

Original Investigation

# Changes in smoking expectancies in abstinent, reducing, and non-abstinent participants during a pharmacological trial for smoking cessation

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## Abstract

**Introduction:** Smoking expectancies are related to smoking consumption and predict smoking cessation. Little is known about whether expectancies change during smoking treatments, consistent with changes in smoking behavior. This study examined reported changes in smoking beliefs during an 8-week smoking cessation trial, which evaluated the safety and efficacy of the monoamine oxidase B inhibitor selegiline hydrochloride versus placebo.

**Methods:** Participants were classified as “Quit” ( $n = 18$ ), “Reduced” ( $n = 34$ ), or “Not Quit” ( $n = 49$ ) by 7-day point prevalence abstinence at the end of treatment. Expectancies were assessed at randomization, 1 week after the target quit date, and at the end of treatment.

**Results:** Beliefs about smoking assessed prior to the quit attempt were not associated with cessation outcomes. Participants who quit smoking reported a reduction in expectations that smoking would reduce negative affect, boredom, and cravings, and facilitate social interactions, while participants who did not quit smoking reported an increase in Negative Social Impression beliefs. There were gender differences in beliefs related to Negative Affect Reduction, Negative Physical Feelings, Social Facilitation, and Cravings and significant Gender  $\times$  Smoking Status interactions for Health Risk and Weight Control beliefs. There were no significant effects of medication on expectancies.

**Discussion:** Baseline expectancies were not associated with abstinence outcomes; however, expectancies changed over time with changes in smoking, and the greatest changes were seen with smoking abstinence. Information about the relationship between smoking beliefs and behaviors may be used to enhance or tailor smoking cessation treatments.

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## Introduction

Smokers hold a variety of beliefs, called expectancies, about the consequences of smoking including affect management (e.g., reducing negative affect and boredom and enhancing positive affect), weight management, and health effects. Reviews of research on smoking expectancies suggest that they play a significant role in smoking initiation, maintenance, and relapse (see Brandon, Juliano, & Copeland, 1999; Kassel, Stroud, & Paronis, 2003). Smoking expectancies are formed in childhood prior to personal experience with smoking (Chassin, Presson, Sherman, & Edwards, 1991; Copeland et al., 2007) and predict smoking initiation or increases in smoking in adolescents and young adults (Cohen, McCarthy, Brown, & Myers, 2002; Wahl, Turner, Mermelstein, & Flay, 2005). Further, smoking expectancies differ by current smoking status (Brandon & Baker, 1991; Jeffries et al., 2004; Mullennix, Kilbey, Fiscaro, Farnworth, & Torrento, 2003), are associated with motivation to quit smoking (Pulvers et al., 2004), predict smoking cessation attempts (Rose, Chassin, Presson, & Sherman, 1996), and predict continued cessation and lapse or relapse after a quit attempt (Copeland, Brandon, & Quinn, 1995; Gwaltney, Shiffman, Balabanis, & Paty, 2005; Rose et al., 1996; Shadel & Mermelstein, 1993; Wetter et al., 1994).

While expectancies are associated with success at smoking cessation, little is known about the ways that smoking expectancies may change over time, concomitant with changes in smoking status. A between-subjects laboratory study of brief (7 hr) abstinence from smoking found that abstinent adult smokers rated the positive smoking consequences to be more likely than non-abstinent smokers while there were no differences by abstinence condition in ratings of the likelihood of negative smoking consequences (Kirchner & Sayette, 2007). Few studies have examined within-subject changes in expectancies over time during treatment for smoking. One study (Shadel & Mermelstein, 1993) reported decreases in stress-related smoking expectancies

over the course of a 7-week group behavioral treatment program. Analysis of changes in expectancies by treatment outcome (abstinent vs. non-abstinent) was not reported. A second study (Copeland et al., 1995) found that adults who quit smoking through behavioral counseling and transdermal nicotine patch (TNP) showed a greater decrease in expectancies related to Negative Affect Reduction, Taste, Social Facilitation, and Craving/Addiction as measured by the Smoking Consequences Questionnaire—Adult (SCQ-A; Copeland et al.) than adults who continued to smoke. These studies offer preliminary evidence of within-person changes in expectancies with changes in smoking behavior. Studies have not yet examined changes in expectancies of smokers receiving medication for smoking cessation.

The primary aim of the current study was to examine whether changes in expectancies during the course of a clinical trial for smoking cessation differed for participants who quit, reduced, or were not able to quit smoking. Because gender differences in smoking expectancies have been reported (e.g., Copeland et al., 1995), one exploratory aim was to examine whether expectancies changed differentially during treatment by gender. In addition, because this was the first study to examine changes in expectancies during a non-nicotine medication treatment study, changes in expectancies of participants who received active medication compared with participants who received placebo (PLO) medication were also examined.

## Methods

### Participants

Participants were adult smokers randomized into a double-blind PLO-controlled clinical trial of selegiline hydrochloride (SEL, L-deprenyl, Eldepryl) for smoking cessation (Weinberger et al., 2010). Participants in the clinical trial were nicotine dependent, treatment-seeking cigarette smokers between the ages of 18 and 70 years who consumed  $\geq 15$  cigarettes/day with expired breath carbon monoxide (CO) levels of  $\geq 10$  ppm, plasma cotinine levels of  $\geq 150$  ng/ml, and reported failed past attempts to quit smoking. All participants reported motivation to quit smoking in the following 30 days as evidenced by a score of  $\geq 7$  on the Contemplation Ladder (range = 1–10; Biener & Abrams, 1991). Smokers were not eligible for the clinical trial if they reported a current major Axis I disorder (other than nicotine dependence), reported drug or alcohol abuse or dependence within the past 6 months, were taking medications that might interact with SEL (e.g., antidepressant medications), or had a positive urine drug screen or pregnancy test at baseline. Written informed consent was obtained from all participants, and the research protocols were approved by Yale Medical School's Human Investigation Committee. The clinical trial was registered at [www.Clinicaltrials.gov](http://www.Clinicaltrials.gov) as NCT00129311.

### Procedures

A total of 1,822 adults were screened by phone for the clinical trial, and 581 adult smokers were determined to be eligible for an in-person screening. Subsequently, 241 smokers attended the first screening appointment. During the screening appointment, which occurred prior to randomization, potential participants completed consent forms, measures of eligibility (e.g., medical and psychological evaluations, and urine drug and

pregnancy screens), and assessments of demographics and smoking. One hundred and one adults were eligible for the study, randomized to a medication condition, and took at least one dose of study medication (for additional details about screening and recruitment, see Weinberger et al., 2010). At the beginning of the study (Week 1), each participant was randomly assigned to receive 8 weeks of either SEL ( $n = 51$ ; 5 mg bid) or matching PLO ( $n = 50$ ). Participants were asked to attend weekly appointments during which they received study medication, completed measures of smoking, and received brief (<10 min) individual smoking cessation counseling from the Mayo Clinic's "Smoke Free and Living It" manual (Mayo Clinic, 2000). Each participant's target quit date was the beginning of the 3rd week of the study (Week 3), and the trial endpoint occurred at the beginning of the 9th week of the study (Week 9). For further information about study procedures, see Weinberger et al.

## Measures

### Demographics, smoking history, and nicotine dependence

Prior to randomization, participants were asked to report demographic information (e.g., gender, race, and age), age of smoking onset, duration of smoking, and number of past quit attempts. Nicotine dependence was assessed using the six-item Fagerström Test for Nicotine Dependence (range = 0–10; Heatherton, Kozlowski, Frecker, & Fagerström, 1991).

### Measures of smoking consumption and abstinence

At all appointments, participants completed a 7-day timeline followback (Sobell, Sobell, Leo, & Cancilla, 1988) as a self-report measure of smoking. Biochemical measures of smoking, collected at baseline and the end of treatment, were expired breath CO level determination (Bedfont EC50 Microsmokerlyzer II, Kent, UK) and plasma cotinine levels. Venous plasma for cotinine levels were determined by reversed-phase high-performance liquid chromatography procedures adapted from Hariharan, VanNoord, & Greden (1988). Smoking abstinence at the end of trial (Week 9) was determined by an absence of self-reported cigarette smoking during the last week of the study and biochemically verified by an expired breath CO level <10 ppm and plasma cotinine level <15 ng/ml (see Weinberger et al., 2010).

### Measure of smoking expectancies

Smoking expectancies were assessed at Week 1 (baseline), Week 4 (1 week after the target quit date), and Week 9 (end of treatment) using the SCQ-A (Copeland et al., 1995). The SCQ-A is a 55-item questionnaire with 10 scales: Negative Affect Reduction, Stimulation/State Enhancement, Health Risks, Taste/Sensorimotor Manipulation, Social Facilitation, Weight Control, Craving/Addiction, Negative Physical Feelings, Negative Boredom Reduction, and Negative Social Impression. Participants were asked to judge how likely each statement was to occur when they were smoking using a 10-point Likert scale (0 = completely unlikely to 9 = completely likely). Responses were averaged to create a mean score for each of the 10 scales (range = 0–9).

## Statistical methods

All participants ( $n = 101$ ) completed the SCQ-A at the Week 1 appointment. Eighty-seven participants completed the Week 4

appointment including the SCQ-A, and 68 participants completed the Week 9 appointment, which included the SCQ-A and assessments of smoking consumption. Smoking outcomes were determined based on information from the Week 9 appointment as described above. Participants were classified into one of three smoking status groups: (a) Quit ( $n = 18$ ): participants who reported an absence of cigarette smoking during the last week of the study that was biochemically confirmed by both CO and cotinine levels, (b) Reduced ( $n = 34$ ): participants whose self-reported smoking during the last week of the trial was <50% of their baseline smoking level, and (c) Not Quit ( $n = 49$ ): participants whose self-reported smoking was  $\geq 50\%$  of their baseline smoking level during the last week of the trial. An “intention-to-treat” approach was used (Hughes et al., 2003), and participants who did not complete the Week 9 assessments were classified as Not Quit.

Differences in baseline demographics, smoking information, and SCQ-A scales by Week 9 smoking status (Quit, Reduced, and Not Quit) were examined using chi-squares and one-way analyses of variance (ANOVAs). Differences in SCQ-A scale scores at baseline by gender and medication assignment were examined using ANOVAs. Mixed model regression analyses, using a compound symmetry covariance structure, were used to examine the main and interactive effects of smoking status, gender, and medication assignment (SEL vs. PLO) on changes across time in smoking expectancies during the clinical trial. Fixed effects were reported from these analyses. Due to baseline differences, age and duration of smoking were included as covariates. Multicollinearity was examined through zero-order correlations of the variables entered into the mixed model regression analyses. No correlations met the criteria for multicollinearity (all  $r$  values < .70). Analyses were repeated in the sample of treatment completers ( $n = 68$ ). Statistical tests were two tailed, and differences were considered significant when  $p < .05$ . Statistical analyses were performed using SPSS v.16.0 software for PC (SPSS Inc., Chicago, IL).

## Results

### Baseline demographics, smoking measures, and smoking expectancies

At baseline, there were no significant differences among participants who quit smoking, reduced smoking, and continued smoking for gender, race, education, past quit attempts, nicotine dependence, and smoking consumption (see Table 1). Participants who reduced their smoking were older and had smoked for a greater number of years than participants who did not quit smoking. Neither group differed significantly from participants who quit smoking on these variables.

There were no baseline differences in the endorsement of the 10 SCQ-A scales by endpoint smoking status (Table 1). Participants who were randomly assigned to receive PLO more strongly endorsed expectancies related to boredom reduction at baseline than participants who received SEL (PLO  $M = 6.2$ ,  $SD = 2.1$ ; SEL  $M = 4.6$ ,  $SD = 2.7$ ;  $t = 3.14$ ,  $df = 95$ ,  $p < .01$ ). There were no other differences in baseline expectancies by medication assignment and no significant differences by gender (all  $p$  values > .05).

### Changes in expectancies over the clinical trial by Week 9 smoking status

There were significant Time  $\times$  Smoking Status interactions for 5 of the 10 SCQ-A scales: Negative Affect Reduction [ $F(2, 241) = 6.98$ ,  $p < .001$ ; Figure 1A], Negative Boredom Reduction [ $F(2, 241) = 8.89$ ,  $p < .001$ ; Figure 1B], Craving/Addiction [ $F(2, 241) = 7.53$ ,  $p < .001$ ; Figure 1C], Social Facilitation [ $F(2, 241) = 5.48$ ,  $p < .01$ ; data not shown], and Negative Social Impression [ $F(2, 241) = 3.82$ ,  $p < .02$ ; data not shown]. Participants who quit smoking reported a decrease in their beliefs related to Negative Affect Reduction, Negative Boredom Reduction, Cravings, and Social Facilitation. Participants who reduced their smoking showed a moderate reduction in these expectancies while participants who did not quit smoking showed little change in these beliefs and reported an increase in beliefs related to the Negative Social Impression aspects of smoking (Not Quit vs. Reduced,  $p < .05$ ; Not Quit vs. Quit, nonsignificant).

There were significant Time  $\times$  Gender effects for four of the SCQ-A scales: Negative Affect Reduction [ $F(1, 241) = 6.86$ ,  $p < .01$ ], Social Facilitation [ $F(1, 241) = 5.04$ ,  $p < .03$ ], Negative Physical Feelings [ $F(1, 241) = 10.44$ ,  $p < .001$ ], and Cravings [ $F(1, 241) = 3.98$ ,  $p < .05$ ]. Across timepoints, women were more likely to endorse smoking expectancies related to Negative Affect Reduction and Cravings while men were more likely to endorse smoking expectancies related to Social Facilitation and Negative Physical Feelings.

Significant Time  $\times$  Smoking Status  $\times$  Gender interactions were found for the Weight Control [ $F(2, 241) = 5.03$ ,  $p < .007$ ] and Health Risks [ $F(2, 241) = 4.28$ ,  $p < .05$ ] scales. Subsequent analyses showed that women who changed their smoking behavior reported a greater reduction in Weight Control beliefs than women who continued to smoke ( $p$  values < .01, Not Quit compared with Quit and compared with Reduced). Men who quit smoking showed greater changes to Weight Control beliefs than men who did not quit ( $p < .05$ ). Men who reduced their smoking did not significantly differ from the other two groups. In terms of expectancies of the Health Risks of smoking, no significant differences were found by smoking status for women. Men who quit smoking differed significantly from men who did not quit smoking ( $p < .05$ ). Men who did not quit smoking showed no change in health risk expectancies during treatment. Men who quit smoking showed a decrease in health risk expectancies at 1 week after their quit date; however, endorsement of these beliefs increased at the end of treatment.

There were no significant differences in changes in smoking expectancies over the course of the study by medication assignment (all  $p$  values > .05). When these analyses were repeated in the sample of treatment completers ( $n = 68$ ), the results were consistent with the full sample.

## Discussion

Smokers who quit smoking with brief behavioral counseling and either SEL or PLO reported reductions in Negative Affect Reduction, Negative Boredom Reduction, Social Facilitation, and Craving/Addiction expectancies while smokers who did not quit smoking reported an increase in Negative Social Impression expectancies. The differences between smoking groups

**Table 1. Baseline demographic, smoking information, and expectancies for the full sample ( $n = 101$ ) and by endpoint smoking status (Quit, Reduced, and Not Quit)**

	Full sample ( $n = 101$ )	Quit ( $n = 18$ )	Reduced ( $n = 34$ )	Not Quit ( $n = 49$ )
Age (years)#	47.4 ± 12.0	50.7 ± 10.4	51.1 ± 10.5	43.4 ± 12.5
% Men	50	44	41	57
% Caucasian	87	94	88	84
Education (years)	14.0 ± 2.1	14.2 ± 1.9	14.6 ± 2.7	13.6 ± 1.5
Age of smoking onset (years)	16.3 ± 5.6	19.1 ± 9.3	15.3 ± 3.0	15.9 ± 5.1
Duration of smoking (years)#	30.7 ± 12.6	31.2 ± 12.0	36.0 ± 11.1	26.8 ± 12.7
Number of quit attempts	6.2 ± 7.5	3.9 ± 2.2	6.9 ± 6.7	6.4 ± 9.1
CPD	22.4 ± 8.1	22.6 ± 7.8	21.0 ± 7.2	23.2 ± 8.8
Expired breath CO level	24.2 ± 9.2	22.7 ± 7.5	24.9 ± 10.5	24.2 ± 8.9
Plasma cotinine level	308 ± 117	271 ± 123	322 ± 121	312 ± 111
FTND	6.3 ± 1.6	6.3 ± 1.4	6.2 ± 1.5	6.3 ± 1.6
% Receiving SEL	51	44	50	53
SCQ-A scales				
Negative Affect Reduction	5.6 ± 2.5	6.0 ± 2.8	5.5 ± 2.3	5.5 ± 2.5
Stimulation/State Enhancement	3.2 ± 2.1	3.8 ± 2.2	3.2 ± 2.1	3.1 ± 2.1
Health Risks	8.6 ± 0.9	8.6 ± 0.8	8.5 ± 1.2	8.8 ± 0.6
Taste/Sensorimotor Manipulation	4.0 ± 2.0	4.4 ± 1.7	4.0 ± 2.1	3.9 ± 2.1
Social Facilitation	3.6 ± 2.3	4.2 ± 2.7	3.0 ± 2.0	3.8 ± 2.2
Weight Control	3.9 ± 2.9	4.3 ± 3.2	3.8 ± 2.8	3.7 ± 2.8
Craving/Addiction	6.9 ± 1.8	7.0 ± 1.7	6.8 ± 2.1	7.0 ± 1.5
Negative Physical Feelings	3.7 ± 2.3	3.6 ± 2.3	3.4 ± 1.8	4.0 ± 2.5
Negative Boredom Reduction	5.4 ± 2.5	5.7 ± 2.5	4.9 ± 2.5	5.6 ± 2.6
Negative Social Impression	5.6 ± 2.3	5.2 ± 2.0	5.4 ± 2.8	6.0 ± 2.1

Note. CO, carbon monoxide; CPD, cigarettes/day; FTND, Fagerström Test for Nicotine Dependence; SCQ-A, Smoking Consequences Questionnaire Adult version; SEL, selegiline hydrochloride. SCQ-A range = 0–9.

# $p < .01$ , Reduced vs. Not Quit.

were most pronounced 1 month after the quit date. The findings of this study were partially consistent with Copeland et al. (1995) who found reductions for three of the same expectancy scales (Negative Affect Reduction, Craving/Addiction, and Social Facilitation) as well as reductions in Taste expectancies for smokers who quit using TNP and behavioral counseling compared with smokers who did not quit.

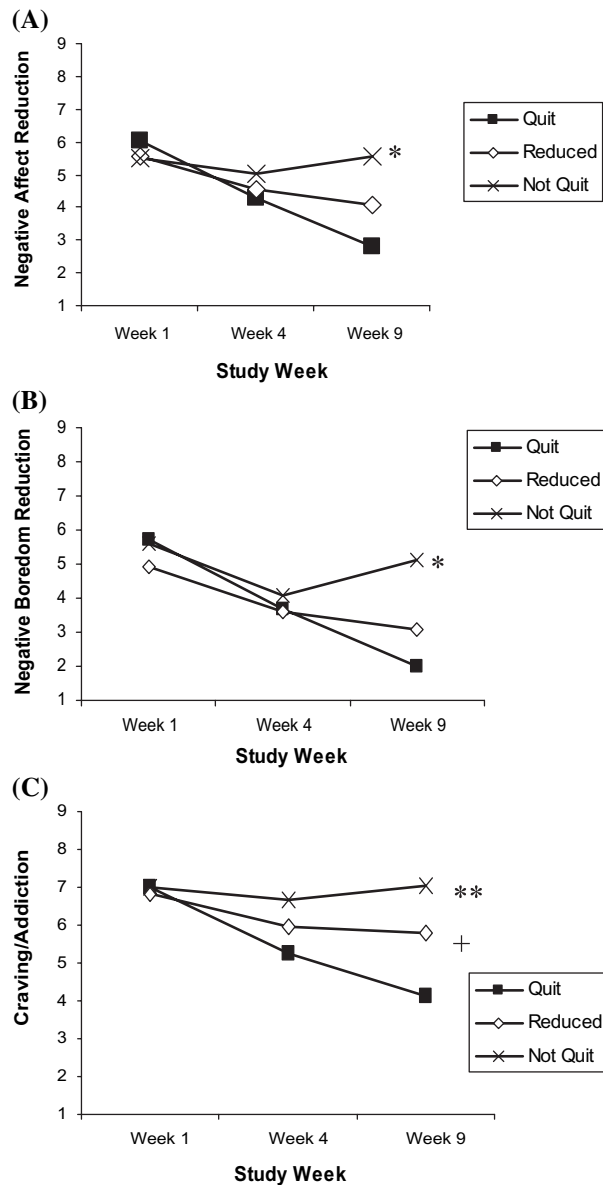
Gender differences in expectancy endorsement across timepoints were found for four scales with women more strongly endorsing beliefs that smoking affects negative affect and cravings and men more strongly endorsing beliefs related to Social Facilitation and Negative Physical Feelings. Past studies of gender differences have been mixed with studies reporting that women more strongly endorsed beliefs related to Health Risks, Weight Control, Social Facilitation (Copeland et al., 1995), and Negative Affect Reduction (Pulvers et al., 2004) and less strongly endorsing beliefs related to Taste/Sensorimotor Manipulation (Copeland et al.) and Negative Physical Effects (e.g., Rohsenow et al., 2003). These findings suggest that studies of expectancies, including changes in expectancies during treatment, should continue to include analysis by gender in order to clarify how the relationship between smoking beliefs and behavior are associated for men and women.

Previous studies of treatment-related changes in expectancies (e.g., Copeland et al., 1995; Shadel & Mermelstein, 1993) did not analyze differences by gender. In this study, gender

interacted with endpoint smoking status for beliefs related to Health Risks and Weight Control. While the differences on Health Risk beliefs were statistically significant for men, it should be noted that all participants reported high endorsement of Health Risk expectancies and means for all timepoints fell within a small range (<2 points on a 10-point scale).

SEL has been hypothesized to have potential as an effective smoking cessation pharmacotherapy by increasing synaptic dopamine levels through inhibition of monoamine oxidase B metabolism (for review, see George & Weinberger, 2008). In the present trial (Weinberger et al., 2010), smokers receiving SEL did not differ from smokers receiving PLO in changes in expectancies during treatment. Future research should examine changes in expectancies for male and female smokers treated with Food and Drug Administration-approved medications for smoking treatment (i.e., bupropion and varenicline).

Expectancies are believed to be learned from previous experience and provide information that allows a person to anticipate consequences of behaviors in situations they encounter (Goldman, 1999; Stein, Goldman, & Del Boca, 2000). Learning processes are also thought to play a major role in smoking behavior and relapse (e.g., Marlatt's relapse prevention theory; Marlatt & Gordon, 1985; see Patten & Brockman, 2006). In this study, participants who quit smoking reduced their endorsement of a number of aspects of smoking related to negative reinforcement (negative affect, boredom, and cravings) as well as



**Figure 1.** Changes in (A) Negative Affect Reduction, (B) Negative Boredom Reduction, and (C) Craving/Addiction expectancies for Quit ( $n = 18$ ), Reduced ( $n = 34$ ), and Not Quit ( $n = 49$ ) participants at the beginning of the trial (Week 1), 1 week after the target quit date (Week 4), and at the study endpoint (Week 9). \* $p < .05$ , Quit compared with Not Quit; \*\* $p < .01$ , Quit compared with Not Quit; + $p < .05$ , Quit compared with Reduced.

one expectancy related to positive reinforcement (Social Facilitation). Abstinent participants may have reported changes in smoking beliefs as they encountered and learned that they were able to manage situations (e.g., negative affect, boredom, and social interactions) in ways other than smoking.

Expectancies may be incorporated into behavioral smoking cessation counseling in a number of ways. For example, counseling could focus on beliefs that changed for successful abstainers (e.g., reducing boredom and negative affect) and emphasize the link between smoking beliefs and experience through role-play and homework assignments. Coping skills specific to cravings and negative moods could be taught prior to quit day in

preparation for difficult situations. In addition, tailored treatments are a promising avenue for treatment refractory smokers (Niaura & Abrams, 2002; Vidrine, Cofta-Woerpel, Daza, Wright, & Wetter, 2006), and expectancy measures could be used to tailor the content of counseling sessions for male and female smokers and to monitor changes in beliefs during quit attempts. It should be noted that while smokers who reduced their smoking showed a moderate level of change in some expectancies, they did not show any change in the endorsement of most smoking-related beliefs. The greatest changes in expectancies were clearly found in smokers who stopped smoking cigarettes entirely. The 2008 update to the Clinical Practice Guidelines on Treating Tobacco Use and Dependence (Fiore et al., 2008) recommendation is that all smokers should be encouraged to quit smoking completely, and this goal should be the main focus of interventions including those based on or incorporating smoking-related beliefs.

A number of limitations of this study should be noted. First, this evaluation of smoking expectancies in a smoking cessation trial of SEL should be considered a secondary analysis since the expectancy measures were added to the trial to explore the association between baseline and post quit date expectancies and were not primary outcomes in the study. Second, participants in this study were mainly Caucasian, highly educated, free from current psychiatric or substance use disorders, and reported high levels of motivation to quit. The findings of this study may have limited generalizability to other groups of smokers. Third, while changes in expectancies were observed, the design of the study does not provide information about the mechanisms behind this change. Additional experimental research is needed to more fully understand the relationship between expectancies and smoking behavior and how this information can be used to enhance smoking cessation treatments.

## Conclusions

In treatment-seeking adult smokers participating in a pharmacological clinical trial for smoking cessation, expectancies changed over time with changes in smoking status. Changes in expectancies were not associated with medication assignment. Research conducted to better understand the relationship between smoking beliefs and behaviors may provide information that can be used to enhance or tailor smoking cessation treatments.

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## Declaration of Interests

*Drs Weinberger and McKee have no competing interests to report. Dr George reports that he has received grant funding from Pfizer,*

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