ORIGINAL INVESTIGATION

Affective Motives for Smoking Among Early-Stage Smokers

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ABSTRACT

Background: As most smokers initiate smoking during adolescence, assessment of smoking motives that underlie trajectories of dependence is critical for both prevention and cessation efforts. In the current study, we expected participants with higher nicotine dependence would smoke (a) less for positive reinforcement (PR) and (b) more for negative reinforcement (NR) motives. We secondarily assessed the relative contribution of PR to NR motives across levels of dependence.

Methods: Data were drawn from a study on cue-elicited craving among occasional versus daily adolescent smokers aged 16–20 years ($N = 111$). Smoking motives were assessed in relation to 3 commonly used measures of nicotine dependence: (a) Fagerström Test for Nicotine Dependence (FTND), (b) Autonomy over Smoking Scale (AUTOS), and (c) Nicotine Dependence Syndrome Scale (NDSS).

Results: Compared to occasional smokers, daily smokers had significantly higher scores on each dependence measure and endorsed more prominent NR smoking motives. Each measure of nicotine dependence was strongly associated with NR motives for smoking, although measures differed in their association with PR motives. As expected, the FTND, AUTOS, and NDSS each significantly predicted smoking motive difference score (PR – NR), such that higher dependence was associated with more prominent NR motives for smoking.

Conclusions: Results are consistent with our understanding of dependence and provide further support for 3 common measures of nicotine dependence among early stage smokers.

INTRODUCTION

Adolescence is an important development period in need of targeted prevention and early intervention efforts for smoking cessation. More than 15% of adolescents smoke regularly (USDHS, 2012), a rate that appears to be largely unchanged since 2002 (Johnston et al., 2011) and confers marked risk for smoking later in life (Chassin, Presson, Pitts, & Sherman, 2000; USDHS, 2011).

Despite strong public health relevance, not much is known about development of smoking motives among early stage smokers. Some evidence suggests that adolescents become dependent on nicotine early in their smoking careers (Colby, Tiffany, Shiffman, & Niaura, 2000; Dierker & Mermelstein, 2010; DiFranza et al., 2000, 2002), but how smoking motives change as dependence develops is unclear. While smoking initiation is largely governed by stimulus control associated

with environmental and social factors (Mayhew, Flay, & Mott, 2000; Oetting & Donnermeyer, 1998; Shiffman & Paty, 2006), progression of nicotine dependence after onset has occurred is characterized increasingly by the desire or need to regulate negative affect (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Heinz, Kassel, Berbaum, & Mermelstein, 2010). Adolescents frequently cite negative affect as a precipitant to smoking (Chassin, Presson, Rose, & Sherman, 2007; Dozois, Farrow, & Miser, 1995; Scales, Monahan, Rhodes, Roskos-Ewoldsen, & Johnson-Turbes, 2009; Stevens, Colwell, Smith, Robinson, & McMillan, 2005), highlighting the importance of affective smoking motives among early stage smokers.

Logically, it would seem that positive reinforcement (PR) motives (i.e., enjoyment or pleasure enhancement) are most relevant to smoking initiation and early stage smoking, while negative reinforcement (NR) motives (i.e., distress reduction or alleviation of withdrawal) become more prominent as

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dependence develops (cf. Baker et al., 2004). While PR and NR smoking motives have been examined as separate constructs in both adult (Piper et al., 2009; Pomerleau, Fagerström, Marks, Tate, & Pomerleau, 2003) and adolescent samples of smokers (Caraballo, Novak, & Asman, 2009; Strong, Kahler, Colby, Griesler, & Kandel, 2009), we are unaware of any previous research making explicit comparison of PR and NR smoking motives as a function of nicotine dependence.

The current study examines the association between nicotine dependence and relative prominence of PR and NR smoking motives among early stage smokers. There are no commonly accepted definitions or cutoffs for early stage smokers or for adolescent/young adult smokers. Herein, early stage smokers are defined as those in mid- to late-adolescence (age 16–20) who are relatively early in their smoking careers (mean duration of smoking: 3.5 years) but whose smoking exceeds the level of initial experimenting (mean of 53 cigarettes/week). We sought to examine smoking motives in relation to level of smoking (occasional vs. daily), as well as the underlying latent construct of nicotine dependence. Analyses of the latter were based on three common measures of nicotine dependence: the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991), Autonomy over Smoking Scale (AUTOS; DiFranza, Wellman, Ursprung, & Sabiston, 2009), and Nicotine Dependence Syndrome Scale (NDSS; Shiffman, Waters, & Hickcox, 2004). For each measure, we expected that those higher in nicotine dependence would endorse more NR smoking motives, relative to PR motives.

METHODS

Participants

Data were drawn from a study on cue-elicited craving among occasional ($n = 58$) versus daily ($n = 53$) adolescent smokers (Carpenter et al., 2014). Participants were recruited from the general community via radio, print, and social media advertising. Eligibility criteria included: (a) age 16–20 (to control for legal drinking status), (b) current occasional or daily smoker not currently trying to quit, (c) no use of noncigarette tobacco within past 6 months, (d) ingestion of alcohol at least once in the past 30 days, and (e) does not meet criteria for past or current alcohol abuse/dependence. Consistent with prior research (Shiffman, Kirchner, Ferguson, & Scharf, 2009), a daily smoker was defined as smoking ≥ 5 cigarettes/day, on at least 26/30 days of each month for at least the past 6 months. Current smoking status was confirmed upon an initial study visit through carbon monoxide (CO) reading of >8 parts per million (Bedfont Scientific). An occasional smoker was defined as smoking ≥ 1 cigarette in each week of the past 8 weeks, no more than 25 days of smoking per month, but without CO verification. Individuals who were experimenting and had very low levels of smoking, and also those who have previously smoked regularly and who were currently smoking less, were screened out of the study.

Procedure

Data from the current study were drawn from the initial study session, at which basic demographics and smoking variables

were assessed. Following telephone prescreening, participants attended an in-person baseline session involving assessment of study eligibility, informed consent, breath CO analysis, and administration of baseline assessments. Potential participants under age 18 were required to provide parental consent. The Medical University of South Carolina granted the appropriate approvals for Protection of Human Subjects.

Measures

Michigan Nicotine Reinforcement Questionnaire

Smoking motives were assessed with PR and NR subscales of the Michigan Nicotine Reinforcement Questionnaire (MNRQ) (Pomerleau et al., 2003). Items are averaged to create each subscale (range of 1–4 for each subscale), with higher values indicating stronger endorsement of the smoking motive. The MNRQ-PR subscale (five items) is associated with novelty seeking, reward dependence, and pleasurable sensations during early experimentation with smoking. Example items include “I smoke to get a sense of euphoria or pleasure.” The MNRQ-NR subscale (eight items) is associated with craving, symptoms of nicotine withdrawal (e.g., anxiety, irritability, difficulty concentrating, restlessness, depressed mood, trouble sleeping, and increased appetite), and smoking to alleviate these symptoms. Example items include “I crave a cigarette to provide relief from withdrawal.” Factor analyses of the MNRQ support distinct PR and NR factors in smoking motivation (Pomerleau et al., 2003).

We combined information from the PR and NR subscales to generate a difference score (PR minus NR). Specifically, for each participant, the mean value of the NR items was subtracted from the mean value of PR items, generating a difference score where positive values indicate greater emphasis on PR while negative values indicate greater emphasis on NR smoking motives.

Fagerström Test for Nicotine Dependence

The FTND (Heatherton et al., 1991) is the most widely used measure of nicotine dependence. The FTND (possible range 0–10) consists of six items, of which the number of cigarettes per day (scored between 0 and 3) and the time of the first cigarette of the day (scored between 0 and 3) may be particularly important items in indexing nicotine dependence (Kozlowski, Porter, Orleans, Pope, & Heatherton, 1994). Though the FTND has been utilized in previous research on intermittent smokers (Shiffman et al., 2012), it may not be ideally suited for evaluating low levels of dependence.

Autonomy Over Smoking Scale

The AUTOS (DiFranza, Wellman, Ursprung, & Sabiston, 2009) is a 12-item self-report measure of nicotine dependence that is a recent iteration of the Hooked on Nicotine Checklist (DiFranza et al., 2002). The AUTOS is thought to be distinct from smoking consumption and more sensitive to low rate smoking behavior than other dependence measures (DiFranza et al., 2007; MacPherson et al., 2008). The measure assesses the development and resolution of three aspects of dependence: nicotine withdrawal, cue-induced desires to use tobacco, and psychological reliance on tobacco use. The AUTOS provides an overall score with potential range from 0 to 36. The AUTOS demonstrates excellent reliability and concurrent validity (DiFranza et al., 2009).

Nicotine Dependence Syndrome Scale

The NDSS (Shiffman et al., 2004) is a 19-item self-report measure of nicotine dependence designed to include a broader array of the dependence symptomatology than other measures. The measure is shown to be sensitive to individual differences even at very low levels of dependence (Shiffman & Sayette, 2005). The NDSS utilizes regression-based scoring, in which participants' total scores are calculated by multiplying items by the specific factor loading provided by Shiffman and colleagues (2004) and summed. Thus, scores below 0 reflect dependence lower than national averages, while scores higher than 0 reflect above-average dependence.

Data Analytic Methods

Scatterplots and Pearson correlations between each measure of dependence (FTND, AUTOS, and NDSS) and smoking motives were examined. Occasional and daily smokers were compared on dependence measures and smoking motives, using two-sample *t* tests. Relationships between each nicotine dependence measure and smoking motives were assessed. Linear regression models were used to examine associations between each nicotine dependence measure and each continuous outcome variable (PR motives, NR motives, and difference score [PR – NR]). Due to strong correlations among nicotine dependence measures (*r* ranged from .64 to .82, *p* < .001), separate regressions were performed for each measure, and models including more than one nicotine dependence measure were not estimated.

RESULTS

Sample Characteristics

On average, participants were 18.9 years old (*SD* = 0.95), primarily male (57.9%), Caucasian (83.2%), and high school graduates (87.9%), many of whom completed some college/technical school (59.7%). Detailed sample characteristics by smoker group are provided elsewhere (Carpenter et al., in press). In brief, occasional smokers smoked 14.1 out of the past 30 days (*SD* = 6.0), averaged 10.2 cigarettes/week (*SD* = 9.9), and had been smoking for 2.8 years (*SD* = 1.6). Daily smokers smoked 28.5 of the past 30 days (*SD* = 4.9), averaged 94.4 cigarettes/week (*SD* = 46.0), and had been smoking for 4.1 years (*SD* = 2.1). As expected, all dependence measures were highly correlated (see Table 1).

Daily Versus Occasional Smokers

Compared to occasional smokers, and as expected, daily smokers had significantly higher scores on each dependence measure: the FTND (3.23 vs. 0.25; *p* < .001), AUTOS (20.61 vs. 9.58; *p* < .001), and NDSS (−0.48 vs. −1.99; *p* = .01). Daily smokers endorsed significantly higher NR motives than occasional smokers (2.00 vs. 1.44; *p* < .001); however, there were no significant between-group differences in PR motives by smoking group (2.42 vs. 2.29; *p* = .29). Using the smoking motives difference score, daily smokers had significantly lower values than occasional smokers (mean PR – NR score of 0.42 vs. 0.85; *p* = .001), indicating more prominent NR smoking motives, relative to PR motives.

Nicotine Dependence and Smoking Motives

Overall, paired *t* tests indicate that participants endorsed significantly greater PR motives than NR motives (2.36 vs. 1.73; *p* < .001). Findings on smoking motives as a function of nicotine dependence, as indexed by the FTND, AUTOS, and NDSS, are presented in Table 2 and represented graphically in Figure 1. All three nicotine dependence measures were strongly related (*p* < .001 for all) to NR smoking motives (see Table 2), such that higher scores indicated more endorsement of NR motives. The FTND accounted for 33% of variance in NR motives, while AUTOS and NDSS accounted for 76% and 61% of variance in NR motives, respectively. The AUTOS (β = 0.02, *p* < .001) and NDSS (β = 0.11, *p* = .03) were positively associated with PR smoking motives, explaining 12% and 4% of variance, respectively. The FTND was not related to PR motives (β = 0.04, *p* = .15). Taken together, higher nicotine dependence scores were associated with an increase in both NR and PR smoking motives, but account for more variance in mean NR versus PR motives. Lastly, all three nicotine dependence measures were significantly associated with the smoking motives difference score (PR – NR), such that higher scores correlated with more prominent NR motives, relative to PR motives. The FTND accounted for 15% of the variance in the difference score, while AUTOS and NDSS explained 21% and 26% of variance in the difference score, respectively.

We also conducted sensitivity analyses to account for potential differences across smokers who endorse minimal levels versus those who endorse high levels of each motive but yield the same difference score. As an example, NR and PR scores of 1 and 1.5, respectively, yield a difference score of 0.5, and so

Table 1. Means, SDs, Correlations, and Internal Consistencies (Cronbach's Alpha; in Parentheses) of Study Variables

	Mean	SD	1	2	3	4	5	6
1. FTND	1.79	2.12	(.69)					
2. AUTOS	15.30	9.47	.64**	(.94)				
3. NDSS	−1.19	1.20	.77**	.82**	(.87)			
4. PR	2.36	0.65	.14	.35**	.21*	(.78)		
5. NR	1.73	0.64	.58**	.87**	.78**	.35**	(.88)	
6. PR – NR	1.49	0.54	−.38**	−.45**	−.51	.58**	−.56**	–

Note. Columns and rows indicated by 1–6 show the Pearson correlation between items in those rows and columns. FTND = Fagerström Test for Nicotine Dependence; AUTOS = Autonomy over Smoking Scale; NDSS = Nicotine Dependence Syndrome Scale; PR = MNRQ-Positive Reinforcement Subscale; NR = MNRQ-Negative Reinforcement Subscale; PR – NR = difference score.

p* < .05. *p* < .01.

Table 2. Prediction of Smoking Motives by Nicotine Dependence Measure

	PR motives	NR motives	PR – NR difference score
FTND			
Parameter estimate (<i>SE</i>)	0.04 (0.03)	0.17 (0.02)	–0.13 (0.03)
95% CI	–0.02 to 0.10	0.13 to 0.22	–0.19 to –0.07
Std. beta	0.14	0.58	–0.38
<i>R</i> ²	.02	.33	.15
AUTOS			
Parameter estimate (<i>SE</i>)	0.02 (0.01)	0.06 (0.003)	–0.04 (0.007)
95% CI	0.01 to 0.04	0.05 to 0.07	–0.05 to –0.02
Std. beta	0.35	0.87	–0.45
<i>R</i> ²	.12	.76	.21
NDSS			
Parameter estimate (<i>SE</i>)	0.11 (0.05)	0.42 (0.03)	–0.31 (0.05)
95% CI	0.01 to 0.21	0.36 to 0.49	–0.41 to –0.21
Std. beta	0.21	0.78	–0.51
<i>R</i> ²	.04	.61	.26

Note. PR = MNRQ-Positive Reinforcement Subscale; NR = MNRQ-Negative Reinforcement Subscale; FTND = Fagerström Test for Nicotine Dependence; Parameter estimate = unstandardized beta; SE = standard error of unstandardized beta; CI = confidence interval; Std. beta = standardized beta; AUTOS = Autonomy over Smoking Scale; NDSS = Nicotine Dependence Syndrome Scale.

do NR and PR scores of 3 and 3.5. To adjust for this difference in intensity, we ran models with each dependence measure as a predictor of difference score by average NR ($[(PR - NR)/NR]$) and inferences were consistent with those presented in Table 2.

DISCUSSION

This study confirms that, even among early stage adolescent smokers, smoking motives vary meaningfully by level of dependence. While all participants reported smoking predominantly for PR motives, daily smokers endorsed more prominent NR versus PR smoking motives, as compared to occasional smokers. The FTND, AUTOS, and NDSS were each associated with smoking motives, such that elevated scores predicted more prominent NR motives, relative to PR, based on the difference score.

While nicotine dependence scores (AUTOS and NDSS only) were positively associated with PR motives, they accounted for a much larger amount of the variance in NR smoking motives. For each measure, higher nicotine-dependent smokers were characterized by a greater emphasis on NR motives, relative to PR. Results are consistent with our understanding of the progression of nicotine dependence, as increased dependence was associated with a relative shift from PR to NR smoking motives. As NR models of dependence become more widely accepted, there is greater emphasis on early signs that smoking is motivated by the desire to regulate negative affect. Escape or avoidance of negative affect is thought to be the motivational core of dependence (Baker et al., 2004) and may begin to develop early in one's smoking trajectory. This notion is consistent with other studies that show potential for early onset of nicotine dependence (Colby et al., 2000; Dierker & Mermelstein, 2010; DiFranza et al., 2000, 2002). Results of the current study contribute to our understanding of early stage smoking behavior through explicit comparison of PR – NR difference score across the dependence continuum.

Additionally, findings provide further support for three common measures of nicotine dependence among early stage

smokers. Although the measures are quite different in theoretical foundations and aspects of dependence assessed, they did not vary significantly in their association with affective motives for smoking. Thus, there is no reason to believe any of the three measures is superior in assessment of nicotine dependence among early stage smokers. Instead, they may each shed light on distinct aspects of the dependence syndrome and may best be used in combination to provide multidimensional assessment of nicotine dependence.

Accurate classification of affective motives for smoking among early stage smokers has important treatment implications, as smoking motives vary by individual and may indicate distinct smoking phenotypes (Pomerleau et al., 2003). Behavioral interventions may be adapted to these smoking motives, by tailoring treatment to individuals who smoke (a) mainly for reward or pleasure or (b) in order to avoid unpleasant symptoms of withdrawal or other aversive states. In the current study, PR motives were predominant among most early stage smokers, suggesting that interventions designed to foster engagement with natural, nondrug rewards in the environment (e.g., behavioral activation) may be warranted. However, NR motives were also shown to develop as dependence increased among early stage smokers. Thus, negative affect regulation may also be a relevant clinical target, even among early stage smokers.

The current study has several limitations. First, data were assessed cross-sectionally, and while this allowed for examination of smoking motives between individuals across a range of dependence, it precludes understanding of how smoking motives change within individuals over time. Second, our sample was comprised of adolescents who, while early in their smoking careers, smoked at a higher level than other studies of early stage smokers (e.g., DiFranza et al., 2000; Heinz et al., 2010) and also differed on some social history variables (i.e., more educated, reported drinking alcohol in the past month). Therefore, generalization of findings to younger adolescents who may be initially experimenting with cigarettes or smoking at a very low rate is unclear. Third, affective smoking motives were assessed through one measure alone (MNRQ). While this measure is designed to assess several symptoms of negative

Figure 1. Smoking motives by dependence score.

Note. AUTOS = Autonomy over Smoking Scale; FTND = Fagerström Test for Nicotine Dependence; NDSS = Nicotine Dependence Syndrome Scale; NR = MNRQ-Negative Reinforcement Subscale; PR = MNRQ-Positive Reinforcement Subscale; PR - NR = difference score.

affectivity (e.g., depression, anxiety, frustration), multimethod assessment of a broader range of negative affect is warranted. Lastly, related concepts of smoking expectancies such as mood enhancement or negative affect reduction were not examined in the current study but could shed further light on the role of affect regulation in smoking behavior.

In conclusion, three common measures of nicotine dependence were shown to be associated with affective motives for smoking among early stage smokers. While smoking among

adolescents is associated more strongly with PR versus NR motives, higher dependence scores were associated with more prominent NR motives for smoking. Findings of the current study are consistent with NR models of nicotine dependence and suggest negative affect regulation is a relevant clinical target even for individuals early in their smoking careers. Ultimately, gaining a greater understanding of motives that govern early stage smoking behavior may inform early intervention efforts and prevent early stage smokers from progressing to chronic nicotine dependence.

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DECLARATION OF INTERESTS

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