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Subjective Reactivity to the First Cigarette of the Day as a Predictor of Smoking Relapse: A Preliminary Study

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Abstract

We examined subjective responses to smoking the first cigarette of the day and investigated how these responses related to smoking cessation treatment outcome. Data from participants (N = 207) in a clinical trial of message framing for smoking cessation with bupropion, obtained prior to the targeted quit day, were used to examine indices of craving, withdrawal, and affect before and after smoking the first cigarette of the day. After smoking the initial cigarette, craving, withdrawal symptoms, and negative affect were lessened, and positive affect increased. Greater decreases in craving as measured by the Questionnaire on Smoking Urges-Brief (QSU-Brief) predicted relapse at the end of treatment (6 weeks) and at the 3 month follow-up time point. These associations do not appear to be mediated by established measures of dependence. Thus, this preliminary study provides evidence that there are significant changes in craving, withdrawal, and affect related to smoking the first cigarette of the day, with the largest of these changes observed for craving. Moreover, changes in tobacco craving in response to the first cigarette of the day may be a novel predictor of smoking relapse that should be tested in future studies.

Keywords

First cigarette; craving; withdrawal; affect; smoking cessation

1. Introduction

Time to the first cigarette of the day has been studied extensively as a measure of nicotine dependence (Heatherton et al., 1989; Hughes et al., 2004; Kozlowski et al., 1994). Indeed, some authors (e.g., Fagerström, 2003) have suggested that time to first cigarette may be the best single measure of nicotine dependence. However, there has been far less research examining changes in subjective reactivity (e.g., craving, mood) in response to the first cigarette of the day, or examining the relationship of these changes to treatment outcome. Existing evidence suggests that individuals who experience less lightheadedness in response to the initial cigarette of the morning are generally heavier smokers with a longer smoking history (Pillitteri et al., 1997). Niaura and colleagues (2001) examined responses to the first three cigarettes of the day among smokers following overnight abstinence and found that those

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with greater changes in subjective and physiological responses had more acute tolerance to subsequent smoking and greater negative affect after quitting.

The results presented here are from a smoking cessation study that assessed subjective reactivity to smoking the first cigarette of the day, prior to the quit date. The primary aim was to quantify changes in subjective reactivity to the first cigarette of the day and to determine whether subjective reactivity was predictive of smoking relapse. The secondary aim was to examine whether established measures of nicotine dependence [Fagerström Test for Nicotine Dependence (FTND; Heatherton et al., 1991), time to first cigarette, Carbon Monoxide (CO), cotinine, daily cigarette consumption, and number of years smoking] mediated associations between subjective reactivity and relapse status.

2. Method

2.1 Participants and Procedure

Treatment seeking smokers participated in a clinical trial investigating varying messages (gain-/loss-framed) to assist smoking cessation with open-label sustained-release (SR) bupropion (Toll et al., 2006b). Smokers had to be between the ages of 18 and 70, English-speaking, smoking at least 10 cigarettes/day, with an expired carbon monoxide (CO) level > 10 ppm, and at least one prior attempt to stop smoking. Women were excluded if they were pregnant, nursing, or not using a reliable form of birth control. Smokers were excluded for current serious neurologic, psychiatric, or medical illness, use of psychoactive medication, alcohol dependence, major depressive episode or a history of anorexia nervosa or bulimia, seizure disorder, hypersensitivity to bupropion, or current use of smokeless tobacco, pipes, cigars, nicotine replacement products or marijuana.

All participants received bupropion SR for 7 weeks (1 week pre- and 6 weeks post-quit; Hurt et al., 1997) and were randomized to receive gain- or loss-framed messages. In the first week of treatment (bupropion SR; 150 mg/day for 3 days followed by 300 mg/day), they were given a packet of questionnaires to complete at home prior to and following their first cigarette of the day. Specifically, participants were instructed: "Please pick one day before your quit day (Day 1) to complete these questionnaires. **Before** smoking your first cigarette, complete the first 5 pages of this packet. Then, **immediately after** smoking your first cigarette, fill out the remaining 5 pages of questionnaires." On average, participants were taking bupropion SR for 6.0 ($SD = 2.25$; range = 0–10) days when they completed the questionnaires.

The sample consisted of 207 smokers (48.8% Men; 82.9% White) with an average age of 42.2 ($SD = 11.18$) years who had smoked for 25.0 ($SD = 11.12$) years, and at baseline had average FTND scores, expired CO levels, and plasma cotinine levels of 5.3 ($SD = 2.09$), 22.7 ppm ($SD = 10.06$), and 282.8 ng/ml ($SD = 126.42$), respectively. At baseline, the mean number of cigarettes/day was 22.7 ($SD = 9.45$), but at the time participants completed the questionnaires they had significantly reduced their cigarette consumption to 15.2 [$SD = 11.23$]; $t(180) = -9.08$, $p < .05$]. This study was approved by the Institutional Review Board of the Yale University School of Medicine.

2.2 Materials

The following assessments were completed prior to and following the first cigarette of the day:

2.2.1 The Questionnaire on Smoking Urges-Brief (QSU-Brief)—The 10-item QSU-Brief is a self-report measure designed to assess urges to smoke (Cox et al., 2001) that asks respondents to indicate how strongly they agree or disagree "right now" with each item using a scale from 1 (strongly disagree) to 7 (strongly agree). Responses are classified into two

factors. Factor 1 (items 1 & 6) represents desire to smoke, and Factor 2 (items 4, 8 & 9) represents desire to smoke for negative affect relief (Toll et al., 2006a)¹.

2.2.2 Minnesota Nicotine Withdrawal Scale (MNWS)—The MNWS (Hughes and Hatsukami, 1986) assesses symptoms associated with nicotine withdrawal. The scale was modified such that participants were asked to rate the severity of eight withdrawal symptoms on a scale from 0 (Not present) to 4 (Severe) at the time of administration. This modified version of the scale included hunger, difficulty concentrating, insomnia, restlessness, and impatience but not craving, anxiety, and depressed mood. Consistent with current evidence, a single total score was reported (Etter and Hughes, 2006; Toll et al., in press).

2.2.3 Circumplex Scale—Affective state was measured using a 10-item questionnaire derived from the circumplex model of mood experience (Larsen and Diener, 1992; Russell, 1980). Respondents are asked to provide ratings on how they feel right now for each affect item on a scale ranging from 1 (Not at all) to 10 (Very), and items are classified into positive (active, peppy, happy, relaxed, quiet) and negative (bored, sad/depressed, nervous/anxious, angry/frustrated) affective dimensions.

2.3 Data Analysis Plan

Two-tailed paired *t*-tests were used to compare scores on each of the measures from pre- to post-smoking. Indices of subjective reactivity (change scores; post - pre values) were then computed for each measure. Logistic regression analyses were used to predict relapse status at the end of treatment (Week 6) and at 3 and 6 months after the quit date, using the indices from each measure. Treatment condition (gain-/loss-framed) was tested as a covariate in these logistic regression analyses. Following procedures outlined in Baron and Kenny (1986) for mediational analyses, we assessed correlations between measures of dependence [FTND, FTND Item 1 (time to first cigarette), CO, cotinine, daily cigarette consumption, and number of years smoking] with each index of subjective reactivity and with relapse. Measures of dependence that were significantly associated with both subjective reactivity and relapse status met criteria to be evaluated as potential mediators of the association between subjective reactivity and relapse. Treatment outcome (smoking, abstinent) was defined by self-reports of not smoking in the past week confirmed by CO $\leq$ 10 ppm on the day of reporting (Fiore et al., 2000).

3. Results

3.1 Change from Pre- to Post-Smoking

All differences from pre-smoking to post-smoking were significant, with craving, withdrawal, and negative affect diminishing and positive affect increasing (Table 1).

3.2 Prediction of Outcome by Subjective Reactivity

The index of subjective reactivity for Factor 1 of the QSU-Brief predicted relapse at the end of treatment and at 3 months (Week 6, SE = .037, Wald = 4.28, p = .039; OR = 1.079, 95% CI = 1.004–1.160; 3 months, SE = .042, Wald = 8.49, p = .004; OR = 1.13, 95% CI = 1.041–1.229). Larger decreases in desire to smoke predicted relapse. None of the other indices predicted relapse status. Results were not altered by including gain-/loss-framed treatment as a covariate.

¹Factor 1 – Intention/Desire to Smoke Items: I have a desire for a cigarette right now: I have an urge for a cigarette.

Factor 2 – Relief of Negative Affect & Urgent Desire to Smoke Items: I could control things better right now if I could smoke: I would do almost anything for a cigarette right now: Smoking would make me less depressed.

3.3 Evaluation of Dependence Measures as Potential Mediators

In order to evaluate whether established measures of dependence mediated associations between subjective reactivity and relapse, dependence measures were correlated with indices of subjective reactivity and relapse status. The FTND was associated with relapse at 3 months ($r = .14, p < .05$; Table 2), but this measure was not associated with QSU-Brief subjective reactivity. Additionally, QSU-Brief (Factor 1) subjective reactivity was related to daily cigarette consumption ($r = -.15, p < .05$) and number of years smoking ($r = -.18, p < .05$), but neither of these variables were related to relapse. Thus, none of the dependence measures met criteria for evaluation as a potential mediator (Baron and Kenny, 1986).

4. Discussion

In the present study, after smoking the first cigarette, craving, withdrawal, and negative affect were reduced, and positive affect increased. Larger decreases in scores on Factor 1 of the QSU-Brief (desire to smoke) were associated with relapse at the end of treatment and at 3 months. This finding is in accordance with other studies demonstrating that craving is the strongest single withdrawal symptom that is predictive of smoking outcome (Etter and Hughes, 2006; Toll et al., in press). Although findings for Factor 2 of the QSU-Brief were not significant, there is growing evidence that assessing multiple aspects of urges allows for a more thorough measurement of this construct. Indeed, there are numerous studies that have revealed differential outcomes across both factors of the QSU (Burton and Tiffany, 1997; Corrigan et al., 2001; Eissenberg et al., 1999).

In contrast with the QSU-brief, established indices of nicotine dependence were not associated with relapse and did not appear to mediate the relationship between QSU-Brief (Factor 1) subjective reactivity and relapse. Hence, decreases in desire to smoke in response to the first cigarette of the day may be a novel predictor of treatment outcome for smoking cessation. Moreover, it may be a better predictor of outcome than standard indices of dependence and may tap different aspects of nicotine dependence, given the overall lack of correlation with other dependence-related measures, including the FTND. Of note, the QSU-Brief is very short (i.e., 5 items) and easy to administer, making it ideal for clinical use (Toll et al., 2006a). In contrast, changes in nicotine withdrawal and mood did not predict relapse for participants. The MNWS, used to measure nicotine withdrawal, may have lacked predictive ability due to the fact that this measure was modified for the present study. Given that negative affect has been implicated in predicting outcome with bupropion (Lerman et al., 2002), the lack of any association with the Circumplex is surprising. However, it is possible that bupropion attenuated both MNWS scores as well as affective reactivity, limiting potential findings with these measures.

This study has several limitations. First, the results can only be generalized to participants taking bupropion SR. It is also possible that acute dosing with bupropion might have altered responses on withdrawal and affect measures. As we did not obtain the time of bupropion administration, we were unable to test this hypothesis. Additionally, reduction in cigarette consumption by participants at the time of assessment could have confounded the results. Last, the odds ratios for the QSU-Brief indices were relatively small, suggesting the findings regarding the predictive utility of these indices should be interpreted with caution.

In summary, this preliminary study suggests that there are changes in craving, withdrawal, and affect related to smoking the first cigarette of the day, with the largest of these changes observed for craving. Moreover, subjective reactivity for the QSU-Brief represents a novel predictor of smoking relapse that should be tested in future studies. Finally, these results need to be replicated using larger samples, in the absence of bupropion SR, and with other medications (e.g., varenicline).

Author Note

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Table 1
Change in Subjective Reactivity for the First Cigarette of the Day

Measure	Pre-Smoking M (SD)	Post-Smoking M (SD)	df	t	p
OSU-Brief Factor 1 (range 2–14)	9.9 (3.16)	4.9 (3.02)	203	18.42	.000
OSU-Brief Factor 2 (range 3–21)	7.5 (4.04)	4.5 (2.62)	203	11.46	.000
MNWS (range 0–20)	2.8 (3.26)	2.3 (3.00)	189	2.75	.006
Circumplex Negative (range 4–40)	10.0 (7.04)	7.7 (6.71)	199	5.89	.000
Circumplex Positive (range 5–50)	26.9 (7.85)	28.2 (8.18)	200	–3.09	.002

Table 2
Correlation of Standard Measures of Dependence with Subjective Reactivity and Relapse Status.

	Subjective Reactivity				Relapse Status		
	QSU- Brief Factor 1	QSU- Brief Factor 2	MNWS	Circumplex Negative	Circumplex Positive	6- week PP	3- month PP
FTND	.04	.09	.01	-.03	-.17*	.09	.14*
FTND Item 1 (Time to First Cigarette) ^a	.00	.03	-.08	-.00	-.10	.05	.10
CO	.01	.03	.00	-.03	-.13	.06	-.10
Cotinine	-.07	-.02	-.02	-.04	-.02	.07	-.01
Daily Cigarette Consumption	-.15*	-.08	.00	-.10	-.09	.04	.04
Number of Years Smoking	-.18*	-.03	-.06	.01	-.06	-.00	-.09
							-.06
							.00

*
 $p < .05$.

^a FTND Item 1 was scored as 1 = within 5 minutes, 2 = 6–30 minutes, 3 = 31–60 minutes, and 4 = after 60 minutes.

Note. PP = point prevalence smoking abstinence defined as self-reporting no smoking in the past week confirmed by a CO reading of less than or equal to 10 ppm on the day of reporting.