Commentary

Light and intermittent smokers: Background and perspective

Saul Shiffman

This special issue of *Nicotine & Tobacco Research* represents a milestone in the thinking in our field about variations in smoking patterns. Over the past several decades, a stereotype has developed—the image of a smoker as consuming one cigarette after another, expressing a constant hunger for nicotine—a need to frequently redose with nicotine to maintain a steady concentration of nicotine in the bloodstream. Like many stereotypes, this one has a large element of truth. Around 1980, the average smoker's daily cigarette consumption was 32 cigarettes/day (Repace & Lowrey, 1980). In other words, in a 16-hr waking day, the typical smoker smoked every 30 min, and smokers who lit up every 15 min (60 cigarettes/day) were not unusual. Smoking, even hourly, results in steady or escalating nicotine levels over the waking day (Benowitz, 1991). This pattern of steady and frequent dosing was striking, indeed, and helped establish tobacco smoking as nicotine dependence.

The observed pattern of constant smoking conformed to a model of dependence that emphasized avoidance of withdrawal as the driving force in tobacco use and dependence (Shiffman, 1989; see Eissenberg, 2004; Shadel, Shiffman, Niaura, Nichter, & Abrams, 2000). This model, drawn from models of opiate dependence, emphasized that repeated use led inexorably to neuroadaptation and tolerance, which led, in turn, to the emergence of withdrawal symptoms when drug levels were allowed to drop, thus motivating continuing use. Russell (1971) called this “trough maintenance”—smoking so as to prevent nicotine levels from dropping below a certain threshold. Under this model, intermittent or very light smoking was seen primarily as a temporary and transitional developmental stage while an individual's smoking was becoming established (Kandel & Logan, 1984; Mayhew, Flay, & Mott, 2000). This model became the “standard model” of smoking, and it has been very productive, not least in providing the scientific foundation for the development of nicotine replacement medications and varenicline to help smokers quit smoking.

The problem with stereotypes, of course, is that they are overgeneralizations and can prevent one from accurately perceiving the world as it is, or even trying. Thus, many smoking studies limited their samples to daily smokers who smoked at least 10 cigarettes/day. For a time, epidemiological surveys did not even ask whether smokers smoked daily. Respondents were

simply asked how many cigarettes a day they smoked. These methodological decisions rendered light and intermittent smokers (LITS) invisible.

Yet, there seems always to have been some smokers who violated the expected pattern. Even if they were rare, the very existence of such “chippers” (Shiffman, 1989) challenged the dominant model of smoking. Although chippers inhaled and absorbed nicotine from cigarettes (Shiffman, Fischer, Zettler-Segal, & Benowitz, 1990), their smoking was not frequent enough to maintain steady-state nicotine levels (Shiffman et al., 1990); yet they did not suffer withdrawal (Shiffman, Paty, Gnys, Kassel, & Elash, 1995) and nevertheless continued to smoke. Nor were chippers purely social smokers (Shiffman, 1989; Shiffman & Paty, 2006). Chippers also were not adolescents just learning to smoke nor was their lack of dependence based on limited exposure to tobacco or nicotine. The chippers in our studies had, over almost 20 years of smoking, consumed an average of nearly 50,000 cigarettes (Shiffman, Paty, Kassel, Gnys, & Zettler-Segal, 1994)—surely enough for neuroadaptation and dependence to take hold—yet they had not escalated their smoking and showed few signs of dependence. Multiple studies confirmed the existence of low-rate smokers and helped characterize chippers and, more broadly, LITS (Evans et al., 1992; Gilpin, Cavin, & Pierce, 1997; Hassmiller, Warner, Mendez, Levy, & Romano, 2003; Husten, McCarty, Giovino, Chrismon, & Zhu, 1998; Owen, Kent, Wakefield, & Roberts, 1995; Wortley, Husten, Trosclair, Chrismon, & Pederson, 2003).

The initial studies of chippers regarded and studied these smokers as rare anomalies—scientific curiosities important primarily because they challenged the standard model of smoking behavior. As we have focused empirical attention on LITS, however, the impression is changing. Until 1992, national surveys of adult smoking, such as the National Health Interview Survey (NHIS), did not allow for reporting of nondaily smoking (Centers for Disease Control and Prevention [CDC], 1994). But as surveys allowed smokers to indicate that they smoke less than daily, researchers analyzed this subgroup and discovered that LITS no longer seemed so rare. According to data from a National Survey on Drug Use and Health (NSDUH; Office of Applied Studies, 2003), over one-third of all adult smokers smoke less than daily. Other

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estimates of nondaily smoking are lower: Data from the Behavioral Risk Factor Surveillance Survey (BRFSS; CDC, 2007) suggest 26% and the NHIS indicates 20% of adult smokers are nondaily smokers (Husten et al., 1998). Why these estimates vary is unclear. We need to be aware that these are self-report data; social pressure may be causing people to claim to be nondaily smokers, even if they smoke daily. However, cotinine levels are dropping at the same rate as reported cigarette consumption (O'Connor et al., 2006), suggesting that the self-reports are valid, consistent with studies suggesting that people are generally truthful about smoking on anonymous surveys (Society for Research on Nicotine and Tobacco Subcommittee on Biochemical Verification, 2002).

So the phenomenon seems real: A substantial proportion of U.S. smokers do not smoke every day. And the proportion appears to be growing. BRFSS data suggest that the proportion of smokers who are nondaily smokers increased by 40% between 1996 and 2001 (CDC, 2003; though see CDC, 2007), possibly because there has been a steep decline in daily smoking, while nondaily smoking has held steady (Backinger et al., 2008). Even among daily smokers, cigarette consumption has been dropping (e.g., Burns, Major, & Shanks, 2003), and it seems likely that the prevalence of very light smoking is increasing, too. LITS now constitute a substantial and important part of the smoking population. According to the 2002 NSDUH (Office of Applied Studies, 2003), *half* of U.S. adult smokers either smoke less than daily (35%) or smoke daily 5 or fewer cigarettes per day (15%). This represents an astounding change in smoking patterns or at least in our understanding of them.

Why would light and intermittent smoking suddenly emerge so strongly at this time in U.S. history? One potential influence is the late-20th-century increase in tobacco control activity, including denormalization of smoking and increasing restrictions on smoking. Indeed, when I compared state-by-state variations in LITS prevalence (Husten et al., 1998), I found that LITS prevalence was highest in those states with the strongest tobacco control policies (indoor air quality, taxation, and youth access, as rated by the American Lung Association, 2003; $r = .54$) and with the lowest overall prevalence of smoking ($r = -.77$), suggesting that increases in light and intermittent smoking may be driven by increasing restraints on smoking. It is also possible that as the number of daily smokers drops and the number of LITS remains constant, LITS simply become a higher proportion of the remaining smokers. This would imply that current tobacco control efforts preferentially affect daily smokers but not LITS, which would be an interesting finding, indeed.

The emergence of light and intermittent smoking patterns in the United States may seem surprising, but perhaps it should not be. Although U.S. smoking patterns seem to have been dominated by daily smoking, a global view gives a different picture. In many countries—developing countries, in particular—nondaily smoking is a highly prevalent, even dominant, pattern. For example, in Mexico, Ecuador, and Guatemala, at least two-thirds of smokers are nondaily smokers (World Health Organization [WHO], 2007). (Note that the majority of U.S. Hispanic smokers do not smoke daily; Office of Applied Studies, 2003; Zhu, Sun, Hawkins, Pierce, & Cummings, 2003.) In China, 20% of male smokers and 46% of female smokers are nondaily smokers (WHO, 2007); this amounts to over 50,000,000 people—more than all the smokers in the United States. Worldwide, with

1.25 billion smokers, hundreds of millions of people are LITS (estimating LITS conservatively at 20%). This suggests that nondaily smoking is no less a “natural” pattern of smoking than the heavy daily smoking seen in the United States in the last half of the 20th century: Hundreds of millions of smokers cannot be wrong.

The global data may be consistent with the previously discussed U.S. trends. It seems likely that economic constraints account in part for the prevalence of nondaily smoking in some developing countries: People simply cannot afford to smoke daily or heavily. Perhaps, heavy daily use of cigarettes occurs only when smoking is not constrained by economic, social, or legal restraints.

Nondaily smoking patterns also seem less surprising when one considers patterns of use that characterize other addictive drugs. Figure 1 shows that in 2001 the vast majority of adult users of heroin, powder cocaine, crack cocaine, and alcohol did not use these drugs daily (Office of Applied Studies, 2003). Indeed, tobacco was the anomaly; it was much more likely to be used daily than heroin, cocaine, or alcohol. In other words, nondaily, intermittent use of addictive drugs is normative, not anomalous. These data suggest that daily use may not be necessary to sustain use of addictive substances, neither for nicotine nor, for that matter, cocaine or heroin. Seen in this light, perhaps the smoking patterns that have been the subject of most of our research—heavy daily use of tobacco in wealthy Western countries—were a particular result of an environment that, for a time, allowed tobacco use that was unconstrained by economic, social, or legal limitations. This suggests that, as we enter the 21st century, when tobacco use is decreasing in developed countries, as a result of social constraints, and increasing in developing countries, as a partial result of increased buying power (but also, at least in some countries, subject to increasing tobacco control measures), we need to understand how addiction expresses itself under various degrees and kinds of constraint.

Whatever the driving factors, light and intermittent smoking patterns and their increasing prevalence significantly challenge our understanding of smoking behavior, drug use, and

Figure 1. The proportion of past month smokers; users of chewing tobacco and snuff; and users of alcohol, cocaine, crack cocaine, and heroin who reported using the respective drug less than daily in 2001. Source: National Survey on Drug Use and Health (Office of Applied Studies, 2003).

addiction. Such smoking cannot readily be explained by the standard model that relies on withdrawal–avoidance to explain smoking. Models that emphasize the direct or acute effects of nicotine in providing immediate reinforcement (see Glautier, 2004; Shadel et al., 2000), or in making other activities reinforcing (Chaudhri et al., 2006), seem better suited to explain light and intermittent smoking patterns. The heavy, constant smoking of heavy daily smokers lent itself to a trough-maintenance model of smoking; the intermittent smoking of LITS lends itself better to a “peak-seeking” (Russell, 1971) model of smoking, as motivated by the immediate effects of smoking and nicotine. But simple nicotine dynamics of any sort will not be adequate to explain light and intermittent smoking. Because such smoking is intermittent and is unevenly distributed over time and context (Shiffman & Paty, 2006), an adequate explanation of light and intermittent smoking will have to take into account how variations in the smoker’s environment or internal states cue smoking or set the context for its reinforcement. We need accounts that explain when LITS smoke and when they do not.

What do we currently know about light and intermittent smoking? Not enough. It is not clear how well the vast body of knowledge we have accumulated about smoking, based on studies of heavy daily smokers studied under conditions of minimal constraint, can be generalized to LITS around the world. Most of what we know about LITS comes from descriptive epidemiology, based on large population surveys in Western countries. So, we know a good deal about the demographics of LITS in the Western world (Husten et al., 1998; Wortley et al., 2003; Zhu et al., 2003) and some about their smoking history (Chassin, Presson, Pitts, & Sherman, 2000; Hassmiller et al., 2003). But surveys are typically limited in the depth of assessments, so we know relatively little about how LITS smoke, when they smoke, why they smoke, and why they have not stopped smoking. Few surveys offer a longitudinal perspective, so we also know too little about the natural history of smoking: how light and intermittent smoking patterns develop over an individual’s smoking career or how smokers progress from light and intermittent smoking to more intensive smoking or to abstinence. And we know even less about LITS in parts of the world where light and intermittent smoking is dominant or about how smoking patterns are changing as economic and policy conditions change.

We need to know more. LITS are typical smokers in many parts of the world, but this may change in the future as smoking becomes more affordable and more heavily marketed. In the developed world, where heavy daily smoking has dominated, LITS are likely to become an increasingly important segment of smokers. We need to understand how smoking patterns evolve in response to changes in the social and economic conditions in which smoking occurs. Much as the hockey player Wayne Gretsky famously skated “to where the puck is *going to be*, not where it’s been,” the smoking research community must focus on LITS if it is to be prepared to explain and intervene in smoking a decade from now. The papers in this volume represent an important step in that direction.

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References

- American Lung Association. (2003). *State of tobacco control, 2003*. Retrieved January 4, 2008, from <http://lungaction.org/reports/rank-states03.html>.
- Backinger, C. L., Fagan, P., O’Connell, M. E., Grana, R., Lawrence, D., Bishop, J. A., et al. (2008). Use of other tobacco products among U.S. adult cigarette smokers: Prevalence, trends and correlates. *Addictive Behavior*, 33, 472–489.
- Benowitz, N. L. (1991). Pharmacodynamics of nicotine: Implications for rational treatment of nicotine addiction. *British Journal of Addiction*, 86, 495–499.
- Burns, D. M., Major, J. M., & Shanks, T. G. (2003). Changes in number of cigarettes smoked per day: Cross-sectional and birth cohort analyses using NHIS. In S. E., Marcus (Ed.). *Those who continue to smoke: Is achieving abstinence harder and do we need to change our interventions?* (Smoking and Tobacco Control Monograph No. 15; NIH Publication No. 03-5270; pp. 83–99). Bethesda, MD: National Cancer Institute.
- Centers for Disease Control and Prevention. (1994). Cigarette smoking among adults—United States, 1992, and changes in the definition of current cigarette smoking. *MMWR Morbidity and Mortality Weekly Report*, 52, 303–307.
- Centers for Disease Control and Prevention. (2003). Prevalence of current cigarette smoking among adults and changes in prevalence of current and some day smoking—United States, 1996–2001. *MMWR Morbidity and Mortality Weekly Report*, 52, 303–307.
- Centers for Disease Control and Prevention. (2007). Cigarette smoking among adults—United States, 2006. *MMWR Morbidity and Mortality Weekly Report*, 56, 1157–1161.
- Chassin, L., Presson, C. C., Pitts, S. C., & Sherman, S. J. (2000). The natural history of cigarette smoking from adolescence to adulthood in a midwestern community sample: Multiple trajectories and their psychosocial correlates. *Health Psychology*, 19, 223–231.
- Chaudhri, N., Caggiula, A., Donny, E., Palmatier, M., Liu, X., & Sved, A. (2006). Complex interactions between nicotine and nonpharmacological stimuli reveal multiple roles for nicotine in reinforcement. *Psychopharmacology*, 184, 353–366.
- Eissenberg, T. (2004). Measuring the emergence of tobacco dependence: The contribution of negative reinforcement models. *Addiction*, 99(Suppl. 1), 5–29.
- Evans, N. S., Gilpin, E. A., Pierce, J. P., Burns, D. M., Borland, R., Johnson, M., et al. (1992). Occasional smoking among

- adults: Evidence from the California Tobacco Survey. *Tobacco Control*, 1, 169–175.
- Gilpin, E. A., Cavin, S. W., & Pierce, J. P. (1997). Adult smokers who do not smoke daily. *Addiction*, 92, 473–480.
- Glautier, S. (2004). Measures and models of nicotine dependence: Positive reinforcement. *Addiction*, 99(Suppl. 1), 30–50.
- Hassmiller, K. M., Warner, K. E., Mendez, D., Levy, D. T., & Romano, E. (2003). Nondaily smokers: Who are they? *American Journal of Public Health*, 93, 1321–1327.
- Husten, C. G., McCarty, M. C., Giovino, G. A., Chrismon, J. H., & Zhu, B. P. (1998). Intermittent smokers: A descriptive analysis of persons who have never smoked daily. *American Journal of Public Health*, 88, 86–89.
- Kandel, D., & Logan, J. (1984). Patterns of drug use from adolescence to young adulthood. *American Journal of Public Health*, 74, 660–666.
- Mayhew, K. P., Flay, B. R., & Mott, J. A. (2000). Stages in the development of adolescent smoking. *Drug and Alcohol Dependence*, 59, S61–S81.
- O'Connor, R. J., Giovino, G. A., Kozlowski, L. T., Shiffman, S., Hyland, A., Bernert, J. T., et al. (2006). Changes in nicotine intake and cigarette consumption over two nationally representative cross-sections of smokers. *American Journal of Epidemiology*, 164, 750–759.
- Office of Applied Studies. (2003). *Results from the 2002 National Survey on Drug Use and Health: National findings (DHHS Publication No. SMA 03–3836; NHSDA Series H–22)*. Rockville, MD: Substance Abuse and Mental Health Services Administration.
- Owen, N., Kent, P., Wakefield, M., & Roberts, L. (1995). Low-rate smokers. *Preventative Medicine*, 24, 80–84.
- Repace, J. L., & Lowrey, A. H. (1980). Indoor air pollution, tobacco smoke, and public health. *Science*, 208, 464–474.
- Russell, M. A. (1971). Cigarette smoking: Natural history of a dependence disorder. *British Journal of Psychology*, 44, 1–16.
- Shadel, W. G., Shiffman, S., Niaura, R., Nichter, M., & Abrams, D. B. (2000). Current models of nicotine dependence: What is known and what is needed to advance understanding of tobacco etiology among youth. *Drug and Alcohol Dependence*, 59(Suppl. 1), S9–S22.
- Shiffman, S. (1989). Tobacco “chippers”: Individual differences in tobacco dependence. *Psychopharmacology*, 97, 539–547.
- Shiffman, S., Fischer, L. A., Zettler-Segal, M., & Benowitz, N. E. (1990). Nicotine exposure in non-dependent smokers. *Archives of General Psychiatry*, 47, 333–336.
- Shiffman, S., & Paty, J. A. (2006). Smoking patterns of non-dependent smokers: Contrasting chippers and dependent smokers. *Journal of Abnormal Psychology*, 115, 509–523.
- Shiffman, S., Paty, J. A., Gnys, M., Kassel, J. D., & Elash, C. (1995). Nicotine withdrawal in chippers and regular smokers: Subjective and cognitive effects. *Health Psychology*, 14, 301–309.
- 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.
- Society for Research on Nicotine and Tobacco Subcommittee on Biochemical Verification. (2002). Biochemical verification of tobacco use and cessation. *Nicotine & Tobacco Research*, 4, 149–159.
- World Health Organization. (2007). *WHO global infobase online [online database]*. Retrieved January 4, 2008, from <http://www.who.int/infobase/report.aspx>.
- Wortley, P. M., Husten, C. G., Trosclair, A., Chrismon, J., & Pederson, L. L. (2003). Nondaily smokers: A descriptive analysis. *Nicotine & Tobacco Research*, 5, 755–759.
- Zhu, S., Sun, J., Hawkins, S., Pierce, J., & Cummings, S. (2003). A population study of low-rate smokers: Quitting history and instability over time. *Health Psychology*, 22, 245–252.