

Simulating Smokers' Acceptance of Modifications in a Cessation Program

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Synopsis

Recent research has underscored the importance of assessing barriers to smokers' acceptance of cessation programs. This paper illustrates the use of computer simulations to gauge smokers' response to program modifications which may produce barriers to participation. It also highlights methodological issues encountered in conducting this work. Computer simulations were based on conjoint analysis, a consumer research method which enables measurement of smokers' relative preference for various modifications of cessation programs.

Results from two studies are presented in this paper. The primary study used a randomly selected sample of 218 adult smokers who participated in a computer-assisted phone interview. Initially, the study assessed smokers' relative utility rating of 30 features of cessation programs. Utility data were used in computer-simulated comparisons of a low-cost, self-help oriented program under development and five other existing programs. A baseline version of the program under development and two modifications (for example, use of a support group with a higher level of cost) were simulated. Both the baseline version and modifications received a favorable response vis-à-vis comparison programs. Modifications requiring higher program costs were, however, associated with moderately reduced levels of favorable consumer response.

The second study used a sample of 70 smokers who responded to an expanded set of smoking cessation program features focusing on program packaging. This secondary study incorporated in-person, computer-assisted interviews at a shopping mall, with smokers viewing an artist's mock-up of various program options on display. A similar pattern of responses to simulated program modifications emerged, with monetary cost apparently playing a key role. The significance of conjoint-based computer simulation as a tool in program development or dissemination, salient methodological issues, and implications for further research are discussed.

IN A RECENT ARTICLE, Fiore and colleagues (1) conclude that smoking cessation programs serve a limited but important public health role. They suggest that public health benefits accruing from cessation programs may be constrained by barriers to their use. Prominent barriers cited include factors reducing program acceptability, such as poorly targeted promotions and unacceptable costs. Consumer research methods may be utilized to evaluate factors influencing the acceptability of a specific cessation program *before* the program is disseminated. This paper presents a method for simulating smokers' relative preferences for several versions of a given cessation program. Specifically, this paper has two purposes. The primary purpose is to illustrate the use of computer simulations in the investigation of smokers' responses to various ver-

sions of a smoking cessation program. The second purpose is to highlight key methodological issues encountered in the preliminary applications of computer simulations.

The computer simulations described in this paper illustrate how adding or deleting a specific element of an individual program may affect consumer response. The program selected for simulation was a low cost, self-help oriented intervention. Modifications of key interest (such as adding a support group) were ones that could potentially enhance efficacy but also could reduce acceptability due to higher costs or the incompatibility of modifications and consumer preferences.

Conjoint analysis served as the basis for the computer simulations illustrated in this paper. This analytic procedure and its rationale were described

in an earlier report (2). It is derived from mathematical psychology and psychometrics, and it facilitates measurement of the *relative value* consumers place on a program (3,4). Such measurement is achieved by analyzing how attributes and benefits are evaluated when considered jointly rather than one at a time (2-4). When considering program modifications, conjoint analysis thus enables assessment of the combination of attributes and benefits ideally emphasized in promotions with specific consumer groups (5).

The computer simulation studies reported in this paper were part of a research effort designed to facilitate the development of a cessation program which could be readily modified to appeal to different consumer groups. A summary of related studies of consumers' preferences (for example, focus group study) (6), an evaluation of preferences associated with stage of quitting (7), and program preferences of employee benefit managers representing a variety of worksites (8) are detailed elsewhere.

Summary of Relevant Literature

The rationale for applying conjoint analytic simulation procedures to study the development of health promotion programs derives from numerous sources (6). Literature from multiple disciplines spanning several decades addresses the significance of preferences or judgments in choice behavior (9,10). Arguments for the evaluation of consumers' preferences and choices can be found in the literature on exchange theory (11,12), expectancy value theory (13), diffusion theory (14), social marketing research (15-18), consumer choice models (19-21), and cost-effectiveness research (22).

Exchange theory (11,12) suggests that health program consumers attempt to maximize the benefit or utility of a given program-related exchange or transaction. This implies that it is helpful to understand consumers' values and preferences when designing services or programs, particularly those targeted at specific segments of the consumer population. Consistent with this tenet, expectancy value theories (13) emphasize the influence of values associated with perceived outcomes of healthful behavior in decisions to perform such behaviors.

Similarly, Rogers (14) contends that characteristics of innovations, such as perceived relative advantages and perceived complexity, influence their rate of adoption. These characteristics can be operationalized in terms of specific features or

attributes of innovations and subsequently investigated among targeted users. Additionally, Lefebvre and Flora (17) advocate maximizing consumer participation in specific health promotion programs through formative consumer research which guides an effective marketing mix of the four p's—product features, price, place, and promotion.

Several researchers (19,21) indicate that certain models of consumer choice offer a number of practical advantages in designing specific services and products. One example is the "profile" approach to choice modeling used in conjoint analysis. A profile method examines respondents' evaluation of groups of attributes representing a product or service rather than their assessment of single attributes. This type of approach is especially appropriate in the study of complex, multiattribute programs such as those in the health promotion area (24). Conjoint analysis is an efficient method to estimate consumer response to the addition or deletion of specific features in modifications of complex programs (23).

The development of smoking cessation programs that can be modified to increase their appeal to consumers with varying needs is particularly important. In a review of the literature concerning the cost effectiveness of cessation programs, Elixhauser (21) concludes that it is important to assess a program's appeal to enhance cost effectiveness. She also notes that programs that target a specific segment of smokers are more likely to be cost effective. These conclusions complement other researchers' claims that American smokers have yet to profit fully from the substantial progress made in identifying techniques and treatments effective in smoking cessation (1,25). Lagging benefits are apparently related to the fact that most smokers find formal programs unappealing; they are unwilling to attend formal programs or prefer to quit on their own (1,26-29). The objective of the programmatic research effort of which the following studies were a part was to develop an appealing, flexibly applied, self-help oriented set of smoking cessation materials that could be adapted for use in support group sessions.

Methods

Subject selection. In the primary study, subjects currently smoking and interested in quitting were randomly selected from four cities identified through the 1980 U.S. census report, with each providing approximately 25 percent of the subjects. Similar to procedures for an earlier survey (6), one

city from each of the four major census regions defined by the 1980 census reports was selected, based on the degree to which its population characteristics matched those of the U.S. population.

To select individual subjects, a random numbers table was used to identify a series of pages from each city's telephone directory, and every tenth number on these pages was selected for a call. Calls were placed during both daytime and evening hours. Following these procedures, 1,852 households were reached. In 1,289 of these, respondents stated that no smoker resided there. Of the 563 households with smokers in residence, 335 (59.5 percent) had smokers who declined to respond, indicating they were not interested in quitting or they did not want to be interviewed. There was thus a total of 228 respondents. Survey data from 10 of these respondents were unusable because of incomplete responses.

Subjects ($N=70$) in the second study were recruited at several locations in an urban shopping mall. Research assistants were specifically trained to approach potential subjects at random in the various mall locations. Although prior studies showed that the demographic composition of visitors to this mall matched that of the State's population, selection procedures yielded a younger sample than that selected for the primary study.

Description of subjects. Demographic data on 129 subjects in the primary study revealed that 62.8 percent were female. Approximately 38 percent stated they were between 18 and 34 years of age, 43 percent were between 35 and 54, and 18 percent were 55 or older. Approximately 68.7 percent of the subjects reported being married. (Note: a computer programming error caused the loss of demographic data on 89 of the 218 subjects.)

Smoking history data were available on all subjects in the primary study. Guidelines for classifying these smokers according to their stage of quitting were obtained from Prochaska and colleagues (30,31). Smokers categorized as precontemplators stated that they were generally interested in quitting but not seriously intending to quit in the next 6 months; smokers categorized as contemplators stated that they were seriously intending to quit within the next 6 months. Smokers who stated that they were seriously intending to quit in the next month, and that they had tried to quit within the previous year were classified as contemplators "ready-for-action." Based on these classification guidelines, 82 (37.6 percent) were precontemplators, 67 (30.7 percent) were contemplators, and 59

(27.1 percent) were contemplators ready-for-action. Incomplete data from the remaining subjects did not allow classification into these categories.

Demographic data collected from the 70 subjects in the secondary study revealed that 65 percent were between 18 and 34 years of age, 17 percent were between 35 and 44, and 12 percent were older than 44. Seventy-one percent of respondents were male, and 31 percent of all respondents reported being married. Subjects were classified according to stage of quitting as follows: 31 (44.3 percent) were classified as precontemplators, 23 (32.9 percent) as contemplators, and 16 (22.9 percent) as contemplators ready-for-action.

Instrument development. A number of researchers have stressed the importance of carefully selecting attributes for conjoint study (19,32,33). Thus, a series of formative research studies was used to select attributes for inclusion in conjoint simulation procedures. A survey of a random sample of 205 adult smokers' preferences for cessation programs (6) was particularly helpful in this regard. Accordingly, the research team critically evaluated a list of program attributes derived from formative research along several dimensions, including consistency with available data, clarity, and viability in terms of interview time limits. In addition, expert smoking cessation researchers were consulted to determine the most appropriate attributes.

In the primary study, the following program attributes and specific attribute levels (in parentheses) were evaluated:

- program cost (\$19, \$49, \$99);
- program duration (lasts 2 weeks after quitting, 6 weeks, 3 months, 6 months);
- stress management components (program emphasizes ways to control stress versus program does not address stress);
- weight control components (program emphasizes methods to avoid weight gain versus program does not address those methods);
- research base (based on extensive research versus not based on extensive research);
- method of nicotine reduction (eliminates smoking all at once without a gradual reduction, reduces nicotine gradually by using disposable filters, reduces gradually by cutting the number of cigarettes, reduces gradually by switching brands);
- reward techniques (emphasizes ways to reward self versus does not emphasize these);
- format flexibility (flexible, with a variety of personal options versus fixed for all participants);

Researchers have stressed the importance of selecting attributes for conjoint study. A series of formative research studies was used to select attributes for inclusion in conjoint simulation procedures.

- behavioral alternatives (emphasizes ways to find healthful substitutes versus does not emphasize these);
- methods of social support (program participant can telephone trained counselor as needed, program supplies tip list about gaining social support, program uses support group);
- types of techniques emphasized in program (preparation techniques versus maintenance techniques); and
- program endorsements (by ex-smokers versus doctors).

In the secondary study, an expanded set of attributes was used. These attributes were primarily ones that could be physically displayed. They were derived from formative research on the program under development and on features of cessation programs generally appealing to smokers. The set of attributes evaluated in this study included the availability of program extras such as a refrigerator magnet, a quit pin, cards to monitor participants' level of confidence in quitting, a success board (a device that guides recognition and rewards of step-by-step progress in quitting and staying quit), and a reward envelope (to hold the money saved by abstinence which is given to a support person, to be used in purchasing a reward for staying quit).

In addition, other attributes evaluated in this study included preferred colors of program materials, variety in colors, inclusion of cessation and maintenance tip sheets, type of package (for example, pocket folder, three ring binder), serial delivery of programs, size of program materials, and the program's vendor (for example, employer, physician, health club). Displays illustrated the relevant additional attributes. Finally, the remainder of the attributes in the secondary study paralleled those in the primary study. Some of these included an expanded set of attribute levels (for example, costs of \$20, \$40, \$60, \$80, and \$100). Thus, a total of 25 attributes, which consisted primarily of attributes used in the primary study, and the afore-

mentioned display-relevant attributes, were evaluated in the secondary study.

Computer software. A discussion of the software used to gather and analyze the data for both the primary and secondary studies can be found in a paper by Johnson (5). Use of this software allows examination of a large number of attributes and attribute levels while minimizing respondents' fatigue. As the interview progresses, the software custom designs it for each respondent, based on his or her earlier responses in the interview. Attribute comparisons are then chosen to "fine-tune" the utility estimates with a minimum number of comparisons. Specifically, a least squares regression updating algorithm is used to estimate the utility of various attributes and to identify subsequent comparisons that will yield the most information about respondents' preferences. Since the administration of the interview is guided by the computer, an advantage of this software is that interviewer and data entry errors are minimized.

Although the particular studies detailed in this paper employed computer software, conjoint analyses can be conducted with paper and pencil measures as well (3,4,19). A typical procedure would require respondents to rank order a set of program or product profiles. If the number of possible combinations of attributes is relatively small, all combinations are included; however, if the number of possible program or product configurations is large, a subset is created for data collection purposes (4,19).

Interview ranking and scaling tasks. Interviews in both the primary and secondary studies were conducted in five phases; these phases were essentially those used in a study of employee benefit manager preferences at various worksites (8). During the first phase of the interview, respondents rank ordered preferences for attributes of smoking cessation programs. In the second phase, they indicated relative preferences for two hypothetical programs, "A" and "B," each consisting of two attributes selected by the computer from the previous rank orderings. In the studies reported in this paper, the respondents had four choices: "I would ALWAYS choose A over B," "I prefer A; might accept B if combined with other important features," "I could accept either A or B," "I would not consider this difference in my decision."

During the third phase, respondents used a nine-point scale to indicate how strongly they

Table 1. Parameters used in simulations of program under development and comparison programs in primary study

Attribute	Program under development ¹	Comparison programs				
		Program 1	Program 2	Program 3	Program 4	Program 5
Length, week	6	3	2	9	2	8
Cost	\$19	\$140	\$10	\$60	\$19	\$300
Type of support	Self-help	Group	Group	Group	Self-help	Group
Research	Yes	Yes	Some	Yes	No	No
Weight control	Yes	Some	Some	Yes	Some	Some
Fixed-flexible	Flexible	Between	Flexible	Flexible	Fixed	Between
Stress control	Yes	Some	Some	Yes	No	Some
Rewards	Yes	Yes	Yes	Yes	Some	Some
Endorsements	Ex-smokers	Ex-smokers	Ex-smokers	None	Ex-smokers	Ex-smokers
Nicotine reduction	Cut cigarettes	Cut cigarettes	Cut cigarettes	Brand switch	Cut cigarettes	Cut cigarettes
Healthful substitutes	Yes	Yes	Yes	Yes	Some	Yes

¹ Baseline version of program modified for study that was originally designed to be consumer utility-responsive. This table is adapted from information presented in an article on smoking cessation preferences associated with stage of quitting,

reference 7.

NOTE: Preparation versus maintenance was "both" for all 6 programs.

preferred two different "stop smoking programs," each having two attributes selected from prior responses. In the fourth phase, respondents used a 100-point scale to rate a three-attribute program, generated by the software using prior ratings, to further refine estimates of the utility of various attributes. Finally, respondents answered demographic and smoking history questions.

Simulation models. A description of these models was originally presented by Johnson (5) and briefly summarized in earlier reports (7,8). To begin, it should be noted that the simulation models yield estimates of consumers' response ratings or "market shares" that a program will receive. These estimates are based upon attribute utilities derived from the ranking and scaling tasks completed by respondents during the conjoint interview, using least squares regression procedures.

A sample of the highest utility attribute levels in the primary study illustrates the utility values that result from these procedures. The highest average utility values associated with specific attribute levels were as follows: costs \$19 ($\bar{X}=95.77$, standard deviation [SD]=37.97), program is based on extensive research ($\bar{X}=82.99$, SD=45.11), program lasts 6 weeks after quitting ($\bar{X}=78.73$, SD=39.66), and program emphasizes ways to control stress ($\bar{X}=75.43$, SD=45.58).

In both the primary and secondary studies, utility values were used to analyze two types of simulations of the data, specifically, "first choice" and "share of preference" models. The first choice model assumes respondents will always choose the program with the highest utility and provides an estimate of the percentage of respondents likely to

Table 2. Parameters used in support group and nicotine filter modifications of baseline program in primary study

Program version	Modifications		
	Cost	Support group	Nicotine filters
Baseline program	\$19	No	No
Baseline with enhanced social support	\$69	Yes	No
Baseline with enhanced nicotine reduction	\$39	No	Yes

NOTE: All other parameters for the 3 versions of the program remain the same as given in table 1.

have a given program as their first choice. In contrast, the share of preference model estimates a likely consumer response for a given program based upon the assumptions that (a) consumers often fail to make the detailed calculations required in assessing utility values and (b) programs are frequently so similar that consumers cannot clearly distinguish among them. The share of preference model adjusts for this reality by assigning non-zero preference shares to all programs according to their total utilities, thereby allowing similar programs to share similar probabilities of being chosen. Finally, this model includes a correction to prevent preference shares of similar programs from being exaggerated or overstated.

Simulations of consumer response require the selection of parameters and parameter values to represent given programs. Parameter values can be interpolated within the endpoints of the specified range of values actually used in the survey and extrapolated beyond the endpoints of that range.

In both the primary and secondary studies, the smoking cessation program under development was

Table 3. "First choice" and corrected "share of preference" ratings in primary study: comparison of modifications in program under development and existing programs

Simulations	Comparison programs											
	Program under development		Program 1		Program 2		Program 3		Program 4		Program 5	
	Rating	SE	Rating	SE	Rating	SE	Rating	SE	Rating	SE	Rating	SE
Baseline version:												
First choice	75.7	2.9	0.0	0.0	11.0	2.1	9.2	2.0	3.2	1.2	0.9	0.6
Share of preference	49.2	1.4	4.3	0.3	18.2	0.8	19.8	1.0	6.6	0.5	1.9	0.4
Baseline with enhanced support:												
First choice	54.1	3.4	0.0	0.0	29.4	3.1	11.5	2.2	4.1	1.3	0.9	0.6
Share of preference	37.0	1.1	5.0	0.3	23.8	1.0	23.1	1.0	9.1	0.6	2.2	0.5
Baseline with enhanced nicotine reduction:												
First choice	53.2	3.4	0.0	0.0	28.9	3.1	13.3	2.3	3.2	1.2	1.4	0.8
Share of preference	41.1	1.4	4.9	0.3	22.7	1.1	21.9	1.1	7.5	0.5	2.0	0.4

NOTE: SE = standard error. Support group, filter and cost-related parameters and values are changed only for the program under development; all other programs' parameters and values were held constant (see table 1). A comparison of the total sample simulation results for the baseline program (data rows 1 and 2) with stages of quitting results is given in reference 7.

Table 4. Parameters used in modifications of baseline program in secondary study¹

Program version	Modifications					
	Cost	Support Group	Nicotine filters	Confidence cards	Reward envelope	Success board
Baseline program	\$19	No	No	No	No	No
Baseline with enhanced support	\$69	Yes	No	No	No	No
Baseline with enhanced nicotine reduction	\$39	No	Yes	No	No	No
Baseline with confidence cards and reward envelope	\$19	No	No	Yes	Yes	No
Baseline with success board and reward envelope	\$19	No	No	No	Yes	Yes

¹ All other parameters for the 3 versions of the program remain the same as in table 1.

compared with five other types of programs. The set of parameters for the program under development was based on evaluation of pilot materials designed through a series of formative research studies, which guided the design of a consumer-oriented, utility-responsive program (6). The other five sets of program parameters were based on an evaluation of programs already in use in the geographic area where the cessation program was being developed. These five programs were chosen because they represented (a) a cross-section of programs differing on key attributes of interest (cost, duration, use of support groups) and (b) the primary types of programs available in the geographic area targeted for initial dissemination of the program under development.

To determine parameters for computer simulation of these five programs, the researchers consulted with the director of smoking interventions in a State affiliate of a national nonprofit health association. In specific cases where parameters were

unknown, or irrelevant to a given program, "best guess" or neutral values were assigned. The program parameters used in computer simulations were thus rough representations of existing programs.

Table 1 outlines the specific attribute-based parameters used in the consumer response simulations for a baseline version of the program under development and the representations of the five existing programs (programs 1-5). Labeling the baseline version as such is intended to convey that it was the basic or core version used as the point of departure in the simulation of potential program adaptations or modifications.

Results

Simulations of response to program modifications in the primary study. Simulation ratings are intended to reflect the likely percentage of consumers who would purchase or participate in a specific

smoking cessation program when choosing from among all those represented. Ratings are given on a 0-100 scale, with the total across all six programs rated adding to 100. Standard errors for these ratings are also calculated.

Two specific program modifications of the program under development were tested. The first modification entailed the addition of a support group at a total cost of \$69 (representing an increase in cost of \$50). The second modification—a self-help format—added a nicotine filter kit, at a total cost of \$39 (an increase of \$20). Table 2 outlines the parameter changes required for these program modifications.

Table 3 presents the first choice and share of preference ratings associated with the baseline version of the program under development and its two modifications, compared with the five representations of existing programs, and thereby illustrates the type of information obtained from conjoint-based computer simulations. For instance, it shows that the low-cost, self-help oriented program under development received the highest ratings across all three program versions when using both first choice and share of preference simulation models. However, modifications in this program that require a higher cost reduced ratings. In the case of the share of preference ratings, these reductions were relatively moderate. Also, the most costly of the two modifications shows the greatest reduction in ratings. The reduction was not, however, proportional to the increase in cost. As indicated by the share of preference analysis, most of the reduction associated with the support group modification is reflected in gains by program 2. This program had the lowest cost of those offering group support (table 1).

Simulations of response to modified programs in secondary study. Similar to the primary study, attribute-based parameters and values were determined for simulation analyses. Attribute levels that were similar across the two studies were given the same values (table 1); values for the extended set of attribute levels enumerated in the instrument development section were also determined. Table 4 outlines parameters used in simulating multiple versions of the program under development. Table 5 provides the consumer response that each program version would likely achieve when compared with the representations of five existing programs. To indicate that the comparison programs simulated parallel those in the primary study but incorporate

several additional attributes, they are labeled programs 1A through 5A.

Two cost-relevant modifications in the program under development were tested: incorporating a support group, at a total program cost of \$69, and using filters to reduce nicotine, at a total program cost of \$39. Several of the “extras” that could be included without increasing the fee charged for the program were also tested to determine their likely impact on consumer response. Specifically, inclusion of two combinations of program extras was evaluated. One combination incorporated confidence monitoring cards and the reward envelope, and another combination incorporated the reward envelope and the success board.

For the most part, table 5 shows a pattern of changes in ratings associated with program modifications that are similar to those evidenced in the primary study. However, in the secondary study, the degree of rating differences between the baseline version and the two versions requiring increased costs (support group and nicotine filters) is somewhat less than that in the primary study. Also, modifications that did not require increased charges (including the program’s extras noted previously) resulted in substantially higher ratings.

Discussion

Significance of studies. The results of the two exploratory studies reported in this paper illustrate computer simulation of consumer response to specific smoking cessation program profiles and selected modifications of the profiles. This type of simulation can be especially helpful in better understanding consumers’ likely acceptance of possible modifications or adaptations of a program under development. Computer simulations further understanding of consumer acceptance issues by quantifying and clarifying possible tradeoffs in program design and delivery. For example, in the primary study, the support group modification raised the program cost by more than 260 percent and reduced the share of preference rate by approximately 25 percent, while the nicotine filter modification increased cost by more than 105 percent and reduced the share of preference rate by approximately 16 percent.

As another example, data from the secondary study indicated the potential benefit of modifications not requiring an increase in program costs to consumers (for example, program extras like confidence cards). Information on such tradeoffs relevant to consumer acceptance can supplement data

on program efficacy when making decisions about program design and delivery. Since simulations can be conducted among population subgroups, they can facilitate decisions specific to these subgroups.

The significance of these results is highlighted by the magnitude of the problem addressed. The documented health consequences of smoking (29,34) and the prevalence rate of smoking in this country underscore the importance of measures that effectively facilitate smoking cessation efforts across the entire smoking population.

Especially worthy of note are Fiore and colleagues' (1) findings that support the need to carefully evaluate the acceptability of a cessation program to its target consumers. A premise in the line of research of which this study is a part is that cessation programming should be user or consumer-utility responsive (4) in addition to having a sound base of outcome research. The relatively low proportion of ex-smokers reporting the use of cessation programs to quit, barriers to the acceptance of programs, and the limited dissemination of programs (1,25,35) highlight the need for more consumer-responsive programming.

Limitations and methodological issues. Care was taken that a reasonable level of confidence in the accuracy of the results could be achieved, at least in consideration of the exploratory objectives of this research. For example, in the case of dichotomous variable responses, a sample size of 218 (such as in the telephone conjoint study) yields a maximum expected error of 6.8 percent at a 95 percent confidence level in analyses that do not segment the sample (assuming a normal distribution approximation of dichotomous responses). The small sample size and the sample selection procedures of the secondary study place an obvious limit on the degree to which those particular results can be generalized. From this perspective, their primary value is in complementing the telephone survey results.

The telephone survey in the primary study also shares limitations often associated with this type of research. First, smokers in telephone-owning households may differ in significant ways from those in households not owning telephones, since smokers with a lower socioeconomic status are less likely to own phones. This is probably a minimally biasing factor, however, given the low percentage of U.S. households without phones (36). Related to this point, there is no way of knowing whether smokers in households with unlisted numbers differ significantly from smokers in households with listed numbers.

Second, respondents in the primary study were those who (a) answered affirmatively when asked if they had *any* interest in quitting smoking and (b) were otherwise willing to complete the survey. The number of smokers refusing the interview raises questions about the representativeness of the survey sample. For example, the majority of those smokers refusing the interview might be in the precontemplative stage of quitting (30,31) or otherwise inclined to express an even higher utility for lower cost smoking cessation programs. This particular concern is reduced somewhat by the fact that the percentage of respondents classified as precontemplators in this study is comparable to that in the general population.

As a result of financial and temporal constraints on the primary study, single contact procedures were chosen, which may limit the representativeness of the sample. However, to mitigate such a limitation, calls were placed during both daytime and evening hours, to include representation of night workers and others not home in the evening hours.

Methodological limitations and issues specific to conjoint analysis and computer simulation procedures are also important to consider. First, accuracy of computer simulation results depends upon inclusion of all attributes significantly affecting respondents' decisions. It is difficult to know for certain that all such attributes have been included. However, this potential problem was addressed by formative research preceding the design of the conjoint experiments (6). The probability of missing important attributes may have been reduced by information gathered through literature reviews, results of an earlier random sample preference survey, and a range of qualitative (for example, focus groups) and preliminary quantitative studies (for example, small sample surveys), which served as a guide for the attributes selected for these studies.

Perhaps the most notable attribute omitted from this research is the program's efficacy. The primary reason it was not included is an empirical one: in the wide ranging formative research studies cited previously it did not emerge as a primary factor in program appeal. This is consistent with other research indicating that the most effective interventions are not necessarily those which are most appealing to consumers (37).

Similarly, previous pilot research suggested that smokers' preferences for programs revolve primarily around attributes not related, or only indirectly related, to cessation techniques (for example, monetary cost, convenience, weight control issues, stress management). However, since it is possible

Table 5. "First choice" and corrected "share of preference" ratings in secondary study: comparison of modifications in program under development and existing programs

Simulations	Comparison programs											
	Program under development		Program 1A		Program 2A		Program 3A		Program 4A		Program 5A	
	Rating	SE	Rating	SE	Rating	SE	Rating	SE	Rating	SE	Rating	SE
Baseline version:												
First choice	72.9	5.3	0.0	0.0	7.1	3.1	18.6	4.6	0.0	0.0	1.4	1.4
Share of preference	51.8	3.2	4.0	0.6	12.8	1.2	20.8	2.1	5.9	0.8	4.7	1.4
Baseline with enhanced support:												
First choice	60.0	5.9	0.0	0.0	14.3	4.2	21.4	4.9	2.9	2.0	1.4	1.4
Share of preference	41.5	2.8	4.3	0.6	16.3	1.5	24.9	2.1	8.1	1.3	4.9	1.4
Baseline with enhanced nicotine reduction:												
First choice	61.4	5.8	0.0	0.0	12.9	4.0	24.3	5.1	0.0	0.0	1.4	1.4
Share of preference	43.3	3.2	4.3	0.7	15.9	1.7	24.8	2.3	6.8	0.8	4.9	1.5
Baseline with confidence cards and reward envelope:												
First choice	92.9	3.1	0.0	0.0	0.0	0.0	5.7	2.8	0.0	0.0	1.4	1.4
Share of preference	64.5	3.1	3.4	0.6	9.3	0.9	14.5	1.6	4.8	0.7	3.5	0.8
Baseline with success board and reward envelope:												
First choice	91.4	3.3	0.0	0.0	1.4	1.4	5.7	2.8	0.0	0.0	1.4	1.4
Share of preference	64.4	3.1	3.4	0.6	9.3	1.0	14.3	1.5	4.8	0.7	3.8	1.0

NOTE: SE = standard error. Modification-related parameters and values are changed only for the program under development; all other programs' parameters and values were held constant (see table 1). A comparison of total sample

simulation results for the baseline program (data rows 1 and 2) with stages of quitting results is given in reference 7.

that methodological limitations in the series of formative research studies resulted in a failure to demonstrate the importance of program efficacy in smokers' preferences, some further points for consideration should be made.

The research base and endorsement attributes may represent meaningful, though proxy, indicators of program efficacy. For example, in a study of employee benefit managers at various worksites (8), program success rates were included in an attribute set because formative study supported their significance. The attribute set of success rates incorporated an attribute level presented to respondents as a "new program based on research." Findings revealed that the research base attribute level had a utility value much higher than a "success rate of 25 percent," though lower than a "success rate of 50 percent."

It is noteworthy that the measurement of consumer response to efficacy of a program is problematic because of the variation in the empirical bases for success rates publicized by vendors. These variations result in consumer exposure to inflated rates for programs that fail to use stringent outcome criteria. Because of this phenomenon and related consumer expectations, it is reasonable to

assume that realistic efficacy attribute levels would likely be associated with relatively lower utilities, especially when evaluated conjointly with a variety of other attributes, including program cost.

Another methodological limitation of the studies reported in this paper concerns the fact that the predictive validity of simulation results was not tested directly. At best, results illustrate what might be predicted of consumers' response to programs closely matching those represented by the parameters presented in table 1. A factor that influences the predictive power of conjoint-based computer simulation is the degree to which all program characteristics are accurately and completely defined. Some attributes (for example, cost or amount of time) are more readily translated into specific values for conjoint analysis than are others (for example, level of emphasis on stress management).

Another factor that affects predictive power is the degree to which all alternative programs of relevance are included in the simulation models. The response levels obtained from the simulations are those that would be theoretically realized from smokers who consider one of the six alternatives to smoking cessation represented in the studies re-

'The documented health consequences of smoking . . . and the prevalence rate of smoking in this country underscore the importance of measures that effectively facilitate smoking cessation efforts across the entire smoking population.'

ported here. Conjoint analysis may overstate the level of response if other program options deemed less relevant (such as hypnosis) were sufficiently appealing to smokers in the locality where the program under development was offered. As previously noted, a judgment call was made concerning the primary programs of relevance in the geographic area targeted for the initial dissemination of the program.

A further note on the role of the cost attribute is in order. Two programs simulated in both studies had costs beyond the range used in the respondents' interviews. Although it is acceptable to extrapolate from this range for simulation purposes under certain circumstances, a clear understanding of the role of high program cost warrants further data analysis. Such analysis could investigate, for instance, the simulated effects of step-wise reduction in the price of higher cost programs while all other parameter values are held constant. These cost-related effects could be assessed across the total sample as well as in subsamples defined on the basis of cost preference (for example, two subgroups based on preference for low and moderate cost programs). Nonetheless, given the additive model used in these analyses and the complex, multiple attribute programs tested, the role of cost in and of itself is likely constrained, despite the higher utility values associated with it.

Finally, further discussion of issues concerning reliability, validity, and the use of additive models for utility value estimation is warranted. Conjoint analysis has been used extensively and tested with considerable success in a wide variety of commercial applications (32). Further, conjoint analysis should be a valid and reliable procedure when used to assess consumer response to health care service programs (38).

Although reliability and validity issues should be evaluated with respect to specific applications of conjoint analysis, a number of researchers have addressed these issues in a more general way (23,39-43). Overall, conjoint analysis has been

found to have acceptably high reliability; there is also some support for reasonable predictive validity, though further research is required in this area. Moreover, reliability and validity may be enhanced by computer interactive data collection procedures similar to those used in the present studies (23). Also, the linear additive model used in conjoint utility value estimation has proven to be fairly robust, particularly in the absence of evidence suggesting probable effects of attribute interactions (3,39, 43, 44).

Future directions. As already noted, the conjoint-based computer simulation studies presented in this paper were part of a multi-stage, programmatic research effort that attempts to integrate studies of consumer choice with research on the outcomes of health promotion programs (2,45,46).

The first stage in this approach to program development and evaluation entails applying findings from the relevant outcome literature to decisions about parameters of the program that are consumer utility-relevant (for example, target audience, types of behavior change strategies, mode of delivery or presentation). Subsequently, after the identification of a comprehensive, working set of program attributes relevant to potential consumers, a subset of key attributes for conjoint analysis is selected (2). These initial steps have been taken in developing the current program.

The next stage of research activity could focus on the application of results to further development or revision of program materials; these materials can then be experimentally tested for both efficacy and consumer appeal. The validity of the results presented in this paper could then be further assessed.

The extensive literature on conjoint analysis, utility judgments and choice behavior, as well as that on social marketing and user-oriented approaches to health promotion, highlight the need to explore application of computer simulations of health promotion programs. Such applications could help to meet some of challenges in the development and dissemination of health promotion programs partially created by their inherent complexity (24,45-48) and the related difficulty in accurately evaluating preference judgments (49,50).

Nonetheless, the research reported in this paper serves primarily to illustrate the use of conjoint-based computer simulation of smokers' response to modifications of cessation programs and highlight relevant methodological issues. Future research is necessary to establish the benefits of integrating

computer simulation procedures with accepted methods of program development and evaluation research.

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Serum Cholesterol Concentrations Among Navajo Indians

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Glenn Tso, Treva McKinley, Laria Benally, Roselyn O'Donnell, MLT, and William Tool, MLT, of the Shiprock PHS Laboratory staff were among those who obtained the serums and performed the chemistry analyses.

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Synopsis

Navajo Indians have been reported by earlier investigators to have low concentrations of serum lipids and a low prevalence of hyperlipidemia, as well as low rates of ischemic heart disease. However, no data on serum lipid concentrations among

Navajos have been reported for more than two decades. The authors conducted a study to determine the distribution of concentrations of serum total cholesterol (TC), high density lipoprotein cholesterol, low density lipoprotein cholesterol, and triglyceride among persons 25-74 years old living in a representative community on the Navajo Indian reservation. Data are reported for 255 subjects, 105 men and 150 women, ages 25-74 years. The authors compared these data to those for the general population as determined by the second National Health and Nutrition Examination Survey (NHANES II).

TC concentrations among Navajo men were similar to those from NHANES II. TC concentrations among younger Navajo women were similar to those for women younger than 55 years from NHANES II, but were significantly lower among older Navajo women. While 27.6 percent of men ages 25-74 years studied in NHANES II had TC concentrations greater than 240 milligrams per deciliter, 33.8 percent of Navajo men had similarly elevated TC. However, the prevalence of serum TC concentrations greater than 240 milligrams per deciliter among Navajo women (17.5 percent) was about half that among women studied in NHANES II (32.9 percent). A similar pattern was found for low density lipoprotein cholesterol.

The researchers concluded that Navajo Indians are no longer characterized by low serum lipid