Published in final edited form as:

Exp Clin Psychopharmacol. 2012 August ; 20(4): 264–277. doi:10.1037/a0027546.

Characteristics and Smoking Patterns of Intermittent Smokers

Saul Shiffman¹, Hilary Tindle², Xiaoxue Li³, Sarah Scholl¹, Michael Dunbar¹, and Chantele Mitchell-Miland¹

¹University of Pittsburgh, Department of Psychology

²University of Pittsburgh, Department of General Internal Medicine

³University of Pittsburgh, Department of Biostatistics

Abstract

Current models of smoking and dependence assume a need to smoke at regular intervals to maintain nicotine levels, yet about 25% of adult smokers do not smoke daily. This subset of intermittent smokers (ITS) has gone largely unexamined. In this study, we describe the demographics, smoking history, and smoking behavior of ITS (n=282; 50.2% male) in comparison to daily smokers (DS; n=233; 60.7% male). Within ITS, we also compare “converted” ITS (CITS), who had previously smoked daily, with “native” ITS (NITS). On average, ITS were 34.66 years of age, and had smoked 42,850 cigarettes in the course of an average of 18 years of smoking. They smoked an average of 4.38 days per week, consuming 4.39 cigarettes a day on smoking days, and demonstrated considerable day-to-day variability in cigarette consumption. Almost half of ITS had Fagerstrom Test of Nicotine Dependence scores of 0, indicating no dependence. Compared to DS, ITS were more likely to cite alcohol drinking, socializing and being with other smokers as common contexts for smoking, and they also more often cited being angry or stressed. Data suggested that ITS’ behavior was not explained by use of other nicotine products or by economic constraints on smoking, nor by differences in psychological adjustment. Within ITS, CITS were heavier, more frequent, and more dependent smokers. In many respects, CITS were intermediate between NITS and DS. ITS show distinct patterns of smoking behavior that are not well explained by current models of nicotine dependence.

Keywords

Smoking; dependence; non-daily smoking

Smoking is typically thought to be maintained by nicotine dependence, such that smokers are motivated to smoke frequently throughout the day, in order to maintain nicotine levels above a threshold necessary to avoid lapsing into nicotine withdrawal (Benowitz, 2010; Stoleran & Jarvis, 1995). This requires frequent and regular smoking, as nicotine is cleared relatively rapidly, with a half-life of 2–3 hours (Benowitz, 2010). This helps explain the behavior of typical daily smokers, who smoke every day and typically every hour or so throughout the day (Al-Delaimy et al., 2007), allowing them to maintain significant nicotine

Correspondence concerning this article should be addressed to Saul Shiffman, Department of Psychology, University of Pittsburgh, 130 N. Bellefield Ave., Suite 510, Pittsburgh, PA 15213. shiffman@pitt.edu.

Publisher's Disclaimer: The following manuscript is the final accepted manuscript. It has not been subjected to the final copyediting, fact-checking, and proofreading required for formal publication. It is not the definitive, publisher-authenticated version. The American Psychological Association and its Council of Editors disclaim any responsibility or liabilities for errors or omissions of this manuscript version, any version derived from this manuscript by NIH, or other third parties. The published version is available at www.apa.org/pubs/journals/pha

levels throughout the day, and well into the night (Benowitz, 1996; Scharf, Dunbar, & Shiffman, 2008).

However, new population patterns of non-daily smoking are emerging that are inconsistent with nicotine maintenance: it is estimated that a quarter to a third of adult US smokers do not smoke daily (Centers for Disease Control and Prevention [CDC], 2008a, 2008b; Substance Abuse and Mental Health Services Administration [SAMHSA], 2009; though see Hassmiller, Warner, Mendez, Levy, & Romano, 2003; Wortley, Husten, Trosclair, Chrismon, & Pederson, 2003). These intermittent smokers (ITS) are increasingly prevalent in some European countries (Korhonen, Broms, Levalahti, Koskenvuo, & Kaprio, 2009; Lindstrom & Ostergren, 2001), and are even more common in Asia and Latin America (World Health Organization [WHO], 2007). Moreover, the prevalence of ITS appears to be growing dramatically in the US: its prevalence increased by 40% in the five year period between 1996 and 2001 (CDC, 2003; though see CDC, 2007), perhaps as a consequence of increasing restrictions on smoking (Shiffman, 2009b). Thus, it seems important to understand ITS and their smoking patterns.

While there has been some analysis of smoking patterns in chippers (who smoke 5 or fewer cigarettes per day, often daily; Shiffman, 1989; Shiffman, Paty, Kassel, Gnys, & Zettler-Segal, 1994), there has been less detailed description of ITS. Some epidemiological research has examined characteristics of ITS. For example, ITS are better educated, and have higher incomes than daily smokers (DS; Ackerson & Viswanath, 2009; Cooper et al., 2010; Wortley et al., 2003). Although younger, ITS typically have initiated smoking later in life than DS (Cooper et al., 2010; Hassmiller et al., 2003). There are no consistent gender differences (Cooper et al., 2010; Hassmiller et al., 2003). Strikingly, ITS are far more likely to be ethnic minorities, including African American, Hispanic and Asian populations (Trinidad et al., 2009), and there are also variations among different Asian groups (Tong, Nguyen, Vittinghoff, & Perez-Stable, 2009). ITS are heterogeneous: about half have never smoked daily ("native" ITS, NITS), whereas the other half previously smoked daily for at least 6 months ("converted" ITS, CITS; Edwards, Bondy, Kowgier, McDonald, & Cohen, 2010; Nguyen & Zhu, 2009). Further, studies have suggested variation in the stability of ITS smoking behavior over time (Evans et al., 1992; Zhu, Sun, Hawkins, Pierce, & Cummins, 2003), especially among CITS (Gilpin, Cavin, & Pierce, 1997). CITS and DS exhibit similar smoking durations, which are longer than NITS (Cooper et al., 2010; Nguyen & Zhu, 2009).

Quite surprisingly, most quit efforts by ITS fail. Among military recruits in a non-smoking environment, most of whom received behavioral treatment, 41% succeeded (Cooper et al., 2010). In a general population undergoing largely-unassisted quitting (Tindle and Shiffman, 2011), success rates were estimated at 22% -- only modestly higher than those seen in DS (13%) -- further suggesting the need to understand ITS' characteristics and smoking patterns.

While these epidemiological findings paint a broad profile of ITS, they do not shed light on ITS' detailed characteristics, smoking patterns, or psychological characteristics, leaving many questions to be answered. For example, it is not clear what the patterning is of ITS' smoking over days: How long and how often do ITS go without smoking? Do they go for long runs of days without smoking, or are smoking days regularly alternated with non-smoking days? Do ITS specifically smoke only or mainly on weekends? If so, this might be part of a pattern of so-called "social smoking" (Schane, Glantz, & Ling, 2009), which is often attributed to ITS.

Also relevant to characterizing ITS' smoking are the situations in which they typically smoke. For example, do they smoke primarily when others are smoking, as implied by social

smoking (Schane et al., 2009)? Do they smoke mostly when drinking (Harrison, Desai, & McKee, 2008)? Among military recruits, ITS are less likely to report smoking under emotional distress (Cooper et al., 2010), whereas DS frequently report this (Kassel, Stroud, & Paronis, 2003), so it is important to establish the relationship of mood to smoking. Particularly as heavy smoking is sometimes conceptualized as self-medication for an underlying psychiatric disorder (Hughes, Hatsukami, Mitchell, & Dahlgren, 1986; Lasser, Woolhandler, Himmelstein, McCormick, & Bor, 2000) or for regulation of emotional distress (Fucito, Juliano, & Toll, 2010), it also seems important to examine indices of psychosocial functioning and adjustment, especially history of depression, which has been associated with smoking and nicotine dependence (Anda et al., 1990; Breslau, Peterson, Schultz, Chilcoat, & Andreski, 1998).

Other important questions relate to the implications that ITS smoking patterns may have for models of smoking based on withdrawal-avoidance (Benowitz, 2010; Shadel, Shiffman, Niaura, Nichter, & Abrams, 2000). ITS' smoking patterns seem anomalous in light of our expectations for regular intake of nicotine. However, if ITS obtain nicotine from other sources, their smoking patterns might be viewed differently. Indeed, Cooper et al. (2010) reported that ITS were more likely to use smokeless tobacco, but this was among a largely male sample of military recruits. Thus, it is important to understand ITS' use of other products that yield nicotine (i.e., tobacco products and nicotine replacement therapy (NRT) medications). Furthermore, if ITS' practice of abstaining on some days were due to economic limitations (i.e., inability to afford daily tobacco), this may alter interpretation and implications of the phenomenon.

ITS might also differ in use of other substances. ITS are reported to drink and binge-drink more often than DS (Cooper et al., 2010; Harrison and McKee, 2008). Consumption of coffee and caffeinated beverages, which also often accompany smoking (Istvan & Matarazzo, 1984; Shiffman et al., 2002) might also illuminate ITS' smoking patterns.

ITS are more prevalent in states with stronger tobacco control measures (Shiffman, 2009b). This suggests the possibility that smoking restrictions shape or maintain ITS, which warrants examination of the extent to which ITS encounter smoking restrictions, compared to DS, and the extent to which they self-impose restrictions (Levy, Romano, & Mumford, 2004; Zhang, Martinez-Donate, Kuo, Jones, & Palmersheim, 2011).

Given their limited and unusual smoking, it would be informative to know if ITS even think of themselves as smokers. As a practical matter, if ITS do not identify themselves as smokers when surveyed, ITS might be under-counted and smoking prevalence underestimated. Further, even among those who identify themselves as smokers, ITS might consider smoking a more minor part of their identity (Shadel & Mermelstein, 1996).

With regards to CITS, a key question is whether these previously-DS have left this history behind and resemble NITS, or whether they show signs of dependence, even now that their smoking behavior has changed to become non-daily. To begin addressing these and other questions, we compared the characteristics of a sample of ITS to a parallel sample of DS, and also contrast NITS and CITS within the ITS sample.

Methods

Sample

Subjects were 515 (282 ITS, 50.2% male; 233 DS, 60.7% male) community volunteers from Pittsburgh, PA, recruited by advertisement and promotion. Because African American smokers are more likely to be ITS, we sought to oversample African American smokers, and

focused extra recruitment efforts on the African American community. Volunteers could earn as much as \$295 for all study procedures, and provided informed consent, based on a protocol approved by the University of Pittsburgh Institutional Review Board (IRB). Subjects were screened by telephone and then rescreened when they appeared for their first appointment. To be eligible, all volunteers had to be at least 21 years old, report smoking for at least 3 years, smoking at their current rate for at least 3 months, and not be planning to quit within the next month. DS had to report smoking every day, averaging 5–30 cigarettes per day. ITS had to report smoking 4–27 days per month, with no restrictions on number of cigarettes.

Procedures

The full study included up to six laboratory sessions to assess cue reactivity (Shiffman et al., 2011), and three additional visits used to assess monitoring of smoking using an electronic diary. With the exception of carbon monoxide (CO) measures, this report focuses solely on data from questionnaires completed over 1–2 weeks of the study. Some assessments were introduced later; these assessments (noted in specific descriptions) have a smaller sample size.

Assessments

In addition to providing demographic data, subjects completed a battery of smoking measures. Data collected included a global report of daily cigarette consumption, preferred brand information, prevalence of smoking among friends and partners, home and workplace smoking restrictions, influence of price of cigarettes on consumption, smoking and tobacco use history, caffeine and alcohol usage and history, and smoking abstinence frequency and behavior.

Smoking behavior and history—Subjects completed a thorough smoking history, assessment of their current smoking practices, and history of quit attempts. Subjects also indicated the three top situations in which they smoked, selecting from a list of activities, social settings, and moods. ITS were characterized as CITS if they reported having smoked daily for 6 months or more at any point in their past smoking history. For 76% of ITS, these data were extracted from a detailed history of their lifetime smoking careers, in which subjects identified sequential periods of their smoking history, using notable life events or changes to help anchor recollections in order to boost recall accuracy (Eisenhower et al., 1991) and reported in detail on each change in smoking pattern within each (Brigham et al., 2008; Shiffman et al., 1994). For an additional 10%, subjects were simply asked whether they had smoked daily for 6 months or more; the remaining 14% were missing this indicator. For subjects who completed the lifetime history interview, data were also extracted on the number and duration of past quit attempts, age of smoking initiation, total years spent smoking (calculated by subtracting the date of interview from the approximate age of initiation), and total lifetime cigarette consumption (calculated by multiplying the number of days in each period by the reported CPD smoked in each, and summing across all periods).

Subjects completed the Smoker Self-Concept Scale devised by Shadel and Mermelstein (1996), which assesses how central smoking is to the subjects' identity, and two original items assessing the degree to which they consider themselves a smoker. The scale has demonstrated moderate internal consistency in previous samples (Cronbach's $\alpha = 0.74$; Shadel & Mermelstein, 1996) and demonstrated strong internal consistency within this sample ($\alpha = 0.95$). The two original items demonstrated similarly high reliability ($\alpha = 0.88$).

Subjects were asked about their lifetime, past-year, and past-month use of tobacco products other than cigarettes (i.e., smokeless tobacco, water pipes, cigars, and pipes), and of nicotine replacement products (i.e., nicotine patch, gum, lozenge, spray and inhaler).

Subjects completed the Fagerstrom Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). This measure has been shown to demonstrate moderate internal consistency ($\alpha = 0.67$, Haddock, Lando, Klesges, Talcott & Renaud, 1999; current sample $\alpha = 0.74$). Since Lichtenstein (1986) indicated that the test can be factored into three components: cigarette consumption, morning smoking, and difficulty refraining, we examined each of the three components separately, in addition to analyzing the total FTND score. We report detail on cigarette consumption, time to first cigarette in the morning (which has been regarded as the single best measure of dependence), and a composite measure of difficulty refraining (i.e., when ill and where smoking is forbidden; current sample $\alpha = 0.59$). We also obtained ratings (1–5 scale) of the amount of difficulty subjects felt they would experience if they were to abstain from smoking for various intervals of time (i.e., a half day, a day, a week, a month; Shiffman, et al., 1994).

Time-line Follow-Back (TLFB)—To capture cigarette consumption by retrospective reports, subjects completed a TLFB procedure (Sobell, Sobell, & Maisto, 1985) during every session. At the first session, they reported the number of cigarettes smoked on each of 30 days preceding the day of that visit. At subsequent sessions (typically a total of eight), they completed a TLFB report covering the period from the prior to the current session. Subjects completed TLFB records covering a median of 65 days.

Other assessments—At each visit to the laboratory, subjects provided a breath sample for CO assessment, using a Vitalograph Breath CO monitor (Vitalograph Inc., Lenexa, KS). The majority of sessions were held in the afternoon, when CO values typically become stable, at least in DS (Benowitz, 1995). The multiple CO values were highly inter-correlated. We report the mean value across all available measures; the median number of assessments was 9.0 (mean= 8.2).

To assess estimated daily consumption of caffeinated beverages and weekly consumption of alcohol, subjects completed quantity/frequency measures for caffeine and alcohol. In addition, we assessed alcohol abuse and dependence using a modified Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1996).

Lifetime history of depression was assessed with the Inventory to Diagnose Depression-lifetime version (IDD-L; Zimmerman & Coryell, 1987). Subjects completed the Global Severity Index (GSI), which is derived from the Brief Symptom Inventory (Derogatis & Melisaratos, 1983), a measure of overall mental health and adjustment. Internal consistency for the GSI is high in this sample ($\alpha = 0.92$). Further, we administered the 10-item Emotion Regulation Questionnaire (Gross & John, 2003), which assesses use of two emotion regulation strategies – cognitive reappraisal and expressive suppression. Each subscale demonstrates moderate internal consistency in both past studies (Reappraisal: $\alpha = 0.79$; Suppression: $\alpha = 0.73$; Gross & John, 2003) and the current sample (Reappraisal: $\alpha = 0.79$; Suppression: $\alpha = 0.74$).

Data Analysis

We compared ITS versus DS and CITS versus NITS, using χ^2 and t-tests, as appropriate. For the TLFB data, records were aggregated to calculate the probability and amount of smoking on each day of the week. We used multivariate repeated-measures analyses to analyze data by day of week. We noted that more smoking took place on Fridays and Saturdays, and constructed a weekday-weekend contrast between Friday and Saturday and

all other days. Subjects identified the top three situations most often associated with smoking; the checklist format, with a limited number of options, made these variables highly interdependent. Accordingly, they were analyzed by multivariate stepwise logistic regression analysis, with subject status (DS vs. ITS; NITS vs. CITS) as the dependent variable.

To account for the oversampling of African American smokers, analyses were weighted by race to adjust for the population proportion of African Americans among DS and ITS, based on estimates from the National Survey on Drug Use and Health (SAMHSA, 2009). Because analyses of demographic factors revealed differences between DS and ITS in age, gender, education and income, we co-varied age, gender and income. (Income was highly co-linear with education, and had better distributional properties). Co-varying these variables almost never materially changed the estimated odds ratio, and only rarely changed the 'significance' of any effects. Moreover, as group differences in these demographic factors appear to be real (they are found in multiple studies; Evans et al., 1992; Gilpin et al., 1997; Hassmiller et al., 2003; Hennrikus, Jeffery, & Lando, 1996), it is not clear they should be adjusted out of the group comparisons. Accordingly, we report the unadjusted results, but note where the adjusted analyses differed.

Results

Comparisons between intermittent smokers (ITS) and daily smokers (DS)

Demographic variables—As shown in Table 1, ITS were slightly younger than DS, and were more likely to be female. ITS were also more educated than DS; relatedly, ITS also reported higher household income (by about \$5,000 annually, \$6,500 after adjusting for ethnicity and gender). Height and weight were similar for ITS and DS. The groups did not differ by race (unweighted).

Smoking behavior: TLFB data—Subjects provided a mean of 64.94 ($SD = 16.89$) days of TLFB data. After the initial baseline TLFB with 30-day recall, the median recall period was 3 days. As expected, DS smoked nearly every day. In contrast, ITS smoked only about 4.38 days per week. However, this was quite variable, with 12.94% of ITS smoking 2 days per week or less and 18.59% averaging more than 6 days per week (i.e., abstaining less than once a week). While ITS reported their longest run of abstinence was about 5 days, on average, 12% of ITS reported having gone at least 10 consecutive days without smoking during the TLFB period.

ITS smoked many fewer cigarettes per day than DS, even on days when they did smoke (Table 3). Among ITS, subjects who smoked on a greater proportion of days also consumed more cigarettes on smoking days, but the correlation was moderate ($r = 0.34$, $p < .0001$).

Day-to-day variations in smoking: We also examined cross-day (within-subject) variability in smoking (see Table 3). ITS showed greater cross-day variability. This was particularly true when considered relative to the mean level (the Coefficient of Variation; the between-day SD in consumption expressed as a percentage of the mean daily consumption). As expected, the variability was less if we limited consideration to days when smoking occurred, although relative variability was still greater among ITS.

Looking across the days of the week, both DS and ITS report increasing their smoking by 1–2 cigarettes on Fridays and Saturdays compared to other days (see Figure 1a). There was no group-by-weekend interaction: the weekend increase is similar for both groups in absolute values. However, the weekend increase is much greater relative to ITS' weekday consumption: For ITS, the increase was 59% of their weekday rate; for DS, it was just 7%.

Some of the increased weekend smoking among ITS was due to their being substantially and significantly more likely to smoke on Fridays and Saturdays than the rest of the week (72.82% vs. 58.52% for DS), as shown in Figure 2. However, this does not account for all of the weekend effect. Even when only smoking days are considered (see Figure 1b), ITS' cigarette consumption goes up by 1.23 cigarettes to reach 5.13 CPD on Friday and Saturday.

Carbon Monoxide—As expected, CO levels differed substantially between groups (see Table 1). ITS' CO levels averaged were roughly one-third those of DS. The median CO concentrations were 3.67 and 20.33 ppm, respectively. As might be expected from their greater variability in cigarette consumption, ITS showed greater variability in CO values.

Use of other tobacco or nicotine replacement products—As shown in Table 1, there were no significant differences in use of other types of tobacco or NRT. Cigars accounted for most use of other tobacco, with 16.79% of DS and 17.76% of ITS reporting use in the prior 30 days.

Smoking and quitting history—ITS reported a slightly later age of initiation and, accordingly, a shorter duration of smoking (Table 1). As expected, DS had smoked more lifetime cigarettes, but ITS' lifetime consumption was also very substantial, averaging 42,850 cigarettes (see Table 1). These means were skewed by outliers, but median values ($Mdn = 15,793$ for ITS, $Mdn = 130,600$ for DS, $p < .0001$) also indicate that ITS have smoked very large numbers of cigarettes in their lifetime.

Most subjects in both groups reported having quit smoking in the past. However, despite their shorter smoking history, ITS reported more quit attempts than DS, as well as a greater longest duration of quitting. These differences remained significant even when we controlled for differences in the length of subjects' smoking careers, and when we limited the analysis to those who reported ever quitting. The differences also remained significant after using nonparametric testing for number of quit attempts ($Mdn = 3$ vs. 2 , $p < .0001$).

Brand and cigarette type—ITS were much more likely than DS to smoke "lights", though this difference was reduced when adjusting for gender, age and income (adjusted $OR = 2.41$ [$1.58, 3.69$]). There were no differences in smoking of menthol cigarettes.

Dependence—On the FTND, ITS scored significantly lower than DS. Indeed, almost half of ITS achieved an FTND score of 0, indicating no dependence at all. ITS report longer time to first cigarette, and this difference is not just due to the different number of cigarettes consumed; it persists even when CPD is co-varied (adjusted means: 217 min vs. 68 min). Similarly, fewer ITS than DS report smoking their first cigarette within 30 minutes of waking, though a substantial fraction of ITS do so. On the index of difficulty refraining from smoking, 30.69% of DS endorsed smoking when ill and difficulty refraining in places where smoking is forbidden; in contrast, only 1.92% of ITS did so. As shown in Figure 3, ITS anticipated less difficulty abstaining than DS at every and across all time interval from half a day to a month. Indeed, ITS expected less difficulty abstaining for a month than DS expected for abstaining for one day.

Smoking among partners and friends—As shown in Table 1, among those who had a spouse or partner, ITS were more likely to report that their spouse or partner was an ex-smoker, whereas DS were more likely to report that their partner currently smoked. Both groups reported that about 75% of household members smoked. Compared to DS, ITS reported that fewer of their five closest friends were smokers, and marginally more were ex-smokers.

Smoking situations—In multivariate analysis of the top three smoking situations (Table 2), ITS were significantly more likely to designate alcohol consumption, socializing, and being with other smokers as frequent contexts for smoking, as compared to DS. They were also more likely to designate being relaxed, stressed, or angry as settings for smoking. Conversely, DS were more likely to designate coffee drinking as a frequent context for smoking. Although individual activities did not otherwise emerge as significant differentiators, it is notable that DS were significantly more likely to designate activities (reading, watching television, etc.) as favored contexts for smoking. Among both DS and ITS, drinking alcohol was the single most endorsed context for smoking.

Smoking restrictions—DS and ITS reported working in similar work environments (e.g., outdoors vs. indoors), and reported similar smoking policies for public or common areas (see Table 1). However, ITS were more likely than DS to report that smoking was not allowed in any part of the work area of their workplace, and less than half as likely to report that smoking was allowed everywhere. ITS were also more than twice as likely to report complete smoking bans at home, and less than half as likely to report having no restrictions at all in their home.

Smoker identity—As expected, ITS identified less strongly as smokers (see Table 1). Indeed, two-thirds of ITS scored below 2 on the 10-point scale of Smoker Identity (vs. just 11.74% of DS). In addition, whereas just 4.21% of DS “might not” identify themselves as smokers (scoring below the mid-point of the Identifying scale), 50.76% of ITS might not. ITS-DS differences accounted for 29.13% of the variance in Smoker Identity and 38.71% in Identifying as a Smoker. Further, almost a quarter of ITS reported that, if asked on a government survey whether they were a smoker, they would say “no.” In contrast, if offered a choice among smoking every day, smoking some days, or not smoking at all, none would deny smoking.

Price and smoking—When asked whether they smoked less than they would ideally like to smoke because cigarettes were too expensive, most ITS said this had no effect on their smoking, while 32.25% said they smoked “a little less” and 12.00% said they thought they smoked “a lot less” because of expense. To assess the perceived influence of cigarette price on ITS smoking, ITS were asked how many more CPD and how many more DPW they would smoke if cigarettes were free (see Table 1). On average, ITS reported they would smoke just a couple more cigarettes than they reported currently smoking; the median number of CPD they thought they would smoke if cigarettes were free was 5 CPD. ITS reported that they would smoke 4.5 days per week if cigarettes were free, which did not differ significantly from the 4.4 days per week they reported currently smoking (on TLFB).

Caffeine and alcohol use—As shown in Table 1, DS reported consuming more caffeinated drinks than ITS, largely attributable to consumption of more than twice as many cola drinks (2.77, vs. 1.26 for ITS). Conversely, ITS report consuming more alcoholic drinks, with the difference being more evident in wine consumption. On quantity-frequency measures, ITS reported drinking more often, but drinking the same amount per occasion (median of 4 drinks). Based on a nonparametric comparison of medians, ITS drank considerably more than DS (*Mdn* = 32, vs. 16 drinks per month for DS). There were no differences in the frequency of binge drinking (5 or more drinks per occasion). The groups were similar in their reported age of drinking initiation, first episode of drunkenness, and period of heaviest drinking, and symptoms of abuse or dependence when drinking most heavily (SCID).

Psychosocial function and mental health—DS and ITS did not differ in their scores on the GSI, indicating similar mental health adjustment. Nor did the groups differ in lifetime history of depression, as assessed by the IDD-L. There were no differences between groups in emotion reappraisal, but DS were slightly higher on emotion suppression. There were no interactions between adjustment (GSI) and emotion regulation.

Comparisons between native ITS (NITS) and converted ITS (CITS)

Among ITS, 65.98% were classified as CITS, based on their reports of having previously smoked daily for 6 months or more; 34.02% were NITS, who had never smoked daily for 6 months or more. (Data were missing for 38 ITS, who are excluded from the following analyses.)

Demographic variables—As shown in Table 1, among ITS, NITS were slightly younger, more likely to be male, and less likely to be African-American. There was a non-significant trend that NITS were better educated than CITS, and NITS earned \$5000 more a year than CITS.

Smoking behavior: TLFB data—here were differences between CITS and NITS in smoking frequency and quantity (see Table 3). CITS smoked on a greater proportion of days, and also smoked more cigarettes per day. NITS reported longer runs of abstinence, with 6.83% having gone at least 15 consecutive days without smoking during the TLFB period; for CITS, this was only 1.59%.

Day-to-day variations in smoking: We also examined cross-day (within-subject) variability in smoking (see Table 3). CITS initially appeared to show greater between-day variability in cigarette consumption across all reporting days, but this was due to their greater smoking rate, which allowed more room for variation; when taking this into account, NITS' smoking was more variable. As seen in Figures 1 and 2, NITS and CITS did not differ in their distribution of smoking over days of week – both groups showed similar increased probability of smoking and increased cigarette consumption on Friday and Saturday.

Carbon Monoxide—As shown in Table 1, CITS demonstrate higher CO concentrations than NITS, as expected from their higher cigarette consumption. Indeed, when cigarette consumption is co-varied, CITS and NITS do not differ in CO concentrations ($p = .2$), indicating that their per-cigarette CO exposure is similar. The groups also show similar degrees of cross-occasion variation in CO, once mean CO or mean smoking rates have been accounted for.

Use of other tobacco or nicotine replacement products—CITS and NITS did not differ in their reported past-month use of other tobacco or NRT products.

Smoking and quitting history—As expected, CITS reported having been smoking longer than NITS, and also reported a much higher lifetime consumption of cigarettes ($Mdn = 32,928$) than NITS ($Mdn = 4,907$). Surprisingly, in light of this, NITS and CITS were equally likely to have tried to quit, and also reported similar number of quit efforts and duration of longest quit effort (see Table 1).

Brand and cigarette type—NITS and CITS differed in brand preferences (see Table 1). CITS were more likely to smoke menthol cigarettes, but this was largely accounted for by race. There were no differences in use of light cigarettes.

Dependence—Seen in Table 1, CITS achieved higher FTND scores than NITS, the majority of whom demonstrated an FTND score of 0. CITS tended to report shorter TTFC and were more likely to report smoking within the first 30 minutes. These differences were largely accounted for by differences in daily cigarette consumption. On measures of difficulty refraining, only 4.16% of NITS endorsed either difficulty refraining where smoking is forbidden, or smoking when ill, whereas 15.35% of CITS did so. As shown in Figure 3, CITS anticipated more difficulty abstaining than NITS at time intervals from a day to a month.

Smoking among partners and friends—NITS and CITS did not differ in partner or household member smoking status. However, CITS reported that more of their friends smoked, and that their spouses were more supportive of smoking than were NITS' spouses.

Smoking situations—In multivariate analysis of multiple contexts (see Table 2), CITS differed from NITS only in citing coffee-drinking more often as a context for smoking; however, this difference disappeared when the model was adjusted for covariates.

Smoking restrictions—CITS and NITS reported no differences in indoor workplace smoking regulations or home smoking bans (see Table 1). However, CITS were more likely than NITS to work primarily outdoors (12.36% vs. 1.73%, $p < .02$), which may affect their exposure to indoor smoking restrictions.

Smoker identity—As might be expected, CITS scored slightly higher on smoker identity ($Mdn = 1.2$ for NITS vs. 1.6 for CITS, non-parametric $p < .04$), and were more likely to identify themselves as smokers in casual inquiries. The groups did not differ in how they said they would respond to a government survey (see Table 1).

Price and smoking—Especially after adjusting for age, education, and gender, CITS and NITS were equally unlikely to report they smoked less than they wanted to because of the expense of cigarettes. While both groups reported they would smoke more CPD if cigarettes were free, CITS reported a projected increase more than double that of NITS (see Table 1).

Caffeine and alcohol use—As shown in Table 1, NITS and CITS report consuming similar numbers of caffeinated drinks, but NITS report drinking more alcoholic drinks per week, mostly accounted for by more beer consumption. Consistent with this, NITS reported drinking more than CITS on quantity-frequency measures (44.03 vs. 32.61 drinks per month), due to consuming alcohol more often, rather than due to differences in the number of drinks per occasion. The two groups did not differ in SCID-assessed alcohol abuse or dependence.

Psychosocial function and mental health—There were no mental health or emotion regulation differences between NITS and CITS.

Discussion

Our data documented smoking patterns among ITS, differences from DS, as well as differences among ITS who had (CITS) and had not (NITS) previously been DS. The data provide a detailed picture of ITS' smoking patterns.

Even in this sample, which excluded ITS who smoked less than four times per month (31% of ITS according to SAMHSA, 2009), ITS' smoking was fairly sparse, with ITS abstaining several days a week, and reporting multi-day runs of abstinence. In other words, ITS abstain

often, and for relatively long times. Given the 2–3 hour half-life of nicotine (Benowitz, 1996), this means that they are nicotine free for days at a time before resuming smoking. It is not known whether they crave smoking or suffer withdrawal during these periods of abstinence, but the fact that these runs of abstinence are voluntary suggests that this is unlikely. Nor can ITS' anomalous periods of abstinence be explained by supplementation of nicotine from other sources (because few ITS use other nicotine or tobacco products) or by constraints imposed by economics (because ITS said they would not smoke daily even if cigarettes were free). Even on the days that they smoked, ITS averaged fewer than 5 CPD, considered a threshold for dependence (Benowitz & Henningfield, 1994). Further, many ITS scored zero on the FTND, indicating no dependence at all. Thus, ITS are typically very light smokers who engage in voluntary abstinence, with little or no sign of nicotine dependence – but very persistent smokers, who have smoked for 18 years (on average), consuming tens of thousands of cigarettes, and who continue to smoke on most days. This highlights the paradox of ITS smoking: despite ample exposure and opportunity to develop dependence, they appear to be largely free of dependence, yet they continue to smoke, and have difficulty quitting (Tindle & Shiffman, 2011).

Our data addressed and contradicted several explanations that would have mitigated the apparent anomaly of ITS' smoking. There was little use of other tobacco or nicotine products that might have accounted for their anomalous need to smoke only intermittently. Nor did economic concerns explain their sparse smoking: ITS indicated that they would not smoke daily, much less heavily, even if cigarettes were free. Finally, ITS were not generally very young smokers who were just 'learning' to smoke: they averaged 35 years of age, had been smoking for almost two decades, and had consumed over 42,000 cigarettes.

In addition to the evidence from their pattern of light and intermittent smoking, formal indices of dependence also confirm that ITS are generally not nicotine-dependent, by traditional metrics, including FTND and TTFC, and reported little difficulty abstaining for periods as long as a month. Thus, based on our data, it is clear that most ITS are not dependent in any traditional sense. This adds to the paradox of the observation that three quarters or more of their attempts to quit end in failure (Tindle & Shiffman, 2011).

ITS' smoking patterns are revealing. Unlike DS' smoking, which was fairly regular – a hallmark of dependence (Shiffman, Waters, & Hickcox, 2004) – ITS' cigarette consumption varied considerably from day to day, even on days that they smoked. This opens the possibility that ITS' smoking is heavily influenced by contextual cues that vary across days. Whereas DS' need to smoke is posited to be driven by the need to replace the nicotine lost at regular intervals to metabolism and excretion (Benowitz, 1996), ITS' smoking might be driven by contextual cues, leading to irregular patterns of intake (Shiffman & Paty, 2006). There is some evidence in these data to suggest this to be true. Whereas DS seemed to characterize their smoking as widely-dispersed across contexts, ITS as a group identified a smaller number of particular situations as being frequently associated with smoking. Moreover, some of the situations they endorsed – smoking when drinking, when socializing, when relaxed, and when others are smoking – fit the picture of social smoking (Schane et al., 2009), which is often ascribed to them.

However, there are reasons to question this characterization of ITS as merely social smokers. Although ITS did smoke more on Friday and Saturday, this was equally true of DS. It seems unlikely that reduced workplace smoking restrictions accounted for this effect, as Friday (a workday) showed increased smoking, but Sunday did not. It is more likely that social cues associated with weekend evening activities (e.g., parties) are responsible. The fact that ITS were more likely than DS to name negative affective states as frequent contexts for smoking seems at odds with the presumption that ITS are social smokers, and may

suggest that ITS are using smoking and the pharmacological effects of nicotine to manage emotional states. While smoking when stressed is often interpreted as reflecting relief of withdrawal, it has also been suggested that nicotine may have direct effects on distress that is not due to nicotine withdrawal (Kassel et al., 2003). Thus, ITS might be using nicotine strategically for its pharmacological impact in particular settings and contexts. ITS may be “peak-seekers” (Russell, 1971) who smoke to achieve the acute effects of nicotine on occasion, in contrast to “trough maintainers” who seek to maintain nicotine levels in order to avoid lapsing into withdrawal. Better light might be shed on the relationships between smoking, affect, and withdrawal using Ecological Momentary Assessment (Stone & Shiffman, 1994) data that can track these phenomena in real time, both when subjects are smoking and when they are not (Shiffman et al., 2002).

Our analyses also noted a number of other differences between ITS and DS. Among DS, both alcohol and coffee have been associated with smoking (Istvan & Matarazzo, 1984). In our data, whereas ITS drank more alcohol, and reported it to be more important for their smoking, the opposite pattern was seen for coffee and caffeinated drinks. DS consumed more coffee and colas and were more likely to name coffee as one of their top-three smoking situations. Since alcohol can loosely be characterized as a depressant, and caffeine is a stimulant, this suggests that ITS may smoke to achieve stimulation and DS smoke for sedation. However, the effects of both drugs are complex, and confounded with social contexts, so more research is needed to understand how and why each influences smoking among DS and ITS.

There is a robust relationship between psychopathology and smoking (Hughes et al., 1986; Lasser et al., 2000), which has led to speculation that smokers smoke in order to self-medicate for underlying psychiatric conditions (Hughes et al., 1986; Lasser et al., 2000). We considered whether differences in psychopathology might explain differences between ITS and DS in their apparent need to smoke, but found no differences between ITS and DS in any indicator of psychopathology. The observed differences in emotion regulation (Gross & John, 2003) were small, and did not interact with measures of psychological distress.

Not surprisingly, ITS were less identified as smokers, as indicated by self-concept measures, but their weaker identity also extended to failing to identify themselves as smokers when surveyed. Reassuringly, when asked whether they smoked “every day, some days, or not at all” – the question now commonly used in surveys – almost all ITS said they would identify themselves as smokers.

We have characterized ITS as a group, but the data suggest that ITS are not homogeneous, but may be strikingly heterogeneous. The mean daily cigarette consumption was 4.85 CPD but the range encompasses 0 to 20 CPD, and CO values ranged from 0.67 to 50.38. The percent of days on which ITS abstained ranged from 0% to 93.18%. Many ITS scored 0 on the FTND, but some scored the maximum of 10. It is not clear what the underlying causes of this heterogeneity are, or whether there are distinct subgroups yet to be identified within ITS. In this paper, the main distinction we make among ITS is between those who have previously been daily smokers (CITS) and those who have not (NITS). Some theories of dependence imply that dependence can never be overcome and that intermittent smoking should not be possible once heavier and dependent smoking has been established, suggesting that a transition from daily to non-daily smoking should be rare. However, past studies have confirmed that many ITS have a prior history of daily smoking.

Comparing CITS and NITS, we consistently find that CITS are, even in their present ITS status, heavier and more dependent smokers. More broadly, it might be said that CITS’ history follows them – in many respects, they seem to be intermediate between NITS and

DS. Like DS – but unlike NITS – they designate coffee-drinking as a situation in which they are likely to smoke. Like DS, they drink somewhat more caffeinated beverages, but less alcohol than NITS. Like DS, they have lower income than NITS. On some measures, they resemble NITS; on many, they are intermediate between NITS and DS.

Some of the differences observed between NITS and CITS may simply reflect the way the groups were selected based on smoking history. CITS are distinguished by having had a past period of smoking daily. Having experienced multiple phases of smoking in their varied history may simply require having more history; thus, CITS are older and have been smoking longer. It also goes naturally with having been a daily smoker that CITS have smoked many more cigarettes – indeed, more than 5 times as many. Overall, the data suggest that CITS have not entirely left their history of daily smoking behind, but rather show residual effects, manifest as differences from ITS who have never smoked daily.

Although we observed some differences between NITS and CITS, and thus accounted for some of the heterogeneity among ITS, it should be noted that there is still considerable heterogeneity within both groups. As just one example: within CITS, daily cigarette consumption on smoking days ranges from 1 to 16. Within NITS, it ranges from 1 to 10. Thus, work still needs to be done to understand variations in patterns of non-daily smoking.

One limitation of this study is the use of a convenience sample. It is not known how well the sample represents the national populations of DS, CITS, and NITS. Population-based samples would provide useful information, but it is often difficult to collect such detailed data from large population surveys. Our sample was also from a single metropolitan area, and thus does not represent regional variation. More specifically, we lacked substantial representation of Latino and Asian smokers, in whom intermittent smoking is very common. Our study is limited by its use of global self-reports; studies that have examined global reports of smoking patterns – including TLFB reports of how many cigarettes were smoked each day (Shiffman, 2009a) or reports of situations associated with smoking (Shiffman, 1993) have found significant problems with such global self-reports. Data from Ecological Momentary Assessment (Shiffman, Stone, & Hufford, 2008; Stone & Shiffman, 1994) would help better address such questions.

More detailed characterization of ITS and their smoking has further highlighted the ways in which ITS violate our models of smoking and dependence. Although ITS have smoked tens of thousands of cigarettes over decades, they seem to have averted developing dependence, and voluntarily and casually undertake abstinence for days at a time. Their smoking is not explained by their getting nicotine from other sources, or by economic constraints. Yet, despite this apparent lack of dependence, they persist in smoking, and, when they try to quit, have very high failure rates, approaching those of daily smokers (Tindle & Shiffman, 2011). This smoking pattern may force us to consider whether there are multiple prototypes of dependence. Our current model of tobacco dependence posits that smoking is driven by withdrawal-avoidance, which requires careful regulation of nicotine levels, and thus frequent, regular smoking (Shadel et al., 2000) – what Russell characterized as trough maintenance. This model clearly does not apply to ITS. Yet, ITS do not seem able to quit. Perhaps they suffer a different form of dependence, experiencing a “need” for nicotine and its acute effects only periodically, in particular circumstances or settings. Such peak seekers (Russell, 1971) may also find it difficult to quit. Indeed, it is striking that most users of other addictive drugs do not use daily (Shiffman, 2009b; SAMHSA, 2009), suggesting that addiction need not depend on trough maintenance. Further studies of ITS may help refine and expand models of addiction.

Acknowledgments

This work was supported by grant R01-DA020742 (Shiffman) from the National Institutes of Health, National Institute on Drug Abuse. Additional support was provided by National Science Foundation Graduate Research Fellowship (Dunbar), National Center for Research Resources (KL2-RR024154-03; Tindle), and National Cancer Institute grants R25-CA057703-15 (Dunbar) and R01-CA141596-02 (Tindle). The authors are grateful to Stuart Ferguson, Thomas Kirchner, and Deborah Scharf for help launching this study and for input on study design; to Anna Tsivina, Joe Stafura, Rachelle Gish, and Aileen Butera for their work conducting research sessions; to Sarah Felter for data management assistance; and to Laura Homonnay-Demilio for editorial assistance.

References

- Ackerson LK, Viswanath K. Communication inequalities, social determinants, and intermittent smoking in the 2003 Health Information National Trends Survey. *Preventing Chronic Disease*. 2009; 6(2):A40. [PubMed: 19288983]
- Al-Delaimy WK, Pierce JP, Messer K, White MM, Trinidad DR, Gilpin EA. The California Tobacco Control Program's effect on adult smokers: (2) Daily cigarette consumption levels. *Tobacco Control*. 2007; 16(2):91–95. [PubMed: 17400945]
- Anda RF, Williamson DF, Escobedo LG, Mast EE, Giovino GA, Remington PL. Depression and the dynamics of smoking: A national perspective. *Journal of the American Medical Association*. 1990; 264:1541–1545. [PubMed: 2395193]
- Benowitz N. U.S. Department of Health and Human Services, National Institute of Health, No.7, 93-111. Washington, D.C.: National Institute of Health; 1995. Biomarkers of cigarette smoking. The FTC cigarette test method for determining tar, nicotine, and carbon monoxide yields of U.S. cigarettes.
- Benowitz N. Pharmacology of nicotine: Addiction and therapeutics. *Annual Review of Pharmacology and Toxicology*. 1996; 36:597–613.
- Benowitz N. Nicotine Addiction. *New England Journal of Medicine*. 2010; 362:2295–2203. [PubMed: 20554984]
- Benowitz N, Henningfield JE. Establishing a nicotine threshold for addiction: the implications for tobacco regulation. *New England Journal of Medicine*. 1994; 331:123–125. [PubMed: 7818638]
- Breslau N, Peterson EL, Schultz LR, Chilcoat HD, Andreski P. Major depression and stages of smoking: A longitudinal study. *Archives of General Psychiatry*. 1998; 55(2):161–166. [PubMed: 9477930]
- Brigham J, Lessov-Schlagger CN, Javitz HS, McElroy M, Krasnow R, Swan GE. Reliability of adult retrospective recall of lifetime tobacco use. *Nicotine and Tobacco Research*. 2008; 10:287–299. [PubMed: 18236293]
- Centers for Disease Control and Prevention (CDC). Prevalence of current cigarette smoking among adults and changes in prevalence of current and some day smoking -- United States, 1996–2001. *Centers for Disease Control and Prevention. Morbidity and Mortality Weekly Report*. 2003; 52:303–307. [PubMed: 12731700]
- Centers for Disease Control and Prevention (CDC). Cigarette smoking among adults - United States, 2006. *Morbidity and Mortality Weekly Report*. 2007; 56:1157–1161. [PubMed: 17989644]
- Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Data. Atlanta: U.S. Department of Health and Human Services; 2008a.
- Centers for Disease Control and Prevention (CDC). Cigarette smoking among adults -- United States, 2007. *Morbidity and Mortality Weekly Report*. 2008b; 57(45):1221–1226. [PubMed: 19008790]
- Cooper TV, Taylor T, Murray AA, DeBon MW, Vander Weg MW, Klesges RC, Talcott GW. Differences between intermittent and light daily smokers in a population of U.S Military recruits. *Nicotine & Tobacco Research*. 2010; 12:465–473. [PubMed: 20203108]
- Derogatis LR, Melisaratos N. The Brief Symptom Inventory: An introductory report. *Psychological Medicine*. 1983; 13(3):595–605. [PubMed: 6622612]
- Edwards SA, Bondy SJ, Kowgier M, McDonald PW, Cohen JE. Are occasional smokers a heterogeneous group? An exploratory study. *Nicotine and Tobacco Research*. 2010; 12(12):1195–1202. [PubMed: 20978108]

- Eisenhower, D.; Mathiowetz, NA.; Morganstein, D.; Biemer, PP.; Groves, RM.; Lyberg, LE.; Sudman, S. Measurement errors in surveys. New York, NY: Wiley; 1991. Recall error: Sources and bias reduction techniques; p. 127-144.
- Evans NJ, Gilpin E, Pierce JP, Burns DM, Borland R, Johnson M, Bal D. Occasional smoking among adults: Evidence from the California Tobacco Survey. *Tobacco Control*. 1992; 1:169–175.
- First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JBW. Structured clinical interview for DSM-IV Axis I disorders, Clinician Version (SCID-CV). Washington, DC: American Psychiatric Press; 1996.
- Fucito LM, Juliano LM, Toll BA. Cognitive reappraisal and expressive suppression emotion regulation strategies in cigarette smokers. *Nicotine and Tobacco Research*. 2010; 12(11):1156–1161. [PubMed: 20829326]
- Gilpin E, Cavin S, Pierce J. Adult smokers who do not smoke daily. *Addiction*. 1997; 92(4):473–480. [PubMed: 9177069]
- Gross J, John O. Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*. 2003; 85(2):348–362. [PubMed: 12916575]
- Haddock CK, Lando H, Klesges RC, Talcott GW, Renaud EA. A study of the psychometric and predictive properties of the Fagerström Test for Nicotine Dependence in a population of young smokers. *Nicotine & Tobacco Research*. 1999; 1:59–64. [PubMed: 11072389]
- Harrison EL, Desai RA, McKee SA. Nondaily smoking and alcohol use, hazardous drinking, and alcohol diagnosis among young adults: Findings from the NESARC. *Alcoholism: Clinical and Experimental Research*. 2008; 32(12):2081–2087.
- Harrison EL, McKee SA. Young adult non-daily smokers: Patterns of alcohol and cigarette use. *Addictive Behaviors*. 2008; 33(5):668–674. [PubMed: 18093745]
- Hassmiller KM, Warner KE, Mendez D, Levy DT, Romano E. Nondaily smokers: Who are they? *American Journal of Public Health*. 2003; 93(8):1321–1327. [PubMed: 12893622]
- 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(9):1119–1127. [PubMed: 1932883]
- Hennrikus DJ, Jeffery RW, Lando HA. Occasional smoking in a Minnesota working population. *American Journal of Public Health*. 1996; 86:1260–1266. [PubMed: 8806378]
- Hughes JR, Hatsukami DK, Mitchell JE, Dahlgren LA. Prevalence of smoking among psychiatric outpatients. *American Journal of Psychiatry*. 1986; 143(8):993–997. [PubMed: 3487983]
- Istvan J, Matarazzo JD. Tobacco, alcohol and caffeine use: A review of their interrelationships. *Psychological Bulletin*. 1984; 95(2):301–326. [PubMed: 6544436]
- 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]
- Korhonen T, Broms U, Levalahti E, Koskenvuo M, Kaprio J. Characteristic and health consequences of intermittent smoking: Long-term follow-up among Finnish adult twins. *Nicotine and Tobacco Research*. 2009; 11(2):148–155. [PubMed: 19246432]
- Lasser K, Woolhandler S, Himmelstein DU, McCormick D, Bor DH. Smoking and mental illness: A population-based prevalence study. *Journal of the American Medical Association*. 2000; 284:2606–2610. [PubMed: 11086367]
- Levy DT, Romano E, Mumford EA. Recent trends in home and work smoking bans. *Tobacco Control*. 2004; 13:258–263. [PubMed: 15333881]
- Lichtenstein E, Mermelstein RJ. Some methodological cautions in the use of the tolerance questionnaire. *Addictive Behaviors*. 1986; 11(4):439–442. [PubMed: 3812054]
- Lindstrom M, Ostergren P. Intermittent and daily smokers: Two different socioeconomic patterns, and diverging influence of social participation. *Tobacco Control*. 2001; 10:258–266. [PubMed: 11544391]
- Nguyen QB, Zhu S. Intermittent smokers who used to smoke daily: A preliminary study on smoking situations. *Nicotine and Tobacco Research*. 2009; 11(2):164–170. [PubMed: 19246632]
- Russell MAH. Cigarette smoking: the natural history of a dependence disorder. *Journal of Medical Psychology*. 1971; 44:1–16.

- Schane RE, Glantz SA, Ling PM. Nondaily and social smoking: An increasingly prevalent pattern. *Archives of Internal Medicine*. 2009; 169:1742–1744. [PubMed: 19858429]
- Scharf D, Dunbar M, Shiffman S. Smoking during the night: Prevalence and smoker characteristics. *Nicotine and Tobacco Research*. 2008; 10:167–178. [PubMed: 18188757]
- Shadel WG, Mermelstein R. Individual differences in self-concept among smokers attempting to quit: Validation and predictive utility of measures of the smoker self-concept and abstainer self-concept. *Annals of Behavioral Medicine*. 1996; 18(3):151–156.
- Shadel WG, Shiffman S, Niaura R, Nichter M, Abrams DB. Current models of nicotine dependence: What is known and what is needed to advance understanding of tobacco etiology among youth. *Drug and Alcohol Dependence*. 2000; 59–51:S9–S22.
- Shiffman S. Tobacco "Chippers": Individual differences in tobacco dependence. *Psychopharmacology*. 1989; 97:539–547. [PubMed: 2498951]
- Shiffman S. Assessing smoking patterns and motives. *Journal of Consulting and Clinical Psychology*. 1993; 61:732–742. [PubMed: 8245271]
- Shiffman S. How many cigarettes did you smoke? Assessing cigarette consumption by global report, Time-Line follow-Back, and Ecological Momentary Assessment. *Health Psychology*. 2009a; 28:519–526. [PubMed: 19751076]
- Shiffman S. Light and intermittent smokers: Background and perspective. *Nicotine and Tobacco Research*. 2009b; 11:122–125. [PubMed: 19246630]
- Shiffman S, Dunbar M, Kirchner T, Li X, Tindle HA, Anderson S, Scholl S. Smoker reactivity to cues: Effects on craving and on smoking behavior. Manuscript submitted for publication (copy on file with author). 2011
- Shiffman S, Gwaltney CJ, Balabanis M, Liu KS, Paty JA, Kassel JD, Gnys M. Immediate antecedents of cigarette smoking: An analysis from ecological momentary assessment. *Journal of Abnormal Psychology*. 2002; 111(4):531–545. [PubMed: 12428767]
- Shiffman S, Paty JA. Smoking patterns and non-dependent smokers: Contrasting chippers and dependent smokers. *Journal of Abnormal Psychology*. 2006; 115(3):509–523. [PubMed: 16866591]
- Shiffman S, Paty JA, Kassel JD, Gnys M, Zettler-Segal M. Smoking behavior and smoking history of tobacco chippers. *Experimental and Clinical Psychopharmacology*. 1994; 2:126–142.
- Shiffman S, Stone AA, Hufford M. Ecological momentary assessment. *Annual Review of Clinical Psychology*. 2008; 4:1–32.
- Shiffman S, Waters AJ, Hickcox M. The Nicotine Dependence Syndrome Scale: A multi-dimensional measure of nicotine dependence. *Nicotine and Tobacco Research*. 2004; 6:327–348. [PubMed: 15203807]
- Sobell, LC.; Sobell, MB.; Maisto, SA., editors. Alcoholism treatment assessment research instruments. Vol. 2. Washington, DC: National Institute on Alcoholism and Drug Abuse DHHS Publications; 1985. Time-line follow-back assessment methods; p. 530-534.
- Stolerman IP, Jarvis MJ. The scientific case that nicotine is addictive. *Psychopharmacology*. 1995; 117:2–10. [PubMed: 7724697]
- Stone AA, Shiffman S. Ecological momentary assessment (EMA) in behavioral medicine. *Annals of Behavioral Medicine*. 1994; 16(3):199–202.
- Substance Abuse and Mental Health Services Administration (SAMHSA). Results from the 2008 National Survey on Drug Use and Health: National Findings. (SMA 09-4434o). Rockville: HHS Publication Substance Abuse and Mental Health Services Administration; 2009.
- Tindle HA, Shiffman S. Smoking cessation behavior among intermittent smokers versus daily smokers. *American Journal of Public Health*. 2011; 101(7):e1–e3. [PubMed: 21566030]
- Tong EK, Nguyen T, Vittinghoff E, Perez-Stable EJ. Light and intermittent smoking among California's Asian Americans. *Nicotine Tob Res*. 2009; 11(2):197–202. [PubMed: 19246424]
- Trinidad DR, Perez-Stable EJ, Emery SL, White MM, Grana RA, Messer KS. Intermittent and light daily smoking across racial/ethnic groups in the United States. *Nicotine and Tobacco Research*. 2009; 11(2):203–210. [PubMed: 19246433]
- World Health Organization (WHO). WHO global infobase on-line. 2007. Retrieved from <http://www.who.int/infobase/report.aspx>, from World Health Organization

- Wortley PM, Husten CG, Trosclair A, Chrismon JH, Pederson LL. Nondaily smokers: A descriptive analysis. *Nicotine and Tobacco Research*. 2003; 5(5):755–759. [PubMed: 14577992]
- Zhang X, Martinez-Donate AP, Kuo D, Jones NR, Palmersheim KA. Trends in home smoking bans in the USA, 1995–2007: Prevalence, discrepancies and disparities. *Tobacco Control*. 2011
- Zhu SH, Sun J, Hawkins S, Pierce J, Cummins SA. A population study of low-rate smokers: Quitting history and instability over time. *Health Psychology*. 2003; 22(3):245–252. [PubMed: 12790251]
- Zimmerman M, Coryell W. The inventory to diagnose depression, lifetime version. *Acta Psychiatrica Scandinavica*. 1987; 75(5):495–499. [PubMed: 3604734]

Figure 1.

Cigarettes per day (CPD) smoked across days of the week. Panel A includes all reporting days; panel B includes only days on which smoking took place. There were no significant interaction between smoker type (ITS vs. DS) and day of week in CPD on all days and on smoking days. And for CITS versus NITS, there were likewise no significant interaction.

Figure 2.

The probability of any smoking, by days of week. ITS patterns differed significantly from DS ($p < .0001$). The interaction between ITS versus DS and day of week is significant in probability of smoking. Within ITS, there were no significant interaction between NITS versus CITS and day of week.

Figure 3.

Self-reported difficulty in abstaining for specified time intervals among smoker groups. In repeated measures analysis, there was a significant smoker type (ITS vs. DS) by time period interaction ($p < .0001$) in difficulty in abstaining; that is, the slope at which difficulty increased over time differed by group, being steeper for ITS, who start at low levels of difficulty, but increase as the interval increases. For NITS versus CITS, the interaction was also significant ($p = .02$), with the slope being steeper for CITS, as they start at similar levels of difficulty as NITS for half a day, but then reach a higher level of difficulty longer intervals.

Table 1

ITS Descriptives

	DS % / M (SD)	ITS % / M (SD)	p	NITS % / M (SD)	CITS % / M (SD)	p
Demographics						
Gender (male)	60.73	50.18	<.02	57.49	44.05	<.04
Race (unweighted)			--			<.05
African-American	37.34	29.79		21.69	35.40	
Caucasian	59.66	67.38		73.49	62.73	
Other	3.00	2.84		4.82	1.86	
Age	39.25 (11.81)	34.66 (11.90)	<.0001	32.14 (11.20)	36.68 (12.22)	<.005
Height	68.14 (3.99)	68.04 (3.96)	--	68.50 (3.96)	67.72 (4.00)	--
Weight	180.74 (48.22)	179.85 (42.53)	--	180.27 (47.16)	179.11 (40.76)	--
Education			<.0001			--
High school or less	36.70	16.08		9.26	20.02	
Some college	44.07	39.04		35.86	37.25	
College graduate	12.01	24.88		33.43	24.19	
Graduate work	7.23	20.00		21.46	18.54	
Annual Income (\$1,000s)	24.54 (19.99)	30.27 (23.26)	<.003	32.55 (25.35)	27.99 (21.77)	<.003
CO						
CO (ppm)						
Mean	21.12 (11.26)	6.58 (6.78)	<.0001	4.81 (5.11)	7.40 (7.09)	<.001
Cross-occasion Standard Deviation	0.29 (0.14)	0.42 (0.20)	<.0001	0.42 (0.20)	0.42 (0.20)	--
Other Sources of Nicotine (% used past 30 days)						
Other Tobacco	18.47	20.03	--	22.27	17.19	--
Nicotine Replacement Products	3.02	2.62	--	3.28	2.44	--
Smoking Behavior and History						
Age at Smoking Initiation	15.13 (3.12)	16.67 (4.13)	<.0001	17.54 (4.12)	16.20 (4.07)	<.02
Total Years Smoking	25.25 (11.71)	18.93 (12.58)	<.0001	15.29 (11.72)	20.91 (12.60)	<.002

	DS % / M (SD)	IIS % / M (SD)	P	NITS % / M (SD)	CIIS % / M (SD)	P
Lifetime Cigarette Consumption (1,000s)	142.53 (97.44)	42.85 (67.18)	<.0001	10.84 (22.84)	60.11 (75.28)	<.0001
Quitting History						
Ever Made a Quit Attempt	84.58	89.56	--	85.27	91.90	--
Number of Quit Attempts	2.90 (3.33)	4.51 (4.79)	<.0001	3.87 (3.44)	4.85 (5.30)	--
Longest Period of Abstinence (days)	331.15 (857.05)	644.58 (1288.63)	<.008	777.68 (1431.16)	577.59 (1218.22)	--
Cigarettes Per Day	16.92 (6.48)	4.85 (3.61)	<.0001	3.66 (2.62)	5.53 (3.96)	<.0001
Cigarette Characteristics						
Lights	28.10	53.23	<.0001	53.92	49.61	--
Menthol	52.83	46.93	--	35.88	53.00	<.01
African American	95.29	96.43	--	94.44	98.25	--
Caucasian	46.76	35.29	<.04	26.67	39.00	--
FTND FTND						
Total Score	5.15 (2.03)	1.18 (1.55)	<.0001	0.74 (1.09)	1.45 (1.72)	<.0002
Score = 0 (No Dependence)	1.36	50.94	<.0001	58.31	46.75	--
Difficulty Restraining Index	0.96 (0.82)	0.13 (0.39)	<.0001	0.04 (0.21)	0.19 (0.47)	<.0008
Time to First Cigarette (min)	22.43 (37.40)	254.29 (264.76)	<.0001	282.14 (255.88)	249.48 (277.36)	--
< 30 minutes	91.14	58.13	<.0001	29.66	68.49	<.001
Smoking In Social Network						
Partner's Smoking Behavior						
No partner *	55.61	39.87	<.0004	40.43	39.61	--
Partner ^A			--			--
Partner has never smoked	31.30	34.27		45.53	26.89	
Partner is a smoker	55.17	42.56		30.58	47.12	
Partner is quitting smoking	4.23	4.28		4.47	5.22	
Partner is an ex-smoker	9.31	18.89		19.42	20.77	
Percentage of Household Members Who Smoke	76.68	73.31	--	72.24	73.25	--
Out of 5 Closest Friends, Number Who Are...						
Smokers	3.47 (1.39)	2.72 (1.38)	<.0001	2.20 (1.27)	2.98 (1.42)	<.0001
Ex-smokers	0.77 (1.16)	0.94 (1.14)	--	0.77 (0.97)	1.06 (1.22)	<.05

	DS % / M (SD)	IIS % / M (SD)	P	NITS % / M (SD)	CTIS % / M (SD)	P
Smoking Restrictions						
Workplace Policies						
Any restrictive policy	54.16	65.78	<.03	66.40	65.46	--
Indoor and Common Areas						
Not allowed in ANY work areas	47.93	54.28	--	59.95	48.34	--
Allowed in SOME work areas	32.61	32.51		28.07	36.50	
Allowed in ALL work areas	19.46	13.21		11.98	15.16	
Work Areas						
Not allowed in ANY work areas	55.50	73.14	<.0008	78.07	69.35	--
Allowed in SOME work areas	27.39	20.49		15.55	23.70	
Allowed in ALL work areas	17.11	6.37		6.38	6.95	
Smoking Rules in Home						
No one allowed to smoke anywhere	20.18	45.37	<.0001	54.54	39.47	--
Smoking allowed some places/ some times	26.50	32.44		23.47	36.39	
Smoking permitted anywhere	53.32	22.19		21.99	24.15	
Smoker Identity						
Smoker Self-Identity	4.80 (2.69)	2.08 (1.61)	<.0001	1.81 (1.36)	2.25 (1.75)	<.06
Identifying as a Smoker	9.09 (1.50)	5.26 (2.99)	<.0001	4.20 (2.74)	5.89 (2.99)	<.0002
Government Survey Response						
Are you a smoker? Yes	100.00	76.06	<.0007	67.43	81.45	--
Do you smoke....			<.0001			--
Not at all	0.00	0.00		0.00	0.00	
Some Days	0.00	98.29		100.00	96.91	
Everyday	100.00	1.71		0.00	3.09	
Influence of Cigarette Pricing						
Smoke Less Because of Price	55.09	44.13	<.04	42.80	46.96	--
Projected Increase if Cigarettes Were Free						
Days per Week	0.01 (0.12)	0.92 (1.24)	<.0001	0.75 (1.57)	0.68 (1.63)	--

	DS % / M (SD)	IIS % / M (SD)	P	NITS % / M (SD)	CIIS % / M (SD)	P
Cigarettes per Day	4.14 (8.28)	2.24 (4.29)	<.01	0.91 (3.38)	2.39 (5.52)	<.03
Alcohol and Caffeine Use						
All Caffeinated Beverages (per day)	5.87 (3.87)	3.55 (2.62)	<.0001	3.16 (1.94)	3.71 (2.97)	--
All Alcoholic Beverages (per week)	7.84 (10.37)	9.76 (9.33)	<.04	11.01 (8.82)	8.15 (8.75)	<.02
Recent Alcohol Consumption (past month)						
Number of drinking occasions/month	7.04 (10.66)	8.92 (9.13)	<.07	10.62 (9.82)	7.89 (8.68)	<.05
Average # of Drinks at One Sitting	5.43 (4.13)	4.84 (3.62)	--	4.85 (3.64)	4.64 (3.36)	--
# Times/Month 5+ Drinks at One Sitting	3.91 (10.40)	4.27 (7.69)	--	5.15 (9.27)	3.09 (4.20)	<.08
SCID - Alcohol Abuse and Dependence						
Abuse	40.28	42.68	--	44.97	40.58	--
Dependence	60.95	57.94	--	54.60	58.49	--
Psychosocial Functioning						
Global Severity Index	1.65 (0.72)	1.59 (0.51)	--	1.64 (0.47)	1.57 (0.54)	--
IDDL - Clinical Depression	28.44	27.95	--	26.98	27.09	--
Emotion Regulation						
Reappraisal	4.91 (1.08)	4.99 (1.04)	--	4.94 (1.08)	5.02 (1.02)	--
Suppression	3.65 (1.45)	3.36 (1.29)	<.05	3.38 (1.16)	3.32 (1.34)	--

Note:

* Chi-Square test comparing those who did not have a partner vs. those who did.

[^] Chi-Square test comparing only those who had a partner. -- Non-Significant.

Table 2

Self-Reported Top Three Situations in Which Smoking is Most Common

Variable	DS		ITS		OR	95% CI		NITS		CITS		OR	95% CI	
	%		%					%		%				
Any activity ^a	60.13		38.84		0.42	*	[0.29, 0.61]	39.88		39.48		0.98		[0.57, 1.70]
Eating meals	14.50		8.75		0.74		[0.20, 2.70]	5.69		10.30		1.64		[0.09, 28.71]
Drinking coffee	32.96		11.51		0.46	*	[0.27, 0.77]	4.91		16.31		3.77	†	[1.28, 11.15]
Drinking alcohol	61.85		81.36		2.68	*	[1.63, 4.38]	87.66		76.41		0.34		[0.02, 4.84]
Under stress	38.81		46.89		2.37	*	[1.50, 3.74]	43.41		49.81		0.70		[0.05, 9.09]
When angry	9.01		13.06		2.39	*	[1.25, 4.56]	11.38		10.44		0.56		[0.04, 7.98]
When tense	11.12		5.54		0.54		[0.15, 1.91]	2.75		7.21		1.76		[0.10, 32.04]
In another negative mood	5.10		5.52		1.84		[0.45, 7.48]	2.75		7.52		2.15		[0.12, 40.28]
Relaxed	2.08		4.43		5.17	*	[1.49, 17.94]	4.31		4.39		1.09		[0.05, 23.88]
In another positive mood	2.09		1.17		0.49		[0.07, 3.64]	2.75		0.45		0.05		[0.00, 3.40]
When socializing	19.08		30.44		2.45	*	[1.50, 3.99]	39.46		26.88		0.48		[0.04, 6.01]
When others are smoking	27.21		47.49		3.18	*	[2.02, 5.03]	53.47		44.62		0.71		[0.06, 8.92]

Note:

* Indicates significance in multivariate stepwise model for DS/ITS.

† Indicates significance in multivariate stepwise model for NITS/CITS.

^a Activities included working, talking, driving, reading, watching TV, and "other activity." The individual activities were included in the multivariate analyses, but none of the activities distinguished the groups. To save space, we do not report data on the individual activities, but rather on an aggregate endorsement of any of these activities (yes/no). The statistical test reported was based on separate univariate analysis of the aggregated variable, as the aggregated variable could not be evaluated in the multivariate model.

Table 3

Time-Line Follow-Back Smoking Data

Variable	DS % / M (SD)	ITS % / M (SD)	p	NITS % / M (SD)	CITS % / M (SD)	p
Percentage of Smoking Days	99.76	62.51	<.0001	56.13	66.04	<.002
Longest Run of Abstinence (days)	0.09 (0.57)	4.88 (4.00)	<.0001	5.92 (4.90)	4.64 (3.59)	<.04
Smoking Across Days						
CPD, Including All Reporting Days						
Mean	16.06 (6.02)	2.98 (2.59)	<.0001	1.99 (1.70)	3.44 (2.80)	<.0001
Across-day SD	2.82 (2.00)	2.25 (1.63)	<.0005	1.66 (1.10)	2.52 (1.77)	<.0001
Across-day Coefficient of Variation (SD/Mean)*100	18.91 (12.31)	98.06 (56.16)	<.0001	111.55 (68.96)	96.66 (49.16)	<.02
Across-day Inter-Quartile Range	3.44 (3.71)	3.37 (3.08)	--	2.50 (2.21)	3.78 (3.45)	<.0005
CPD, Including Only Smoking Days						
Mean	16.09 (6.01)	4.39 (2.92)	<.0001	3.28 (1.88)	4.87 (3.13)	<.0001
Across-day SD	2.99 (2.05)	2.35 (1.71)	<.0002	1.82 (1.27)	2.54 (1.81)	<.0004
Across-day Coefficient of Variation (SD/Mean)*100	20.29 (13.54)	53.82 (18.11)	<.0001	54.42 (21.60)	52.88 (16.27)	--
Across-day Inter-Quartile Range	3.45 (3.73)	3.14 (2.84)	--	2.23 (1.86)	3.53 (3.10)	<.0001

Note: CPD = Cigarettes Per Day; -- Non-Significant