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REDUCED NICOTINE EXPOSURE AND ABSTINENCE OUTCOME IN TWO NICOTINE FADING METHODS

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Abstract — Two methods of nicotine fading as a smoking cessation preparation technique were compared. A brand-switching procedure and a three-stage set of "Nicotine Faders" graduated filters were the preparation strategies. Both methods implemented a putative 30–50–80% nicotine exposure reduction schedule in three weekly phases. There were a total of 110 study participants (57 in brand switching) enrolled in eight clinic groups. Results indicated that at the 80% reduction level, meaningful reductions in nicotine (measured by its metabolite cotinine) and carbon monoxide (CO) exposure were measurable with both nicotine fading procedures. Overall pooled nicotine and CO exposure drops from baselines of 48.2% and 35.5%, respectively, were recorded. The abstinence outcome measures (pooled 1-year abstinence prevalence = 30.9%) were not significantly different between the two preparation strategies. Trends in nicotine and CO exposure drops, and abstinence outcome measures, however, were consistently in favor of the graduated filters. Potential advantages of filters in the context of a preparation-for-quitting strategy were suggested.

Brand switching enjoys widespread current use as a preparation method for smoking cessation. A number of published studies have evaluated the brand switching procedure (often referred to as "nicotine fading"). Foxx and Brown (1979) reported early optimistic results with a procedure in which subjects were instructed to switch brands over a 3-week period following a 30–60–90% nicotine reduction schedule (based on the Federal Trade Commission [FTC] machine-derived values). Not only did they achieve a promising abstinence rate with this method (40% at 18-month follow-up), but nonabstinent subjects reported having returned to lower tar and nicotine cigarettes. Foxx and Brown argued that even their nonabstinent subjects had reduced their intake of harmful substances and were therefore at less risk for disease.

Some other evaluations of brand switching have been less promising. Beaver, Brown, and Lichtenstein (1981) obtained only a 16% 6-month abstinence rate using nicotine fading procedures. Of 21 subjects who were smoking at this point, 18 reported smoking reduced nicotine content cigarettes compared to baseline. Lando and McGovern (1985) reported that 8 of 42 (19%) subjects who underwent nicotine fading were abstinent at 1-year follow-up, although they found a 44% abstinence rate (18 of 41) at the same follow-up among subjects who underwent a nicotine procedure combined with a smoke-holding technique (Kopel, Suckerman, & Baksht, 1979). Fifty-seven percent of those smoking at 1 year in the combined nicotine-fading conditions were smoking a lower tar and nicotine cigarette.

Brand switching presents several attractive features. It is fairly readily implemented by subjects, and it has high face validity. Subjects view themselves as having progressed toward abstinence even prior to the quit date (Lando & McGovern, 1985). Most important, subjects enjoy a concrete success experience, and this in turn is likely to increase self-efficacy. Several studies have found that a high level of self-efficacy is a good predictor of successful outcome (cf. Condiotte & Lichtenstein, 1981; DiClemente, 1981).

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Unfortunately, brand switching also appears to have several major weaknesses. Despite some promising findings (Prue, Krapfl, & Martin, 1981), it is at best unclear that brand switching actually leads to reduced nicotine intake. A number of investigators have found small or nonexistent differences in nicotine and carbon monoxide (CO) exposure in people smoking cigarettes with different machine-determined yields (Benowitz et al., 1983; Jaffe, Kanzler, Friedman, Stunkard, & Verebey, 1981; Russell, Jarvis, Feyerabend, & Saloojee, 1986). Smokers tend to regulate their intake of nicotine (Benowitz et al., 1986) by taking more frequent and deeper puffs. They can also inadvertently or deliberately defeat many filter systems. This can be accomplished by blocking smoke dilution holes in low-yield, ventilated filter cigarettes (Kozlowski et al., 1980a). Some smokers assigned ultralow-yield cigarettes have even broken off filters altogether (Benowitz et al., 1986).

Brand switching has also proven difficult to implement in practice. The FTC publishes a list of major cigarette brands along with machine-rated tar, nicotine, and CO yields. Unfortunately, not only is this list an inaccurate indication of actual human smoke exposure, it is almost immediately out of date (Grunberg, Morse, Maycock, & Kozlowski, 1985; Kozlowski et al., 1980b). New brands are constantly introduced by manufacturers, and old brands are reformulated. This can increase the difficulty of appropriately assigning subjects to reduced tar and nicotine cigarettes. Foxx and Brown (1979) also excluded smokers of low tar and nicotine cigarettes from the brand-switching procedure, further limiting the applicability of this technique.

Considerable experience with brand switching in our laboratory suggests that problems are often encountered in identifying rated nicotine content of baseline brands. Increasing proportions of clinic participants enter at low nicotine levels and cannot easily be accommodated in treatment. Many participants find the brand switching method to be cumbersome. Common complaints include limited choice of ultra low tar and nicotine brands, unacceptable taste, and an excessively abrupt transition to the final assigned brand (90% rated nicotine reduction).

A recently developed system of graduated filters, known as "Kick the Habit" (ViaCare Products, Inc., Fort Collins, CO), can potentially overcome all of the shortcomings of brand switching. The filters are designed to reduce actual exposure to harmful substances in three stages. Furthermore, the faders can be used by virtually all smokers regardless of initial brand of cigarettes.

The filters also overcome several major shortcomings of the Teledyne-Water Pic "One Step at a Time" smoking cessation filters that were introduced in the 1970s. The most serious of these was the use of an air inlet hole at the forward end of the filter. This hole could easily be blocked by smokers, thereby permitting compensation. Nevertheless, Martin, Prue, Collins, and Thames (1981) reported that the "One Step at a Time" filters produced substantial reductions in CO exposure in four current smokers.

The major focus of the present research was to measure saliva cotinine and CO levels in subjects undergoing preparation through graduated filters, and through brand switching to evaluate the extent of compensation occurring with each method. Cotinine (a metabolite of nicotine) and CO are excellent indicators of smoke exposure (Benowitz et al., 1986). The filters were also evaluated against brand switching as a preparation method for smoking cessation, and to record abstinence outcome with both approaches when incorporated as part of a multicomponent smoking cessation treatment developed by Lando (1982). This program, which includes a 3-week preparation for the quitting phase, helped ensure a high response rate for the multiple exposure measures.

METHODS

Subjects

Study participants had to meet the following conditions to participate: (a) be smoking 15 or more cigarettes per day, and (b) be smoking cigarettes rated as containing at least 0.4 mg of nicotine. We placed a lower limit on the nicotine content of cigarettes because of limitations of brand switching, and to ensure comparability of results between the two methods of nicotine fading. Two smoking cessation clinics charging a nominal fee were offered to excluded persons.

One hundred and ten persons met the various entry criteria (including attending at least one session in addition to the informational meeting) and were enrolled in the eight clinics that made up the study. Clinic enrollees included 55 men and 55 women. Their mean baseline consumption was 32.6 (± 12.7) cigarettes per day. Average age of subjects was 41.3 (± 10.6) years, and mean number of years as a smoker was 23.5 (± 11.1). Mean rated nicotine content of baseline brands was 0.83 (± .25) mg. The median number of previous quit attempts was 2, with the median longest abstinence period equalling 0.75 months. The eight clinics ranged in size from 12 to 16 participants.

Procedure

Clinic facilitators were three trained paraprofessionals who had previously conducted clinics on numerous occasions. Lando (1987) found that these paraprofessional facilitators fared at least as well as advanced doctoral students in counseling psychology in facilitating smoking cessation. Each of the facilitators conducted the same number of groups of each type (brand switching and filters).

The smoking cessation clinic, which consisted of 16 sessions (approximately 45 min–1 hr in length) over a 9-week period, has been described in more detail by Lando and McGovern (1985). The first 3 weeks were devoted to preparation for quitting and the final 6 weeks to maintenance. The specific preparation technique involved two types of nicotine fading procedure adapted from that originally described by Foxx and Brown (1979). Subjects reduced nicotine exposure on a putative 30–50–80% weekly reduction schedule. The two nicotine fading procedures are described below. Four clinics were randomly assigned to each of the nicotine fading procedures.

The importance of the approaching target date for abstinence (Flaxman, 1978) and a firm commitment to quitting were stressed. Active coping rather than passive suffering was presented as both a slogan and a theme. Subjects were encouraged to monitor their smoking prior to the quit date with special attention to the situations in which they smoked.

Subjects attended eight maintenance sessions over a 6-week period following the quit date. Considerable emphasis was placed upon relatively unstructured group discussion. In addition, subjects signed contracts calling for specific rewards for abstinence. Group discussion tended to emphasize problem solving. Subjects were encouraged both to discuss their own problems and to suggest possible strategies for other group members.

Brand switching. Groups assigned this procedure followed a modified version of the Foxx and Brown (1979) method. They were to switch systematically to brands containing progressively lower-rated nicotine content. Nicotine content of cigarettes was derived from figures published by the FTC. Where nicotine content information was not readily available, cigarette packages themselves or recent advertisements were examined.

Once baseline nicotine content had been established, subjects switched brands on a 30–50–80 weekly reduction schedule for comparability with the filters. This is a slight variation from the 30–60–90% reduction schedule used by Foxx and Brown (1979). Subjects were free to choose any cigarette that provided the required nicotine rating.

Graduated filters. Subjects assigned to the filters condition continued with their baseline cigarettes throughout the preparation period. However, they were to use the filters according to an assigned schedule. Each level of filter was to be used for a 1-week period. The sequence was type I filter (30% nicotine reduction) followed by the type II (50% nicotine reduction) and type III filters (80% nicotine reduction). They were advised to replace filters approximately every 20 cigarettes.

Physiologic assessment. Carbon monoxide and saliva samples were collected on a weekly basis beginning with the orientation session and continuing until the quit date. Measurement time was almost the same on each occasion ($\pm$ 15 min). Study participants were paid $20 if they were present for all of the saliva samples.

Saliva samples were analyzed for cotinine, a primary metabolite of nicotine. Cotinine is an excellent indicator of nicotine exposure (Di Giusto & Eckhard, 1986). Specificity and sensitivity of this measure are both excellent (Abrams, Follick, Biener, Carey, & Hitti, 1987; Jarvis, Tunstall-Pedoe, Feyerabend, Vesey, & Saloojee, 1987). The 16–25-hr half-life of cotinine is optimal for purposes of the present study. It is sufficiently long to minimize variation as a function of time of day and sufficiently short to allow a precise indication of level of exposure as a function of weekly changes in cigarette brand or types of filters. Concentrations of cotinine are relatively stable throughout the smoking day, although they do reach a maximum at the end of the day. Saliva samples were shipped to the laboratory of the Division of Epidemiology at the University of Minnesota for analysis. Nicotine and cotinine are measured in saliva by gas chromatography using an adaptation of the method described by Verebey, Depace, and Jaffe (1982). The method uses ketamine as an internal standard. Samples were frozen until assayed.

Carbon monoxide has a short half-life (approximately 4 hr) and is useful in detecting recent smoke exposure (Jarvis et al., 1987). Carbon monoxide is most effective as a dose indicator when collected toward the end of the smoking day. Clinics were held in the evening, thus facilitating CO measurement at the most optimal time. Alveolar CO levels were measured with the Ecolyzer apparatus (Model 2000, Energetics Science, Inc., Elmsford, NY) using a standard procedure. This instrument measures the rate of conversion of CO to CO_2 as it passes over a catalytically active electrode. Subjects were instructed to take a deep breath, hold it for approximately 15 s, and exhale into a polyvinyl bag. The bag was attached to the measuring apparatus and a measurement taken in parts per million (ppm) of CO when the measuring needle had stabilized at a maximum.

Self-efficacy assessment. Subjects completed an abbreviated self-efficacy measure derived from the work of Condiotte and Lichtenstein (1981) at the orientation and quit-date sessions. The self-efficacy measure required subjects to rate items on a 0–100-point scale. The baseline assessment was taken before actual treatment content was described. As noted previously, a major rationale for the specific preparation procedure (brand switching or use of filters) is that subjects perceive themselves as progressing toward their goal of abstinence. Adherence to preparation can represent a concrete success experience. This success experience may in turn increase self-efficacy.

Table 1. Mean carbon monoxide levels (standard deviations in parentheses) at four time points categorized by treatment

Treatment	Sample (n)	Baseline	Nicotine Reduction 30%	50%	80%
Nicotine faders	44	24.6 (13.0)	18.7 (6.2)	17.1 (6.7)	15.8 (6.6)
Brand switching	40	26.8 (11.5)	25.7 (11.1)	19.2 (7.3)	17.3 (9.1)

Abstinence levels. Subjects' smoking status was based on self-report at 3- and 12-month follow-up surveys. Those not successfully contacted were assumed to be smoking.

RESULTS

Baseline differences associated with treatment

One-hundred and six subjects (96.4%) had complete baseline data on age, cigarette consumption, cigarette nicotine level, number of previous quit attempts, a self-efficacy measure (Condiotte & Lichtenstein, 1981), and CO levels. Multivariate analysis of variance (MANOVA) revealed no treatment differences on these six variates (Wilks's lambda $F(6, 99) = 1.04, p = .41$).

CO results

Ninety-four of the 110 total subjects had complete CO testing profiles representing: baseline; end of Week 1 (30% nicotine reduction); end of Week 2 (50% nicotine reduction); and end of Week 3 (80% nicotine reduction—also the quit-day session). However, contrary to instructions, 10 of these subjects (8 in brand switching) had quit at some point in the week prior to the quit-date, thus invalidating the final measurement.

Multivariate analysis of covariance (with baseline CO measures as the covariate) was rejected as the method of analysis because a preliminary analysis revealed that the necessary assumption of homogeneity of regression surfaces across treatment groups was questionable (Wilks's lambda $F(3, 78) = 2.14, p = .10$). Neither repeated measures ANOVA of difference scores (between the three nicotine fading measurements and baseline) nor repeated measures analysis of covariance (ANCOVA) were indicated because the linear relationship of baseline to the three subsequent measures of CO was very low—the estimate of the slope parameter (within treatment groups) $< .3$ in all cases (Cook & Campbell, 1979). Thus, a repeated measures ANOVA (*ignoring baseline values*) was performed because baseline CO differences between treatment groups were nonsignificant ($F(1, 82) < 1$). Carbon monoxide values were square-root transformed to stabilize within-cell variances.

There was a significant effect for the type of nicotine fading regimen undertaken in favor of greater reductions produced by the filters ($F(1, 82) = 5.79, p = .018$). The 30–50–80% nicotine reduction scheme produced overall declines in carbon monoxide levels ($F(2, 164) = 21.3, p < .0001$ by Geisser-Greenhouse correction). Both main effects were qualified by a significant reduction scheme × treatment interaction ($F(2, 164) = 4.4, p = .015$ by Geisser-Greenhouse correction). Inspection of means (see Table 1) reveals that by far the largest reduction in carbon monoxide levels produced by filters over brand switching was with the 30% reduction filter. By the end of Week 3, the greater reduction provided by filters was nonsignificant ($t(82) = .86, p > .20$). Both nicotine fading techniques do produce substantial reductions in mean CO readings, albeit far short of the putative reductions

Table 2. Mean cotinine levels (standard deviations in parentheses) at four time points categorized by treatment

Treatment	Sample (n)	Baseline	Nicotine Reduction		
			30%	50%	80%
Nicotine faders	28	320 (182)	256 (153)	241 (136)	151 (102)
Brand switching	28	314 (169)	277 (186)	270 (111)	177 (116)

suggested by standardized smoking machine data. The average reduction in CO level from baseline to the 80% nicotine reduction schedule was 35.5%. Table 1 summarizes the mean carbon monoxide data (CO is measured in ppm).

Cotinine results

Measurement of cotinine levels for the 494 (out of a maximum possible of 550) saliva samples collected during the study was beset with problems. Fifty-three samples were unusable because the quantity of saliva was insufficient, 30 samples were mislaid or lost at the laboratory, and approximately 100 samples had to be diluted (usually in a 1:1 ratio) to enable measurement to take place. As previously indicated, 10 subjects quit prematurely, and their quit-date cotinine measurements were thus judged to be invalid indicators of the nicotine exposure associated with putative 80% nicotine reduction. Finally, data from one extreme outlier were dropped because of a suspect baseline measurement.[1]

Consequently, complete measurement exists for only 56 subjects (51%). A MANOVA carried out to determine if these subjects differed from the remaining subjects on six baseline variates (age, cigarette consumption, cigarette nicotine level, number of previous quit attempts, self-efficacy, and CO levels) revealed no significant differences (Wilks's lambda $F(6, 99) < 1$). Nevertheless, the statistical power to detect hypothesized differences with this small sample size is severely circumscribed.

A repeated measures ANOVA (including baseline cotinine as a repeated measure) was performed. The 30–50–80% nicotine reduction scheme yielded falling cotinine levels ($F(3, 162) = 20.0$, $p < .0001$ by Geisser-Greenhouse correction). There was no effect for type of nicotine fading regimen as indicated by a nonsignificant interaction between fading regimen and reduction schedule ($F(3, 162) < 1$), although cotinine levels were lower at all time points in the case of the graduated filters. There was no nicotine gum use reported during the course of the clinics.

The mean cotinine data (cotinine is measured in ng/mL) are summarized in Table 2. A linear contrast revealed that continine levels fell approximately linearly in accordance with the 30–50–80% reduction schedule ($F(1, 54) = 47.0, p < .0001$), while the nonlinear component of variation was nonsignificant ($F(2, 108) = 2.08$, $p = .13$). However, the final (i.e., Week 3) reductions produced by the nicotine fading strategies are well short of the 80% level obtained with standardized smoking machines. As in the case of CO data, there is a clear suggestion that smokers can compensate compared to smoking machines and intake higher nicotine levels. On the other hand, the reductions from baseline to Week 3, 53.4% with filters and 47.3% with brand switching, are substantial.

An analysis of covariance was performed on Week 3 measurements (omitting Week 1 and

[1]Both Week 2 and Week 3 cotinine measurements for this individual were approximately four times greater than baseline. Carbon monoxide measurements from the same person were in direct contradiction.

Table 3. Mean cigarette consumption levels (standard deviations in parentheses) at three levels of nicotine reduction categorized by treatment

Treatment	Sample (n)	Nicotine reduction 30%	50%	80%
Nicotine faders	42	23.8 (9.0)	22.3 (8.7)	20.7 (8.7)
Brand switching	41	24.3 (11.2)	24.4 (11.6)	23.5 (12.0)

Week 2 measurements) using the baseline measure as a covariate in an effort to increase sample size. The sample size rose from 56 to 66. The effect of nicotine fading regimen (still in favor of the filters) increased but did not reach significance ($F(1, 63) = 2.24, p = .14$). Using these data, the reductions from baseline were 55.2% with filters and 42.5% with brand switching.

Cigarette consumption during nicotine fading

A possible confounding explanation of observed CO and cotinine level reductions is that cigarette consumption levels were going down at the same time. In each of the 3 weeks prior to quitting, where each week corresponds to a particular nicotine reduction schedule, subjects were asked to complete a self-monitoring booklet wherein they recorded the number and time of all cigarettes smoked on each of 7 days. The booklets were collected and an average daily cigarette consumption computed for each of the nicotine reduction levels. These data are not directly comparable with baseline smoking consumption data that were obtained in response to the following questionnaire item given at intake: "Average number of cigarettes smoked per day." Complete data were available from 91 (of 110 subjects), but the analysis is restricted to 83 subjects since 8 subjects quit smoking at some point in the week prior to the quit-date and were not smoking on the quit-date.

To stabilize within-cell variances, a log transformation was performed on the responses. A repeated-measures ANOVA revealed no effect for type of nicotine fading regimen ($F(1, 81) < 1$), a significant effect for degree of nicotine fading ($F(2, 162) = 7.79, p = .001$ by Geisser-Greenhouse correction), and a nonsignificant interaction ($F(2, 162) = 2.21, p > .10$). Means are presented in Table 3. The average reduction in reported smoking consumption between the 30% and 80% smoking reduction schedules is 8.5%. This compares with parallel average reductions of 25.0% and 38.4% in CO and cotinine levels, respectively. Thus, at most, changes in cigarette consumption can explain only part of the

Table 4. Mean self-efficacy levels (standard deviations in parentheses) at baseline and at quit-date categorized by treatment (possible scores range from 0 to 100)

Treatment	Sample (n)	Self-efficacy Baseline	Quit-date
Nicotine faders	45	52.4 (17.0)	71.8 (17.3)
Brand switching	44	43.0 (18.8)	73.7 (19.8)

Table 5. Three-month prevalence, and 1-year prevalence, sustained, and continuous abstinence outcome by treatment condition

	Treatment Condition	
Frequency percent	Nicotine faders	Brand switching
3-Months	26	23
prevalence	49.06	40.35
1-Year	18	16
prevalence	33.96	28.07
1-Year	16	13
sustained	30.19	22.81
1 Year	12	11
continuous	22.64	19.30

observed drops in CO and cotinine. Furthermore, an alternative explanation of the small drop in cigarette consumption is that careful recording in the self-monitoring booklets might be expected to decrease over time.

Self-efficacy

Repeated measures ANOVA was carried out on self-efficacy data from the orientation and quit-date sessions. Data from subjects who quit prior to the quit-date were not employed in this analysis. It was found (see Table 4) that self-efficacy levels increased sharply from the orientation session to the quit-date ($F(1, 87) = 117.56$, $p < .001$). There was no effect caused by nicotine fading regimen ($F(1, 87) = 1.44$, $p = .23$), although there was a significant interaction ($F(1, 87) = 6.11$, $p = .02$), which derived from unexpected, lower self-efficacy levels at baseline in the brand switching condition ($t(87) = 2.44$, $p = .017$).

Outcome data

Results of 3-month and 1-year abstinence outcome follow-up are presented in Table 5. All but two subjects (98.2% response rate) were contacted at 1 year. One-year sustained abstinence is defined as the absence of relapse in accordance with guidelines recommended by the National Heart, Lung, and Blood Institute National Working Conference on Smoking Relapse (Shumaker & Grunberg, 1986). One-year continuous abstinence is defined as absolutely no use of any tobacco product.

Treatment status, facilitator, and baseline self-efficacy were entered as predictor variables for each outcome using logistic regression. There were no significant differences between the treatments on any of the outcome measures ($\chi^2(1) < 1$, in all cases), although there was a consistent trend in favor of filters. Generally, neither baseline self-efficacy nor facilitator predicted outcome ($p > .20$ in all cases, apart from a facilitator effect on 1-year abstinence prevalence, $p = .04$).

DISCUSSION

The results indicate that both brand switching and "Nicotine Faders" graduated filters produced meaningful reductions in nicotine exposure despite substantial compensation. Both CO and cotinine data indicate that the filters and the brand switching regimen reduced nicotine (as measured by saliva samples of its metabolite cotinine) and CO intake to a similar degree. These pooled reductions were 48.2% and 35.5% for cotinine and carbon monoxide, respectively. Although the filters produced bigger reductions in the measures of nicotine yield employed at all time points, these differences only achieved significance in the case of

CO exposure (and that in the presence of a significant interaction with nicotine reduction schedule). Indeed, in order to have had satisfactory statistical power (viz. $\geq .80$) with a two-tailed test and $\alpha = .05$ to detect a difference in Week 3 cotinine reductions *in the absence of missing data*, the population difference would have to exceed 50 ng/mL assuming the same levels of variability (Cohen, 1977)—the observed sample difference was 26 ng/mL.

The Week 3 reductions in nicotine and CO exposure for study participants attempting to quit smoking using the brand-switching procedure were similar to results Benowitz et al. (1986) obtained with two different populations: (1) habitual smokers switched to ultralow-yield cigarettes (defined as tar content ≤ 1 mg), and (2) habitual smokers smoking their self-selected brands. In a sample from the first population, tar, nicotine, and CO exposures were reduced by 56%, 49%, and 36%, respectively, as compared to a predicted 90% drop from smoking machine yield data. In the case of smokers smoking self-selected brands, those smoking ultralow-yield cigarettes (defined as nicotine content $\leq .21$ mg) had blood cotinine levels 39% lower than those smoking higher-yield cigarettes.

All but three persons who underwent the brand switching procedure were smoking an ultralow-yield cigarettes (defined as nicotine content $\leq .21$ mg) in Week 3. Thus, it appears that motivated smokers attempting to quit smoking via a brand switching preparation program had similar drops in nicotine exposure when smoking ultralow-yield cigarettes as did habitual smoker populations.

Impressive gains in self-efficacy were observed across conditions between baseline and quit-date measurements. Although this appears to support the value of the nicotine fading procedures as preparation for cessation strategies, the lack of a no-fading control clearly qualifies this finding. The observed interaction in favor of brand switching is probably of little consequence, since it was due to unexpected baseline differences.

The smoking cessation outcome data indicate a nonsignificant trend in favor of the graduated filter preparation technique. Clearly, the data show that the filters are a viable nicotine fading preparation for quitting technique when compared with the standard brand switching method of nicotine fading. The 1-year follow-up point prevalence and sustained abstinence estimates of 34.0% and 30.2%, respectively, obtained with this method are promising. Biochemical validation was not planned or carried out in this study because significant differences were not expected, and the major focus of the study was on reductions in nicotine and CO exposure. It should be noted that in a recent, large-scale study reported from this laboratory (Lando, McGovern, Barrios, & Etringer, 1989), the deception rate was estimated at just 4%. Further work is needed to assess outcomes for graduated filters using larger sample sizes and biochemical validation of self-reported abstinence.

The filters have important practical advantages over brand switching as a preparation for quitting strategy. These largely center around convenience: There is no need to change brand, and the tedious task of figuring which alternative brand to choose is eliminated. As a consequence, they appear much more promising as a nicotine-fading strategy in a self-help context. On the other hand, there are negative reactions to the filters of which potential subjects should be forewarned, namely, the filters gradually accumulate tar deposits and become dirty, and many smokers report having to "puff too hard" by the end of Week 3. The latter observation is consistent with the reduced nicotine intake reported above. Of course, both of these "negative" reactions can and should be reframed as positive steps on the road to complete abstinence.

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