (cf. Johnson 1986; Perry et al. 1980; Weissman et al. 1986). The almost exclusive emphasis on prevention has caused some health education specialists to overlook the fact that until the social climate changes dramatically, it is almost inevitable that a substantial proportion of adolescents will try smoking and a large number will become dependent to a greater or lesser degree on cigarettes. Yet, adolescents have access to few of the tools that adults have at their disposal. Lando (1985) has asserted that a coordinated effort between prevention and cessation researchers would be far more likely to produce an impact at the community level than a continuation of existing piecemeal approaches.

Dissemination

We think that future work should focus on expanding the range of interventions available and on evaluating cost-effective public health policies that are feasible in today's economic and political climate. As indicated earlier, we should begin to study the factors that facilitate or inhibit the widespread diffusion of programs.

In an earlier review of smoking cessation and prevention programs, we speculated that the most efficacious way to reduce smoking among adolescents would be to provide them with basic information about health and wellness in a basic health education curriculum (Leventhal

and Cleary 1980). We think it is worthwhile to reconsider this recommendation given the limited efficacy and diffusion of specialized programs. If one looks at a narrow definition of a problem in a particular age group and looks at short-term outcome, the specialized programs have slightly better results than general education. The problem we are facing, however, is more general than is often admitted, and what we need is a general program for a wide range of problems that have a protracted natural history. The concerns of health educators include not only smoking, but also drug use, alcohol abuse, general hygiene, violent behavior, and health promotion. Curricula that include all of these areas would be of interest to a broader range of educators. Furthermore, it is necessary to impart skills and knowledge that will be effective over a longer period of time. Social pressure may be one of the more salient influences on smoking among adolescents, but as the young person matures, peer pressure may become a trivial concern and the physiological regulating functions of smoking may be the factor motivating use (Leventhal and Cleary 1980). A general program may turn out to have a greater impact on a wider range of behaviors in the long run. Developing and refining general health education and focusing on health policy in the schools and work place is certainly a more feasible political goal than encouraging school districts to adopt costly, labor intensive, categorical programs.

The lack of success of early education programs does not mean that health education will not work. We have learned a tremendous amount about how people process information about health over the past decade, and newer models of information processing and behavior change (e.g., Leventhal, Safer, and Panagis 1983) provide good reason to reconsider using health education programs to prevent, change, and/or encourage the cessation of adolescent smoking. A final, but extremely important consideration is the probability of implementation. No matter how good a program is, it will not be effective if it is not disseminated widely enough. The infrastructure for implementing improvements in general health education is already in place, for the most part.

Policy

Another area deserving of more research attention is the study of the impact of public policies on smoking behavior. Changes in public

norms and attitudes have had a dramatic impact on smoking behavior that is much greater than could have been achieved through intensive smoking cessation programs (Leventhal and Cleary 1980). Unfortunately, we know very little about how these broader social changes took place. The schools offer an ideal setting for studying how social institutions influence patterns of behavior. Such research would be much easier to conduct and have much greater relevance than most of the intervention studies reviewed in this article. For example, in California, starting in 1979, school districts were allowed to establish student smoking areas. As a result of recent policy changes, however, schools may no longer permit student smoking on school property or at school events. It would be useful to know the answers to such questions as: What is the impact of having an enforced no-smoking policy for teachers and staff, and what is the impact of having designated smoking areas? Also, what would be the impact of a program directed at teachers and parents, as well as students?

Another extremely important question concerns the extent to which adolescent smoking behavior is responsive to the price of cigarettes. There is now an accumulating body of evidence focused on this issue among adults (Institute for the Study of Smoking Behavior and Policy 1985), and this is undoubtedly a fruitful area for future research on adolescent smoking.

Media

Important influences on how adolescents view smoking are the general media and advertising. There have been some large school-wide and even community-wide studies of the effect of health promotion campaigns on smoking. Aside from these demonstration projects, however, there have been relatively few well-controlled studies examining how adolescents perceive, process, and react to different types of information. It is ironic that the social-influence approaches to prevention were based on such studies by psychologists and social psychologists, yet funding agencies and applied researchers now place little emphasis on this type of research.

The relation between television and other adolescent behaviors such as eating habits and violent behavior has been studied extensively (Milavsky et al. 1982; Dietz and Gortmaker 1985). The methodologies used in these studies could easily be applied to adolescent smoking.

An example of such work is the program being conducted by Bauman *et al.* (1986) on the implementation of a mass media campaign designed to prevent the initiation of smoking by young people.

Conclusion

Our review of research and public health policy suggests a need to reassess the direction of efforts to reduce smoking among adolescents. Research activity has focused intensively on the nature and role of social learning and on prevention models based primarily on that theory. Yet, the literature suggests a wide variety of other powerful determinants such as socioeconomic status, region, race, occupation, and general social factors. Other factors, such as dramatic changes in the social context of smoking behavior, have also been underemphasized. Furthermore, there is a need for studies of the impact of media and public policies on adolescent smoking behavior.

Smoking-intervention evaluators have tended to look at adolescent smoking as a series of discrete stages, and have not fully taken advantage of the numerous fluctuations and the potential for intervening at many different points in the process of becoming a regular smoker. The natural history of smoking in its early stages suggests that assistance in cessation, restrictions on the opportunity to smoke and the availability of cigarettes, and other interventions may have significant effects on adolescent smoking without the potential problems of cost and dissemination outlined in this article.

Social-learning models have been designed primarily as school-based programs, yet scant attention has been paid to the factors that ensure widespread adoption by schools. Although schools are concerned about smoking, alcohol, and drugs, there has been little attention paid to their practical needs, and there is poor coordination among the research and policy agencies who hope to develop successful interventions. We are left with the question: "If we had a better mousetrap, would anybody buy it, or would we know how to market it?"

The Surgeon General's goal of a "smoke-free society by the year 2000" offers an incentive to undertake efforts to develop a more thoughtful strategy for addressing smoking, alcohol, and drug abuse among young Americans—a strategy that would examine the wisdom and the feasibility of broadening research and would target it at the

most promising and most easily disseminated approaches. Such an effort would also aim at identifying a mix of interventions more in tune with the capabilities and funding resources of schools and other sites of intervention. It would take into account the ubiquitous nature of experimentation by young people and would examine the potential contributions of health education, school policies, and applications of our social influence knowledge. The results of such an effort hopefully would be a better coordinated, more comprehensive approach which could move quickly from the behavioral laboratory into the field.

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