Published in final edited form as:
Addict Behav. 2013 February ; 38(2): 1527–1531. doi:10.1016/j.addbeh.2012.06.002.

NEGATIVE MOOD EFFECTS ON CRAVING TO SMOKE IN WOMEN VERSUS MEN

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Abstract

Negative mood situations increase craving to smoke, even in the absence of any tobacco deprivation (e.g. “stressors”). Individual differences in effects of negative mood situations on craving have received relatively little attention but may include variability between men and women. Across two separate within-subjects studies, we examined sex differences in craving (via the QSU-brief) as functions of brief smoking abstinence (versus satiation; Study 1) and acute induction of negative mood (versus neutral mood; Study 2). Subjective ratings of negative affect (via the Mood Form) were also assessed. In study 1, we compared the effects of overnight (>12 hr) abstinence versus non-abstinence on craving and affect in adult male (n=63) and female (n=42) smokers. In study 2, these responses to negative versus neutral mood induction (via pictorial slides and music) were examined in male (n=85) and female (n=78) satiated smokers. Results from each study were similar in showing that craving during the abstinence and negative mood induction conditions was greater in women than men, as hypothesized, although the sex difference in craving due to abstinence was only marginal after controlling for dependence. Craving was strongly associated with negative affect in both studies. These results suggest that very acute negative mood situations (e.g. just a few minutes in Study 2), and perhaps overnight abstinence, may increase craving to smoke to a greater extent in women relative to men.

Keywords

sex; abstinence; negative mood; craving; affect; smoking

1. Introduction

Negative mood experiences often increase craving and risk of relapse among those trying to quit smoking (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Shiffman & Waters, 2004). Even among those not trying to quit, negative mood situations can increase craving to smoke (Maude-Griffin & Tiffany, 1996; Perkins & Grobe, 1992; Willner & Jones, 1996). These findings on craving may help explain greater smoking behavior during the experience of acute negative mood and the resulting negative affect (e.g., Rose, Ananda, & Jarvik, 1983;

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Author Disclosures
The authors have no disclosures to make other than to restate that this research was supported by Grants DA027449 and DA031218 from the U.S. National Institute on Drug Abuse.

Conklin & Perkins 2005; see also Kassel, Stroud, & Paronis, 2003). ("Mood" is defined here as the situational context for smoking, while "affect" is the subjective emotion produced by the mood context [e.g., Diener & Emmons, 1984; Mayer, Salovey, Gomberg-Kaufman, & Blainey, 1991; Salovey, 1992]).

The influence of negative mood on craving varies between smokers, but relatively few controlled studies have specifically examined individual differences in craving responses, especially to acute negative mood situations. Craving responses to negative mood situations, such as smoking abstinence or other causes, may be greater in women than men, perhaps consistent with other research suggesting greater smoking reward and behavior of women in response to more direct smoking-related stimuli (Perkins, 2009). Greater craving due to negative mood situations could also help explain the often greater difficulty women have with quitting smoking (e.g., Perkins, 2001). In one study, for example, women reported a greater increase in negative affect (tension-anxiety subscale of the POMS) due to overnight abstinence, and also greater subsequent relief of that negative affect by resuming smoking, compared to men (Xu, Azizian, Monterosso, Domier, Brody, London, & Fong, 2008). In other studies, compared to men, women seeking treatment to quit report greater motivation to smoke as a means of controlling stress (McEwen, West, & McRobbie, 2008) and admit to less ability to manage the perceived risks of attempting to quit smoking, which is predictive of poorer cessation outcome (McKee, O'Malley, Salovey, Krishnan-Sarin, & Mazure, 2005). Even in a study of non-abstinent smokers, women reported a greater decline in a single "desire to smoke" item (i.e. craving relief) than men after smoking a single cigarette through a topography device (Eissenberg, Adams, Riggins, & Likness, 1999). Yet, magnitude of craving in response to brief smoking abstinence has not been clearly shown to vary between men and women.

Moreover, to our knowledge, very little research has assessed sex differences in craving brought on by negative mood situations other than smoking abstinence, such as acute "stressors" or other environmental challenges. Experimental manipulations of mood contexts may provide clearer findings on the influence of negative mood on craving and other responses (see Cheetham, Allen, Yucel, & Lubman, 2010). In two recent studies, non-abstinent smokers were exposed to induction of negative versus neutral mood via music (Weinberger & McKee, 2011) or film clips (Fucito & Juliano, 2009). No differences in craving (or negative affect) responses were found between women and men, although other differences were reported. Both studies randomized subjects to the different mood conditions, and a within-subjects comparison of mood effects may increase statistical power to find sex differences in craving responses to negative versus neutral mood per se (e.g., Fleiss, 1986).

We report two studies that examined the influence of overnight smoking abstinence or negative mood induction on craving to smoke in women versus men. We also explored whether subjective negative affect would be associated with increased craving differentially between women and men. Importantly, both studies involved two sessions varying in mood condition so we could compare responses to negative (versus neutral control) mood using a within-subjects design. Study 1 compared craving and negative affect in response to the negative mood situations of overnight tobacco abstinence versus non-abstinence (satiation). To examine the generalizability of results to a more specific cause of negative mood that did not involve tobacco deprivation, Study 2 compared the craving and negative affect of non-abstinent smokers in response to an acute negative versus neutral mood induction procedure. Both studies hypothesized that the increase in craving in response to these negative mood conditions (including abstinence) would be greater in women than men. We assessed, but did not formally hypothesize, sex differences in the subjective affect responses to these mood conditions.

2. Study 1

2.1 Study 1 Material and Methods

2.1.1. Participants—Participants in Study 1 (n=105; 63 male, 42 female) met DSM-IV nicotine dependence criteria (updated from a measure reported by Breslau, Kilbey, & Andreski, 1994) and smoked ≥ 10 cigarettes per day for at least one year. They were recruited through advertisements in the surrounding community for a larger study on smoking and negative affect (Perkins, Karelitz, Giedgowd, Conklin, & Sayette, 2010). Mean (±SD) characteristics for the men and women, respectively, were 26.9 (±8.9) and 27.6 (±9.6) years of age, 18.6 (±4.0) and 20.3 (±7.4) daily cigarettes, and 4.4 (±1.8) and 5.2 (±2.1) for score on the Fagerstrom Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991), indicating moderate dependence. In terms of ethnicity, most were Caucasian (85%), with 14% as African-American, and 1% Hispanic. Men and women did not differ on any of these characteristics, except higher FTND in women, $F(1,103) = 4.39$, $p=.039$.

2.1.2. Measures—Subjective negative affect was assessed with the five items of the Negative Affect subscale of the Diener & Emmons (1984) Mood Form (each converted from 0–6 to a 0–100 visual analog scale, or VAS, with 0 and 100 anchored by “Not at all” and “Very much”, respectively). This subscale asks how “depressed/blue”, “unhappy”, “frustrated”, “worried/anxious”, and “angry/hostile” the person is feeling. This measure has been shown to be sensitive to changes in acute negative affect elicited by a variety of mood situations among smokers (e.g. Conklin & Perkins, 2005; Perkins Ciccocioppo, Conklin, Milanak, Grottenthaler, & Sayette, 2008; Tiffany, Cox, & Elash, 2000).

Craving to smoke was assessed by the Questionnaire of Smoking Urges-Brief (QSU; Cox, Tiffany, & Christen, 2001; Tiffany et al., 2000), a very widely used 10-item craving scale. Example items include “A cigarette would taste good now” and “I could control things better right now if I could smoke”, with each item using a similar 0–100 VAS (with 0 and 100 anchored by “Do not agree” and “Strongly agree”, respectively). The QSU has been validated as a measure of craving in many prior studies (see Tiffany, Warthen, & Goedeker, 2009).

2.1.3. Procedure and Analyses—Subjects were instructed to abstain overnight (>12 hrs) from smoking, or to smoke ad libitum, prior to each of two separate sessions administered in counterbalanced order. Overnight smoking abstinence was verified by expired-air CO ≤ 10 ppm (SRNT Subcommittee, 2002). (Subjects whose CO exceeded this cutoff had sessions canceled and rescheduled once. They were excluded from the study if the CO failed to meet the cutoff during the rescheduled session.) For the non-abstinent session, subjects were instructed to smoke ad libitum prior to the session and then to smoke one of their preferred brand immediately upon arrival, to ensure smoking satiation (i.e., an absence of nicotine withdrawal). In both sessions, all participants first received an overview of the the procedures that would follow the affect and craving assessments analyzed here. Briefly, each session involved administration of a separate (but comparable) set of neutral mood slides, which were intended to equate subject attention during the later periods of each session (see Perkins, et al. 2010). After session instructions and a brief rest period, subjects completed the Mood Form and the QSU, to assess subjective negative affect and craving, respectively, under the smoking abstinent versus non-abstinent mood conditions.

Separate repeated-measures analyses of variance (ANOVA) were used to compare men and women on negative affect and craving responses to the abstinence versus non-abstinence conditions. For all analyses, we examined main and interaction effects involving sex. Generalized Estimating Equations (GEE) were used to relate differences in subjective

negative affect to craving via Wald chi-square (X^2), with sex and abstinence condition as additional factors.

2.2. Study 1 Results

Negative affect was significantly greater due to abstinence versus non-abstinence, as expected, F(1,103)=54.95, p<.001. As shown in Figure 1 for men and women, there was no main effect of sex on negative affect, F(1,103)<1, although the interaction of abstinence condition x sex was marginal, F(1,103) = 3.19, p=.077. Craving of men and women in response to the abstinence conditions is also shown in Figure 1. Also as expected, craving was significantly greater due to overnight abstinence, F(1,103) = 509.46, p<.001. Notably, the interaction of abstinence condition x sex on craving was significant, F(1,103) = 4.38, p=.039. As hypothesized, the craving response to overnight abstinence was greater in women versus men, who reported very similar levels of craving during the non-abstinence session (see Figure 1). However, when these analyses were repeated while covarying for FTND dependence, which differed by sex (see 2.1.1 Participants), the interaction of abstinence condition x sex on craving was only marginal, F(1,101)= 3.18, p=.077.

GEE results indicated that greater subjective negative affect was linearly associated with greater craving, Wald X^2 (df=1) of 7.24, p=.007, after controlling for the very significant effect of abstinence condition. No GEE effects were significant for sex, the interaction of sex x negative affect (both Wald X^2<1), or the interaction of sex x abstinence condition (Wald X^2=1.49, p>.20), suggesting that negative affect was similarly related to craving in men and women under these mood conditions.

2.3 Study 1 Discussion

Results indicated that, compared with men, women may respond to overnight smoking abstinence (versus non-abstinence) with greater craving, as hypothesized. However, this sex difference in craving response to abstinence was only marginal after controlling for the higher mean FTND score in women versus men of this study, suggesting this finding may be tentative and require replication. Yet, if confirmed, this result could provide directions for understanding why women may generally be more likely than men to relapse after a quit attempt (Perkins, 2001). Some research has indicated the acute smoking behavior of women may be more responsive to smoking cues and less responsive to nicotine intake per se, compared with men (Perkins, 2009). Therefore, research manipulating exposure to smoking cues (e.g., Conklin, Robin, Perkins, Salkeld, & McClernon, 2008) may show even greater craving among overnight abstinent women versus men. Although not explicitly hypothesized here, the marginally greater subjective negative affect response to abstinence in women versus men in this study is consistent with prior research showing such a similar sex difference in tension-anxiety response to overnight abstinence (Xu et al., 2008). Further research should examine sex differences in negative affect and craving following shorter and longer durations of smoking abstinence, and as a function of environmental stimuli such as smoking cues, as well as a smoker's nicotine dependence level, quit motivation, and, perhaps, presence of emotion dysregulation (e.g., Fucito & Juliano, 2009).

To examine sex differences in craving response to a more focused negative mood condition that did not involve tobacco deprivation (i.e., smoking abstinence), Study 2 assessed craving among satiated (non-abstinent) men and women during an acute negative versus neutral mood induction procedure.

3. Study 2

3.1 Study 2 Material and Methods

3.1.1. Participants—Participants (n=164; 86 male, 78 female) were very similar, and recruited in the same fashion, as those in Study 1 but consisted of a totally separate sample of adult smokers. Mean (±SD) characteristics for the men and women, respectively, were 28.6 (±11.2) and 28.3 (±9.9) years of age, 16.7 (±5.8) and 16.2 (±5.0) daily cigarettes, and 4.4 (±2.2) and 4.8 (±1.9) for score on the FTND. Most were Caucasian (76%), with 13% African-American, 3% Asian, about 1% each Hispanic or Native American, and 6% more than one race. Men and women did not differ on any of these characteristics.

3.1.2. Measures—As in Study 1, subjective negative affect was assessed via the Negative Affect scale of the Mood Form (Diener & Emmons, 1984), and craving was assessed by the QSU-Brief (QSU; Cox, et al., 2001).

3.1.3. Mood Induction—The mood induction procedure is described fully in Conklin and Perkins (2005). Negative mood was induced by presenting high arousal negative pictorial slides adapted from the International Affective Picture System (IAPS; Lang, Ohman, & Vaitl, 1988), along with mood-congruent classical music, such as Bartok's "The Miraculous Mandarin" and Prokofiev's "Battle on the Ice". "Neutral" mood was induced very similarly, with use of positive slides from the IAPS and congruent pleasant music, including Williams' "The Wasps" and Vivaldi's "Mandolin Concerto". These stimuli were selected for the neutral mood control condition to maintain consistency in the participants' generally pleasant affect at baseline due to their non-abstinent, satiated smoking status at the start of each session (see 3.1.4. Procedure and Analyses). All slides were presented on a computer monitor for 12 sec each in a darkened room. Slides and music have each been employed separately in past mood induction studies of smokers (e.g., McKee, et al. 2005; Willner & Jones, 1996), but we devised a method that combines these approaches to enhance mood induction, as reported elsewhere (Conklin & Perkins, 2005; Perkins, Ciccocioppo, Conklin, Milanak, Grottenthaler, & Sayette, 2008).

3.1.4. Procedure and Analyses—After an initial screening session, participants engaged in two virtually identical experimental sessions (in counter-balanced order) varying only in the valence of mood induction conditions presented (negative or neutral). As in the non-abstinent session of Study 1, all participants in Study 2 were instructed to smoke ad libitum prior to each session and one cigarette of their own brand upon arrival to both sessions. This procedure ensured that reported negative affect during mood induction could not be attributed to recent tobacco deprivation but rather to the mood induction manipulation itself, which was aimed at producing a negative mood context free of smoking abstinence. After this initial smoking opportunity and quiet rest, each mood induction session began with a baseline assessment (BL) of subjective negative affect and craving, as in Study 1. Following the first 4 mins of induction of negative or neutral mood (i.e. 20 IAPS slides), both measures were again assessed for comparison of negative affect and craving responses due to the mood induction conditions. The full study (Perkins, Giedgowd, Karelitz, Conklin, & Lerman, in press) included subsequent assessments of additional measures and responses during continued mood induction that followed the results obtained here. Because they are not pertinent to this analysis, they are not presented.

Separate repeated-measures analyses of variance (ANOVA) were used to compare men and women on negative affect and craving responses from baseline to the negative versus neutral mood inductions. For all analyses, we examined main and interaction effects involving sex. Generalized Estimating Equations (GEE) were again used to relate differences in the

increase in negative affect to the increase in craving due to the mood induction conditions, with sex and mood as additional factors.

3.2 Study 2 Results

Baseline negative affect and craving did not differ by session or between men and women, indicating successful control over initial study conditions. Means (SE) at baseline during the negative and neutral mood induction sessions, respectively, were 15.3 (1.2) and 17.1 (1.4) for negative affect, and 21.4 (1.4) and 22.2 (1.5) for craving. As shown for men and women in Figure 2, the change from baseline in negative affect due to the mood induction conditions was highly significant, $F(1,161)=135.11$, $p<.001$, as expected. In addition, the interaction of mood x sex was significant, $F(1,161)=8.53$, $p=.004$, as the difference in negative affect due to the mood induction conditions was greater for women compared to men. The increase in craving from baseline was also significantly greater during negative versus neutral mood, $F(1,160) = 79.20$, $p<.001$, as also shown in Figure 2. Most importantly, craving was increased by negative (versus neutral) mood to a greater extent among women compared to men, as hypothesized, as the interaction of mood x sex was significant, $F(1,160)=4.02$, $p=.047$.

In GEE analyses, we examined the association of the change from baseline in negative affect with the change from baseline in craving, by subject sex and mood induction condition. After controlling for the substantial influence of mood condition, no significant main effects of negative affect change, Wald X^2 (df=1) of 1.28, $p>.25$, or sex, Wald $X^2 < 1$, were found on the increase in craving from baseline. However, the increase in craving was significantly predicted by the interaction of negative affect x sex, Wald X^2 (1) = 9.29, $p=.002$, and by the interaction of negative affect x sex x mood condition, Wald X^2 (1) = 4.67, $p=.031$. In exploratory follow-up correlations of change from baseline in negative affect versus craving, this association was stronger in women versus men, both during negative mood, r's of .38, $p<.001$, and .17, $p>.10$, respectively, and particularly during neutral mood, r's of .39, $p<.001$, and −.27, $p=.013$, respectively.

3.3 Study 2 Discussion

These findings indicate that negative mood induction via pictorial slides (and congruent music) increases craving to smoke to a greater degree in women compared to men, as hypothesized, under the non-abstinent conditions of the present experiment. Moreover, negative affect in response to the mood conditions was greater in women than men, which was an exploratory notion but not directly hypothesized. Importantly, we found these sex differences in craving response after rather brief exposure to the negative mood induction condition (about 4 min) just after smoking a cigarette (i.e. satiation), suggesting these sex differences in non-abstinent smokers may be apparent rather quickly during at least some negative mood situations. The degree to which this negative mood induction condition increased subjective negative affect was similar to, or greater than, effects of other mood induction procedures (e.g., Doran, McChargue, Spring, Vander Veen, Cook, & Richmond, 2006; Fucito & Juliano, 2009; Weinberger & McKee, 2011). Thus, even the brief induction procedure in this study was sufficient to produce substantially elevated negative affect, as well as greatly increased craving. Finally, GEE results showed that the association of increased negative affect with increased craving was also stronger in women regardless of the mood induction condition, which was not specifically hypothesized. These last findings require replication, but they may suggest a more general sex difference in the relationship between subjective affect and craving response that is not specific to experiencing a negative mood condition per se.

4. Conclusions

In two separate studies comparing different negative versus neutral mood situations, either overnight smoking abstinence or an induction procedure involving negative mood slides and music during no abstinence, we found greater increases in craving to smoke among women compared to men, as hypothesized. In Study 1, these craving differences due to overnight abstinence may have been partly a function of the sex difference in FTND dependence score. Yet, the sex differences in craving due to negative mood induction in Study 2 were not likely influenced by FTND, since women and men there did not differ on FTND. These results may be consistent with other research indicating that the sensory and pharmacological factors promoting acute smoking behavior may differ by sex (see Perkins, 2009). Also, in Study 2, but not Study 1, a similar significant sex difference was observed for subjective negative affect response to the acute mood induction conditions, which was an exploratory comparison in this research but not a formal hypothesis.

For both studies, negative affect response was directly predictive of craving. Although we did not formally hypothesize sex differences in affective responses to negative mood, this association was comparable between men and women during the smoking abstinence manipulation in Study 1 but stronger among women during the mood induction procedures in Study 2. Yet, craving due to overnight smoking abstinence likely was not due solely to the resulting level of negative affect, as tobacco deprivation per se contributes to craving independent of changes in affect. Notably, comparing results in Figure 1 with the absolute means for the acute negative mood condition in Study 2 (not directly shown in Figure 2) for all participants, overnight abstinence in Study 1 produced a level of subjective negative affect (22.6) comparable to, or less than, that in Study 2 (27.8). By contrast, Study 1 resulted in a far greater level of craving (74.3) than that in Study 2 (38.7). Therefore, the extent to which sex differences in negative affect per se lead to a sex difference in craving is uncertain but likely varies between abstinent and non-abstinent negative mood situations, which clearly differ in the factors responsible for craving. For example, craving due to abstinence is prompted mostly by nicotine deprivation and the resulting effects on neurophysiology, while craving due to negative mood situations in non-deprived smokers likely results from any of several factors, including stressors or other environmental stimuli as well as degree of negative affect (Tiffany, et al., 2009).

Further research manipulating different intensities of negative mood experiences may be able to gauge the influence of subjective affect on craving responses in women versus men. Also uncertain is whether craving responses to these negative mood situations generalize to other causes of negative mood. Comparing men and women on craving responses to other types of negative mood situations that are commonly experienced by smokers, such as interpersonal stress or workplace challenges, may determine the specificity of these observed sex differences. Finally, further research also should investigate potential mediators of craving and examine whether these sex differences in craving responses extend to potentially relevant cognitive or neuroimaging responses to negative mood situations (e.g., Cepeda-Benito & Tiffany, 1996; Drobes, Elibero, & Evans, 2006; Rose, McClernon, Froeliger, Behm, Preud-homme, & Krystal, 2011).

Acknowledgments

This research was supported by Grants DA027449 and DA031218 from the U.S. National Institute on Drug Abuse.

References

Baker TB, Piper ME, McCarthy DE, Majeskie MR, Fiore MC. Addiction motivation reformulated: An affective processing model of negative reinforcement. Psychological Review. 2004; 1:33–51. [PubMed: 14756584]

Breslau N, Kilbey MM, Andreski P. DSM-IIIR nicotine dependence in young adults: prevalence, correlates and associated psychiatric disorders. Addiction. 1994; 89:743–754. [PubMed: 8069175]

Cepeda-Benito A, Tiffany ST. The use of a dual-task procedure for the assessment of cognitive effort associated with cigarette craving. Psychopharmacology. 1996; 127:155–163. [PubMed: 8888382]

Cheetham A, Allen NB, Yucel M, Lubman DI. The role of affective dysregulation in drug addiction. Clinical Psychology Review. 2010; 30:621–634. [PubMed: 20546986]

Conklin CA, Perkins KA. Subjective and reinforcing effects of smoking during negative mood induction. Journal of Abnormal Psychology. 2005; 114:153–164. [PubMed: 15709822]

Conklin CA, Robin N, Perkins KA, Salkeld RP, McClernon FJ. Proximal vs. distal cues to smoke: The effects of environments on smokers' cue-reactivity. Experimental and Clinical Psychopharmacology. 2008; 16:207–214. [PubMed: 18540780]

Cox LS, Tiffany ST, Christen AG. Evaluation of the brief questionnaire of smoking urges (QSU-Brief) in laboratory and clinical settings. Nicotine and Tobacco Research. 2001; 3:7–16. [PubMed: 11260806]

Diener E, Emmons RA. The independence of positive and negative affect. Journal of Personality and Social Psychology. 1984; 47:1105–1117. [PubMed: 6520704]

Doran M, McChargue D, Spring B, Vander Veen J, Cook JW, Richmond M. Effect of nicotine on negative affect among more impulsive smokers. Experimental and Clinical Psychopharmacology. 2006; 14:287–295. [PubMed: 16893271]

Drobes DJ, Elibero A, Evans DE. Attentional bias for smoking and affective stimuli: a Stroop task study. Psychology of Addictive Behaviors. 2006; 20:490–495. [PubMed: 17176185]

Eissenberg T, Adams C, Riggins EC, Likness M. Smokers, sex and the effects of tobacco cigarettes: subject-rated and physiological measures. Nicotine and Tobacco Research. 1999; 1:317–324. [PubMed: 11072428]

Fleiss, JL. The Design and Analysis of Clinical Experiments. Wiley; New York: 1986.

Fucito LM, Juliano LM. Depression moderates smoking behavior in response to sad mood induction. Psychology of Addictive Behaviors. 2009; 23:546–551. [PubMed: 19769439]

Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. British Journal of Addiction. 1991; 86:1119–1127. [PubMed: 1932883]

Kassel JD, Stroud LR, Paronis CA. Smoking, stress, and negative affect: Correlation, causation, and context across stages of smoking. Psychological Bulletin. 2003; 129:270–304. [PubMed: 12696841]

Lang, PJ.; Ohman, A.; Vaitl, D. The International Affective Picture System [Photographic Slides]. Gainesville, FL: The Center for Research in Psychophysiology, Univ of Florida; 1988.

Maude-Griffin PM, Tiffany ST. Production of smoking urges through imagery: the impact of affect and smoking abstinence. Experimental and Clinical Psychopharmacology. 1996; 4:198–208.

McEwen A, West R, McRobbie H. Motives for smoking and their correlates in clients attending Stop Smoking treatment services. Nicotine & Tobacco Research. 2008; 10:843–850. [PubMed: 18569758]

McKee SA, O'Malley SS, Salovey P, Krishnan-Sarin S, Mazure C. Perceived risk and benefits of smoking cessation: Gender-specific predictors of motivation and treatment outcome. Addictive Behaviors. 2005; 30:423–425. [PubMed: 15718060]

Mayer JD, Salovey P, Gomberg-Kaufman S, Blainey K. A broader conception of mood experience. Journal of Personality and Social Psychology. 1991; 60:100–111. [PubMed: 1995832]

Perkins KA. Smoking cessation in women: special considerations. CNS Drugs. 2001; 15:391–411. [PubMed: 11475944]

Perkins, KA. Sex differences in nicotine reinforcement and reward: influences on the persistence of tobacco smoking. In: Bevins, R.; Caggiula, AR., editors. The Motivational Impact of Nicotine and its Role in Tobacco Use. New York: Springer-Verlag; 2009. p. 143-169.

Perkins KA, Ciccocioppo M, Conklin C, Milanak M, Grottenthaler A, Sayette M. Mood influences on acute smoking responses are independent of nicotine intake and dose expectancy. Journal of Abnormal Psychology. 2008; 117:79–93. [PubMed: 18266487]

Perkins KA, Giedgowd GE, Karelitz JL, Conklin CA, Lerman C. Smoking in response to negative mood in men versus women as a function of distress tolerance. Nicotine and Tobacco Research. in press. in press.

Perkins KA, Grobe JE. Increased desire to smoke during acute stress. British Journal of Addiction. 1992; 87:1037–1040. [PubMed: 1643396]

Perkins KA, Karelitz JL, Conklin CA, Sayette MA, Giedgowd GE. Acute negative affect relief from smoking depends on the affect measure and situation, but not on nicotine. Biological Psychiatry. 2010; 67:707–714. [PubMed: 20132927]

Rose JE, Ananda S, Jarvik ME. Cigarette smoking during anxiety-provoking and monotonous tasks. Addictive Behaviors. 1983; 8:353–359. [PubMed: 6677075]

Rose JE, McClernon FJ, Froeliger B, Behm FM, Preud-homme X, Krystal AD. Repetitive transcranial magnetic stimulation of the superior frontal gyrus modulates craving for cigarettes. Biological Psychiatry. 2011; 70:794–799. [PubMed: 21762878]

Salovey P. Mood-induced self-focused attention. Journal of Personality and Social Psychology. 1992; 62:699–707. [PubMed: 1583593]

Shiffman S, Waters AJ. Negative affect and smoking lapses: a prospective analysis. Journal of Consulting and Clinical Psychology. 2004; 72:192–201. [PubMed: 15065954]

SRNT Committee. Biochemical verification of tobacco use and cessation. Nicotine & Tobacco Research. 2002; 4:149–159. [PubMed: 12028847]

Tiffany ST, Cox LS, Elash CA. Effects of transdermal nicotine patches on abstinence-induced and cue-elicited craving in cigarette smokers. Journal of Consulting and Clinical Psychology. 2000; 68:233–240. [PubMed: 10780123]

Tiffany, ST.; Warthen, MW.; Goedeker, KC. The functional significance of craving in nicotine dependence. In: Bevins, RA.; Caggiula, AR., editors. The motivational impact of nicotine and its role in tobacco use. New York: Springer Science; 2009. p. 171-197.

Weinberger AH, McKee SA. Gender differences in smoking following an implicit mood induction. Nicotine & Tobacco Research. 2011; 13 (First published online: September 8, 2011).

Willner P, Jones C. Effects of mood manipulation on subjective and behavioural measures of cigarette craving. Behavioral Pharmacology. 1996; 7:355–363.

Xu JS, Azizian A, Monterosso J, Domier C, Brody A, London E, Fong T. Gender effects on mood and cigarette craving during early abstinence and resumption of smoking. Nicotine & Tobacco Research. 2008; 10:1653–1661. [PubMed: 18988078]

Highlights

- Experiencing negative mood may increase craving to smoke more in women than in men.
- Overnight abstinence tended to increase craving more in women than in men in study 1.
- Acute negative mood induction increased craving more in women than in men in study 2.
- Craving was strongly associated with negative affect responses in both studies.

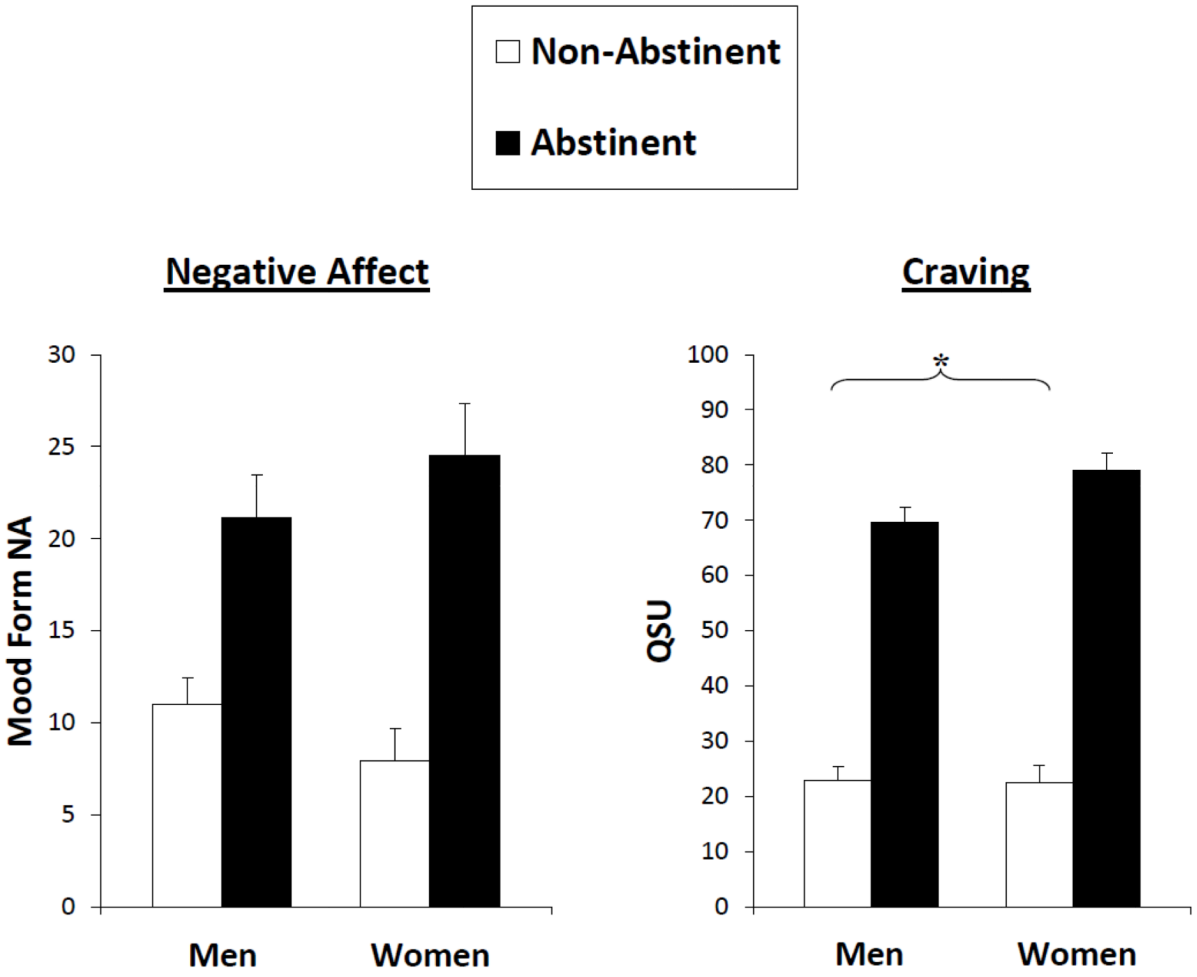

Figure 1.
Mean (SE) scores for negative affect and craving due to overnight smoking abstinent and non-abstinent conditions in men and women. * p<.05 for the interaction of sex x abstinence condition in craving response.

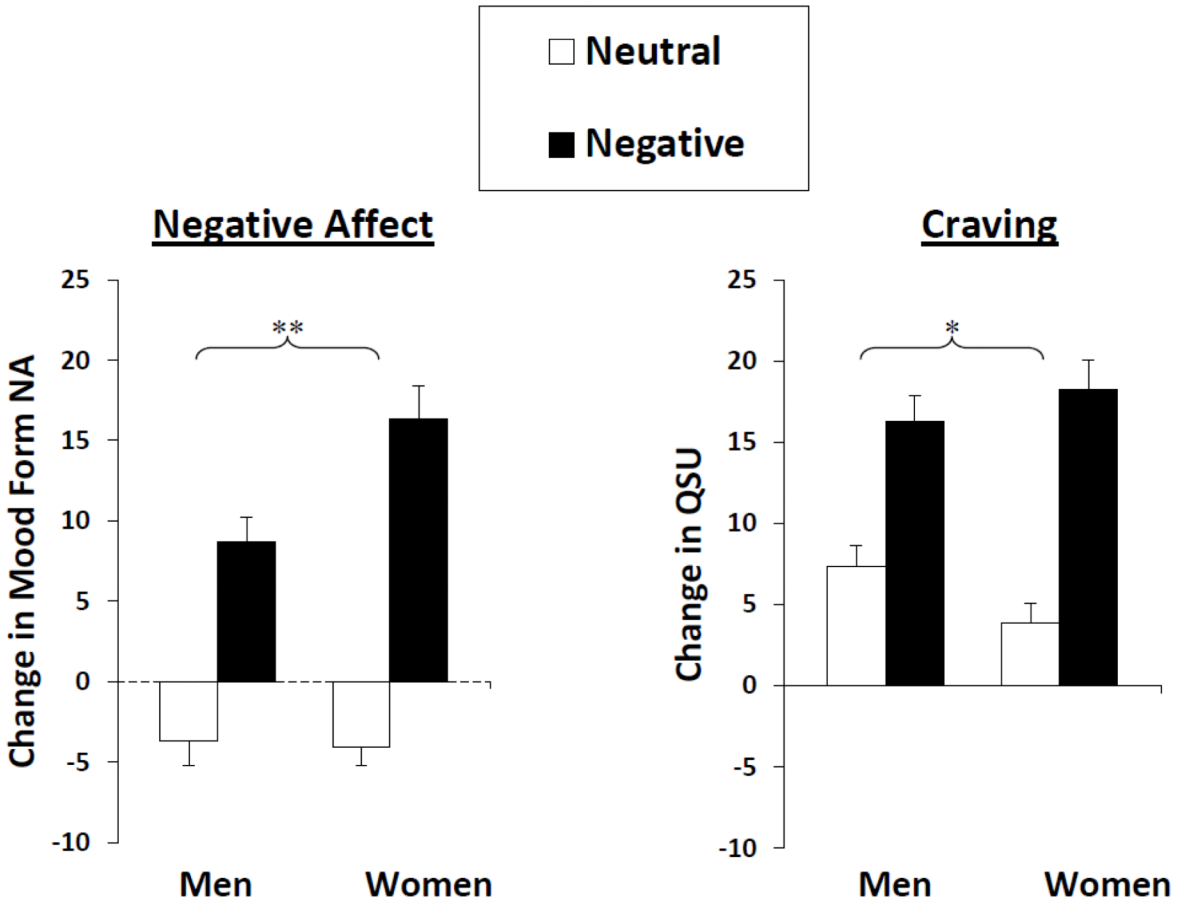

Figure 2.
Mean (SE) change from initial baseline in subjective negative affect and craving scores due to negative mood and neutral mood induction conditions in men and women. ** p<.005, * p<.05 for the interaction of sex x mood condition in negative affect and craving response.