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Mood and smoking behavior: The role of expectancy accessibility and gender

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Abstract

Little is known about overall or gender-specific factors that may influence the relationship between negative affect and smoking behavior such as smoking expectancies. This paper presents a secondary analysis from a laboratory studying gender differences in smoking behavior following a musical mood induction [Weinberger, A.H., & McKee, S.A., 2012, Gender differences in smoking following an implicit mood induction. *Nicotine & Tobacco Research*, *14(5),* 621–625]. The current analyses examine the role of expectancies (endorsement and accessibility) in the relationship of gender, affect, and smoking. Ninety adult smokers (50% female) were randomly assigned to a negative mood induction, positive mood induction, or neutral condition while completing a single laboratory session. Expectancy endorsement, expectancy accessibility, affect, and smoking topography were assessed following the mood induction. Female smokers with faster accessibility of negative reinforcement expectancies smoked more cigarettes, had longer puff durations, and had shorter inter-puff intervals. Women with faster expectancy accessibility were also more likely to endorse negative reinforcement smoking expectancies. This study was the first to demonstrate links among gender, mood, and accessibility of smoking-related beliefs. Information about the role of expectancy accessibility in smoking behavior can lead to both a better understanding of gender-specific mechanisms of smoking behavior and new directions for smoking treatment development.

Keywords

expectancies; accessibility; smoking; negative affect; gender

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Contributors

Dr. McKee designed the study, wrote the protocol, and conducted the statistical analyses. Dr. Weinberger conducted the literature review and wrote the first draft of the manuscript. Both authors contributed to and have approved the final manuscript.

Conflicts of Interest

Drs. Weinberger and McKee have no conflicts of interest to report.

1. Introduction

Negative affect plays an important role in smoking behavior (Copeland, Brandon, Quinn, 1995) especially for women (e.g., Husky, Mazure, Paliwal, & McKee, 2008; Wetter, Kenford, Smith, Fiore, Jorenby, & Baker, 1999). We previously reported results from a laboratory study utilizing a musical mood induction that women began smoking more quickly than men following a negative mood induction (Weinberger & McKee, 2012). The purpose of these secondary analyses was to examine whether smoking expectancies interacted with affect and gender in predicting smoking behavior.

Smokers learn to connect negative affect relief to smoking through repeated experience. As a result, negative affect becomes a conditioned cue to smoke and this learned connection is stored cognitively as an expectancy (e.g., “Cigarettes help me deal with anxiety or worry.”; Brandon & Baker, 1991). Negative affect expectancies play an important role in the relationship between negative affect and smoking (Kassel, Stroud, & Paronis, 2003) and poor cessation outcomes (Wetter et al., 1994; Weinberger, McKee, & George, 2010).

Explicit expectancies, accessible to conscious awareness, and implicit expectancies, outside of conscious awareness, each have a unique relationship with drug use behavior (e.g., McCarthy & Thompsen, 2006; Wiers, van Woerden, Smulders, & de Jong, 2002). Implicit expectancies are elicited through methods such as expectancy accessibility (i.e., reaction time measures; Palfai, Monti, Ostafin, & Hutchison, 2000). Reaction time measures are suggested to reflect the strength of an expectancy (i.e., well-learned beliefs will be accessed more quickly) and provide an estimate of how a belief would likely impact behavior in real world situations (Fazio, Powell, & Williams, 1989).

Few laboratory studies have examined the relationship of smoking expectancies (explicit or implicit), mood, and smoking. Perkins et al. (2008) found that induction of negative affect increased and induction of positive affect decreased endorsement that smoking would reduce negative affect (although see also Conklin & Perkins, 2005). McKee and colleagues (McKee et al., 2003) reported that participants in a negative mood condition were more likely to generate negative reinforcement expectancies, a measure of implicit expectancies.

The current study was a secondary analysis from a fully-crossed 3 (Negative Mood Induction, Positive Mood Induction, Neutral Mood condition) by 2 (female, male) between-subjects design (Weinberger & McKee, 2012). It was hypothesized that greater explicit expectancies (i.e., higher likelihood ratings), and greater accessibility of implicit expectancies (i.e., faster reaction times) would each interact with greater negative affect ratings to predict more intense smoking behavior. It was further expected that this relationship would be stronger in female smokers than male smokers. Finally, we explored the relationship between expectancy endorsement and expectancy accessibility by gender.

2. Materials and Methods

2.1. Participants

The participants and procedures for this study have been described previously (Weinberger & McKee, 2012). Eligible participants had to be current smokers between the ages of 18 and 60 without significant medical and psychiatric disorders. The study was approved by the Yale Human Investigation Committee and was carried out in accordance with the Declaration of Helsinki.

2.2. Procedures

2.2.1. Laboratory Session—Participants completed one 3-hour laboratory session (+0 to +180 min). Randomization to one of three mood induction conditions (Negative Mood Induction, Positive Mood Induction, Neutral Mood) was stratified by gender.

Following baseline assessments, participants smoked a cigarette using the topography equipment (+60 min) then completed a computerized Lifestyle Questionnaire (+60 to +90 min; questions related to smoking, mood, and other domains such as alcohol and caffeine consumption). Participants in the Negative and Positive Mood Induction conditions listened to music through headphones for the 10-minute mood induction (+90 to +100 min) and the 50-minute mood maintenance period (+100 to +150 min). All participants completed computer-administered measure of explicit (i.e., likelihood ratings) and implicit expectancies (i.e., expectancy accessibility) (+100 to +110 min) and an ad-lib smoking period using the smoking topography equipment (+120 to +150 min). Participants completed measures of mood before and after the mood induction (+90, +100 min), after the smoking expectancy measure (+120 min), and during the ad lib smoking period (+130, 140, 150 min).

2.3. Measures

2.3.1. Demographics and Baseline Smoking—Information was collected on demographics and history of cigarette use. Smoking levels were biochemically verified using CO levels (Vitalograph, Inc.; Lenexa, KS) and urine cotinine.

2.3.2. Current Affect—Current affective state was rated on VAS scales using bipolar adjectives assessing positive affect (i.e., cheerful, happy) and negative affect (i.e., sad, depressed; Mongrain & Tramabakoulos, 1997).

2.3.3. Mood Induction—Mood was induced using pre-recorded cassettes of classical, contemporary, and New Age instrumental pieces (Pignatiello, Camp, & Rasar, 1986) previously modified for a college sample (Mongrain & Trambakoulos, 1997) to induce either a positive mood (e.g., Yanni's "Aria") or negative mood (e.g., Pink Floyd's "Shine on You Crazy Diamond").

2.3.4. Smoking Expectancies—Both explicit expectancies (i.e., expectancy endorsement assessed as likelihood ratings) and implicit expectancies (i.e., expectancy accessibility assessed as reactions times) were assessed using a single administration of a computerized adaptation of the Smoking Consequences Questionnaire (SCQ; Brandon & Baker, 1991). Two domains of expectancies were assessed: 1) Negative Reinforcement/ Negative Affect Reduction expectancies (e.g., reduction of sadness and anxiety) and 2) Positive Reinforcement expectancies (e.g., taste, relaxation). Participants were instructed to use computer keys reflecting a 10-point Likert response scale (0=Completely Unlikely to 9=Completely Likely) to respond as quickly as possible as to whether each item applied to their experience with smoking. Participants were also asked to respond as quickly as possible to a number of items listing traits that they were to judge as "applicable" or "not applicable" to themselves as an internal control for speed of response (see Palfai, Monti, Colby, & Rohsenow, 1997). Consistent with prior studies (e.g., McKee, Wall, & Hinson, 1998; Palfai et al., 2000), accessibility of smoking expectancies was determined as the differences in latencies to respond to expectancy items compared to self-items.

2.3.5. Smoking Topography Equipment—A table-top Clinical Research Support System (CreSS; Plowshare Technologies, Richmond, VA) was used to assess smoking topography (e.g., puff frequency, puff volume, puff duration, inter-puff interval, depth of inhalation, inter-cigarette interval).

2.4. Statistical Analyses

Hierarchical linear regressions were used to examine the primary research question of whether explicit (likelihood ratings) and implicit (reaction times) smoking expectancies interacted with affect and gender in predicting smoking topography (time to first cigarette, puff duration, number of puffs, puff volume, inter-puff internal, peak puff, and total number of cigarettes). Preliminary data analysis revealed significant overlap in individual positive and negative affect ratings across mood conditions and the evaluation of mood condition x expectancies x gender showed no significant effects associated with the mood conditions. As a result, the reported analyses focused on individual differences in post-prime affect (assessed at +100 min), irrespective of the original mood assignment. The first set of analyses examined main and interactive effects of post-induction negative affect ratings, expectancies for negative reinforcement, and gender (dummy coded) predicting measures of smoking topography with post-induction positive affect ratings included as a covariate. Main effects were entered on the first step and then all two and three-way interactions were entered on second and third steps, respectively. Analyses were repeated with the measure of implicit expectancies (expectancy accessibility measured by reaction times) replacing the explicit expectancy measure (likelihood ratings). Baseline smoking topography measures, age, and CPD were entered as control variables. 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 $p<0.05$.

3. Results

3.1. Sample Characteristics, Baseline Smoking and Smoking Topography, and Manipulation Check

Ninety participants completed the study (50% female; 80% Caucasian; mean age = 25.66 years, SE=0.96; mean CPD=17.38, SE=0.65). Analyses reported in Weinberger and McKee (2012) determined that there were no differences in demographics or baseline smoking across mood groups or by gender, with the exception of higher cotinine levels in men than women ($p<0.05$). Men, compared to women, showed greater baseline puff volume (M=48.78, SE=2.44 versus M=41.21, SE=2.17, $p<0.05$) and peak puff (M=50.63, SE=2.36 versus M=44.30, SE=2.18, $p<0.05$). Previously reported analyses also showed that the mood manipulation was equally effective across gender (i.e., the Negative Mood Induction condition resulted in a decrease in positive affect and increase in negative affect in comparison to the Positive Mood Induction and Neutral Mood conditions equally for men and women).

3.2. Interactions of Explicit and Implicit Smoking Expectancies, Negative Affect Ratings, and Gender Predicting Smoking Topography

In the main effects analyses (Table 1, Step 1), changes in negative affect, reaction times, and gender were significantly associated with aspects of smoking topography. Greater changes in negative affect were significantly associated with smoking more cigarettes, shorter latencies to begin smoking, greater puff volume, and longer puff duration (trend, $p<0.10$). Faster reaction times for negative reinforcement expectancies were associated with greater puff duration and volume. Male gender was associated with greater puff duration.

There were significant two-way interactions of reaction times and gender for several indices of smoking topography (Step 2, RT x Gender). Females with faster reaction times for negative reinforcement expectancies smoked more cigarettes, had longer puff durations and volume (trend, $p<0.10$), and shorter inter-puff intervals ($p<0.05$) compared to females with slower accessibility and compared to males.

There was a significant two-way interaction of changes in negative affect ratings and gender on one indice of smoking topography (Step 2, NA x RT). Greater negative affect ratings and faster reaction times for negative reinforcement expectancies interacted to significantly predict the total number of cigarettes smoked.

There were no significant two-way interactions of negative affect and gender (Step 2, NA x Gender) nor significant three-way interactions of negative affect, reaction time, and gender (Step 3, NA x RT x Gender) on indices of smoking topography.

3.3. Relationship between Explicit and Implicit Expectancies by Gender (Figure 1)

Women with faster reaction times were more likely to endorse that smoking would result in negative reinforcement ($F=5.07$, $p<0.03$; see Figure 1).

4. Discussion

This study demonstrated links among gender, affect, and an implicit measure of smoking-related beliefs across mood induction conditions. Women who more quickly accessed expectations that smoking would reduce negative affect smoked more cigarettes and smoked their cigarettes more intensely compared to women with slower expectancy accessibility and to men. Further, women with the highest level of accessibility of negative reinforcement beliefs were also more likely to positively endorse such beliefs. Across the lifespan, negative mood is more prevalent in women (Hankin & Abramson, 2001; Twenge & Nolen-Hoeksema, 2002) which may provide greater opportunities to learn and strengthen associations between smoking and negative affect.

The findings of this study suggest potential targets for behavioral interventions. Cognitive-behavioral smoking treatments primarily focus on cognitive restructuring while smoking studies utilizing extinction principles have focused on the ability of pharmacological treatments (e.g., nicotine replacement therapy, mecamylamine) and denicotinized cigarettes to reduce the rewarding value of cigarettes (e.g., McClernon et al., 2007; Rose, 2006). Preliminary research from the alcohol field suggests that implicit alcohol expectancies may be brought to awareness and modified (Fazio & Olson, 2003; Wiers et al., 2006). Research is needed to understand whether applying techniques from the alcohol expectancy field would result in the modification of smoking expectancies and consequent smoking behavior.

A number of limitations should be noted. First, mood was induced in a laboratory setting using one type of sensory stimulus (i.e., music). Differential results would be demonstrated with another method of mood induction. Further, standardized music used to induce affect and may not have provided as great a music-induced change in affect as individualize music selections. Second, while laboratory studies have the potential for context and demand effects, the setting can also provided the opportunity to study mechanisms of smoking behavior (e.g., expectancy accessibility) which would be extremely difficult to examine outside of a controlled environment.

5. Conclusions

This study provides the first experimental evidence for gender differences in the relationship between expectancy accessibility and mood-related smoking behavior. A better understanding of expectancy accessibility can provide valuable information about the mechanisms of smoking behavior and guide treatment development with the goals of improving quit rates and reducing relapse for smokers who have a difficult time quitting.

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RESEARCH HIGHLIGHTS

- Smoking expectancies were assessed following a mood induction.
- A link was demonstrated between gender, mood, and smoking belief accessibility.
- Women with faster negative reinforcement expectancy accessibility smoked more intensely.
- A better understanding of expectancy accessibility can guide smoking treatment development.

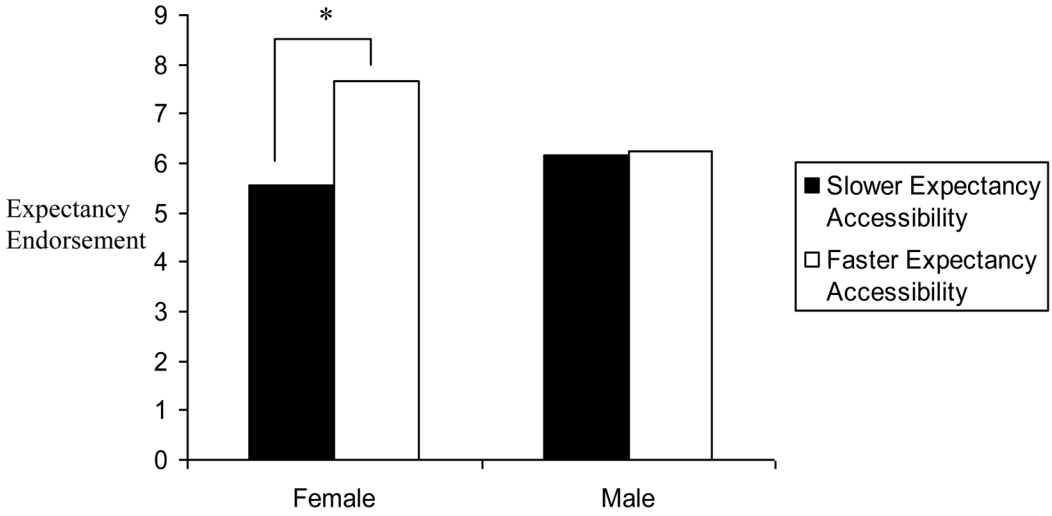

Figure 1.
Endorsement of negative reinforcement expectancies by gender and a median split of expectancy accessibility. *p<0.05

Table 1

Results of Hierarchical Regression Examining Post-Induction Negative Affect Ratings, Negative Reinforcement Expectancy Reaction Times, and Gender Predicting Indices of Smoking Topography.

Predictor Variables	Total Number of Cigarettes		Latency to First Cigarette		Puff Duration		Puff Volume		Inter-Puff Interval	
	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value
Step 1										
Negative Affect (NA)	0.40	0.004	-0.30	0.05	0.11	0.06	0.14	0.04	--	--
Reaction Time (RT)	--	--	--	--	−0.40	0.03	−0.39	0.05	--	--
Gender	--	--	--	--	−0.46	0.05	--	--	--	--
Step 2										
NA x Gender	--	--	--	--	--	--	--	--	--	--
RT x Gender	1.22	0.05	--	--	0.59	0.04	0.54	0.08	−0.61	0.05
NA x RT	1.12	0.04	--	--	--	--	0.47	0.07	--	--
Step 3										
NA x RT x Gender	--	--	--	--	--	--	--	--	--	--

Key: β, Standardized Beta; NA, post-induction negative affect ratings; RT, reaction times calculated as differences in latencies to respond to negative reinforcement smoking expectancy items versus self-items. Covariates included baseline smoking topography, post-induction positive affect ratings, age, and cigarettes per day.

Note: There were no significant effects associated with puff number or peak puff.