

## Brief Report

# Gender Differences in Smoking Following an Implicit Mood Induction

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Received June 3, 2011; accepted August 4, 2011

## Abstract

**Introduction:** Smoking is significantly associated with negative affect, which may play an especially important role in the smoking behavior of women. The purpose of this laboratory study was to examine the role of gender in the relationship of negative mood and smoking maintenance for male and female smokers following an implicit mood induction using music.

**Methods:** Ninety adult smokers (50% female) completed a laboratory session during which they were randomly assigned to a negative mood induction, a positive mood induction, or a neutral mood condition. Latency to smoke and number of cigarettes smoked were assessed during an *ad libitum* smoking period following the mood induction.

**Results:** Female smokers began smoking more quickly following the negative mood induction when compared with males. There were no gender differences in the number of cigarettes smoked or for cravings to smoke by mood condition.

**Conclusions:** This study demonstrated gender differences in the relationship between negative affect and smoking behavior following an implicit and subtle mood manipulation. A better understanding of gender differences in smoking behavior can provide valuable information about mechanisms that maintain smoking behavior and guide treatment development to help adults quit smoking.

## Introduction

Negative affect plays an important role in smoking initiation, maintenance, cessation, and relapse (Kassel, Stroud, & Paronis, 2003). Most laboratory studies of negative affect and smoking have used explicit methods meant to induce significant changes in affect (e.g., noise stressor, personal imagery, pictures; Fazio & Olson, 2003; Payne, Schare, Levis, & Coletti, 1991; Sinha, 2009). Two laboratory studies found shorter latencies to smoke after induction of negative affect using both mood-congruent pictures and music (Conklin & Perkins, 2005; Perkins et al., 2008). Daily hassles or minor stressful events have also been associated with

smoking behavior (Guthrie, Young, Boyd, & Kintner, 2001), and proximal increases in negative affect in naturalistic settings appear to be more strongly related to smoking lapses than on-going stressors (Shiffman & Waters, 2004). There is a need for controlled laboratory studies of minor fluctuations in negative mood on smoking behavior to better understand this relationship.

Managing negative affect through smoking may be particularly important for women. Women are more likely to report smoking to reduce negative affect (Cepeda-Benito & Reig-Ferrer, 2000; Rundmo, Smedslund, & Gotestam, 1997), the belief that smoking will reduce negative affect (Brandon & Baker, 1991) and that they will be unable to manage negative affect after quitting (McKee, O'Malley, Salovey, Krishnan-Sarin, & Mazure, 2005). Few studies have experimentally examined mood-induced smoking outcomes by gender. One study (Fucito & Juliano, 2009) found no gender differences in smoking following an induction of a sad mood, while a second study found that women reported greater smoking-induced relief of negative affect than men after overnight abstinence (Xu et al., 2008). Additional studies are needed to clarify the role of gender in the relationship of negative affect and smoking.

## Aims of the Current Study

The purpose of this laboratory study was to examine the smoking behavior of men and women following an implicit mood induction using a fully crossed 3 (Negative Mood, Positive Mood, Neutral Mood Induction) by 2 (female, male) between-subjects design. The primary aim of the study was to examine the overall and gender-specific impact of negative affect on smoking behavior. It was hypothesized that the induction of a negative mood state, as opposed to a positive or neutral mood state, would result in shorter latencies to smoke and a greater number of cigarettes smoked overall and for female smokers in particular.

## Methods

### Participants

Participants were recruited from the greater New Haven, Connecticut area through advertising (e.g., newspaper ads, flyers).

doi: 10.1093/ntr/ntr198

Advance Access published on September 8, 2011

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## Gender differences in smoking

Participants were eligible to enroll if they were 18–60 years old, smoked >10 cigarettes per day (CPD), had an expired breath carbon monoxide (CO) level of  $\geq 10$  ppm, were free from significant medical conditions, and did not meet criteria for any Axis I disorders other than nicotine dependence and alcohol abuse. Participants were excluded if they used psychotropic medications in the past thirty days, were currently attempting to quit smoking, or were pregnant. The study was approved by the Yale Human Investigation Committee and carried out in accordance with the Declaration of Helsinki.

## Procedures

### Screening Session

After written informed consent was obtained, data were collected about demographics, smoking history, and nicotine dependence. The Structured Clinical Interview for *DSM-IV* (First, Spitzer, Gibbon, & Williams, 1997) was used to identify current Axis I disorders. Women completed a urine pregnancy test.

### Laboratory Session

The laboratory session was described as a study of “lifestyle and musical preferences” to disguise the true purpose of the experiment. Each participant was randomly assigned to one of three mood induction conditions (Negative Mood, Positive Mood, Neutral Mood). Randomization to condition was stratified by gender. Female participants completed the laboratory procedures during the follicular phase of their menstrual cycle (Days 1–14). All laboratory sessions were scheduled to start at 1 p.m. Participants were instructed to smoke as usual prior to the laboratory session.

During the first 60 min of the laboratory session, participants completed baseline assessments (e.g., Smoking History), and then smoked a cigarette to standardize the time from the last cigarette to the *ad libitum* smoking period, which occurred 1 hr later. Participants then completed a 30-min computerized Lifestyle Questionnaire, followed by the 10-min Mood Induction. In the Negative and Positive Mood Induction conditions, participants were instructed to put on headphones and listen to music selected to induce negative or positive emotions. Participants were asked to record any thoughts, feelings, or images that occurred while they listened to the music and to rate their preference for the music pieces in order to obscure the true purpose of the music (i.e., mood induction). Participants in the Neutral Mood condition were given a 10-min break during which they remained in the laboratory. Participants in the Negative and Positive Mood Induction conditions were instructed to keep their headphones on during a 50-min Mood Maintenance period. In the Neutral Mood condition, participants did not have any background music. During the first 20 min of the 50-min Mood Maintenance period, participants repeated measures of positive affect, negative affect, and cravings to smoke. After 20 min had passed (i.e., 60 min since the participants' last cigarette), participants completed an *ad libitum* smoking period. The *ad libitum* smoking period comprised the last 30 min of the 50-min Mood Maintenance period. CO levels were collected at all timepoints. Following completion of the session, participants were queried as to the true purpose of the experiment. None guessed correctly. Participants were then debriefed and monitored until their mood returned to preinduction levels.

## Measures

### Demographics

Information was collected on demographics and medical history. Women used a calendar to report the timing of their menstrual cycles for the past three months.

### Smoking History

Participants were asked to report their frequency of smoking, preferred brand of cigarette, years of smoking, and number of quit attempts.

### Biochemical Confirmation of Smoking

CO levels were measured using a Vitalograph Breath CO (Vitalograph, Inc., Lenexa, KS). Urine cotinine was analyzed on site by reversed-phase high-performance liquid chromatography with ultraviolet detection modified from the literature (Hariharan, VanNoord, & Greden, 1988) to include a micro acid back extraction cleanup step. The lower limit of quantitation for cotinine was set to 25 ng/ml.

### Nicotine Dependence

Nicotine Dependence was assessed using the six-item Fagerström Test for Nicotine Dependence (range = 1–10; Heatherton, Kozlowski, Frecker, & Fagerström, 1991).

### Cravings to Smoke

Participants evaluated their current cravings to smoke using a Visual Analogue Scale (VAS, range 1–100).

### Current Mood

Participants were asked to report their current mood in response to bipolar adjectives assessing positive affect (i.e., cheerful, happy) and negative affect (i.e., sad, depressed; Mongrain & Tramabakoulos, 1997) using VAS-mood scales (range 1–100).

### Lifestyle Questionnaire

The Lifestyle Questionnaire included measures of nicotine dependence, cravings to smoke, and current mood as described above. The Lifetime Questionnaire also included questions assessing alcohol use, caffeine consumption, exercise patterns, and eating behaviors in order to reduce demand characteristics.

### Mood Induction

Similar to our previous work (McKee, Wall, Hinson, Goldstein, & Bissonnette, 2003), a prerecorded cassette of segments of musical pieces was played during the 10-min mood induction and the 50-min mood-maintenance phase. Examples of musical pieces used to induce a positive mood were Beethoven's “Symphony No. 3, Eb Major” and Yanni's “Aria.” Selections used to induce a negative mood included Beethoven's “Piano Trio No 4, D Major” and Pink Floyd's “Shine on You Crazy Diamond.”

## Statistical Analyses

Analyses of variance (ANOVAs) were run to determine whether baseline differences existed across gender and treatment condition. In order to ensure that the mood manipulation was effective, a repeated measures multivariate analysis of variance (MANOVA) was performed with mood condition (Negative Mood Induction, Positive Mood Induction, Neutral Mood) and gender as the between-subjects independent variables and ratings of positive affect and negative affect at two timepoints (pre-mood induction, post-mood induction) as the two dependent

**Table 1. Demographics and Baseline Smoking Measures for the Full Sample ( $n = 90$ ) and by Gender (%;  $M$ ,  $SE$ )**

Demographics and smoking measures	Full sample ( $n = 90$ )	Women ( $n = 45$ )	Men ( $n = 45$ )
Age (years)	25.66 (0.96)	25.42 (1.42)	25.89 (1.30)
Caucasian (%)	80	84	71
College educated (%)	78	80	76
Unmarried (%)	87	84	89
CPD	17.38 (0.65)	17.64 (0.91)	17.11 (0.94)
FTND	4.54 (0.22)	4.64 (0.30)	4.44 (0.33)
Yrs of daily smoking	7.21 (0.92)	7.17 (1.26)	7.26 (1.35)
Urine cotinine (ng/ml)*	1116 (88)	910 (101)	1343 (139)
Expired breath CO (ppm)	18.69 (0.75)	18.47 (1.05)	18.91 (1.09)

Note. CPD = cigarettes per day; FTND = Fagerström Test for Nicotine Dependence; CO = carbon monoxide.

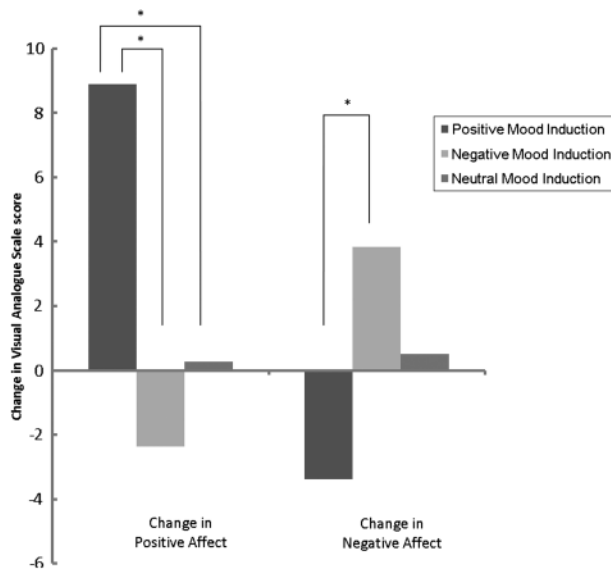
\* $p < .05$ , women versus men.

variables. To test the primary research questions, univariate ANOVAs were used to analyze the main and interactive effects of mood conditions and gender on smoking behavior. Mood condition and gender were the between-subjects independent variables, and measures of smoking (latency to smoke, total number of cigarettes smoked) were the dependent variables. Finally, changes in cravings were examined through an ANOVA with mood condition (Negative Mood Induction, Positive Mood Induction, Neutral Mood) and gender as the between-subjects independent variables and cravings to smoke as the dependent variable. Statistical analyses were performed using SPSS v.16.0 software for PC (SPSS Inc., Chicago, IL). Statistical tests were two tailed, and differences were considered significant when  $p < .05$  using the Wilks' Lambda index.

## Results

### Baseline Characteristics

One hundred and eight adults were screened for this study. Eighteen potential participants were excluded from the study

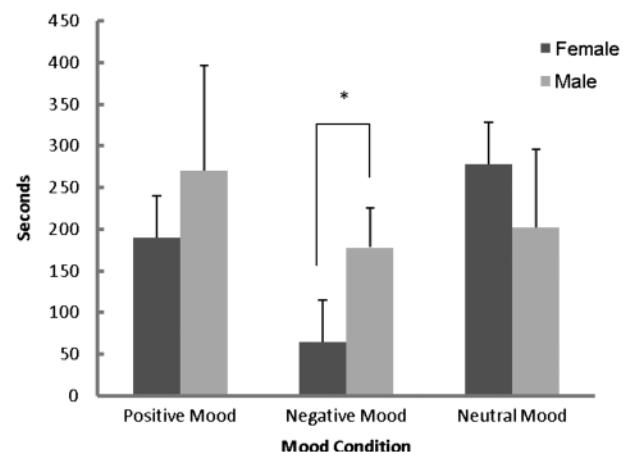


**Figure 1.** Change in positive and negative affect ratings from pre- to post-mood induction for the positive mood induction, negative mood induction, and neutral mood induction conditions. \* $p < .05$ .

for not meeting the medical ( $n = 9$ ), psychiatric ( $n = 2$ ), and smoking ( $n = 7$ ) inclusion criteria. Ninety adults (50% female) completed the study with 30 participants randomized to each of the three mood conditions (Negative Mood Induction, Positive Mood Induction, Neutral Mood). Participants were primarily Caucasian, smoked 17.7 CPD, and reported a moderate level of nicotine dependence. See Table 1 for demographics and smoking variables for the full sample and by gender. Only cotinine levels varied by gender, and when evaluated as a potential covariate in subsequent models, it did not contribute significant variance nor change the pattern of findings. There were no significant demographic or smoking differences by mood condition.

### Mood Manipulation

There were no significant differences in positive or negative affect ratings prior to the mood induction by mood conditions or gender. A MANOVA comparing pre- to post-induction negative and positive affect ratings demonstrated a significant two-way interaction of affect ratings by time and condition,  $F(2, 84) = 4.63$ ,  $p < .02$ . Simple effects analyses demonstrated that participants in the Negative Mood Induction condition reported a greater decrease in positive affect than the Positive Mood Induction and Neutral Mood conditions and a greater increase in negative affect than the Positive Mood Induction condition (see Figure 1). There were no main effects of gender



**Figure 2.** Latency to smoke by mood condition and gender. \* $p < .05$ .

( $p = .63$ ), no interactive effects of gender and mood condition ( $p = .13$ ), and no interaction effects of gender, mood condition, and time ( $p = .72$ ).

### Effect of Mood on Smoking Behavior by Gender

There was a significant Mood Condition  $\times$  Gender interaction on latency to start smoking,  $F(1, 85) = 4.21, p < .05$ . Women had shorter latencies to smoke,  $t(25) = 2.26, p < .05$  (see Figure 2), following the negative mood induction when compared with men. There were no significant main or interactive effects of gender or mood condition on the number of cigarettes smoked (female mean = 1.49,  $SE = 0.84$ ; male mean = 1.53,  $SE = 0.63$ ). Furthermore, there were no significant main or interactive effects of gender or mood condition on cravings to smoke.

### Discussion

The purpose of this laboratory study was to investigate the role of gender in smoking behavior subsequent to the implicit induction of negative affect. Compared with males, female smokers began smoking more quickly following the negative mood induction. Previous research has shown that women are more likely to report smoking to reduce negative affect (Cepeda-Benito & Reig-Ferrer, 2000; Rundmo et al., 1997) and the belief that smoking will reduce negative affect (Brandon & Baker, 1991). The current study suggests that the stronger relationship for women between negative affect relief and smoking occurs in response to subtle increases in negative affect.

No effects of gender were found for the number of cigarettes smoked following the negative mood induction. This result may have been related to the fixed duration of the *ad libitum* smoking period. It is also possible that women respond to negative affect by increasing the intensity of their smoking rather than the amount of smoking. Additional research, including studies of smoking topography, is needed to further understand how men and women differ in their smoking-related response to negative affect.

There were no differences following the manipulation in cravings to smoke by condition or gender. As we were interested in the maintenance of smoking behavior, participants were only deprived of smoking for 1 hr, and we did not expect to see large increases in cravings to smoke during that time.

A number of limitations should be noted. First, adults in the sample were primarily Caucasian, young, and smoked a little less than a pack of cigarettes per day. Findings may not generalize to other groups of smokers. Second, all female participants were premenopausal and in the follicular phase of their menstrual cycle. Differences in affect-related smoking by menstrual cycle phase or menopause status could not be examined. Third, laboratory studies have the potential for context and demand effects; however, the setting also provides the opportunity to study behavior that would be extremely difficult to examine outside of a controlled environment. Additional strengths of the study include the use of a subtle mood induction, standardization of the time since last cigarette, and the stratification by gender to conditions.

In conclusion, this study highlighted gender differences in mood-related maintenance of smoking behavior. Gender

differences in negative mood begin during adolescence (Hankin & Abramson, 2001; Twenge & Nolen-Hoeksema, 2002) and adult women are more likely to report sadness (Brebner, 2003; Fischer, Rodriguez Mosquera, van Vianen, & Manstead, 2004) and depression (Kessler, McGonagle, Swartz, Blazer, & Nelson, 1993). Women may therefore have more opportunities to learn and strengthen a conditioned association between smoking and negative affect. A better understanding of gender differences in smoking behavior would provide valuable information about the mechanisms of smoking behavior and ultimately help to guide treatment development to help adults quit smoking.

### Funding

This work was supported by *Women's Health Research at Yale* (to SAM), the National Institutes on Health (R21-DA017234, RL1-DA024857, and CTSA-UL1RR024139 to SAM and K12-DA000167 to AHW), and the State of Connecticut, Department of Mental Health and Addiction Services.

### Declaration of Interests

*Drs. Weinberger and McKee have no competing interests to report.*

### Acknowledgments

*None.*

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