

A Meta-Analysis of Adolescent Smoking Prevention Programs

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ABSTRACT

Objectives. A large number of studies evaluating adolescent smoking prevention programs have been published. Systematic quantitative reviews of this literature are needed to learn what does and does not work. The present meta-analysis focuses on the efficacy of school-based programs.

Methods. Evaluations of 94 separate interventions were included in the meta-analysis. Studies were screened for methodological rigor and those with weaker methodology were segregated from those with more defensible methodology; major analyses focused on the latter.

Results. Behavioral effect sizes were found to be largest for interventions with a social reinforcement orientation, moderate for interventions with either a developmental or a social norms orientation, and small for interventions with the traditional rational orientation. Attitude effect sizes followed the same pattern, but knowledge effect sizes were similar across all four orientation categories.

Conclusions. Because behavioral effect represents the fundamental objective of programs for prevention of adolescent tobacco use, the present results indicate that school-based programs should consider adopting interventions with a social reinforcement, social norms, or developmental orientation. (*Am J Public Health*. 1993;83:872-880)

Introduction

A substantial number of research reports evaluating programs designed to prevent adolescent smoking have been published in the last 2 decades. A very important set of questions deals with (1) how successful these programs have been in general, (2) whether programs of different orientation show different levels of success, and (3) what variables, in addition to program orientation, may account for different levels of success. Nonquantitative reviews¹⁻⁴ of this literature devote little effort to answering these three questions; rather, they focus on pervasive methodological issues encountered by much of the published evaluation research in this area. None of the four reviews employed meta-analytic techniques for assessing program outcomes. The methodological critiques provided by these reviews¹⁻⁴ centered on (1) the use of appropriate comparison groups; (2) the use of appropriate pretests, posttests, and follow-up assessments; (3) the control of research attrition; (4) the validity of dependent variable assessment; and (5) the use of statistical procedures appropriate for program evaluation research. A fifth nonquantitative review⁵ focused on the underlying theoretical program orientation rather than evaluation research methodology. A fourfold classification of commonly used program approaches was presented (information, affective education, alternatives, and social pressures); however, meta-analytic techniques were not employed to assess differential outcomes associated with the four program approaches.

Quantitative reviews of prevention programs targeting adolescent drug use⁶⁻⁸ represent a new approach in that program classification schemes similar to that proposed by Battjes⁵ were used to categorize outcomes, which were then employed in

a quantitative meta-analysis⁹ of study effect sizes in an attempt to answer the first two questions noted above. All three reviews⁶⁻⁸ suggested that newer programs based on affective education, alternatives, or social pressures produced larger average study effect sizes than did those based on information alone. However, these findings have not satisfied critics¹⁰ of the newer programs, who still find evidence for the superiority of the innovative interventions unconvincing. As Cook et al.¹¹ point out, quantitative research summaries are needed to deal authoritatively with questions such as the relative efficacy of interventions with different program orientations. These authors¹¹ note that such reviews should (1) comprehensively cover a defined set of evaluation studies spanning a specified time period; (2) systematically screen out studies with weaker research methodology; (3) systematically code the program orientation of the studies analyzed; (4) employ a defensible meta-analytic strategy for categorizing study effect size; and (5) employ appropriate statistical techniques for the quantitative meta-analysis. None of the three quantitative reviews⁶⁻⁸ meets these five criteria, and thus the concerns of the critics regarding the apparent superiority of newer programs cannot be allayed. The present paper presents a meta-analysis of studies published in the 1970s and 1980s that evaluated school-based programs designed to deter adolescents from smoking tobacco products. The meta-analysis was

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designed to meet the five criteria just outlined to provide a more definitive assessment of the relative efficacy of the newer programs than can be obtained from presently available nonquantitative¹⁻⁵ and quantitative⁶⁻⁸ reviews.

Methods

Program Classification

Efforts have been made to identify and classify interventions designed to deter individuals from the consumption of tobacco and other drugs.^{1,5-7,12-16} The fourfold typology of approaches proposed by Battjes⁵ clearly summarizes efforts in the drug prevention field to classify the models guiding actual interventions, and it relates well to the work of prominent theorists. The rationally oriented information approach is represented by the work of Ajzen and Fishbein,¹⁷ the developmentally oriented affective education approach by the work of Rosenberg,¹⁸ the social norms-oriented alternatives approach by the work of Jessor and Jessor,¹⁹ and the social reinforcement-oriented social pressures approach by the work of Bandura.²⁰ Table 1 summarizes the fourfold classification⁵ and provides a summary of program focuses and methods that were followed to produce the coded data employed in this meta-analysis.

Application of the classification system in the present meta-analysis was accomplished by systematically analyzing each intervention to identify major and secondary program orientations. The analysis was based on an assessment of each lesson or session forming the intervention as presented in the published report, or from an assessment of the curriculum cited in the published report. Earlier experience in such an effort⁷ led to the conclusion that direct curricular assessments were necessary to attain acceptable reliability in coded results. Because intervention programs were often eclectic in orientation, the major program orientation was scored as 2, secondary orientations were scored as 1, and absent components were scored as 0. Coding of program orientations was performed by two researchers who had coded program orientations in earlier research.⁷ Reading and discussion of the Battjes⁵ classification system produced a revised and sharpened coding procedure, which was used to independently code all of the 84 reports included in the meta-analysis. The 84 reports provided results for 94 interventions (the detailed programmatic codes given each intervention are available on re-

TABLE 1—A Classification of the Orientations of Prevention Programs

Orientation	Approach	Focus	Typical Methods
Rational	Information	Provide factual information about drugs, their effects and consequences.	Lecture; questions and answers; displays of substances.
Developmental	Affective education	Increase self-esteem and self-reliance; decrease alienation; development of decision-making skills and/or interpersonal skills; usually includes minimal or no focus on drugs per se.	Lecture; discussion; group problem solving; minimal role playing.
Social norms	Alternatives	Reduce alienation; increase self-esteem and/or reduce boredom; usually includes minimal or no focus on drugs.	Participation in community improvement projects; vocational training; tutoring; recreational activities.
Social reinforcement	Social pressures	Develop abilities to recognize social pressures to use drugs; develop skills in resisting pressures; identify immediate social and physical consequences of drug use.	Discussion; behavior modeling; role playing; extended practice; public commitment not to use.

Source. Adapted with permission from Battjes.⁵(p.111)⁶ Copyright ©1985 Marcel Dekker Inc.

quest from the author). Disagreement regarding the major program orientation code occurred for 8 interventions (9% of the 94 coded) and disagreement regarding the less important secondary codes occurred for 16 (17%). Complete agreement was obtained for 70 (74%) of the 94 interventions coded. Discrepant codes were resolved by discussion and by rechecking curriculum descriptions after the independent coding described above had been completed. All program orientation classifications were performed, compared, resolved, and fully completed before the methodological analysis and computation of study effect sizes were initiated, thus requiring classification of program orientations before study methodology codes and effect sizes had been documented.

Methodological Criteria

A coding scheme developed earlier⁷ was used to systematically assess evaluation methodology regarding the five most prominent methodological features identified by the nonquantitative reviews cited above. A three-category code was employed in which a rating of 1 was "exemplary," 2 was "defensible," and 3 was "unacceptable." All categories except those for attrition represent direct assessments of methodology described in published research reports. The best measure of the impact of attrition requires assessment of pretest equivalence of all partici-

pants remaining at posttest and follow-up assessments.²¹ However, such information is not included in published reports, and all that can be determined is differential attrition between research groups. These data were used to code attrition; it was assumed that less differential attrition indicates better pretest equivalence among those remaining for follow-up measures. (The table listing the programmatic codes for each of the 94 interventions also includes the methodology codes; it is available on request from the author.)

Each study reviewed was independently evaluated on the five methodology characteristics by the same two researchers who had earlier assessed program orientation. The 46 studies that received one or more ratings of 3 (unacceptable) were segregated from the primary meta-analysis. Coding disagreements involving this decision occurred for 8 (9%) of the 94 interventions coded. The 48 studies that received methodology ratings of 1 or 2 for all five characteristics were chosen to provide a select group of studies whose cumulative results would form the major findings of this quantitative summary. Coding disagreements involving discrepancies only between ratings of 1 and 2 occurred for 14 (15%) of the 94 interventions coded; thus, complete agreement was obtained for 72 (76%) of the interventions coded. Like discrepancies in the programmatic coding, discrepancies in the

TABLE 2—Overall Knowledge Effect Sizes (ES) from Prevention Programs, by Program Orientation

	Rational			Social Reinforcement			Social Norms			Developmental		
	n	ES	Q	n	ES	Q	n	ES	Q	n	ES	Q
	Weighted mean effect sizes from better methodology studies Posttest 9 .54* 31.66* 1 .97* 0.00 3 .22* 19.66* 3 .55* 35.86* First follow-up 4 .51* 22.31* 1 .95* 0.00											
Weighted mean effect sizes from all studies Posttest 12 .64* 138.02* 2 1.04* 0.19 5 .20* 20.19* 6 .40* 53.93* First follow-up 6 .43* 31.54* 1 1.26* 0.00 4 .46* 21.76*												
Estimated effect sizes from a comprehensive vote count Posttest 24 .19* ... 5 .12 ... 6 .40* ... 11 .15* ... First follow-up 16 .09* ... 5 .12 6 .50* ...												

Note. Ellipses indicate that no studies or data were available. n = no. studies.
*P < .05.

methodology codes were resolved by discussion and by rechecking program methodology after all coding had been completed independently by the two researchers. All methodology coding was completed and reconciled before the computation of study effect sizes was initiated.

Meta-Analytic Procedures

Earlier meta-analytic efforts⁶ indicated that all studies relevant to the topic under investigation, whether published or unpublished, should be included in the quantitative review to ensure a fair and unbiased estimation of effect size. More recently it has been argued²² that meta-analysis should conform to the five criteria listed above to provide a defensible methodological base for the meta-analytic outcome. Thus, it is argued that progress in explaining study effects¹¹ depends more on the analysis of results from substantial but independent subsets of studies segregated by systematic methodological assessments than on questionable attempts to obtain an all-inclusive review including study effect sizes from all reports without regard to methodological quality.²²

The subset of studies selected for this quantitative review, as noted earlier, were those published during the 1970s and 1980s that dealt with the prevention of smoking in a school setting. Only college-level interventions were excluded. The search involved checking the index issues

of relevant journals to find appropriate studies and then using the references in these papers to locate other appropriate papers; conducting ERIC and MEDLINE computer-based searches; and perusing US Department of Health and Human Services bibliographies on smoking and health. The search located 141 articles, of which 27 were set aside because they were review or theoretical papers; 21 articles, such as survey research or curriculum descriptions, were set aside because they did not report on the evaluation of an intervention; and 9 were set aside because the comparison group received an organized intervention designed to prevent adolescent smoking or because no comparison group of any kind was included. Thus, 84 articles^{21,23-105} were included in this meta-analysis because they met the three general selection criteria: (1) they were school based; (2) they evaluated programs designed to prevent adolescent smoking; and (3) they employed a control or comparison group that received no organized program designed to prevent adolescent smoking.

This study followed the major recommendation promulgated¹⁰⁶ for conducting a meta-analysis of study effect size: the major measure of a construct—in this case knowledge, attitude, or behavior—was selected to represent that outcome for the study under review. In this manner one outcome for a construct and study was associated with an exact number of par-

ticipants in the intervention group and in the untreated comparison group. Outcome measures were classified as falling into one of four time periods: (1) immediate posttest, (2) first follow-up, (3) second follow-up, and (4) third follow-up. Time periods between outcome measures were not identical; however, because the number of intervening measurement sessions was identical, this procedure was used to assess intermediate-term results. Longer term follow-up measures were too infrequent in the body of literature reviewed to support meta-analysis of such effects.

Effect sizes for behavior, attitude, and knowledge measures were computed whenever possible for the posttest and for the three follow-up assessments. As indicated, however, each study and construct was never represented more than once at any of the four measurement periods. Study effect sizes were computed for all studies reporting the required means and standard deviations; the formula used to compute effect sizes was that proposed by Glass et al.,⁹ $Me - Mc/SDc$, where Me is the mean of the experimental group, Mc is the mean of the control group, and SDc is the standard deviation of the control group. This definition of effect size is one of five comparatively evaluated by Hedges and Olkin.¹⁰⁷ It was chosen for this research because it is applicable in studies with one control and several different intervention groups, because it avoids the assumption of equal variances for control and intervention groups, and because it was consistent with the formulas and procedures recommended by Glass et al. to estimate effect sizes from proportions, *t* tests, and *F* ratios whenever direct computations based on means and standard deviations cannot be performed. For some studies and constructs only the direction of an effect, and not an effect size, could be determined, reflecting the recent publication practice of presenting neither detailed descriptive nor inferential statistics in research reports.

Results

Overall Summary

Tables 2, 3, and 4 present an overall summary of results from the current meta-analysis for knowledge, attitude, and behavior, respectively. First, weighted average effect sizes, averages in which studies with larger samples have proportionally more influence than those with smaller samples,¹⁰⁷ were computed for all better methodology studies, that is, those

receiving ratings of 1 or 2 for each of the five methodological criteria employed. Next, weighted average effect sizes¹⁰⁷ were computed for all studies for which effect sizes could be calculated, regardless of the methodology ratings obtained. Weighted average effect sizes were not computed for the second and third follow-up measures of knowledge and attitude because of a lack of studies obtaining such measures. Finally, a nonparametric vote-count estimate of effect size¹⁰⁷ was determined for all studies in which a direction of difference could be determined, regardless of the methodology ratings obtained. To include results from studies for which effect sizes could not be computed, the nonparametric technique listed all effect sizes as showing an outcome either favoring (+) or not favoring (-) the intervention group. The vote-count analysis was the most inclusive of all those reported but it was also the most problematic because of assumptions made during computation and because of questions raised by including studies with weaker methodology.¹⁰⁷ The most defensible estimates of overall effect sizes were those computed for the better methodology studies.

Studies in all orientation classifications had significant impact on knowledge outcome measures (Table 2). The only exceptions were the two vote-count analyses of studies falling in the social reinforcement classification. *Q* statistics, which assess whether or not effect sizes were obtained from a single population, indicated that program orientation codes did not account for all variation among knowledge effect sizes and that knowledge heterogeneity was apparently less for the better methodology studies. The positive results for knowledge found in programs with developmental, social norms, and social reinforcement as their major orientation were very likely due to the rather common practice of including a didactic subcomponent as a secondary part of the intervention.

Results for attitude (Table 3) were generally not as positive. Programs classified as primarily social reinforcement-oriented seem to have had the most impact on attitudes, followed by those classified as primarily developmental. *Q* statistics assessing effect size homogeneity showed less heterogeneity for attitude than for knowledge; however, the number of measures was also smaller. The generalization that social reinforcement-oriented and developmentally oriented programs had more impact on attitudes than programs based on rational and social norms models is limited by the small

TABLE 3—Overall Attitude Effect Sizes (ES) from Prevention Programs, by Program Orientation

	Rational			Social Reinforcement			Social Norms			Developmental		
	n	ES	Q	n	ES	Q	n	ES	Q	n	ES	Q
Weighted mean effect sizes from better methodology studies												
Posttest	6	-.03	13.95*	...	...	...	3	.04	3.33	1	.04	0.00
First follow-up	2	.08	0.43	1	.59*	0.00	...	...	...	...	...	...
Weighted mean effect sizes from all studies												
Posttest	8	-.03	41.45*	1	.33	0.00	4	.03	6.44	5	.15*	3.56
First follow-up	4	.10*	0.75	2	.51*	0.20	...	...	...	3	.12	0.71
Estimated effect sizes from a comprehensive vote count												
Posttest	16	-.01	...	3	.70*	...	5	.19	...	9	.29*	...
First follow-up	12	.21	...	5	.70*	...	...	...	...	5	.40*	...

Note. Ellipses indicate that no studies or data were available. n = no. studies.
*P < .05.

TABLE 4—Overall Behavioral Effect Sizes (ES) from Prevention Programs, by Program Orientation

	Rational			Social Reinforcement			Social Norms			Developmental		
	n	ES	Q	n	ES	Q	n	ES	Q	n	ES	Q
Weighted mean effect sizes from better methodology studies												
Posttest	16	-.01	38.92*	7	.32*	25.12*	6	.29*	4.48	6	.36*	7.96
First follow-up	12	.13*	64.15*	12	.31*	30.00*	2	.19*	0.27	5	.08	39.08*
Second follow-up	7	-.03	18.07*	10	.39*	43.40*	1	.36*	0.00	1	-.42*	0.00
Third follow-up	3	-0.1	2.45	4	.27*	18.88*	...	...	...	...	...	...
Weighted mean effect size from all studies												
Posttest	28	.04*	121.59*	9	.39*	75.63*	8	.30*	5.94	11	.29*	23.55*
First follow-up	16	.17*	79.19*	13	.62*	545.97*	3	.55*	20.32*	9	.30*	77.63*
Second follow-up	8	-.01	19.05*	10	.39*	43.40*	1	.36*	0.00	1	-.42*	0.00
Third follow-up	4	-0.1	2.46	4	.27*	18.88*	...	...	...	...	...	...
Estimated effect sizes from a comprehensive vote count												
Posttest	34	.01	...	12	.50*	...	8	.40*	...	14	.17*	...
First follow-up	23	.03	...	16	.20*	...	3	.30*	...	10	.14*	...
Second follow-up	11	-.04	...	10	.40*	...	1	.30*	...	1	-.30*	...
Third follow-up	4	-.07	...	4	.40*	...	...	...	...	...	...	...

Note. Ellipses indicate that no studies or data were available. n = no. studies.
*P < .05.

number of attitude measures obtained in the studies reviewed.

The results for behavioral outcome measures represent the most comprehensive findings of the present study in that almost all studies included in the meta-analysis assessed behavior and many as-

essed behavior with first and second follow-up measures. A clear generalization emerges from a perusal of Table 4: behavioral effect sizes for programs with social reinforcement and social norms orientations were consistently positive and significant, those for programs with develop-

TABLE 5—Analysis of Better Methodology Behavioral Outcomes, by Time of Follow-Up

	Immediate Posttest			First Follow-Up			Second Follow-Up			Third Follow-Up		
	ES	χ^2	df	ES	χ^2	df	ES	χ^2	df	ES	χ^2	df
Q_T	...	151.95*	34	...	162.63*	30	...	218.95*	18	...	33.75*	6
$Q_{W/RA}$	-.01	38.92*	15	.13	64.15*	11	-.03	18.07*	6	-.01	2.45	2
$Q_{W/RE}$	.32	25.12*	6	.31	30.00*	11	.39	43.40*	9	.27	18.88*	3
$Q_{W/SN}$	.29	4.48	5	.19	0.27	1	.36	0.00	0	...	...	...
$Q_{W/DE}$	.36	7.96	5	.08	39.08*	4	-.42	0.00	0	...	...	...
Q_B	...	75.47*	3	...	29.13*	3	...	157.49*	3	...	12.42*	1

Note. Ellipses indicate that no studies or data were available. ES = effect size; B = between; DE = developmental; RA = rational; RE = social reinforcement; SN = social norms; T = total; W = within.
* $P < .05$.

TABLE 6—Analysis of Better Methodology Behavioral Outcomes, by Grade Level and Time of Follow-Up

	Immediate Posttest			First Follow-Up			Second Follow-Up			Third Follow-Up		
	ES	χ^2	df	ES	χ^2	df	ES	χ^2	df	ES	χ^2	df
Q_T	...	151.95*	34	...	162.63*	30	...	218.95*	18	...	33.75*	6
$Q_{W/RA/L}$	-.02	12.61	13	.09	45.95*	7	-.03	0.61	5	-.01	2.45	2
$Q_{W/RA/H}$	.08	24.02*	1	.19	15.36*	3	.00	0.00	0	...	...	...
$Q_{W/RE/L}$	.31	24.95*	5	.31	25.48*	10	.39	43.40*	9	.27	18.88*	3
$Q_{W/RE/H}$	.43	0.00	0	.87	0.00	0	...	...	...	...	...	...
$Q_{W/SN/L}$	.20	0.76	2	.12	0.00	0	...	...	...	...	...	...
$Q_{W/SN/H}$	.33	3.14	2	.22	0.00	0	.36	0.00	0	...	...	...
$Q_{W/DE/L}$	.34	5.13	4	.05	29.35*	3	-.42	0.00	0	...	...	...
$Q_{W/DE/H}$	.60	0.00	0	.60	0.00	0	...	...	...	...	...	...
Q_B	...	81.34*	7	...	46.49*	7	...	157.62*	4	...	12.42*	1

Note. Ellipses indicate that no studies or data were available. ES = effect size; B = between; DE = development; L = eighth grade or lower; H = ninth grade or higher; RA = rational; RE = social reinforcement; SN = social norms; T = total; W = within.
* $P < .05$.

mental orientations were mixed in sign but generally positive and significant, and those for programs with rational orientations were mixed in sign and usually not significant. Again, Q statistics show that variation among effect sizes within program orientation classifications was substantial but was apparently lower for the better methodology studies.

Further Analysis of Behavioral Outcomes

The results regarding behavioral outcomes (Table 4) were substantial enough to warrant further analysis of the differential effects obtained. The major question concerns the identification of variables to explain the significant variation among study effect sizes. This question may be addressed by means of the analogue to a

one-way analysis of variance proposed by Hedges and Olkin.¹⁰⁷ The procedure, as employed here, uses the program orientation categories of (1) developmental, (2) rational, (3) social reinforcement, and (4) social norms as the major categories of analysis. If program orientation alone is sufficient to account for the explainable variance, the Q value for "between" will be significant and the Q value for each of the four "within" categories will not be significant. If any of the "within" category Q values is significant, further searching is indicated to locate the other variables that, in addition to program orientation, would account for explainable variance. Such an analysis is also responsive to concerns that research on the effectiveness of school-based smoking prevention programs systematically assesses more than

the main effects associated with program orientation.^{4,11}

Secondary programmatic emphasis represented by codes of 1 for program orientation provided one basis for further subdivision. Three other bases were provided by noting the number of sessions held in the intervention, the grade level of the intervention, and the date of the published article. It has been shown that number of sessions and study effect sizes are positively related,¹⁰⁸ that adolescent smoking prevalence is positively correlated with grade level,⁷ and that adolescent smoking prevalence has declined from the 1970s into the 1980s.¹⁰⁹ Finally, two additional subdivisions were based on results from knowledge and attitude measures, because these may also be related to behavior change.⁷

Tables 5 and 6 present summary-of-fit statistics for behavioral outcomes based on better methodology studies following the analogue to analysis of variance proposed by Hedges and Olkin.¹⁰⁷ Because the analyses reported in Table 6 represent only a portion of those actually performed on further subdivisions of the behavioral effect sizes of the better methodology studies, some explanation of the larger analytic effort is in order. The first analysis was performed for behavioral outcomes at each time of follow-up measurement; only the major program classification was used to define classes for analysis. This effort produced four separate analyses, reported in Table 5. The analysis would have concluded with these four if all within-class Q values were non-significant. However, because some Q values were significant in all four analyses, the analysis continued by subdividing program-based categories at the midpoint of variables shown by the literature^{4,7,108,109} to be related to behavior or behavior change: grade level ($\leq 8, \geq 9$); number of sessions ($\leq 9, \geq 10$); number of secondary program components ($\leq 1, \geq 2$); and year of publication ($\leq 1984, \geq 1985$). A review of all 16 subdivided analyses showed that only subdivision by grade level consistently reduced within-class Q values for behavioral outcomes for the better methodology studies across all four times of measurement. These results are shown in Table 6. Further, although larger effect sizes were always associated with higher grade levels (≥ 9), larger effect sizes were associated sometimes with fewer sessions (≤ 9), fewer secondary program elements (≤ 1), and earlier publication (≤ 1984) and sometimes with

more sessions (≥ 10), more secondary program elements (≥ 2), and later publication (≥ 1985).

Corrected Bonferroni contrasts¹⁰⁷ can be used to assess numerous pairwise differences between effect sizes with appropriately adjusted significance levels.¹⁰⁸ Computation of numerous such contrasts between effect sizes occurring at the same time of follow-up (Table 6) indicated the following: (1) Average weighted behavioral effect sizes for programs with a social reinforcement orientation were always significantly larger than those for programs with a rational orientation when the contrast was based on the same level in school. (2) Average weighted behavioral effect sizes for programs with developmental and social norms orientations were often significantly larger than those for programs with a rational orientation when the contrast was based on the same level in school. (3) The average weighted behavioral effect sizes for programs with a social reinforcement orientation were usually not significantly different from those for programs with social norms and developmental orientations when the contrast was based on the same level in school.

Ideally, as outlined above, the summary-of-fit analysis should show no significant within-class *Q* values. Because some of the within-class *Q* values shown in Table 6 remained significant under the subclassification of grade level and time of follow-up, the effort to find an explanation for significant unaccounted variance turned away from further subdivisions based on variables not successful in consistently reducing heterogeneity and toward a consideration of knowledge and attitude change produced by the intervention.⁷ The assessment of knowledge and attitude change as explanatory variables posed challenges that were met by analyzing data from all studies that assessed knowledge, attitude, and behavior at posttest and at the first follow-up, the only period for which sufficient measures were available for further analysis. Fortunately, for the posttest and first follow-up measures, all programs were junior high (< grade 9) interventions; thus, the major variable consistently accounting for differences in behavioral outcomes beyond the primary theoretical classification was also controlled.

Table 7 presents results for the 14 studies that measured all three constructs at posttest and for the 6 studies that measured all three constructs at the first follow-up. The pattern of analysis adopted was to subdivide the four major classifications first by direction of knowledge outcomes and

TABLE 7—Analysis of Better Methodology Behavioral Outcomes for Junior High Interventions, by Knowledge, Attitude, and Time of Follow-Up

	Knowledge Immediate Posttest			Attitude Immediate Posttest			Knowledge First Follow-Up			Attitude First Follow-Up		
	ES	χ^2	df	ES	χ^2	df	ES	χ^2	df	ES	χ^2	df
<i>Q_T</i>	...	41.21*	13	...	41.21*	13	...	42.33*	5	...	42.33*	5
<i>Q_{W/RA/L}</i>	...	...	...	-.07	2.88	3	...	...	...	-.23	2.08	1
<i>Q_{W/RA/H}</i>	-.03	3.92	5	.05	0.01	1	.16	21.84*	2	.32	0.00	0
<i>Q_{W/RE/L}</i>	...	...	...	...	...	...	...	...	...	...	...	...
<i>Q_{W/RE/H}</i>	.04	0.00	0	.04	0.00	0	.52	0.00	0	.52	0.00	0
<i>Q_{W/SN/L}</i>	...	...	...	.19	0.00	0	...	...	...	...	...	...
<i>Q_{W/SN/H}</i>	.26	0.82	3	.28	0.77	2	...	...	...	...	...	...
<i>Q_{W/DE/L}</i>	...	...	...	...	...	...	...	...	...	...	...	...
<i>Q_{W/DE/H}</i>	.35	2.35	2	.35	1.06	2	.29	8.20*	1	.29	8.20*	1
<i>Q_B</i>	...	34.12*	3	...	36.49*	5	...	12.29*	2	...	31.95*	3

Note. Ellipses indicate that no studies or data were available. ES = effect size; B = between; DE = developmental; H = > 0 mean knowledge or attitude change; L = < 0 mean knowledge or attitude change; RA = rational; RE = social reinforcement; SN = social norms; T = total; W = within. **P* < .05.

then by direction of attitude outcomes. Computed *Q* values for within-group and between-group differences in average weighted effect sizes were then examined to determine whether knowledge or attitude directionality was associated with effect size variation. The results for posttest effect sizes show that attitude directionality provided a better subclassification variable than did knowledge directionality, as in earlier research.⁷ The results for attitude at the first follow-up were even more definitive for programs based primarily on a rational model. Bonferroni contrasts¹⁰⁷ for like attitude categories were significant between rational and social norms effect sizes and between rational and developmental effect sizes for the posttest, and between rational and social reinforcement effect sizes for the first follow-up. The finding that primary program orientation, grade level, and desired attitude change together account for variation in program outcome, although limited by the number of studies producing results necessary for a complete three-way assessment, is nonetheless important.

Discussion

In the terminology outlined in Table 1, traditional orientations to the prevention of adolescent smoking are called rational and the newer orientations are called developmental, social norms, and social reinforcement. The quantitative reviews by Tobler,⁶ Bruvold and Rundall,⁷

and Bangert-Drowns⁸ all indicated that traditional orientations generally produced greater knowledge changes than did the newer orientations taken as a group, but that they generally produced smaller attitudinal and behavioral changes than did the newer orientations taken as a group. The present analysis separated the newer orientations into three groups, as shown in Table 1, and conformed to the five criteria for a defensible meta-analysis set out in the Introduction. The results obtained for knowledge provided support for the earlier observations that rational orientations were effective in changing knowledge. Programs with the newer orientations often contained a knowledge component in the intervention that effectively enhanced knowledge. The results obtained for attitude, although limited by the small number of attitude measures administered in the studies reviewed, provided support for the earlier observations that the newer orientations were more successful in modifying attitudes than was the traditional rational orientation. The results obtained for behavior, supported by the relatively large number of behavioral measures administered in the studies reviewed, gave strong support to the earlier observations that the newer orientations had a greater impact on behavior than did the traditional rational orientation. Further, on the basis of results from the better methodology studies, the present analysis showed that the rational orientation had

very little if any impact on behavior, that the social norms and developmental orientations had approximately the same intermediate impact on behavior, and that the social reinforcement orientation had the greatest impact on behavior. Further analysis of the better methodology studies of junior high interventions suggested that attitude change was related to behavior change, whereas knowledge change was not, as was also suggested by the general pattern of results obtained in this analysis and in the earlier quantitative reviews.⁶⁻⁸

Behavior is the most important of the variables analyzed here and the current findings indicate that intervention programs based on social reinforcement, developmental, and social norms orientations were more effective in preventing adolescent smoking than were those based on a rational orientation. The meta-analysis presented in this paper gave more definitive support for the earlier conclusion⁶⁻⁸ regarding adolescent smoking and are much more substantial than can be provided by selective nonquantitative reviews of the same literature.¹⁰ On the other hand, the present results must not be construed as an argument for short-term tobacco-specific programs rather than comprehensive school- and community-based drug abuse prevention programs.¹⁰ Rather, by indicating which of the tobacco use prevention programs reviewed have had a significant impact during the past 2 decades and which have not, the meta-analytic results are most useful for specifying school-based components for the comprehensive programs recommended.

School districts wishing to include classroom interventions targeting adolescent smoking should consider adopting a social reinforcement program like that initiated by McAlister et al.⁶⁷ A program based on social norms, like that initiated by Coe et al.,³⁸ or on developmental orientations, like that initiated by Botvin et al.,³³ would be viable alternatives. A traditional program based primarily on a rational orientation, like that initiated by Stone,¹⁰¹ should be viewed with skepticism. Such traditional programs, because of easy community acceptance and minimal specialized training, may be better than no program at all; however, the data presented here indicate that rationally based program interventions require substantial revision and further evaluation before their continued application can be recommended with confidence.

The theory of reasoned action proposed by Ajzen and Fishbein¹⁷ and extended to a theory of planned behavior by

Ajzen¹¹⁰ yields some useful guidelines for improving traditional approaches that emphasize information regarding the negative consequences of smoking. According to these theorists, behavioral intention to smoke is determined by one's personal attitude about one's own smoking, by one's individualized social norm regarding smoking, and by one's perceived behavioral control over smoking. Personal attitude is determined by a series of primary behavioral beliefs about the consequences of one's smoking. The individualized norm is determined by a series of primary normative beliefs regarding the perceived recommendation of significant others regarding one's smoking. Perceived behavioral control is determined by a series of primary beliefs involving the power of control factors to influence one's smoking. Interventions directed at adolescent smoking, then, should carefully assess primary behavioral, normative, and control beliefs held by the target group and then move forward with educational exercises specifically designed to substantially modify these beliefs and the attitudes, norms, and perceived controls they produce.^{17,110} Such procedures imply much more individually based instruction, involving experiential learning designed to modify belief structures, than is usually seen in traditional didactic classroom sessions regarding the negative consequences of smoking.

Evaluative research should continue on programs based on social reinforcement, social norms, and developmental orientations to expand knowledge in two important areas. First, it is important to learn, by means of evaluative studies that meet sound methodological criteria, whether the newer programs can be successfully implemented in school districts removed from centers of innovation.⁴ Second, it is important to learn more about the longer term effects of the newer programs. Two recent studies assessed behavioral impacts at the 12th grade of 6th-¹¹¹ and 7th-¹¹² grade interventions and found little behavioral effect on the cohort by the time of high school graduation. Both interventions^{111,112} given this unusual long-term evaluation were represented in the present meta-analysis by several published studies. However, two long-term outcomes are not sufficient to permit definitive conclusions at this time. An even more important research issue than continued long-term follow-up of upper elementary and junior high smoking prevention programs involves the nature and amount of comprehensive early and later high school interven-

tion necessary to produce substantial behavioral impact at the time of high school graduation.¹⁰ □

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