IS STAGE-OF-CHANGE A USEFUL MEASURE OF THE LIKELIHOOD OF SMOKING CESSATION?[1]

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ABSTRACT

We compared two stage-of-change models that differentiate smokers by their level in the quitting process. The original 1983 model by Prochaska and DiClemente (1) divided smokers first by relapse status and then by intention to quit; their revised 1991 model (2) reversed the primacy of these factors. No published data justify whether the revision improves prediction of cessation. We used data from a population-based panel of 1,921 smokers interviewed in 1990 and 1992 for the California Tobacco Surveys. Model variables (quitting intention and recent quitting history) were used in a logistic regression to predict 30-day or longer cessation at follow-up and quit attempts made during the year preceding the survey. Predictive power of the revised model was not better than predictive power of the original model. New approaches to differentiating smokers on likelihood to quit should emphasize quitting behavior rather than intention to quit.

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INTRODUCTION

Prochaska and DiClemente have presented their transtheoretical model as a comprehensive model of behavior change (1,3–6). As currently formulated, the transtheoretical model consists of 15 components: ten processes of change (e.g. catharsis, counterconditioning) (1,2,7–9) derived from a variety of psychotherapeutic approaches (e.g. behavioral, psychoanalytic); two variables that represent the person's decisional balance toward a potential change in behavior (i.e. pros versus cons) derived from Janis and Mann's model of decision-making (10–12); two variables that represent the person's self-efficacy to change the behavior (i.e. confidence versus temptation) derived from Bandura's social learning theory (2,13–18); and the person's stage-of-change (e.g. precontemplation) in the process of modifying the target behavior. The key construct in the transtheoretical model is the person's stage-of-change which Prochaska et al. (19) consider to be the underlying dimension that integrates the effects of the remaining 14 components included in their model. The use of stage-of-change as a stand-alone predictor of smoking cessation (20), as the sole stratification variable for matching intervention to clients in recent smoking cessation intervention trials (21), and as the interim outcome measure to chart progress toward smoking cessation (22) clearly demonstrate the central role assigned to this construct in the transtheoretical model. In addition, stage-of-change has also been applied to a broad range of behaviors including smoking cessation, quitting cocaine, weight control, high-fat diets, adolescent delinquent behavior, safer sex, condom use, sunscreen use, radon gas exposure, exercise acquisition, mammography screening, and physicians' preventive practices with smokers (19).

The primary support for the stage-of-change construct comes from a series of retrospective, cross-sectional, and longitudinal studies of how people quit smoking on their own (1,2,11,12,16,17,19,23). As can be seen in the first four studies listed in Table 1, current smokers were classified as either a "Relapser," a "Contemplator," or an "Immotive" on the basis of quit attempts in the previous year and quitting intentions in the next year. The relapse category contains those current smokers who are most advanced in the cessation process, while the immotive category contains those who are the least advanced. In the fifth study, the time frame of the quit attempts used to classify smokers as relapsers was reduced to six months, while that for intentions remained at a year. In the sixth study, the time frames for quit attempts and intentions were both reduced to six months. In addition, the name for the least advanced category was changed from "Immotive" to "Precontemplation." It should be noted that while there has been some variation in the time frames and category names used in these six studies, in every case behavior was the primary classification variable which was used to assign smokers to the most advanced stage, and then intention was used to separate the remaining smokers into those in the contemplation and precontemplation stages.

In 1991, the operational definitions of the first three stage-of-change categories underwent a major revision. In contrast with all of the previous studies, intention, rather than behavior, was used as the primary classification variable. Under 1991 operational definitions, smokers were included in the new precontemplation stage if they did not intend to quit smoking within the next six months, even if they had made a quit attempt in the previous year. Smokers were assigned to the new preparation stage only if they intended to quit smoking in the next month

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TABLE 1
Definitions Used to Assign Smokers to Stages of Change (1983–1991)

Prochaska and DiClemente (1)	R: "... failed within the past year in their attempt to quit smoking." C: "... seriously thinking about quitting smoking in the next year." I: "... no intention of quitting smoking in the next year."
Prochaska, DiClemente, Velicer, et al. (12)	R: "... successfully quit on their own but then relapsed in the past year." C: "... considering quitting in the next year." I: "... not considering quitting."
Wilcox, Prochaska, Velicer, et al. (23)	R: "... failed within the past year in their attempts to quit smoking." C: "... seriously thinking about quitting smoking within the next year." I: "... no intention of quitting in the next year."
DiClemente, Prochaska, and Gibertini (16)	R: "... tried to quit smoking and were abstinent for a minimum of 24 hours at least once in the year prior to initial assessment." C: "... seriously contemplating quitting in the next year." I: "... no intention of quitting in the next year."
Velicer, DiClemente, Prochaska, et al. (11)	R: "... quit for a period of at least 24 hours within the last six months." C: "... intending to quit within the next year." I: "... no intention of quitting in the near future."
Velicer, DiClemente, Rossi, et al. (17)	R: "... initially quit on their own for at least 24 hours but then relapsed in the six months prior to the study." C: "... seriously considering quitting in the next six months." PC: "... not considering quitting."
DiClemente, Prochaska, Fairhurst, et al. (2)	PA: "... planning to quit within the next 30 days" and "had made a 24-hr quit attempt in the past year." C: "... seriously considering quitting within the next six months; were not considering quitting within the next 30 days, had not made a quit attempt of 24 hr in the past year, or both." PC: "... not seriously considering quitting within the next six months."

R: Relapser; C: Contemplators; I: Immotives; PA: In Preparation; PC: Precontemplator.

and had also made a quit attempt during the previous year. All of the remaining smokers were assigned to the new contemplation stage. The new contemplation stage contained smokers who intended to quit in the next month but had not made a quit attempt in the previous year, as well as all smokers who intended to quit in the next six months. Thus, in their new operational definitions, the relapse category was eliminated and those smokers who would have been assigned to this category were divided among the three, newly-defined stage-of-change categories. Although Prochaska et al. (24) have stated that they never intended the relapse category to be considered a stage, all of the stage-of-change research on smoking prior to their 1991 paper clearly treated the relapse category as if it were a stage.

In this article, we use a population-based longitudinal survey conducted as part of the California Tobacco Surveys (CTS) to investigate the predictive power of both the original and revised operational definitions of the stage-of-change categories with respect to smoking cessation and cessation attempts. In an effort to produce a state-of-the-art questionnaire, the baseline 1990 CTS included the exact items used by Prochaska et al. to assign smokers to the precontemplation, contemplation, and preparation stages based on their 1991 definitions (25). Thus, for the smokers who had not made a quit attempt in the year prior to baseline, we could only approximate their distribution into the immotive and contemplation stages under the 1983 definitions since only six-month and 30-day rather than one-year intentions were collected. Even with the change in time frame, our comparison should reveal whether the revised definitions represent an improvement over the original definitions.

METHOD

Sample

The 1990 California Tobacco Survey used a modified Waksberg random-digit-dialed telephone methodology (26) and a two-stage sampling design to conduct a 25-minute computer-assisted telephone interview (CATI) with 24,296 adults on issues relating to tobacco use (27,28). Fieldwork was completed by Westat, Inc., following a protocol aimed at maximizing response rates and data quality (29,30).

On the 1992 follow-back survey, we identified a sample of 2,066 respondents who answered "Yes" to both of the following questions on the 1990 baseline survey: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you smoke cigarettes now?" These 2,066 respondents represented a stratified, random sample of all of the current smokers who were interviewed in 1990. We restricted our analysis to the 1,921 smokers who had also answered "Yes" to the following question in 1990: "Were you smoking at all around this time twelve months ago?" We excluded the remaining 145 smokers from our analysis because a majority of the definitions listed in Table 1 seemed to imply that only quit attempts that both began and ended in the previous six to twelve months should be used to stage smokers. The interval between surveys ranged from 437 to 751 days (median 609 days). All data were weighted to account for the study design as well as to ensure that estimates were representative of the California population by age, sex, race/ethnicity, education, and geographical region (30).

TABLE 2
Distribution of Smokers in Two Stage-of-Change Models

Revised Stages of Change–1991 (2)	Original Stages of Change–1983 (1): PRECONTEMPLATION No Quit Attempt* No Intent to Quit	CONTEMPLATION No Quit Attempt* Intend to Quit in Six Months	RELAPSE Quit Attempt*	N	%
PRECONTEMPLATION					
No Intent to Quit	544	0	178	722	33.3
CONTEMPLATION					
Intend to Quit in One to Six Months	0	551	370	921	50.8
PREPARATION					
Intend to Quit in One Month and Quit Attempt*	0	0	278	278	16.0
N	544	551	826		
%	23.8	27.5	48.7		

* Quit attempt of one day or longer in last year.

Measures of Intention to Quit and Recent Quitting History

In the 1990 CTS, we ascertained intention to quit smoking using the more recent Prochaska and DiClemente nested questions: "Are you planning to quit smoking in the next 30 days?" and "Are you contemplating quitting smoking in the next six months?" Accordingly, we define intent as intention to quit in the next six months to evaluate the original Prochaska and DiClemente model, even though their original model defined intent as intention to quit in the next year. Also, as with the Prochaska and DiClemente studies, we established recent quitting history by asking, "During the past twelve months, have you quit smoking intentionally for one day or longer?"

From the responses to these questions, we assigned each smoker in the longitudinal panel to one of six groups based on his or her baseline quitting history and intention to quit: (a) smokers with no history of a one day or longer quit attempt in the last year (not a relapser) with no intention to quit, (b) not a relapser with intention to quit in the next one to six months, (c) not a relapser with intention to quit in the next 30 days, (d) relapser with no intention to quit, (e) relapser with intention to quit in the next one to six months, and (f) relapser with intention to quit in the next 30 days.

Measures of Cessation at Reinterview and Quit Attempts

In 1992, cessation status was established by two nested questions: "Do you smoke now?" and "Did you smoke any cigarettes in the past 30 days?" Smokers who answered "No" to both questions were classified as in cessation at reinterview. We ascertained recent quit attempts during the year prior to follow-up by using three nested questions. Respondents were classified as having made a quit attempt if they answered "No" to the following question: "Do you smoke now?" In addition, smokers who answered "Yes" to the previous question were still classified as having made a quit attempt if they answered "No" to the following question: "Were you smoking at all around this time twelve months ago?" or "Yes" to the following question: "During the past twelve months, have you quit smoking intentionally for one day or longer?"

Statistical Methods

We have provided 95% confidence intervals (CIs) for all percentages in the tables, text, and figures. These CIs are based on variance estimates together with the appropriate critical value from the student's t distribution. We derived the variance estimates using a jackknife procedure (31) in which 51 subsamples were drawn from the full data file and sample weights computed using the same procedures as for the full sample. The basis for estimating variance was provided by deviations in an estimate of interest between the subsamples and the full data file. We used modified chi-square statistics to examine the relationships of intention to quit and relapse status with the outcome variables (32,33); fractional degrees of freedom in the reference distribution arose as a consequence of unequal eigenvalues associated with the multivariate design effect.

We performed four logistic regression analyses to evaluate the predictive power of the two staging schemes as predictors of cessation for 30 or more days at follow-up or future quit attempts: one logistic regression for each outcome for each scheme. In each logistic regression, category membership, as defined by the model being considered, was coded using two dummy variables such that the precontemplation or the immotive stage, respectively, was the reference group. We constructed a receiver–operating–characteristic (ROC) curve (34) for each of the predicted outcomes for the original and revised models using the computed probabilities from the logistic model and the actual outcomes for each smoker. The ROC curve plots the one-specificity versus the sensitivity of each possible cutpoint (or classification) on the continuum of the predictor variable. If some cutpoint or classification yielded perfect prediction, this point would be plotted at the upper left corner of the curve and the area under the curve would be 1.0. If prediction is poor with all cutpoints, the curve would approximate a line at a 45° angle from the origin and the area under the curve would be around 0.5 (35). In addition, we report the -2 log likelihood χ^2 values for the covariates obtained from these logistic regressions as an indication of the extent of the variability explained by the fitted models.

RESULTS

Distribution of Smokers Across the Original and Revised Stage-of-Change Models

Table 2 shows how smokers in the longitudinal panel were assigned to a category using the original and the revised Prochaska and DiClemente staging algorithms. With the original algorithm, nearly half (48.7%) of the population of California

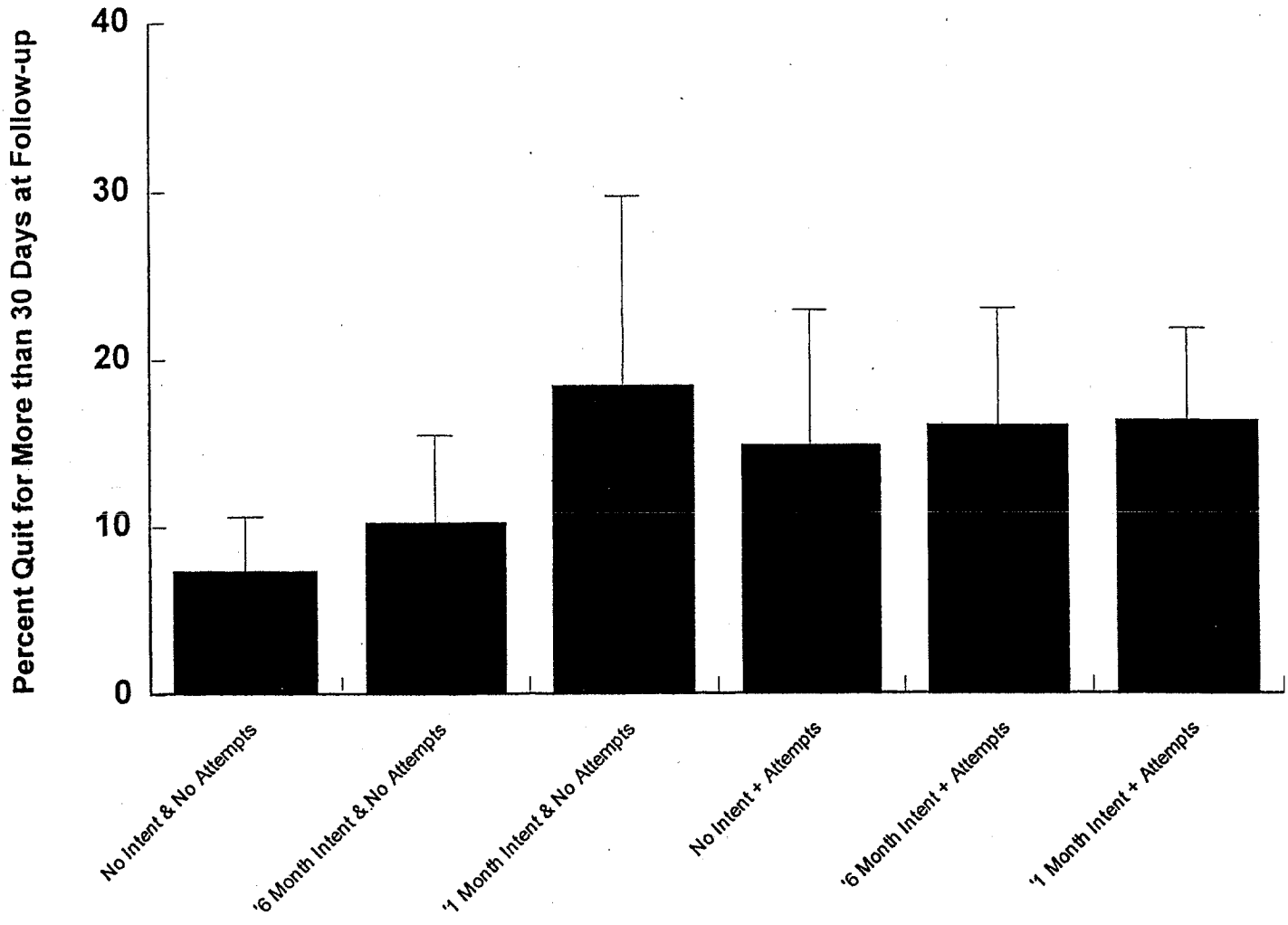

FIGURE 1: Intention to quit at baseline and a quit attempt of at least a day in the year prior to baseline as predictors of cessation of at least 30 days at the follow-up interview.

smokers had made a quit attempt during the previous twelve months and, thus, were placed into the relapse category; the remaining smokers were approximately equally distributed between precontemplation (no intention to quit in next six months, 23.8%) and contemplation (intention to quit in next six months, 27.5%). In contrast, under the revised scheme, more than half of the smokers in this sample were in the new contemplation category (intention to quit in the next one to six months, 50.8%), a third were in the new precontemplation category (no intention to quit in the next six months, 33.3%), and less than a sixth were in the preparation category (intention to quit in the next month and a quit attempt in the past year, 16.0%). Thus, the application of the revised Prochaska and DiClemente algorithm results in a categorization of California smokers that is considerably different from that resulting from their original algorithm. It should be noted that the rates of smokers who fell into the three stages as defined by the 1991 criteria for the smokers in the longitudinal panel were approximately the same as the rates observed for the smokers in the entire 1990 cross-sectional sample from which the longitudinal panel was drawn; the largest difference between the longitudinal and cross-sectional samples was less than 5% (25).

Predicting Cessation at Follow-up

Figure 1 shows the percentage of smokers who reported being quit for 30 days or more at follow-up for the six categories generated using the quitting history and intention variables from the baseline interview. Given that smokers reported a recent quit attempt at baseline, intention to quit was not associated with a difference in the percentage of smokers who were successfully quit at follow-up (14.9 ± 8.1% versus 16.1 ± 7.0% versus 16.4 ± 5.5% for those with no intent, one to six month intent, and one month intent, respectively; $\chi^2 = 0.09$, df = 1.8, ns). However, for smokers who did not report a recent quit attempt at baseline, intention appeared to more than double the percentage who were quit at follow-up (7.4 ± 3.2% versus 10.3 ± 5.2 versus 18.5 ± 11.3; $\chi^2 = 3.211$, df = 1.0, $p < .05$, one-tailed).

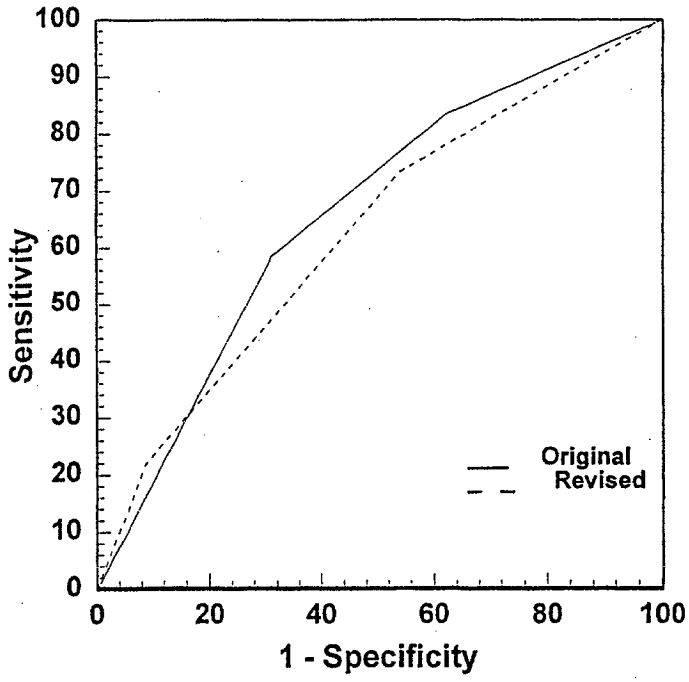

FIGURE 2: Receiver–operating–characteristic (ROC) curves for predicting 30-day or longer cessation at follow-up for the original and the revised stage-of-change models.

The logistic regression analysis of 30-day or longer cessation at follow-up for both the original and revised staging algorithms provided a statistically significant fit to the study data; however, as indicated by the χ^2 for the −2 log likelihood statistic, more variability in the data is accounted for with the original model ($\chi^2 = 21.47$, df = 2, $p < .001$ and $\chi^2 = 12.79$, df = 2, $p < .005$, for the original and revised models, respectively). Figure 2 shows the ROC curves for predicting cessation for both models. The area under the curve is 58.9% for the original model and 55.7% for the revised model.

Predicting Future Quit Attempts

The study data for predicting a quit attempt in the year before follow-up is presented for the six baseline categories in Figure 3. Again, the three categories defined by a recent quit attempt at baseline showed the highest levels of recent quit attempts before follow-up. Among smokers with a recent quit attempt at baseline, the degree of intention to quit at baseline was not associated with a significant trend in the percentages of smokers who reported a recent quit attempt at follow-up (53.0 ± 12.1% versus 59.4 ± 10.7% versus 66.1 ± 6.9%; $\chi^2 = 2.89$, p = ns). However, as for cessation, among smokers who did not report a recent quit attempt at baseline, intention to quit was significantly associated with reporting a future quit attempt (24.8 ± 5.8% versus 31.1 ± 8.4% versus 45.5 ± 12.2% for those with no intent, one to six months intent, and one month intent, respectively; $\chi^2 = 11.85$, $p < .005$).

Again, the logistic regression analyses of future quit attempts indicate that the original model explains more variation in the data ($\chi^2 = 182.63$, df = 2, $p < .001$ and $\chi^2 = 96.37$, df = 2, $p < .001$ for the original and new models, respectively). The areas under the ROC curve are 65.9% for the original model and 62.3% for the new model.

DISCUSSION

In this analysis, we have applied the original and revised stage-of-change models for differentiating smokers to a randomly selected sample of smokers studied in California in 1990 and reinterviewed in 1992; the sample was weighted to be representative of the state population. These two models have different variables as primary classifiers; the original model emphasizes behavior and the revised model emphasizes intention. Even though these two algorithms use the same classification variables, their rules of application resulted in a considerable shift of smokers among categories in our study sample. The original model indicates that only about a quarter of the population are precontemplators, compared to about a third under the revised model; the proportion of the population who are contemplators under the original model is half that under the revised model; and, whereas the proportion of the population in the most advanced state is nearly half for the original model, it is only about a sixth for the revised model.

To evaluate these differentiation schemes, we classified our sample at baseline into six categories that arise from the use of the model variables: recent quitting and intention to quit. Such an examination should test the use of recent quitting behavior (original model) or intention to quit (revised model) as the primary classifying variable for differentiating smokers on likelihood to quit. This analysis showed that smokers with recent quitting behavior at baseline generally tended to have both more successful cessation and more reported recent quitting activity at follow-up than those without such a history (Figures 1 and 3). Analysis of intention to quit showed that it was significantly associated with outcome only among smokers with no history of recent quit attempts at baseline. These results suggest that recent quitting behavior should be retained as the primary classifying variable rather than intention to quit although there appears to be a role for intention to quit among those without a recent quitting history.

Intention to quit may have a different meaning for smokers who have recently tried to quit than for smokers who have not. Lack of intention to quit among some smokers in relapse may reflect temporary discouragement over their recent failure rather than a true loss of desire to quit. Thus, smokers who have made a quit attempt in the previous year should be assigned neither to the precontemplation stage nor to the contemplation stage as proposed in the revised stage-of-change model. Under the revised stage-of-change model, smokers with very different probabilities of successful quitting would be assigned to the same category.

However, inspection of the sensitivity and specificity (via the ROC curve) of these classification schemes indicates that neither model has much predictive power for who will quit successfully. We infer from our results that we need a new algorithm for differentiating smokers so that interventions can be tailored to the current level of the smoker in the quitting process. These results also raise questions concerning the appropriateness of identifying levels in the quitting process as distinct stages. The existence of such stages implies qualitatively different modes of thinking that are uniform among smokers within each stage. That individuals progress to a higher stage implies some transformation in these cognitive processes. The notion that cognitive thought processes undergo discrete global changes throughout the life cycle is vigorously disputed in the psychology literature (36–38).

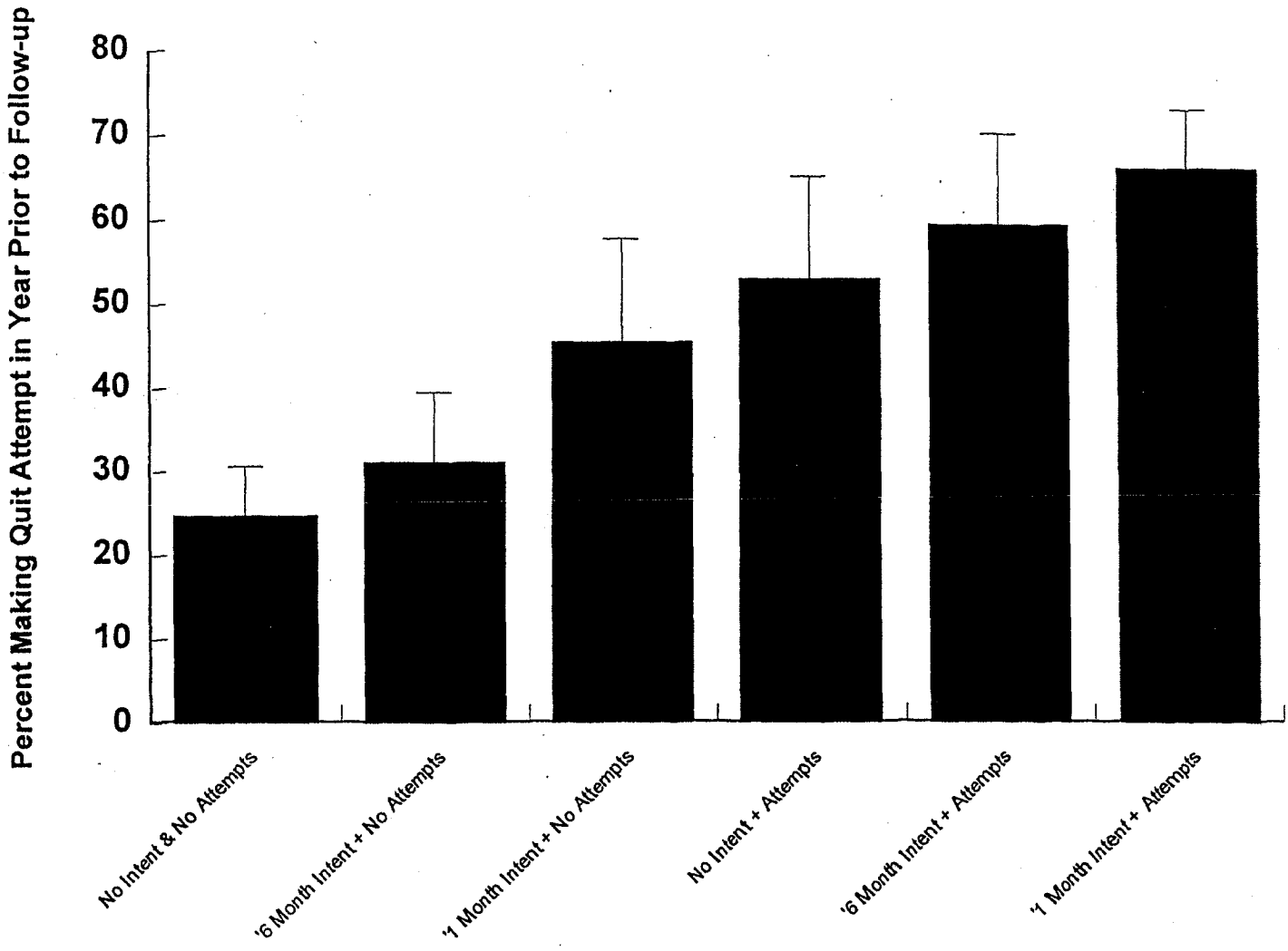

FIGURE 3: Intention to quit at baseline and a quit attempt of at least a day in the year prior to baseline as predictors of a quit attempt of at least a day in the year prior to the follow-up interview.

In contrast with previously published work on stage-of-change models, our study used a representative sample which was randomly selected from the population rather than a self-selected sample recruited via newspaper advertisements (2). As evidence that self-selected smokers might be more motivated to quit than those who are randomly selected, nearly a third of self-selected smokers in the recent Prochaska and DiClemente study were in their preparation category (2), whereas less than a sixth of randomly selected smokers in either the entire 1990 California Tobacco Surveys cross-section panel (25) or the longitudinal panel used in the present study were in this category. One reason for this difference may stem from the fact that the smokers included in the present study only had to agree to be interviewed, while those included in other studies had to initiate contact in response to a newspaper advertisement seeking participants for a study of smoking cessation.

Our results and those from the previous work on stages of change in smoking cessation are based primarily on self-reports rather than concurrently validated observations of actual behavior. Prochaska and DiClemente (1) have argued quite persuasively that self-reported cessation is an adequate outcome measure in stage-of-change research since these studies involve more than discriminations between smokers and non-smokers but also comparisons among different types of smokers. Furthermore, these self-reports have been shown to be meaningfully related to each of the following: (a) coping strategies (1,12,16); (b) self-efficacy, decisional balance, and the temptation to smoke (12,16); (c) actual smoking behaviors (23); and (d) smoking cessation that has been biochemically validated (1,12).

Recent research using data from the California Tobacco Surveys (39) has shown that the overall rate of discrepancies between proxy-reports and self-reports of smoking status is small (4.3%), and that these discrepancies act in both directions so that the net bias results in only a slight overestimation of smoking prevalence (<0.4%). The greatest number of proxy-

report versus self-report discrepancies, however, occurred for smokers who reported having quit within the last month where the proxy still considered the self-proclaimed quitter to be a smoker. Therefore, we chose to use self-reported abstinence of at least 30 days, a more stringent measure of successful cessation, rather than point-prevalence which has been used in previous stage-of-change research conducted by Prochaska et al. since 1983 (1,12,23). To rule out the possibility that the use of a more stringent outcome measure may have biased the results, we reanalyzed these data using point-prevalence, rather than 30+ day cessation, as the outcome. The change in outcome increased the cessation rates for all of the groups shown in Figures 1 but did not change the overall pattern of results.

Before successful cessation can occur, the smoker must make a quit attempt. Thus, new quit attempts are also an important outcome measure. In the present study, the estimate of quit attempts in the year before follow-up provides a conservative estimate of quit attempts since baseline. Smokers were reinterviewed from 14 to 25 months after baseline but were only asked to report quit attempts that had occurred in the previous 12 months. Thus for every smoker, quit attempts were not reported for an interval that varied from 2 to 13 months. However, since the CATI randomly scheduled the follow-up interviews, these intervals were equally distributed for smokers in each category at baseline. It is possible that smokers at baseline who intended to quit in the next 30 days may have made a quit attempt during the interval of non-observation, became discouraged, and failed to make another attempt during the one-year interval of observation prior to follow-up. Since the quit attempt rate for those with 30-day intention was significantly greater than that for those with six months intention or no intention to quit, this potential bias does not seem to have affected the results of the present study. Therefore, differences in quit attempt rates observed for different categories of smokers are probably not due to differences in the timing or interval of follow-up. Also, smokers are more likely to forget (within a few months) short quit attempts that lasted a few days than they are to forget longer quit attempts (40). This underreporting bias also applied equally to all smokers regardless of their level in the quitting process at baseline. Finally, previous longitudinal studies (20,21) have shown that smokers in different categories at baseline experienced increasing rates of cessation at follow-up intervals of 1, 6, 12, and 18 months, and, as a result, differences among categories became more pronounced. These findings suggest that longer-term follow-up, as in the present study, may be necessary for a fair comparison of alternative algorithms for categorizing smokers.

These data strongly suggest the following conclusions. First, the revised staging algorithm does not represent an improvement over the original. If anything, it does a poorer job of predicting both cessation attempts and successful cessation than the original staging algorithm. Second, previous quitting behavior clearly appears to be a stronger predictor of subsequent cessation and cessation attempts than is the intention to quit. The weakness of intention as a predictor of smoking cessation has been documented in other research (41,42). Third, there does appear to be a role for intention, albeit more modest than that posited by the proponents of the stage-of-change construct, especially in the prediction of cessation attempts rather than in the prediction of successful cessation. These data indicate that among smokers who lack recent quitting behavior: (a) those who express some intention to quit are more likely to make quit attempts than those who express no intention to quit; and (b) those who express more urgent intentions to quit appear more likely to make attempts than those who express less urgent intentions. Finally, our findings suggest that stage-of-change as presently defined is not sufficiently robust to justify its use as a stand-alone predictor, as the sole stratification variable for matching interventions to individuals, or as an interim outcome in smoking cessation studies.

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