2009

Predictors of amount smoked per day in light smoking college students: A 7 day diary assessment.

Thom Taylor
Theodore V. Cooper, *University of Texas at El Paso*

Running head: PREDICTING LIGHT SMOKING

Predictors of amount smoked per day in light smoking college students: A 7 day diary assessment

Thom Taylor
Department of Psychology
The University of Texas at El Paso

Theodore V. Cooper
Department of Psychology
The University of Texas at El Paso

Manuscript submitted for publication

Address All Correspondence To:
Theodore V. Cooper, PhD.
Department of Psychology
University of Texas at El Paso
500 W. University Avenue
El Paso, Texas 79968
Phone: (915) 747-6270
Fax: (915) 747-6553
E Mail: tvcooper@utep.edu

Abstract

Both Hispanic and college student populations smoke at non trivial rates but less frequently than other smoking groups. Limited information exists about the proximal predictors of light smoking fewer than 10 cigarettes per day, particularly among college students. Participants (N = 118 young adults) completed a 7 day Tobacco Consumption Diary by recording for each cigarette smoked: time and day, location, number of people present, number of smokers present, mood, and whether alcohol was consumed. Results suggest light smoking is most strongly associated with the alcohol intake, later time of day, and multiple locations both within and outside the social context (but not at work). The amount smoked per day by light smokers does not appear to be influenced by the number of people present and number of smokers present. Overall, young adult light smokers appear to be cue oriented in their smoking similar to heavier smokers, despite lower levels of addiction and fewer cigarettes per day than heavier smokers. Light smokers may benefit from tailored intervention approaches to identifying the ideographic triggers that occur in certain locations and later time of day and are likely to include alcohol intake.

Keywords: Tobacco use, Light smoking, College students

1. Introduction

Young adults exhibit the highest rates of tobacco use (Substance Abuse and Mental Health Services Administration [SAMHSA], 2004) with little sign of change (Moran, Wechsler, & Rigotti, 2004). Young adult smokers tend not to smoke as heavily as older individuals (Wetter et al., 2004), though this may not attenuate short term health consequences such as a sore throat, cough, or shortness of breath (An et al., 2009) or risk for long-term health consequences (Bjartveit & Tverdal, 2005; Husten, 2009). Furthermore, many young adult light smokers go on to smoke more regularly (Kenford et al., 2005; McCarthy, Zhou, & Yih-Ing, 2001; Russell, 1990; Wetter et al., 2004), or at least transition into and out of heavier smoking (White, Bray, Fleming, & Catalano, 2009) and thereby warrant clinical attention (Fiore et al., 2008). Along the U.S./México border, focus on young adult light smokers may be particularly relevant as Hispanics appear to be 4.64 times more likely to smoke lightly relative to non-Hispanic Whites (Trinidad et al., 2009), and evidence suggests young adults living on the border manifest light smoking patterns (Rodríguez-Esquivel, Cooper, Blow, & Resor, 2009).

1.1 Dynamics of Light Smoking

Smoking urges are strongly associated with mood, negative affect, and anxiety (Aronson, Almeida, Stawski, Klein, & Kozlowski, 2008; Delfino, Jammer, & Whalen, 2001). While light smokers' affective states may be less influenced by smoking relative to heavier smokers (Sayette, Martin, Wertz, Shiffman, & Perrott, 2001), negative affect (Hoz et al., 2004), depressive symptoms (Patton et al., 1996; Zhu, Sun, Billings, Choi, & Malarcher, 1999) as well as anxiety (Patton et al., 1996) may be associated with adolescents' and young adults' smoking patterns. Still, light smokers may also smoke more as an indulgent activity (Shiffman & Paty,

2006) or when mood is higher (Shiffman, Paty, Kassel, Gnys, & Zettler-Segal, 1994). It is therefore not entirely clear what influence mood has on light smoking.

Light smokers appear to smoke more during the weekend (Colder et al., 2006; Murphy-Hoefer, Alder, & Higbee, 2004), when going out to bars and restaurants (Shiffman & Paty, 2006), and when relaxing (Shiffman & Paty, 2006; Shiffman et al., 1994). More relaxed situations may provide relevant light smoking cues. In addition, light smokers appear to smoke more after at night (Krukowski, Solomon, & Naud, 2005; Shiffman & Paty, 2006) and, rather than the first cigarette of the day, the last cigarette is often reported to be most difficult to give up (Shiffman et al., 1994). Nighttime smoking may thereby be the most probable at-risk time for light smokers.

Light smokers also appear to react strongly to conditioned environmental cues to smoke (Lazev, Herzog, & Brandon, 1999), even when very subtle (Sayette, Martin, Wertz, Perrott, & Peters, 2005). Some of these cues may be social, such as being near family members who smoke (Chandola, Head, & Bartley, 2004; Zhu et al., 1999) or other adolescent peers (Patton et al., 1996) and young adults who smoke (Ridner, 2005; Morrell, Cohen, Bacchi, & West, 2005).

Alcohol intake appears to cue smoking (Krukowski et al., 2005; Shiffman & Paty, 2006) and intoxication may amplify smoking cravings (Lazev et al., 1999; Sayette, 2002; Sayette et al., 2005). Further, a dose-dependent link between amount smoked and amount drunk may exist (Dierker et al., 2006). Overall, alcohol consumption and light smoking appear to be strongly intertwined behaviors. In college students, alcohol consumption in the context of light smoking is especially pertinent, as more than 80% of young adults report some degree of alcohol consumption (Johnston, O'Malley, Bachman, & Schulenberg, 2004).

1.2 Assessment of Light Smoking in Diary Format

One useful method of assessment of health behaviors is a recording diary (Bolger, Davis, & Rafaeli, 2003). Assuming a cigarette takes approximately 5 min. to smoke, and 10 cigarettes are smoked in a day (i.e., light smoking), only 3.5% of a 24 hour period is spent smoking. Diary methods work well for recording rare events (Bolger et al., 2003; Moghaddam & Ferguson, 2007), as is the case for light smoking. Thomsson (1997) found that the most diligent at recording in paper based diaries were light smokers (M = 7 cigarettes per day (cpd)), with heavier smokers dropping out of the study. Hence, light smokers may be fairly amenable to diary recording. While sensitive to the debate about relative compliance with paper diaries (Bolger et al., 2003; Hufford, Stone, Shiffman, Schwartz, & Broderick, 2002; Stone, Shiffman, Schwartz, Broderick, & Hufford, 2003), this study employed a small easily completed paper diary designed to minimize participant burden.

1.3 Aims and Hypotheses

Given that both Hispanic and college student populations smoke in a light fashion, assessing the proximal predictors commonly associated with lighter smoking in other groups is a needed direction for research into low level smoking. This study examined the strongest associations to increased smoking within a given day in light smoking young adults. It was hypothesized that light smoking college students would smoke significantly more on the weekend compared to weekdays and in the evening relative to earlier in the day. The presence of other smokers, alcohol intake, and higher mood were all predicted to increase cpd on a given day.

2. Methods

2.1 Participants

After Institutional Review Board approval of this study, participants were recruited (N = 124) from courses where extra credit was available to students. Of those recruited, 118 light smokers (54% male; 65% Hispanic, 15% Mexican National, 17% non Hispanic White, 3% other) completed the study (4.8% attrition). The smoking inclusion criterion was a report of smoking between one cigarette a week and 10 cpd.

2.2 Measures

Standard demographic information was provided by participants as were estimates of cpd in a given week.

Tobacco Consumption Diary (TCD). A 7 page diary was provided to all participants containing columns to record the time of a cigarette, the location where the cigarette was smoked, the number of people present while smoking, the number of smokers present while smoking, and a Likert-scale mood rating. The TCD contained a yes/no item asking whether the individual was drinking alcohol at the time of the cigarette. Each page (1 day of recording) contained spaces for 10 cigarettes. If participants smoked more than 10 cigarettes, they were instructed to record those cigarettes on the back of the page. Many individuals did follow this procedure, increasing the likelihood of valid smoking estimates.

The Fagerström Test of Nicotine Dependence (FTND). This scale measures the participants' degree of psychological dependence on nicotine (Heatherton, Kozlowski, Frecker, & Fagerström, 1991), is the most commonly used measure for this purpose (Steinberg, Williams, Steinberg, Krejci, & Ziedonis, 2005), and has been used successfully in both college students (Haddock, Lando, Klesges, Talcott, & Renaud, 1999) and relatively lighter (M = 12 cpd)

smokers (Etter, Duc, & Perneger, 1999). Here, the baseline (α = .42) and follow-up (α = .45) reliabilities were low, potentially reflecting a floor effect of variability and/or the very low dependence levels observed in light smokers (Rubinstein, Benowitz, Auerback, & Moscicki, 2009).

2.3 Procedure

Participants attended 2 sessions. The first session included the consent process and education as to how to complete the TCD. Participants scheduled a follow-up time with researchers no fewer than 7 days later in order to enable a full 7 days or recording, beginning on the subsequent day. Diary completion education included recording only at the time of smoking a cigarette, recording the "people present" and "smokers present" with acquainted individuals, and recording on the back of the page if they consumed more than 10 cpd. Participants' carbon monoxide (CO) level was measured to validate smoking self-reports. Finally, participants completed a worksheet to demonstrate their understanding and illustrate the limited time it takes to complete the diary.

The second session enabled researchers to examine that TCD records were consistent with baseline information (i.e., cpd estimates, carbon monoxide level). Participants returned diaries, had CO measured, and were debriefed.

2.4 Approach to Analyses

Data reduction. Time of day was recoded into four time periods: a) from 5:00am to 11:59am, b) from 12:00pm to 4:59pm, c) from 5:00pm to 9:59pm, and d) from 10:00pm to 4:59am. Despite the last category technically encompassing two days, many individuals may have smoked in the early morning hours, and these cigarettes are appropriately considered part of the prior day's cigarettes. In a similar manner, reported location of each cigarette smoked was

coded into: a) a house or apartment, b) bar or club, c) restaurant, d) school, e) work, f) car, g) a party, or h) "other" location. In subsequent analyses, the "other" category was excluded as the variety of locations it included would not result in a variable of predictive utility. It was not a statistically significant predictor in preliminary models and was thus excluded.

All variables in the TCD were collapsed within each participant and each day. The number of cigarettes smoked in a given time period, location, and the number of times a cigarette was smoked when the individual was consuming alcohol were summed for each day. Lastly, the median number of people present (versus mean persons present), smokers present, and mood ratings recorded each day were collapsed into values for each of the seven days within each participant.

Modeling approach. A number of individual predictors were subjected to a negative cube-root transformation because of skew and kurtosis: average number of persons present, smokers present, number of times alcohol was present, all four times of day, and specific locations (home/apartment, school, and car). Bar/club, restaurant, work, and party cigarettes were limited enough within each day whereby the distributions were essentially binomial and were recoded as such. The resulting values enabled examination of the strength of associations with cpd.

The distribution of cigarettes per day contained a 0 probability of 0 cigarettes per day which made the count distribution overdispersed and zero-truncated. A zero-truncated negative binomial regression was used to account for this distribution. Finally, the resulting standard error estimates for each model were adjusted for the clustering (Williams, 2000) of days within persons.

Four nested models were examined in addition to a fifth, full model with all predictors of interest. In all models, gender and baseline FTND score were included to adjust parameter estimates for predictors of interest. The first nested model included only persons present, smokers present, alcohol present, and mood. The second model included only the day of the week using effect coding. The third model included the time variables. The fourth model included only the location variables. The full model included all variables included in the four previous nested models.

3. Results

Participant characteristics are in Table 1. Smokers self-identified as social (46%), light (25%), or regular (24%) most often and self-reported consistently at follow-up, $\gamma = .91$ (.01). At baseline, participants expired a median CO level of 2 ppm, and this value did not change at follow-up ($Z = -.06$, $p = .95$); FTND scores were also not significantly different between baseline and follow-up, $t\ (117) = -.55$, $p = .58$. The lack of change in these variables suggests limited reactivity to recording.

Overall, 575 smoking days were recorded. Light smokers smoked an average of 5 days per week. Descriptive information obtained from TCDs is in Table 2. In the aggregate, participants did not record equally among the 7 days, $\chi^2\ (6) = 12.43$, $p = .053$, with the highest number of recording days being Saturdays ($n = 95$) and the lowest being Sunday ($n = 58$). Removing Sunday values from the distribution resulted in non-significant variability in the distribution, $\chi^2\ (5) = 3.96$, $p > .56$. The number of cigarettes recorded on each of the 7 sequential (1-7) days of the week was also not variable, $\chi^2\ (102) = 107.77$, $p > .33$. This suggests that smoking was roughly equal among all 7 days of the week.

The number of cigarettes recorded on each day was compared to estimates of amount smoked each day provided at baseline. Daily smoking estimates reasonably correlated (all *p*'s < .0001) with actual cigarettes recorded in the TCD: Monday, r (71) = .73, Tuesday, r (74) = .70, Wednesday, r (79) = .57, Thursday, r (84) = .51, Friday, r (90) = .60, Saturday, r (92) = .48, Sunday, r (55) = .59, and overall, r (498) = .64, indicating congruence between recorded and estimated cigarettes.

3.1 Predicting cpd

The first model included control variables as well as psycho-social predictors of smoking included in the diary, *Wald* χ^2 (6) = 108.59, $p < .001$ (see Table 4 for model fit statistics). Interestingly, despite 46% of the sample identifying as social smokers, only the presence of alcohol proved to be a significant predictor of an increase in cpd, *IRR* = 2.37, $p < .001$, while neither increases in median persons present or median smokers present were predictive of increased smoking during the day (both *p*s > .45). Mood was also not influential to cpd ($p > .26$).

The second model included the day variable, *Wald* χ^2 (8) = 67.35, $p < .001$, with Tuesday, *IRR* = .82, $p < .01$, and Wednesday, *IRR* = .77, $p < .001$, having a lower rate of smoking; and Friday, *IRR* = 1.40, $p < .001$, and Saturday, *IRR* = 1.31, $p < .001$, having a higher rate of smoking. Neither Thursdays nor Sundays were statistically significant.

Model 3 included the four time categories, *Wald* χ^2 (6) = 289.07, $p < .001$. All time periods were significant predictors of cpd: before 12pm, *IRR* = 1.60, $p < .001$, 12pm to 4:59pm, *IRR* = 1.59, $p < .001$, 5pm to 9:59pm, *IRR* = 2.28, $p < .001$, and 10pm to 4:59am, *IRR* = 2.58, $p < .001$.

Model 4 included location variables, *Wald* χ^2 (9) = 200.14, $p < .001$. All locations were significant predictors including the house or apartment, *IRR* = 2.40, $p < .001$, at school, *IRR* =

1.63, $p < .001$, the car, $IRR = 2.00$, $p < .001$, a bar or club, $IRR = 2.21$, $p < .001$, a restaurant, $IRR = 1.65$, $p < .001$, at work, $IRR = 1.26$, $p < .05$, and at a party, $IRR = 2.24$, $p < .001$.

Model 5 included all variables included in the previous 4 models and resulted in a significant model, $Wald\ \chi^2\ (22) = 461.36$, $p < .001$. When adjusting for other relevant TCD predictors in the previous models, the significant effect for the presence of alcohol was retained, $IRR = 1.46$, $p < .001$. All time periods remained statistically significant, as did location variables, with the exception of smoking at work ($p = .40$).

The 11 significant parameters in the full model were compared with each other to examine the strongest associations to cpd. The p value of these tests was Bonferroni corrected to a level of .0009 (.05/55)(Table 4). The 5pm to 9:59pm variable was more strongly associated with cigarettes smoked per day than school cigarettes, $\chi^2\ (1) = 13.29$, $p = .0003$. The 10pm and 4:59am time period was more strongly associated than being at school, $\chi^2\ (1) = 22.85$, $p < .0001$, in the car, $\chi^2\ (1) = 12.50$, $p = .0004$, in a bar or club, $\chi^2\ (1) = 16.31$, $p = .0001$, and in a restaurant, $\chi^2\ (1) = 11.25$, $p = .0008$.

Model 5 resulted in a predicted conditional median incidence rate of 2.47 cpd and a mean conditional incidence rate of 3.69 ($SD = 2.71$) cpd. These rates are close to the actual observed cigarette incidence rates reported by participants including a median of 2.00 cpd and a mean of 2.93 ($SD = 2.58$) cpd. The correlation between the linear cpd estimate with the actual cpd observed in the TCD was high, $r\ (572) = .85$, $p < .001$, or an approximate 73% of the variance in light daily smoking.

Potential reactivity and under-reporting. Participants appeared to not have changed their recording pattern throughout the week, with no significant variation in recording among the 7 consecutive days, $\chi^2\ (6) = 6.99$, $p > .32$, though under-reporting may have occurred for some

more than others in cpd. Use of an estimator adjusting for the independent clusters in the data (i.e., participants) may have additionally controlled for underreporting to the degree under-reporting occurred intra-individually. A zero-truncated negative binomial model adjusting for participant as a cluster was computed with the main predictor being the day of recording. Day of the week (Monday-Sunday) was also entered to adjust unequal probabilities of smoking on different days. The explanatory power of the resulting model was due entirely to the day of the week and not the day of recording. This supports an interpretation that reactivity did not occur.

4. Discussion

Alcohol consumption, evening smoking, and a variety of locations were associated with cpd in this study consistent with others (Krukowski et al, 2005; Shiffman & Paty, 2006). Indeed, light smokers appear to be cue oriented (Lazev et al., 1999; Sayette et al., 2005), and attention to significant cues may provide future avenues for intervention. However, some discrepancies with previous studies were also found.

In contrast to some (e.g., Colder et al., 2006; Murphy-Hoefer et al., 2004), light smokers may smoke frequently on the weekends, but no more extensively relative to other days of the week. As such, the day of the week may be less influential to smoking than momentary situational influences to light smoking (cf., Shiffman & Paty, 2006).

Discrepant with previous ecological studies (e.g., Aronson et al., 2008; Shiffman et al., 2007) and large scale surveys (Emmons, Wechsler, Dowdall, & Abraham, 1998), mood was unrelated to cpd. Light smoking college students appear to rate more positive feelings as a smoking trigger relative to heavier smokers, especially in the evening (Krukowski et al., 2005; Piasecki, Richardson, & Smith, 2007). It may be that both negative and positive affect are predictive of smoking (Emmons et al., 1998; Shapiro, Jamner, Davydov, & James, 2002). Still,

much evidence supports the limited influence of affect related variables on smoking considering other relevant smoking cues (Shiffman et al., 2002; Shiffman, Paty, Gwaltney, Dang, 2004; Shiffman & Paty, 2006). As mood may be highly contextual (Shiffman et al., 2004), positive mood appears to cue smoking, and smoking a cigarette appears not to change mood post-consumption in light smokers (Moghaddam & Ferguson, 2007), it may be that contextual locations serve as more primary triggers than affective cues for light smokers.

Contrary to much evidence (Flay, Hu, & Richardson, 1998; Krukowski et al., 2005; Shiffman et al., 2004; Shiffman & Paty, 2006), social pressures to smoke (i.e., smokers present) appear not to have been salient for light smokers. Rather than a quantitative (i.e., number of smokers present) association, the presence of others may be more qualitative, with the relationship to the light smoker, such as a friend (Nguyen & Zhu, 2009; Piasecki et al., 2007) having more impact on smoking. Psychological perceptions, such as feeling less socially connected to peers may also increase the likelihood of smoking (Otsuki, 2009). To that end, light smoking may be better assessed not only by considering amount smoked, but also by considering contextual qualitative (e.g., environmental, cognitive, and social) cues to smoking at a given smoking criterion.

Time of day associations suggest that, in contrast to heavier smokers, early morning craving is not present in light smokers. Rather, cigarettes smoked after 5:00pm appear most associated with smoking, suggesting a late-day steep incline pattern similar to the "daily dip-evening incline" pattern observed by Chandra, Shiffman, Scharf, Dany and Shadel (2007)—a finding recently supported in multiple latent classes of lighter smokers (Sutfin, Reboussin, McCoy, & Wolfson, 2009). Light smokers in particular may benefit from a deeper examination of triggers present for them at night versus the rest of the day, or conversely, which prohibitive

factors (e.g., a non-smoking workplace) may not be present at latter times which facilitate their smoking. Aiding light smokers to understand situational and time triggers (cognitive) to light smoking and develop *personal* prohibitive situations (cognitive-behavioral) in which smoking will not take place may be one reasonable cessation strategy.

In addition to at-risk times to smoke, situations where smoking may be more likely include the home, the car, a bar or restaurant, but not the workplace (Shiffman & Paty, 2006; Shiffman et al., 2004; Shiffman et al., 2002). That the car appears to be an at risk location for even light smoking (Shapiro et al., 2002; Shiffman et al., 2004) may indicate that both social and less social locations are associated with light smoking. Furthermore, the equality among these locations in strength of association with amount smoked as well as the lack of association found between light smoking and smokers present suggests that the label of "social smoker" may be inappropriate for many light smokers consistent with Sutfin and colleagues (2009). Locations found to be related to light smoking indicate a largely ideographic set of location triggers for many light smokers perhaps necessitating a more tailored approach to cue-identification and intervention (Schumann et al., 2007; Velicer et al., 2006). As the workplace was not associated with an increase in cpd, this may also suggest that helping light smokers find means of occupying more time in the day may also be helpful when intervening.

Finally, alcohol was as strongly associated with smoking as any other association with light smoking. This is not surprising as this link is found in general (e.g., Rose et al., 2004; Shapiro et al., 2002), in lighter smokers (Flay et al., 1998; Krukowski et al., 2005; Sayette et al., 2005; Shiffman & Paty, 2006; Shiffman et al., 2002; Sutfin et al., 2009), and in college students (Emmons et al., 1998; Mackey, McKinney, & Tavakoli, 2008; Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004; Piasecki et al., 2007). Alcohol appears to have a strong

urge promoting effect on cigarette craving in real time and also reinforces the effects of cigarettes (Piasecki et al., 2008). Hence, dampening the likelihood of smoking may be aided by intervening with alcohol intake as well.

4.1 Limitations and Future Directions

The paper diaries included did not enable analysis of days when individuals did not smoke relative to smoking days. On average, this was only 2 of the 7 days a week. Still, many light smokers may be intermittent or non-daily smokers (Husten, 2009). However, this study could not address the impact of non-smoking days as random momentary assessments on non-smoking days would have permitted.

Small size of the TCD and a concerted effort to limit participant burden also prohibited the inclusion of some potentially relevant influences of light smoking (cf., Shiffman et al., 2007; Shiffman et al., 2002). While an effort was made to choose the most salient influences to light smoking, the present study also suggests that light smoking is likely highly ideographic. To the extent that this is true, methods of assessment and intervention may do well to tailor the intervention to the smoker as much as possible (Velicer et al., 2006).

Lastly, the ecological validity of paper records and the times at which records were made is always of potential concern, although paper records, questionnaire reports, and electronic momentary assessments tend to be moderately to highly concordant (Garber, Nau, Erickson, Aikens, & Lawrence, 2004). In line with this observation, values recorded here were consistent with self-reports via questionnaires, verbal reports, and CO measurement. Nevertheless, corroboration of recorded material via a clinician, independent observer assessment, more sensitive health biomarkers (e.g., thiocyanate), or real-time documentation may enhance future studies.

4.2 Conclusions

Environmental triggers such as increased presence of alcohol or situations in which alcohol is likely to be present, as well as latter times of day appear to be strongly associated with light smoking. However, a broad array of time and ideographic situational influences may need to be considered when intervening with light smokers. Finally, assessments of and interventions with light smokers will likely be more accurate and effective if tailored to the unique cognitive and behavioral aspects of light smokers.

References

An, L. C., Berg, C. J., Klatt, C. M., Perry, C. L., Thomas, J. L., et al. (2009). Symptoms of cough and shortness of breath among occasional young adult smokers. *Nicotine & Tobacco Research, 11,* 126-133.

Aronson, K. R., Almeida, D. M., Stawski, R. S., Klein, L. C., & Kozlowski, L. T. (2008). Smoking is associated with worse mood on stressful days: Results from a national diary study. *Annals of Behavioral Medicine, 36,* 259-269.

Bjartveit, K., & Tverdal, A. (2005). Health consequences of smoking 1-4 cigarettes per day. *Tobacco Control, 14,* 315-320.

Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology, 54,* 579-616.

Chandola, T., Head, J., & Bartley, M. (2004). Socio-demographic predictors of quitting smoking: how important are household factors? *Addiction, 99,* 770-777.

Chandra, S., Shiffman, S., Scharf, D. M., Dang, Q., & Shadel, W. G. (2007). Daily smoking patterns, their determinants, and implications for quitting. *Experimental and Clinical Psychopharmacology, 15,* 67-80.

Colder, C. R., Lloyd-Richardson, E. E., Flaherty, B. P., Hedeker, D., Segawa, E., & Flay, B. R. (2006). The natural history of college smoking: trajectories of daily smoking during freshman year. *Addictive Behaviors, 31,* 2212-2222.

Delfino, R.J., Jammer, L.D., & Whalen, C.K. (2001). Temporal analysis of the relationship of smoking behavior and urges to mood states in men versus women. *Nicotine & Tobacco research, 3,* 235-348.

Dierker, L., Lloyd-Richardson, E., Stolar, M., Flay, B., Tiffany, S., Collins, L., Bailey, S., Nichter, M., Clayton, R., & The Tobacco Etiology Research Network (2006). The proximal association between smoking g and alcohol use among first year college students. *Drug and Alcohol Dependence, 81,* 1-9.

Emmons, K. M., Wechsler, H., Dowdall, G., & Abraham, M. (1998). Predictors of smoking among US college students. *American Journal of Public Health, 88,* 104-107.

Etter, J. F., Duc, T. V., & Perneger, T. V. (1999). Validity of the Fagerström test for nicotine dependence and of the heaviness of smoking index among relatively light smokers. *Addiction, 94,* 269-281.

Fiore, M. C., Jaen, C. R., Baker, T. B., Bailey, W. C., Benowitz, N. L., Curry, S. J., et al. (2008). *Treating tobacco use and dependence: Clinical Practice Guideline*. Rockville (MD): U.S. Department of Health and Human Services, Public Health Service.

Flay, B. R., Hu, F. B., & Richardson, J. (1998). Psychosocial predictors of different stages of cigarette smoking among high school students. *Preventive Medicine, 27, A*9-A18.

Garber, M. C., Nau, D. P., Erickson, S. R., Aikens, J. E., & Lawrence, J. B. (2004). The concordance of self-report with other measure of medication adherence. *Medical Care, 42,* 649-652.

Haddock, C. K., Lando, H., Klesges, R. C., Talcott, G. W., & Renaud, E. A. (1999). A study of the psychometric and predictive properties of the Fagerström Test for Nicotine Dependence in a population of young smokers. *Nicotine and Tobacco Research, 1,* 59-66.

Heatherton, T. F., Kozlowski, L. T., Frecker, R. C., & Fagerström, K. O. (1991). The Fagerström test for nicotine dependence: A revision of the Fagerström Tolerance Questionnaire. *British Journal of Addiction, 86,* 1119-1127.

Hoz, E.V., Poch, F.V., Ferrer, J.J., Caparrós, B.C., Guerra, I.P., & Canals, M.C. (2004). Dimensiones psicopatológicas asociadas al consume de tabaco en problación universitaria. *Anales de Psicologia, 20*, 33-46.

Hufford, M. R., Stone, A. A., Shiffman, S., Schwartz, J. E., & Broderick, J. E. (2002) Paper vs. electronic diaries: Compliance and subject evaluations. *Applied Clinical Trials, August,* 38-43.

Husten, C. G. (2009). How should we define light or intermittent smoking? Does it matter? *Nicotine & Tobacco Research, 11,* 111-121.

Johnston, L. D, O'Malley, P. M., Bachman, J. G., Schulenberg, J. E. (2004). *Monitoring the Future national results on adolescent drug use: Overview of key findings, 2003.* NIH Publication No. 04-5506). Bethesda , MD : National Institute on Drug Abuse.

Kenford, S. L., Wetter, D. W., Welsch, S. K., Smith. S. S., Fiore, M. C., & Baker, T. B. (2005). Progression of college-age cigarette samplers: what influences outcome. *Addictive Behaviors, 30,* 285-294.

Krukowski, R.A., Solomon, L.J., & Naud, S. (2005). Triggers of heavier and lighter cigarette smoking in college students. *Journal of Behavioral Medicine, 28*, 335-345.

Lazev, A.B., Herzog, T.A., & Brandon, T.H. (1999). Classical conditioning and environmental cues to cigarette smoking. *Experimental and Clinical Psychopharmacology, 7,* 56-63.

Mackey, M. C., McKinney, S. H., & Tavakoli, A. (2008). Factors related to smoking in college women. *Journal of Community Health Nursing, 25,* 106-121.

McCarthy, W.J., Zhou, Y., & Hser, Y.-I. (2001). Individual change amid stable smoking patterns in polydrug users over 3 years. *Addictive Behaviors, 26,* 143-149.

Moghaddam, N. G., & Ferguson, E. (2007). Smoking, mood regulation, and personality: An event-sampling exploration of potential models and moderation. *Journal of Personality, 75,* 451-478.

Moran, S., Wechsler, H., & Rigotti, N. A. (2004). Social smoking among US college students. *Pediatrics, 4*, 1028-1034.

Morrell, H.R., Cohen, L.M., Bacchi, D., & West, J. (2005). Predictors of smoking and smokeless tobacco use in college students: A preliminary study using web-based survey methodology. *Journal of American College Health, 54*, 108-115.

Murphy-Hoefer, R., Alder, S., & Higbee, C. (2004). Perceptions about cigarette smoking and risks among college students. *Nicotine & Tobacco Research, 6,* 371-374.

Nguyen Q. B., & Zhu, S. (2009). Intermittent smokers who used to smoke daily: A preliminary study on smoking situations. *Nicotine & Tobacco Research, 11,* 164-170.

Otsuki, M. (2009). Social connectedness and smoking behaviors among Asian American college students: An electronic diary study. *Nicotine & Tobacco Research,11,* 418-426.

Patterson, F., Lerman, C., Kaufmann, V. G., Neuner, G. A., & Audrain-McGovern, J. (2004). Cigarette smoking practices among American college students: Review of future directions. *Journal of American College Health, 52,* 203-210.

Patton, G.C., Hibbert, M., Rosier, M.J, Carlin, J.B, Caust, J., & Bowes, G. (1996). Is smoking associated with depression and anxiety in teenagers? *American Journal of Public Health, 86,* 225-230.

Piasecki, T. M., Richardson, A. E., & Smith, S. M. (2007). Self-monitored motives for smoking among college students. *Psychology of Addictive Behaviors, 21,* 328-337.

Ridner, S.L. (2005). Predicting smoking status in a college-age population. *Public Health Nursing, 22,* 494-505.

Rodriguez-Esquivel, D., Cooper, T. V., Blow, J. A., & Resor, M. R. (2009). Characteristics associated with smoking in a Hispanic sample. *Addictive Behaviors, 34,* 593-598.

Rose, J. E., Brauer, L. H., Behm, F. M., Cramblett, M., Calkins, K., & Lawhon, D. (2004). Psychopharmacological interactions between nicotine and ethanol. *Nicotine & Tobacco Research, 6,* 133-144.

Rubinstein, M. L., Benowitz, N. L., Auerback, G. M., & Moscicki, A. (2009). Withdrawal in adolescent light smokers following 24-hour abstinence. *Nocotine & Tobacco Research, 11,* 185-189.

Russell, M. (1990). The nicotine addiction trap: A 40-year sentence for four cigarettes. *British Journal of Addiction, 85,* 293-300.

Sayette, M. A., Martin, C. S., Wertz, J. M., Perrott, M. A., & Peters, A. R. (2005). The effects of alcohol on cigarette craving in heavy smokers and tobacco chippers. *Psychology of Addictive Behaviors, 19,* 263-270.

Sayette, M. (2002). The effects of alcohol on cigarette craving. *Alcoholism: Clinical and Experimental Research, 26,* 1925-1927.

Sayette, M.A., Martin, C.S., Wertz, J.M., Perrot, M.A., & Peters, A.R. (2005). The effects of alcohol on cigarette craving in heavy smokers and tobacco chippers. *Psychology of Addictive Behaviors, 19,* 263-270.

Schumann, A., Ulrich, J., Ulbricht, S., Rüge, J., Bischof, G., & Meyer, C. (2007). Variability of tailoring of a smoking cessation intervention based on the transtheoretical model. *Addictive Behaviors, 32,* 3083-3087.

Shapiro, D., Jamner, L.D., Davydov, D.M., James, P. (2002). Situations and moods associated with smoking in everyday life. *Psychology of Addictive Behaviors, 16,* 342-345.

Shiffman, S., Balabanis, M. H., Gwaltney, C. J., Paty, J. A., Gnys, M., Kassel, J. D., el al. (2007). Prediction of lapse from association between smoking and situational antecedents assessed by ecological momentary assessment. *Drug and Alcohol Dependence, 91,* 159-168.

Shiffman, S., Gwaltney, C. J., Balabanis, M. H., Liu, K. S., Paty, J. A., Kassel, J. D., et al. (2002). Immediate antecedents of cigarette smoking: An analysis from ecological momentary assessment. *Journal of Abnormal Psychology, 111,* 531-545.

Shiffman, S, & Paty, J. (2006). Smoking patterns and dependence: Contrasting chippers and heavy smokers. *Journal of Abnormal Psychology, 115,* 509-523.

Shiffman, S., Paty, J. A., Gwaltney, C. J., & Dang, Q. (2004). Immediate antecedents of cigarette smoking: An analysis of unrestricted smoking patterns. *Journal of Abnormal Psychology, 113,* 166-171.

Shiffman, S., Paty, J.A, Kassel, J.D., Gnys, M., & Zettler-Segal, M. (1994). Smoking behavior and smoking history of tobacco chippers. *Experimental and Clinical Psychopharmacology, 2,* 126-142.

Steinberg, M. L., Williams, J. M., Steinberg, H. R., Krejci, J. A., & Ziedonis, D. M. (2005). Applicability of the Fagerström Test for Nicotine Dependence in smokers with schizophrenia. *Addictive Behaviors, 30,* 49-59.

Stone, A. A., Shiffman, S., Schwartz, J. E., Broderick, J. E., & Hufford, M. R. (2003). Patient compliance with paper and electronic diaries. *Controlled Clinical Trials, 24,* 182-199.

Substance Abuse and Mental Health Services Agency; SAMHSA. (2004). National Survey on Drug Use and Health. Substance Abuse and Mental Health Services Agency, Office of Applied Studies. Accessed August 2, 2006. http://www.oas.samhsa.gov/nsduh.htm#NSDUHinfo.

Sutfin, E. L., Reboussin, B. A., McCoy, T. P., & Wolfson, M. (2009). Are college student smokers really a homogenous group? A latent class analysis of college student smokers. *Nicotine & Tobacco Research, 11,* 444-454.

Thomsson, H. (1997). Women's smoking behaviour – caught by a cigarette diary. *Health Education Research, 12,* 237-245.

Trinidad, D. R., Pérez-Stable, E. J., Emery, S. L., White, M. M., Grana, R. A., & Messer, K. S. (2009). Intermittent and light daily smoking across racial/ethnic groups int he United States. *Nicotine & Tobacco Research, 11,* 203-210.

Velicer, W.F., Prochaska, J.O., & Redding, C.A. (2006). Tailored communications for smoking cessation: past successes and future directions. *Drug and Alcohol Review, 25*, 49-57.

Wetter, D. W., Kenford, S. L., Welsch, S. K., Smith, S. S., Fouladi, R. T., Fiore, M. C., Baker, T. B. (2004). Prevalence and predictors of transitions in smoking behavior among college students. *Health Psychology, 23,* 168-177.

White, H. R., Bray, B. C., Fleming, C. B., & Catalano, R. F. (2009). Transitions into and out of light and intermittent smoking during emerging adulthood. *Nicotine & Tobacco Research, 11,* 211-219.

Williams, R. L. (2000). A note on robust variance estimation for cluster-correlated data. *Biometrics, 56,* 645-646.

Zhu, S.-H., Sun, J., Billings, S.C., Choi, W. S., & Malarcher, A. (1999). Predictors of smoking cessation in U.S. adolescents. *American Journal of Preventive Medicine, 16,* 202-207.

Table 1
Participant Characteristics (N = 118)

Categorical Variables		*N*	%
Gender			
Male		54	46
Female		64	54
Ethnicity			
Hispanic		77	65
Mexican National		17	15
Non-Hispanic White		20	17
Other		4	3
Self-Reported Smoking Status			
Daily		49	42
1 to 6 cpd per week		47	40
< 1 Cigarette a Month		13	11
Experimenter		9	7
Self-Described Smoking Behavior			
(Note: All smoked <10cpd some days)			
Non-Smoker		5	4
Social Smoker		54	46
Light Smoker		29	25
Regular Smoker		28	24
Heavy Smoker		2	1
Continuous Variables	*Mean*	*SD*	*Median*
Age	19.57	2.52	19
Degree Consider's Oneself a Smoker	3.47	1.62	3
Average CPD Survey Response	2.93	2.58	2
Days Until Return of 7 Day TCD	4.27	4.02	2
Total Cigarettes Recorded in 7 Days	18.30	16.85	12
Contemplation Ladder Motivation Level		t (114) = .96, p = .34	
Baseline	5.09	3.20	5
Follow-Up	4.85	3.28	4
Expired CO		*Rank Sign Z* = -.06, p =.95	
Baseline	3.50	4.07	2
Follow-Up	3.56	4.17	2
FTND		t (117) = -.55, p = .58	
Baseline	0.92	1.02	1
Follow-Up	0.96	1.10	1

Table 2
TCD Recording Behavior (N = 575 Days)

Categorical Variables	*N*	%
Day of the Week		
Monday	75	13
Tuesday	78	13
Wednesday	85	15
Thursday	91	16
Friday	93	16
Saturday	95	17
Sunday	58	10
Count Variables [a]	*Median*	*Range*
Time Period		
5am to 11:59pm	0	0 - 10
12:00pm to 4:59pm	0	0 - 7
5pm to 9:59pm	1	0 - 6
10pm to 4:59am	0	0 - 13
Location		
House or Apartment	0	0 - 16
School	0	0 - 8
Car	0	0 - 9
Bar or Club	0	0 - 10
Restaurant	0	0 - 4
Work	0	0 - 3
Party	0	0 - 8
Other	0	0 - 17
Drinking Alcohol	0	0 - 17
No. of People Present[b]	2	0 - 25
No. of Smokers Present[b]	1	0 - 10
Mood[b]	5	1 - 7

[a] Count of Cigarettes Recorded Within Location, Time, or Situation

[b] Median Value for Cigarettes Recorded in a Given Day

Table 3

Zero-Truncated Negative Binomial Regression Models predicting CPD

	Model 1			Model 2			Model 3			Model 4			Model 5		
Predictor	IRR	S.E.[d]	*p*	IRR	S.E.[d]	*p*	IRR	S.E.[d]	*p*	IRR	S.E.[d]	*p*	IRR	S.E.[d]	*p*
Demographics[a]															
Gender (Female)	.75	.10	.04	.67	.11	.01	.87	.07	.07	.74	.08	.01	.89	.06	.10
Baseline FTND	1.24	.06	.01	1.22	.07	.01	1.01	.04	.83	1.10	.05	.05	1.04	.03	.23
Potential Triggers															
Alcohol Present[e]	2.37	.29	.01										1.45	.11	.01
Persons Present[e]	.83	.20	.45										.85	.09	.14
Smokers Present[e]	1.07	.24	.76										1.15	.10	.10
Median Mood	1.04	.04	.26										1.01	.03	.66
Day of the Week[b]															
Tuesday				.82	.06	.01							1.06	.06	.28
Wednesday				.77	.06	.01							.92	.05	.09
Thursday				1.10	.08	.18							1.03	.06	.66
Friday				1.40	.10	.01							1.01	.05	.88
Saturday				1.31	.10	.01							1.01	.07	.88
Sunday				.87	.08	.15							1.06	.07	.38
Time of Day[c]															
6am to 12pm[e]							1.60	.12	.01				1.58	.11	.01
12:01pm to 5pm[e]							1.60	.13	.01				1.52	.12	.01
5:01pm to 10pm[e]							2.28	.23	.01				1.83	.19	.01
10:01pm to 4:59am[e]							2.58	.23	.01				1.83	.14	.01
Location[c]															
House or Apartment[e]										2.40	.22	.01	1.30	.10	.01
School[e]										1.63	.14	.01	1.15	.08	.04
Car[e]										2.00	.23	.01	1.20	.09	.02
Bar or Club										2.21	.20	.01	1.19	.08	.02
Restaurant										1.65	.14	.01	1.23	.09	.01
Work										1.26	.12	.05	.94	.07	.40
Party										2.24	.21	.01	1.27	.13	.02
Likelihood Ratio of dispersion (δ)	χ^2 (1) = 144.38***			χ^2 (1) = 253.32***			χ^2 (1) = 4.01*			χ^2 (1) = 41.39***			χ^2 (1) = .17, *n.s.*		
Model Dispersion	δ = .35 (S.E. = .10)			δ = .58 (S.E. = .16)			δ = .03 (S.E. = .02)			δ = .12 (S.E. = .05)			δ = .01 (S.E. = .01)		

[a] Age was restricted in range and estimation was problematic; it was not significant in converging models and so was excluded from models.

[b] Effect Coding was used and estimates are for the deviation from the grand mean for all days combined.

[c] Time of Day and Location categories are the sum of cigarettes smoked in that time period or in the respective location each day.

[d] S.E. =Standard Errors: Cluster adjusted robust standard errors were estimated accounting for observations nested within persons.

[e] Variables are Inverse Cubic Log transformed to account for skew and kurtosis; **p*<.05, ***p*<.01, ****p*<.001, *n.s.* = not significant

Table 4

Post Estimation Comparisons of Significant Estimates for Model 5

Variable	1	2	3	4	5	6	7	8	9	10	11
Alcohol Present (1)	--										
6am to 12pm (2)	1 = 2	--									
12:01pm to 5pm (3)	1 = 3	2 = 3	--								
5:01pm to 10pm (4)	1 = 4	2 = 4	3 = 4	--							
10:01pm to 4:59am (5)	1 = 5	2 = 5	3 = 5	4 = 5	--						
House or Apartment (6)	1 = 6	2 = 6	3 = 6	4 = 6	5 = 6	--					
School (7)	1 = 7	2 = 7	3 = 7	4 > 7	5 > 7	6 = 7	--				
Car (8)	1 = 8	2 = 8	3 = 8	4 = 8	5 > 8	6 = 8	7 = 8	--			
Bar or Club (9)	1 = 9	2 = 9	3 = 9	4 = 9	5 > 9	6 = 9	7 = 9	8 = 9	--		
Restaurant (10)	1 = 10	2 = 10	3 = 10	4 = 10	5 > 10	6 = 10	7 = 10	8 =10	9 = 10	--	
Party (11)	1 = 11	2 = 11	3 = 11	4 = 11	5 = 11	6 = 11	7 = 11	8 = 11	9 = 11	10 = 11	--