Published in final edited form as:

Soc Sci Res. 2005 March ; 34(1): 117–139.

Diffusion, cohort change, and social patterns of smoking^{*}

Fred C. Pampel^{*}

Population Program, University of Colorado, Boulder, CO 80309-0484, USA

Abstract

In noting that common explanations of smoking cannot account for both its current inverse relationship with SES and the shift over time toward greater concentration among low SES groups, this paper presents an explanation based on diffusion and status distinctions. The explanation predicts that, as cigarette diffusion proceeds and fashions change, the social determinants of smoking will shift across cohorts, such that initially positive relationships between pre-adult components of socioeconomic status and smoking in early cohorts become negative in later cohorts. Tests using historical, cohort-linked aggregate data on cigarette diffusion, and individual-level data from the General Social Surveys covering the years from 1978 to 1994 and cohorts from 1889 to 1976 largely support the predictions. In comparing older to newer cohorts, the results show correspondence between the stage of cigarette diffusion and the direction and strength of the relationships of education, parental status, urban residence, and gender with cigarette smoking.

Keywords

Socioeconomic status; Cigarettes; Smoking; Cohort; Social trends

1. SES patterns of smoking

Like illness and mortality more generally (Ross and Wu, 1995; Williams and Collins, 1995), smoking currently has an inverse relationship with SES or socioeconomic status (Duncan et al., 1999; Rogers et al., 1995; Ross, 2000). For example, 28% of those with less than a high school degree smoke, compared to 13% of those with a college degree (Centers for Disease Control, 2003). However, the relationship between status and smoking has shifted over time. Although the evidence remains incomplete, it appears that smoking emerged first among high status groups but has over time become increasingly concentrated among low status groups (Department of Health and Human Services (DHHS), 2001, p. 135; Escobedo and Peddicord, 1996; Ferrence, 1989). Any explanation of smoking must account first for the tendency of smoking to vary by socioeconomic status and related social characteristics such as parental background, urban–rural residence, gender, and race. In addition, it must, in recognizing that these social determinants of smoking are not invariant, account for changes over time in SES differences in smoking.

Most explanations of smoking have difficulty in accounting for both these facts. First, psychological traits such as impulsiveness, fatalism, rebelliousness, shyness, low self-esteem, propensity to addiction, and poor coping skills either increase the attraction to

^{*}I thank Rick Rogers, John Williamson, Robert O'Brien, David Strang, and anonymous reviewers for helpful comments on the paper, and the Institute for Behavioral Science at the University of Colorado for research support.

© 2004 Elsevier Inc. All rights reserved.

^{*}Fax: 1-303-492-6924. fred.pampel@colorado.edu.

smoking, or reduce the ability to resist pressures from others to smoke. Although these factors explain individual differences in smoking among those in similar positions in society, they do less to explain variation in smoking across social groups and changes in that variation.

Second, beliefs that smoking helps to control the user's weight, improve the user's mood, and realize a desirable image also increase smoking, as do beliefs that smoking does not harm one's physical health. While important predictors, these beliefs leave unexplained how users obtain them in the first place, and why they vary across social structural positions. Similarly, smoking by family members and peers encourage pro-smoking beliefs and increase the likelihood of a person starting and continuing to smoke. Yet, the source of status-based differences in smoking among family members and peers remains unexplained. Positing that low SES groups smoke more because they have more supportive attitudes and more smoking friends and family members, while true, offers little insight into the forces underlying these differences.¹

Third, the propensity to smoke, despite its long-term harm and immediate financial cost, may serve as a short-term coping mechanism to deal with the difficult circumstances faced by individuals with relatively few economic and social resources. Low status persons face chronic stress, personal frustration, and social strain in the daily struggle to meet demands that exceed their economic and social resources (Duncan et al., 1999; Graham, 1995; Marsh and McKay, 1994). Indulging in the addictive pleasure of nicotine, even given its long-term harm, might provide some relief from chronic stress to those unable to purchase more expensive forms of pleasure or therapy (Colby et al., 1994; Schrijvers et al., 1999; Wilkinson, 1996, p. 185). A related set of stress-based arguments focuses on blocked opportunities and anomie. Lacking access to legitimate, normatively defined means of social success and a sense of control over life's circumstances, disadvantaged persons may develop feelings of helplessness in resisting pressures for tobacco use (Ross, 2000; Ross and Wu, 1995). They may even come to view smoking as a source of opposition to conventional norms, a means to express personal values and identity, and a component of self-esteem (Johnson and Hoffman, 2000). Still yet, realizing that, because they face less favorable health outcomes and life expectancy than more advantaged groups, deprived groups may gain fewer benefits from avoiding cigarette use (Lawlor et al., 2003).

Although these arguments explain the higher cigarette use of low SES groups, they imply that stress and the risks of smoking are inherent in low socioeconomic status, and will produce an inverse relationship that has not changed over time. If the smoking of higher status persons in the past exceeded that of lower status persons and the influence of status on smoking has changed, then smoking must involve something more than efforts to cope with stress among the deprived. Unless high status persons once faced stresses and blocked opportunities greater than those of low status persons, arguments about smoking as a coping mechanism are incomplete.

Fourth, economic factors may prove important. High prices for cigarettes (including high excise taxes) reduce aggregate cigarette purchases. However, since low income groups—those least able to afford cigarettes—often have the highest rates of smoking, prices alone cannot explain the observed SES differential.² They also cannot explain the trend in lessened use of cigarettes by members of high SES groups who can best afford them.

¹One might also extend arguments about beliefs to include lack knowledge of the harm of smoking among low SES groups. However, Viscusi (1992) demonstrates substantial awareness—even overestimation—of the risks of cigarette smoking. He notes, for example, that by 1977 in the United States, 90% of survey respondents agreed that smoking is harmful. Other studies find little evidence that cognitive ability and understanding of risks reduce smoking (Wray et al., 1998). To the contrary, the knowledge of the harm of cigarettes is widespread, but higher status persons respond more successfully to the knowledge (Elstad, 1998).

In sum, the tendency of these explanations to focus on proximate individual risks rather than on the more distant social conditions that generate the risks reflects a common limitation in understanding the sources of health. Link and Phelan (1995) argue that the dominant focus of social epidemiology on the immediate causes of disease neglects the larger social forces that expose individuals to these causes. For example, the harm of low socioeconomic status for health persists over time even though the specific risk factors that mediate the relationship have changed (e.g., as class differences in immunization disappear, new class differences in smoking, exercise, and diet emerge as important). The same criticism applies to the understandings of the causes of smoking. The attention to the proximate risks of smoking, such as psychological traits, beliefs, peer and family influence, stress, and affordability, neglects the larger social forces that generate these risks in the first place.

Another type of approach—one that extends the individualistic attention to proximate risk factors by focusing on changes in the social meaning of cigarette use—can help make sense of the social patterns of smoking, and the changes in those patterns. In this paper, I present and test such an approach. The theory, stimulated by the work of Ferrence (1989), explains changes in group variation in smoking with arguments concerning the diffusion of innovations and changes in tastes or fashion. The arguments focus more on status-based processes of social imitation, network ties, and normative change than on factors commonly included in explanations of cigarette smoking. In making testable predictions, the theory allows for empirical evaluation using data on cohort changes in social patterns of smoking and can ideally contribute to a more complete understanding of why people smoke.

2. Patterns of cigarette diffusion

Using the terminology of epidemiology, changes in smoking take a form analogous to an epidemic that spreads from relatively small parts of a population to other parts, and then eventually recedes (Lopez, 1995; Lopez et al., 1994). In the early stages, smoking emerges first among high status groups, who are most open to innovations and have the resources to adopt them. During the middle stages of the process, smoking diffuses to the rest of the population. In the later stages, smoking declines first among high status persons, who become concerned with health, fitness, and the harm of smoking, and separate themselves from other groups by rejecting smoking and other unhealthy lifestyles (Griswold, 1994, p. 62). Like smoking decades earlier, the adoption of healthy lifestyles is itself an innovation that emerges after the spread of the epidemic, and relates closely to socioeconomic status.

Two closely related mechanisms can account for the tendency of the epidemic to begin with high status groups, diffuse to lower status groups, and recede among high status groups. The first involves the diffusion of innovations through a population according to status-based communication networks, while the second involves the status-based cycle of adoption and replacement of fashions. Both mechanisms imply a changing rather than an invariant relationship of smoking with its social determinants, and explain the current tendency for smoking to become concentrated among low status groups. They also imply changing patterns of smoking based on related social divisions such as parental background, urban residence, sex, and race.

First, a large literature on diffusion of innovations recognizes the tendency for high status persons to most quickly adopt new ideas and behaviors (Katz, 1999; Rogers, 1995; Strang and Soule, 1998). The diffusion of the use of manufactured cigarettes, both a technological

²Low income may limit access to expensive counseling, medical help, and private programs aimed at stopping clients from smoking. However, since most smokers stop without a formal program (DHHS, 2001, p. 478), and programs cannot explain starting to smoke, the inverse relationship between status and smoking involves more than the ability to pay for better health.

and cultural innovation (Griswold, 1994), follows such a status-based pattern (Ferrence, 1989). High status groups (led, ironically, by physicians, Lopez et al., 1994) begin smoking earlier than the general public. Smoking spreads first within high status networks, but later patterns of imitation lead to diffusion of the practice and normative change across classes and down the status hierarchy. As smoking diffuses to lower status groups, however, new concerns about health emerge among higher status groups, who are among the first to reject smoking (again led by physicians, and speeded by the negative publicity about the harm of smoking). The later diffusion of smoking to lower status groups, and the adoption of innovative health-promoting behaviors by high status groups serve to concentrate smoking among low status groups. However, this does not occur until cigarette use has passed the early stages of diffusion and spread throughout the population (Ferrence, 1989).

Second, at the turn of the century, Simmel (1971[1904]) and Veblen (1992[1899]) posited a cycle whereby the upper classes, in using symbolic devices to distinguish themselves from other classes, first adopt innovative fashions. Imitating the upper classes, middle and lower classes successively follow in the adoption of the latest fashion, but as a fashion becomes widespread across all classes and loses its distinctiveness, new fashions emerge among the upper classes and the cycle repeats. Although contemporary studies of clothing fashions recognize the replacement of such top-down cycles of diffusion in more recent periods by less centralized patterns of fashion innovation (e.g., Crane, 1999), the top-down cycle appears to apply to tobacco use (Ferrence, 1989). Viewed as newly fashionable by elite groups who first adopt the habit, cigarette smoking comes to lose that allure among high status groups as middle and lower classes later begin to widely use tobacco (and health concerns of cigarette use become widely publicized). Elites then define smoking as immoral as well as unhealthy (Gusfield, 1993; Rozin, 1999), and status differences in smoking serve to reinforce symbolic boundaries that exist between classes and status groups (Bourdieu, 1994; Lamont and Fournier, 1992).

These status-based processes of change in cigarette smoking should produce diverse experiences and patterns across generations (Ferrence, 1989). Since smoking begins by adulthood for the vast majority of those adopting the addictive habit, the attitudes and behaviors at the time of a cohort's adolescence will shape later patterns of smoking (DHHS, 2001, p. 453; Harris, 1983, 1989; Mendez et al., 1998). Reflecting the idea that the experience of historic events and environments at young ages has enduring influences (Elder, 1985; Ryder, 1965), the smoking experiences of cohorts during adolescence should persist over the life course.³ Among older cohorts, who enter adolescence during periods of growing cigarette use, high socioeconomic status groups should show the highest rates of smoking and produce a positive relationship between status and smoking. In contrast, among younger cohorts, who enter adolescence during periods of declining cigarette use, lower socioeconomic status groups should show the highest rates of smoking and produce a negative relationship between status and smoking. These generational changes thus reflect the diffusion of tastes for use of tobacco down the status hierarchy, and the emergence of anti-tobacco tastes among groups at the top of the status hierarchy.⁴

This general argument takes more precise form when considering the components of socioeconomic status relevant to the diffusion of smoking. If the general thesis holds, the

³More precisely, the cohort experiences during youth will influence whether persons start smoking. Once started, efforts to stop smoking relate to age and period forces, but may also relate to cohort-specific attitudes toward smoking. The methods section distinguishes more carefully between starting and continuing to smoke, but in terms of the theoretical argument, the diffusion process can affect both the starting and quitting behavior across cohorts.

⁴This argument is consistent with claims that the extent and targeting of advertising may affect the level of smoking and differences in smoking across social groups. However, it suggests that advertisers follow social trends rather than cause them, and have increasingly come to focus on lower SES groups.

patterns of smoking should change with regard to education, parents' education and income, adolescent urban residence, sex, and race. Each of these status characteristics is determined at birth or before adulthood. Since smoking initiation nearly always begins by young adulthood, the influences on smoking involve traits during youth rather than at later ages. Thus, the effects of education, parents' education, and parents' income on smoking should shift across cohorts from positive to negative as smoking works its way down the status hierarchy. Similarly, more innovative, cosmopolitan urban residents should adopt smoking earlier, and then stop smoking sooner, than rural residents. Finally, the higher status of white males should lead them to adopt smoking first and reduce their smoking earliest, while women and minorities will adopt and reduce smoking later (DHHS, 2001, p. 38; Lopez et al., 1994; Pampel, 2001). In summary, then, the highly educated, those with high status parents, residents of urban areas during adolescence, males, and whites will have relatively high rates of smoking among older cohorts, but these patterns of smoking will shift among newer cohorts.

3. Hypotheses

These arguments about how cigarette diffusion generates cohort differences in the social patterns of smoking imply multilevel influences. At the individual level, education, parents' education and income, adolescent urban residence, sex, and race affect smoking, and at the aggregate level, cohort characteristics relating to the stage of cigarette diffusion affect the influence of the individual-level determinants on smoking. This approach treats cohort—or more precisely, the stage of cigarette diffusion when a cohort reaches adolescence—as a contextual characteristic that shapes the relationships between the components of status and smoking, and thereby represents something more than another individual-level determinant of smoking. While other multilevel approaches treat nations, states, communities, or neighborhoods as contexts, the theoretical arguments here specify the importance of cohort and the time when a cohort reaches adolescence as a relevant context for understanding individual smoking decisions.

Based on this framework, the hypotheses suggest that as cigarette use diffuses throughout the population and then begins to recede, the status-based patterns of smoking will change across cohorts. More specifically, the hypotheses take the following form: (1) the effect of education becomes increasingly negative across cohorts as cigarette diffusion proceeds; (2) the effect of parents' education becomes increasingly negative across cohorts as cigarette diffusion proceeds; (3) the effect of parents' income becomes increasingly negative across cohorts as cigarette diffusion proceeds; (4) the effect of adolescent urban residence becomes increasingly negative across cohorts as cigarette diffusion proceeds; (5) the effect of being male becomes increasingly negative across cohorts as cigarette diffusion proceeds; (6) the effect of being white becomes increasingly negative across cohorts as cigarette diffusion proceeds.

These hypotheses say little about the average effect of these components of status on smoking. Based on recent patterns, education, parents' education, and parents' income should lower smoking, while urban residence during adolescence, being male, and being white should raise smoking. More importantly, however, the hypotheses argue that much variation across cohorts exists around these average effects, and that cohort change will shift the size and direction of the effects of the components of status. In so doing, the hypotheses contradict arguments presented earlier that specify invariant effects of status characteristics on smoking. Similarly, the hypotheses say little about changes in the levels of smoking, which should obviously decline among younger cohorts. Rather, the hypotheses predict that the decline in smoking across cohorts should be larger among high status groups than low status groups.

Along with status and cohort, period and age should influence smoking. On average, period trends should lower smoking, as public health campaigns, restrictions on advertising, taxes on cigarettes, and negative publicity about the tobacco companies reduce starting and increase quitting. Age will affect smoking nonlinearly, with the rates of starting reaching a peak in young adulthood, and rates of quitting increasing after young adulthood (Rogers et al., 1995). However, examining cohort influences on smoking when age and period influences operate simultaneously presents well-known identification problems. With cohort, age, and period all defined in terms of years, the definitional dependency among the concepts makes separation of their influences difficult. To deal with the general problem, O'Brien (2000) suggests focusing directly on the cohort component responsible for the outcome under study. According to the arguments presented here, the stage of the cigarette diffusion process during the years when a cohort enters adolescence affects the individual-level determinants of smoking. Viewing cohort in terms of the stage of cigarette diffusion when a cohort reaches adolescence rather than as birth year can circumvent the definitional dependency of cohort, age, and period, and can allow for tests of the cohort effects specified by the diffusion arguments.

4. Data and methods

4.1. Data

Testing the hypotheses requires both individual-level data on smoking of persons with varied status characteristics, and aggregate data on the diffusion of cigarettes over time and across birth cohorts. The General Social Surveys (GSS) provide suitable individual-level data. Of the 19 surveys done from 1972 to 1998 (Davis and Smith, 1998), 12 contain questions on smoking (beginning in 1978 and ending in 1994), each of which uses full probability samples of the non-institutional, English-speaking adult population in the United States. These surveys contain identical smoking items and comparable samples, and, although not longitudinal, have the advantage of adding members of new cohorts into each year's sample. The 17-year time span means the surveys contain cohorts that grew into adulthood during different historical periods and different stages of the diffusion process. For example, the oldest cohort was born in 1889 and reached age 18 in 1907; the youngest cohort was born in 1976 and reached age 18 in 1994. Pooling the data for the 12 years and numerous cohorts, and selecting only whites and blacks,⁵ yields 14,274 cases with data on all the relevant variables.

Cohort represents the contextual unit of analysis, with the models allowing the effects of status variables on smoking to vary across cohorts. As the smoking environment or the stage of the cigarette diffusion process changes, each cohort enters adolescence in a different smoking environment or context. This smoking context influences the individual-level relationships between the status variables and smoking. Aggregate data on cigarette diffusion that is historically situated to correspond to a cohort's late adolescence thus link context to individuals.

4.2. Survey measures

The GSS ask two questions about smoking, each with a yes and no answer: Do you smoke? and Have you ever smoked regularly? The two questions define a three-category smoking measure: smokes (yes to both questions), quit smoking (no to the first question, yes to the second), and never smoked (no to both questions). Validation studies find that these self-reported measures of cigarette use reflect actual usage (Patrick et al., 1994; Willis and

⁵With only 423 persons in the other race category, and the diversity of groups contained in this residual classification, the analysis focuses only on whites and blacks.

Cleary, 1997). However, the GSS contain no information on age of initiation or age of cessation of smoking, or on the number of cigarettes currently or formerly smoked per day.

The GSS contain numerous measures related to socioeconomic status during adolescence or before adulthood. Education equals the number of completed years of school.⁶ Father's education (which has a stronger influence on smoking than mother's education for both men and women) also measures years of completed school. Parents' income at age 16 ranges from one to five with far below average, below average, average, above average, and far above average comprising the five categories.⁷ City size at age 16 equals the natural logarithm of a six-category measure ranging from on a farm (1) to in a large city over 250,000 (6). Sex takes the form of a dummy variable with men coded one, and race takes the form of a dummy variable with whites coded one.

Other variables reflect current socioeconomic status and other possible contemporaneous determinants of smoking. Age measures years since birth and year measures year of survey. Marriage takes the form of a dummy variable with married persons coded one. Current city size equals the natural logarithm of the population of the respondent's residence. Current family income in inflation-adjusted dollars taps the resources available to respondents for consumer purchases.⁸ Since these variables change substantially over the life course, current status may have little connection to status when respondents started or quit smoking at younger ages. The analysis therefore uses these variables as controls in the models of smoking rather than as factors whose influence changes with cohort-based cigarette diffusion.

4.3. Aggregate measure

The aggregate measure of context varies across cohorts, and relates to the stage of the cigarette diffusion process during a cohort's adolescence. The measure requires historical figures on cigarettes consumed per capita (Lee, 1975; US Bureau of the Census, 1980, 1999).⁹ However, the level of cigarette consumption does not fully reflect the stage of diffusion, as the level may be identical both before the peak (the early stages) and after the peak (the late stages). As the patterns of growth vary with diffusion, a measure based on change better identifies diffusion of smoking through the population. Therefore, I begin with the proportional change in cigarettes consumed per capita for a particular year over the previous ten years. This means that positive values reflect growth typical at the early stages of the smoking epidemic when cigarette use spreads rapidly; values near zero occur during middle stages of the epidemic when cigarette growth levels off around the peak; and negative values occur during later stages of the epidemic when cigarette use declines. However, this leads to awkwardness in interpretation, as values of the variable generally get smaller with cigarette diffusion. To have a measure that rises with cigarette diffusion and increases over time, I multiply the proportional change by minus one. Thus, *the greater the*

⁶Tests show that the relationship between education and smoking is better represented by a linear term than by quadratic terms. Using numerous dummy variables to represent completion of degrees rather than years of schooling increases the strength of the relationship between education and smoking (Zhu et al., 1996), but also complicates the models, makes the interpretation of interactions difficult, and does little to change the general pattern of the results.

⁷Those respondents missing data for father's education and parent's income at age 16 are assigned mean values.

⁸The categories for reporting income differ across years in the GSS. For each year, I first code each category to its midpoint in dollars and then divide by the consumer price index (with 1981–1983 serving as the baseline). Those lacking income data are assigned mean values. Real family income has stronger effects on smoking than current family income, real personal income, and real family income adjusted for household size.

⁹Lee (1975) provides figures on cigarette sales per person 18 and over from 1920 to 1973, while Historical Statistics and Statistical Abstract provide figures on cigarettes produced per person 18 and over for the years 1900–1920 and 1973–1994. With some produced cigarettes being exported, the production figures exceed the sales figures. Therefore, using the ratio of produced to sold cigarettes in 1920, I adjust downward the figures from Historical Statistics on cigarettes produced for the years from 1900 to 1919; and using the ratio of produced to sold cigarettes in 1973, I adjust downward the figures from Statistical Abstract for the years 1974–1994. This produces a consistent time series based on sales rather than production.

*value of the cigarette diffusion measure, the later the stage of cigarette diffusion and the less the growth in cigarette consumption.*¹⁰

To match the aggregate measure to cohorts, I assign the cigarette diffusion measure for a particular year to the cohort that reaches 18 during that year. For example, the cigarette diffusion measure in 1918, which reflects changes in consumption from 1908 to 1918, would most affect the propensity to begin smoking of the cohort born in 1900 and reaching age 18 in 1918. The measure in 1919 would then affect the propensity to begin smoking of the 1901 cohort, and so on. Thus, with the earliest respondent born in 1889 and the latest in 1976, data exist for 88 single-year cohorts, each of which receives a cigarette diffusion score based on the year the cohort reaches age 18.

The use of this direct measure of cigarette diffusion rather than the use of a measure of the year of birth avoids estimation problems. The variance explained by age and year in the cigarette diffusion measure equals .685—well below the 1.00 variance explained by age and year in birth year—and allows for use of all three measures in multivariate analysis. Since age and year together already control for year of birth, the effect of cigarette change taps the cohort-specific characteristics relevant to smoking that are partly independent of birth year. The measure thus offers a stringent test of the importance of cohort experiences for smoking.

4.4. Weighting

Differential mortality among smokers and non-smokers may distort comparisons across cohorts in smoking. Since smokers die younger than non-smokers, cohorts will lose more smokers than non-smokers as they age, and cohorts will increasingly come to include a disproportionate number of non-smokers. The older the cohort, the greater the effects of differential mortality on the composition of a cohort.¹¹ To counter such bias, I weight the cases in the analysis on the basis of age-specific relative risks of dying for former and current smokers compared to non-smokers.¹² Rogers and Powell-Griner (1991) use data from the National Health Interview and National Mortality Followback Surveys of the United States to calculate life expectancies in 1986 for those who never smoked, formerly smoked, currently smoke lightly, and currently smoke heavily. Their appendix presents the probability of dying of men and women for five-year age groups beginning with ages 25–29. For each smoking group, I cumulate the probability of dying to reflect the risks up to and including the age group (e.g., the risks of dying by ages 55–59 add the probabilities of dying at earlier ages to the probability at this age group). For each age group (separately for males and females), I then divide the cumulative probability of dying for former smokers by that of non-smokers, and the cumulative probability of dying for current smokers by that of non-smokers.¹³ Non-smokers thus receive a weight of one, and former smokers and current smokers receive a weight (nearly always greater than one) based on their relative risk of dying by a particular age.¹⁴ For example, the weight for male current smokers at ages 55–59

¹⁰It may seem that the aggregate measure of cigarette diffusion overlaps with the dependent variable of smoking. Yet, the hypotheses focus not on how cigarette diffusion affects smoking, but on how cigarette diffusion affects the relationships between pre-adult socioeconomic status variables and smoking. Since the aggregate measure does not distinguish between cigarette use by those of different status, it reduces the potential overlap with the key micro-level outcomes.

¹¹Because smokers die sooner than smokers at all levels of the independent variables, the mortality differential should less strongly bias estimates of the effects of the determinants of smoking than estimates of the prevalence of smoking.

¹²I could also weight for oversampling of blacks, but the control for this variable in the regression models makes such weights unnecessary (Winship and Radbill, 1994).

¹³Since Rogers and Powell-Griner (1991) present separate life tables for light and heavy smokers, and since the GSS measures do not make this distinction, I take the average of mortality probabilities for light and heavy smokers to obtain the mortality probabilities for all smokers.

¹⁴The weighting resembles the reverse survival method used to restore deaths and estimate the size of an age group in previous years (Shyrock and Siegel, 1975, p. 452).

equals 2.33, which reflects their risks of dying over ages 25–59 relative to the risks of dying for never smokers over the same ages.¹⁵ Finally, I divide the weights by a constant so that the weighted sample size equals the unweighted size.

4.5. Estimation

The hypotheses specify relationships in which aggregate historical characteristics during a cohort's adolescence affect the individual determinants of the propensity to smoke. They thus imply relationships not only between individual characteristics and smoking, but also relationships between the aggregate characteristic of cigarette diffusion and the effects of the individual characteristics on smoking. Multilevel or hierarchical models, which nest one level of data (in this case, individuals) within another level of data (in this case, cohorts), are appropriate for testing such hypotheses. The alternative of assigning aggregate or macro-level values to individuals in each cohort has problems: it ignores non-independent errors for individuals within the same cohort and heteroscedasticity across cohorts, and exaggerates the degrees of freedom for macro-level variables (Gua and Zhao, 2000). These problems bias downward the estimates of standard errors. Multilevel or hierarchical models correct for these problems by including a separate error term for the macro-level units, and allow for appropriate tests of significance for macro-level variables (Kreft and de Leeuw, 1998; Raudenbush and Bryk, 2002).

With a cohort-based multilevel design, smoking for individual i in cohort j (Y_{ij}) is a function of k individual-level pre-adult status variables (X_{kij}) and m individual-level control variables (Z_{mij}). Based on a multinomial logistic model that distinguishes those who never smoked, those who once smoked, and those who now smoke, the level one model specifies separate equations for i individuals within each cohort or macro-level unit j :

$$\ln[\text{Prob}(Y=q)/\text{Prob}(Y=Q)] = \beta_{0j(q)} + \sum \beta_{kj(q)} * X_{kij} + \sum \beta_{mj(q)} * Z_{mij}. \quad (1)$$

The dependent variable represents the logged odds of belonging to category q relative to baseline category Q , and defines equations for each contrast. The β_{0j} and β_{kj} for category q then become dependent variables in a second set of contextual equations that use the cohort-based measure of cigarette diffusion (represented by C_j) as a determinant:

$$\beta_{0j(q)} = \gamma_{00(q)} + \gamma_{01(q)} * C_j + u_{0j(q)}, \quad (2a)$$

$$\beta_{kj(q)} = \gamma_{k0(q)} + \gamma_{k1(q)} * C_j + u_{kj(q)}, \quad (2b)$$

$$\beta_{mj(q)} = \gamma_{m0(q)}. \quad (2c)$$

Combining the equations produces:

$$\begin{aligned} \ln[\text{Prob}(Y=j)/\text{Prob}(Y=J)] = & \gamma_{00(q)} + \gamma_{01(q)} * C_j + \sum \gamma_{k0(q)} * X_{kij} \\ & + \sum \gamma_{k1(q)} * X_{kij} * C_j + \sum \gamma_{m0(q)} * Z_{mij} + u_{0j(q)} + \sum u_{kj(q)} * X_{kij}. \end{aligned} \quad (3)$$

¹⁵Because the life tables begin at age 25, and any relationship between smoking and mortality during adolescence and early adulthood stems from other factors, I assume relative risks of one for ages under 25. The last age group of 75 and over also has relative risks of one since all smokers and nonsmokers die in that open-ended category.

The error in the equation is heteroscedastic in the dependence of $u_{kj(q)}$ on X_{kij} . Otherwise, the average effects of the individual variables show in $\gamma_{k0(q)}$ and $\gamma_{m0(q)}$, and the effect of the macro variable shows in $\gamma_{01(q)}$. Of crucial importance, the cross-level interaction terms $X_{kij} * C_j$ allow the macro-level determinant C_j to influence the individual-level relationships between X_{kij} and Y_{ij} (or equivalently, allow the effects of X_{kij} to vary across C_j). The coefficients for the cross-level interaction terms, $\gamma_{k1(q)}$, provide tests of the hypotheses. If the effects of the pre-adult individual-level status variables shift from positive to negative with cigarette diffusion, it will show in negative interaction coefficients.

The estimates of the multinomial logistic regression coefficients for the combined multilevel model come from quasi-maximum likelihood techniques in HLM 5 (Raudenbush et al., 2000). The models use never smoked as the reference category for the dependent variable in the multinomial logistic regressions, thus contrasting those who once or formerly smoked with those who never smoked, and those who now smoke with those who never smoked.¹⁶

5. Results

5.1. Descriptive

Comparisons of smoking across cohorts by sex and race can illustrate changes in both the level of smoking and the relationship between smoking and one crucial measure of socioeconomic status—education. Table 1 lists the smoking percentages of white males, white females, black males, and black females for 10 cohorts (categorized so that each cohort contains about 10% of the cases). With the earliest cohorts born around 1890, and the latest cohorts born in the 1970s, the statistics reflect nearly a full century of change in smoking. To provide a simple overview of smoking patterns, Table 1 lists statistics for those who ever smoked (both former and current), and those who currently smoke (more precise contrasts follow in the multivariate analyses). For example, 80% of the white male sample born from 1889 to 1914 (and reaching the teenage years in the early part of the 20th century) ever smoked, while 40% of the white female sample born from 1962 to 1976 (and reaching the teenage years in last quarter of the century) currently smokes.

According to the weighted figures in Table 1, the percentage of ever having smoked among white males peaks among cohorts born from 1923 to 1938, and begins falling most among the post-World War II cohorts—the ones reaching their teenage years and making smoking decisions about the time of the 1964 Surgeon General's report on the hazards of cigarettes. The cohorts born between 1962 and 1976 reach the lowest level of 50%.¹⁷ The changes for male cohorts over the century thus reflect the right half of an inverted U, with smoking peaking early, and declining afterward. A similar pattern of cohort change appears among white males for currently smokes, except that excluding former smokers lowers the percentages more among older than younger cohorts. As a result, the percentage of current smokers peaks later.

The changes for white females reveal a different pattern. Beginning at 41% among the oldest cohort, the percentage ever having smoked increases to a peak of 71% (still below the male peak of 85%) among the 1923–1938 cohorts. The percentage declines some from that peak, but not as quickly as it declines for men. The changes thus reflect a fast rise in smoking,

¹⁶HLM 5.0 does not allow use of weights for non-linear models. To adjust the estimates, I therefore sample the cases in proportion to their weights, and use this “pseudo-weighted” sample for the multinomial logit analyses. For example, since the weight for male current smokers at ages 55–59 equals 2.33, I select males ages 55–59 twice and then select a 33% random sample of them. When represented in proper proportion to their weights, the new sample adjusts for differential mortality.

¹⁷The newest cohort includes members young enough to be interviewed before they start to smoke, which may exaggerate the size of the drop in the percentages of smokers.

leveling of, and the beginning of a decline. The pattern of change for women thus lags behind that for men, but eventually results in growing equality of percentages in smoking.

Along with the smoking percentages, the relationships between education and ever having smoked have changed. The next columns of Table 1 list the cohort-specific correlations of these two variables for white males and females. The male correlations begin at zero for the oldest cohorts, indicating similar smoking across levels of education early in the century. The relationship becomes steadily more negative for later cohorts, with correlations reaching approximately $-.30$ for those born after 1950. The lower the level of smoking of males, the stronger the negative relationship between education and starting to smoke. Thus, smoking declines most among the highly educated, and becomes increasingly concentrated among the less educated. The same pattern holds for the correlations of education and currently smokes.

The results for females also indicate a strengthening relationship between education and smoking. Until the 1931–1938 cohort, the education correlations with ever having smoked and currently smokes differ little from zero, but with the post-war baby boom, less educated women show strong evidence of smoking more than highly educated women. Although the processes emerge later than for men, increasing concentration of smoking among the less educated in newer cohorts also occurs for women.

The trends for blacks appear similar to those for whites. With smaller sample sizes, the percentages for blacks fluctuate more than for whites, but otherwise show little initial change in male cohorts and eventually a drop. For female cohorts, an increase is followed by a leveling off. Also like whites, blacks show a strengthening of the negative relationship of smoking with education in more recent cohorts. More precise comparisons await multivariate analysis, but the descriptive statistics show few racial differences in patterns of cohort change.

5.2. Multivariate

The first columns of Table 2 present the multinomial logit coefficients and t ratios for the individual-level determinants of smoking and the cigarette diffusion measure. The coefficients for the individual-level variables represent effects on the smoking contrasts—never smoked versus former smoker and versus current smoker—averaged across all cohorts.¹⁸ The effect for year demonstrates a linear downward trend in current smokers, the curvilinear effects of age show a peak in middle to old age, and the effects of marital status and family income reduce current smoking. The effects of the variables determined before adulthood—education, father's education, parents' income at age 16, size of city of residence at age 16 (logged), a male dummy variable, and a white dummy variable—are mixed. Sometimes insignificant, the averaged coefficients for these variables are possibly misleading because, according to the hypotheses, they vary across cohorts. The negative coefficient for the cigarette diffusion measure indicates, not surprisingly, that smoking is lower at later stages, but this variable may have less obvious and more important interactive influences.

To begin examining the hypothesized interactions, the last columns in Table 2 include a term for education times the cigarette diffusion measure. With the variables in this model centered around their means, the coefficient for education represents the effect averaged across all cohorts, and the coefficient for education by cigarette diffusion represents changes in the effect of education for a unit increase in cigarette diffusion. The product term

¹⁸Based on a multinomial analysis of smoking with only individual-level determinants, the pseudo-variance explained equals 6.8%.

coefficients (-1.398 and -2.480) test the hypotheses that cigarette diffusion produces changes across cohorts in the relationships of education to smoking.

To test the hypotheses concerning the other pre-adult variables, the results are presented in more compact form in Table 3. It lists only the subset of the coefficients directly relevant to testing the interaction hypotheses but nonetheless controls for other individual-level variables. To illustrate, the first rows in Table 3 present the coefficients for education and education by cigarette diffusion obtained from Table 2. The other rows come from models just like that in Table 2 but test for the interaction of the other pre-adult variables (again with controls).

The first four columns of Table 3 present results from adding each interaction term individually to the model, and the last four columns present results from adding all interaction terms together. Since the interaction terms correlate highly with one another and tend to change similarly with cigarette diffusion, including all of them in the same equation reduces the size of their effects and the power of the statistical tests. It therefore makes sense to consider the results for the interactions both separately and together. I evaluate each hypothesis based first on the results in Table 3 for the separate interactions, and then for the combined model.¹⁹

1. The results for once smoked and now smokes support the hypothesis that the effect of education becomes increasingly negative across cohorts as cigarette diffusion proceeds. At the mean of cigarette growth, education has negative and significant effects on both once smoked ($b = -.072$, $t = -6.10$) and now smokes ($b = -.170$, $t = -12.70$). The odds of having once smoked and now smoke fall, respectively, by 7 and 16% for a one year increase in completed schooling. More importantly, the interaction of education and cigarette growth has a significant negative effect on once smoked ($b = -1.398$, $t = -5.04$), and now smokes ($b = -2.480$, $t = -7.77$). This means that the negative average effect becomes even stronger as the cigarette diffusion measure increases and the spread of cigarettes reaches later stages. It also means that the average negative effect of education moves closer to zero or becomes positive at low values and early stages of cigarette diffusion. This supports the cigarette diffusion hypothesis: the effect of education shifts from positive to negative as cigarette diffusion proceeds.

Some illustrations can make the modifying influence of cigarette diffusion on the cohort-specific effect of education on smoking more concrete. When the diffusion measure takes a value two standard deviations below its mean, when cigarettes are diffusing quickly in the early stages of the epidemic, education raises the logged odds of once smoked (relative to never smoked) by .040 and the odds by 4%, and raises the logged odds of now smokes (relative to never smoked) by .028 and the odds by 3%. At this stage of diffusion, education increases both starting and continuing to smoke. When the diffusion measure takes a value two standard deviations above its mean, after cigarette use has peaked and declined, education lowers the logged odds of once smoked by $-.184$ and the odds by 17%, and lowers

¹⁹Of the total variance in the smoking measure, 97% occurs across individual and within cohorts, while the remaining variance occurs across cohorts. Even given the small between-cohort variation, however, the effects of most individual-level, pre-adult status variables differ significantly across cohorts. Tests of significance based on χ^2 statistics reveal that all but one of the individual-level variables allowed to interact with cigarette diffusion—education, father's education, parents' income, urban residence at age 16, and gender, but not race—have effects on at least one contrast of the dependent variable that vary significantly across cohorts. The bottom rows of Table 2 lists the standard deviation or square root of the variance components for the intercept and education, which all differ significantly from zero according to the associated χ^2 values. To summarize the relevant statistics for all the equations in Table 3, the standard deviation of the variance component and the χ^2 probability for once smoked and then now smokes are as follows: Education (.058, .000; .085, .000), father's education (.023, .500; .024, .001), parents' income (.086, .451; .065, .047), urban residence at age 16 (.202, .013; .068, .000), male (.604, .000; .498, .000), and white (.202, .500; .159, .149).

the logged odds of now smokes by $-.368$ and the odds by 31%. These calculations reveal how the context of cohort-based change in cigarette diffusion leads to a shift from positive to negative in the relationship between education and smoking, and to the inverse education gradient in smoking.

2. The results for once smoked and now smokes support the hypothesis that the effect of father's education becomes increasingly negative across cohorts as cigarette diffusion proceeds. The average effects of father's education differ little from zero. However, these effects mask differences at the early and late stages of cigarette diffusion. The interaction coefficients of cigarette diffusion by father's education equal $-.507$ ($t = -2.74$) for once smoked and -1.150 ($t = -6.87$) for now smokes, indicating that the influence becomes increasingly negative as cigarettes diffuse. For example, when the cigarette diffusion measure takes a value two standard deviations below the mean (during the early stages of cigarette diffusion), the effect of father's education becomes positive for once smoked ($b = .046$, $e^b = 1.047$), and for now smokes ($b = .100$, $e^b = 1.105$). When the diffusion measure takes a value two standard deviations above the mean (as cigarette use abates during the late stages of diffusion), the effect of father's education becomes negative for once smoked ($b = -.036$, $e^b = .965$) and for now smokes ($b = -.084$, $e^b = .919$). Although the effects for father's education are weaker than for respondent's education, they likewise shift from positive to negative during the cohort-based process of cigarette diffusion.
3. The results for once smoked and now smokes support the hypothesis that the effect of parents' income becomes increasingly negative across cohorts as cigarette diffusion proceeds. The average effect of parents' income at age 16 is positive and insignificant ($b = .018$, $t = 0.56$) for once smoked, and positive and significant ($b = .084$, $t = 3.96$) for now smokes. Cigarette diffusion significantly modifies this relationship for once smoked ($b = -1.753$, $t = -2.31$) and for now smokes ($b = -3.957$, $t = -6.09$). For once and now smokes, respectively, the effects of parents' income equal $.158$ ($e^b = 1.171$) and $.401$ ($e^b = 1.493$) at two standard deviations below the mean, and $-.122$ ($e^b = .885$) and $-.233$ ($e^b = .793$) at two standard deviations above the mean.
4. The results for now smokes support the hypothesis that the effect of adolescent city size of residence becomes increasingly negative across cohorts as cigarette diffusion proceeds. The average effect of logged city size at age 16 is positive and significant for once smoked ($b = .351$, $t = 6.73$) and now smokes ($b = .391$, $t = 8.77$). The interaction effect with cigarette diffusion is negative and insignificant for once smoked ($b = -1.030$, $t = -0.83$), but negative and significant for now smokes ($b = -4.695$, $t = -4.47$). The coefficients indicate that the increase in smoking due to city size declines with cigarette diffusion. At early stages of the process (again, two standard deviations below the mean), the effect of city size on now smokes equals $.767$ ($e^b = 2.152$), while at the late stages of the process (two standard deviations above the mean), the effect of city size on now smokes falls to $.015$ ($e^b = 1.016$). Thus, current smoking shifts from being much more common among those raised in urban areas to only slightly more common among those raised in urban areas.
5. The results for once smoked and now smokes support the hypothesis that the effect of being male becomes increasingly negative (or less positive) across cohorts as cigarette diffusion proceeds. With positive and significant coefficients for once smoked ($b = .941$, $t = 10.85$) and now smokes ($b = .931$, $t = 12.70$), the dummy variable shows substantially higher smoking among men than women. In addition, the interaction effect of the dummy variable with cigarette diffusion is negative and

significant for once smoked ($b = -14.152, t = -6.72$) and now smokes ($b = -10.690, t = -6.06$). This indicates that the gap between the smoking of men and women decreases with cigarette diffusion. At early stages of the process (two standard deviations below the mean), the difference between men and women for once smoked equals 2.073 ($e^b = 7.950$) and for now smokes equals 1.786 ($e^b = 5.967$). These huge effects decline at later stages of the process (two standard deviations above the mean) to $-.191$ ($e^b = .826$) for once smoked and $.076$ ($e^b = 1.079$) for now smokes. In the most recent cohorts and later stages of diffusion, women are slightly more likely than men to have once smoked, and the gender gap in current smoking has narrowed substantially.

6. The results for once smoked and now smokes do not support the hypothesis that the effect of being white becomes increasingly negative across cohorts as cigarette diffusion proceeds. On average, whites smoke slightly more than blacks ($b = .303, t = 3.71$ for once smoked; $b = .168, t = 2.58$ for now smokes). The insignificant coefficients for the interaction terms ($b = -.476, t = -0.25$ for once smoked; $b = .095, t = 0.06$ for now smokes) indicate that this difference changes little across cohorts, and that the higher rates of white smoking persist with cigarette diffusion. This result suggests that the pattern of diffusion occurs in parallel within the white and black populations rather than occurring sequentially from whites to blacks.

The results thus far support five of the six hypotheses. In the last four columns of Table 3, which include all the interaction terms simultaneously, the results continue to support the hypotheses, although not as strongly as when including them one at a time. The interaction coefficients often decline in size in the combined models, as one would expect given the overlap of these socioeconomic variables with one another. The coefficients still reflect the same pattern in direction and significance as previously, and offer substantial evidence for the hypotheses. As before, the findings appear more clearly for now smokes than once smoked.

5.3. Graphing the relationships

A few graphs can illustrate how individual-level relationships change across cohorts as cigarette diffusion proceeds. Using the coefficients in column 3 of Table 3 for the now smokes contrast, Figs. 1A–F plot the relationship between each of the pre-adult individual-level variables (i.e., education, father's education, parents' income at age 16, logged city size at age 16, being male, and being white) for cohorts reaching adolescence at the early and late stages of cigarette diffusion (i.e., at two standard deviations below and above the mean of the cigarette diffusion measure). The slope for the early stage in Fig. 1A reveals slightly higher smoking at high education levels. In contrast, the slope for the later stage reveals a reversal—less educated persons smoke the most. The figure also reveals that smoking among the highly educated falls with diffusion, while smoking among the less educated increases. In Figs. 1B and C, father's education and parents' income increase smoking among cohorts in the early stage of diffusion, but reduce smoking among cohorts in the later stages of diffusion. Although weaker than for education, the changes are consistent with the hypotheses. In Fig. 1D, the slopes again demonstrate a shift in the direction of the effect of adolescent urban residence on smoking in later stages of diffusion. In Fig. 1E, the weaker slope in the late stage indicates smaller sex differences in smoking among recent cohorts. Finally, the slopes in Fig. 1F differ little for whites and blacks, reflecting lack of support for the interaction hypothesis involving race.

6. Conclusion

This paper links arguments concerning the diffusion of innovations, the adoption and rejection of fashions, and the importance of cohort-based social change to variation over the last century in social patterns of smoking. Although arguments about diffusion, fashions, and cohorts have appeared in rudimentary form in the smoking literature, this paper develops and extends the arguments by deriving specific hypotheses about how the relationships of pre-adult socioeconomic statuses with smoking change across birth cohorts during the process of cigarette diffusion. The hypotheses specify greater concentration of smoking among lower status, less dominant groups in recent cohorts and during later stages of cigarette diffusion than in older cohorts and earlier stages of cigarette diffusion.

The analysis tests the hypotheses with GSS data and multilevel models that allow the effects of education, father's education, parents' income, adolescent urban residence, sex, and race on smoking to vary across cohorts and stages of cigarette diffusion. The results support the predictions of the cohort-based diffusion arguments for all the relationships except those involving race. In older cohorts and early stages of cigarette diffusion, the measures of pre-adult socioeconomic status increase smoking, but in younger cohorts and later stages of cigarette diffusion, the measures reduce smoking. The results emerge stronger for the contrast between current smokers and never smokers than for the contrast between former smokers and never smokers, but the end result is to concentrate both former and current smokers among lower status groups. Similarly, the gaps in smoking that exist between urban and rural residences and between men and women in older cohorts and earlier stages decline substantially in younger cohorts and later stages. The major exception to the support for the predictions involves race: the small racial gap in smoking changes little across cohorts and stages of diffusion. Although the need to better explain racial patterns of smoking remains, the results otherwise correspond closely to the predictions of the theory and match cross-national differences across the European Community (Pampel, 2002).

The theory and results suggest the value of viewing smoking as an innovation or fashion that diffuses through a population in cohort-based processes. Although addictive, tobacco use follows class-based smoking fashions or tastes at the time of a cohort's adolescence, and changes according to class-based norms and networks. Thus, the adoption of the habit by high status groups early in the century diffuses to low status groups, but later, high status groups come to reject smoking in favor of healthy life styles. The process thereby comes to produce a strong negative relationship between socioeconomic status and smoking. Because cigarette smoking differs from changes in other fashions such as the choice of first names (Lieberson, 2000), clothing styles (Crane, 1999; Davis, 1992), and art (Halle, 1993) in more closely following class-based patterns of change, it better fits classic models of the diffusion of innovations. Attitudes toward medical research and media advertising may relate to class-based norms and tastes for smoking, and help explain the patterns of change observed in the analysis. For example, the more recent efforts of tobacco companies to target less educated audiences, and the greater success of the public health community in reaching more educated audiences, perhaps contribute to the diffusion of cigarettes from high to low status groups. Given the evidence of the diffusion of cigarettes across classes, future research should do more to identify the forces behind the changes.

In summary, the results provides some insights about the social determinants of smoking: they are not invariant, but change across social contexts. However, this approach represents only part of the process determining cigarette use. The socioeconomic status variables leave most of the variance in cigarette smoking unexplained, and the analysis makes no effort to prove the superiority of these variables over measures of personal traits, beliefs, and attachments. Indeed, the contextual approach cannot replace more individualistic approaches

to smoking, but can complement and extend them by giving more attention to distant social forces and processes of social change.

References

- Bourdieu, P. *Distinction: A Social Critique of the Judgement of Taste*. Nice, Richard, editor. Harvard University; Cambridge, MA: 1994.
- Centers for Disease Control. *Cigarette Smoking Among Adults—United States, 2000*. 2003. Available online, URL: www.cdc.gov/tobacco/research_data/adults_prev/ccmm5040.pdf
- Colby JP, Linsky AS, Strauss MA. Social stress and state-to-state differences in smoking and smoking-related mortality in the United States. *Social Science and Medicine*. 1994; 38:373–381. [PubMed: 8140464]
- Crane D. Diffusion models and fashion: a reassessment. *Annals ASPSS*. 1999; 566:13–24.
- Davis, F. *Fashion, Culture, and Identity*. University of Chicago Press; Chicago: 1992.
- Davis, JA.; Smith, TW. *General Social Surveys, 1972–1998: Cumulative Codebook*. National Opinion Research Center; Chicago: 1998.
- Department of Health and Human Services. *Women and Smoking: A Report of the Surgeon General*. US Department of Health and Human Services; Rockville, MD: 2001.
- Duncan C, Jones K, Moon G. Smoking and deprivation: are there neighborhood effects. *Social Science and Medicine*. 1999; 48:497–505. [PubMed: 10075175]
- Elder, G., editor. *Life Course Dynamics*. Cornell University; Ithaca, NY: 1985.
- Elstad JI. The psycho-social perspective on social inequalities in health. *Sociology of Health and Illness*. 1998; 20:598–618.
- Escobedo LG, Peddicord JP. Smoking prevalence in US birth cohorts: the influence of gender and education. *American Journal of Public Health*. 1996; 86:231–236. [PubMed: 8633741]
- Ferrence, RG. *Deadly Fashion: The Rise and Fall of Cigarette Smoking in North America*. Garland Publishing; New York: 1989.
- Graham H. Cigarette smoking: a light on gender and class inequality in Britain. *Journal of Social Policy*. 1995; 24:509–527.
- Griswold, W. *Cultures and Societies in a Changing World*. Pine Forge Press; Thousand Oaks, CA: 1994.
- Gua G, Zhao H. Multilevel modeling for binary data. *Annual Review of Sociology*. 2000; 26:441–462.
- Gusfield, JR. The social symbolism of smoking and health. In: Rabin, RC.; Sugarman, SD., editors. *Smoking Policy: Law, Politics, and Culture*. Oxford University; New York: 1993. p. 49–68.
- Halle, D. *Inside Culture: Art and Class in the American Home*. University of Chicago Press; Chicago: 1993.
- Harris JE. Cigarette smoking among successive birth cohorts of men and women in the United States during 1900–80. *Journal of the National Cancer Institute*. 1983; 71:473–478. [PubMed: 6577223]
- Johnson RA, Hoffman JP. Adolescent cigarette smoking in US racial/ethnic subgroups: findings from the national education longitudinal study. *Journal of Health and Social Behavior*. 2000; 41:392–407. [PubMed: 11198564]
- Katz E. Theorizing diffusion: tarde and sorokin revisited. *Annals ASPSS*. 1999; 566:144–155.
- Kreft, I.; de Leeuw, J. *Introducing Multilevel Modeling*. Sage; London: 1998.
- Lamont, ML.; Fournier, M., editors. *Cultivating Differences: Symbolic Boundaries and the Making of Inequality*. University of Chicago; Chicago: 1992.
- Lawlor DA, Frankel S, Shaw M, Ebrahim S, Davey Smith S. Smoking and ill health: does lay epidemiology explain the failure of smoking cessation programs among deprived populations? *American Journal of Public Health*. 2003; 93:266–270. [PubMed: 12554581]
- Link BG, Phelan J. Social conditions as fundamental causes of disease. *Journal of Health and Social Behavior*. 1995; (Special Issue):80–94. [PubMed: 7560851]
- Lee, PN., editor. *Tobacco Consumption in Various Countries*. Tobacco Research Council; London: 1975.

- Liebertson, S. *A Matter of Taste: How Names, Fashions, and Culture Change*. Yale University; New Haven: 2000.
- Lopez, AD. The lung cancer epidemic in developed countries. In: Lopez, AD.; Caselli, G.; Valkonen, T., editors. *Adult Mortality in Developed Countries: From Description to Explanation*. Clarendon; Oxford: 1995. p. 111-143.
- Lopez AD, Collishaw NF, Piha T. A descriptive model of the cigarette epidemic in developed countries. *Tobacco Control*. 1994; 3:242-247.
- Marsh, A.; McKay, S. *Poor Smokers*. Policy Studies Institute; London: 1994.
- Mendez D, Warner KE, Courant PN. Has smoking cessation ceased? Expected trends in the prevalence of smoking in the United States. *American Journal of Epidemiology*. 1998; 148:249-258. [PubMed: 9690361]
- O'Brien RM. Age period cohort characteristic models. *Social Science Research*. 2000; 29:123-139.
- Pampel FC. Cigarette diffusion and sex differences in smoking. *Journal of Health and Social Behavior*. 2001; 42:388-404. [PubMed: 11831139]
- Pampel FC. Inequality, diffusion, and the status gradient in smoking. *Social Problems*. 2002; 49:35-57.
- Patrick DL, Cheadle A, Thompson DC, Diehr P, Koepsell T, Kinne S. The validity of self-reported smoking: a review and meta-analysis. *American Journal of Public Health*. 1994; 84:1086-1093. [PubMed: 8017530]
- Raudenbush, SW.; Bryk, AS. *Hierarchical Linear Models: Applications and Data Analysis Methods*. 2. Sage; Thousand Oaks, CA: 2002.
- Raudenbush, SW.; Bryk, Anthony; Cheong, Yuk Fai; Congdon, Richard. *HLM 5: Hierarchical Linear and Nonlinear Modeling*. Scientific Software International; Chicago: 2000.
- Rogers, EM. *Diffusion of Innovations*. 4. Free Press; New York: 1995.
- Rogers RG, Nam CB, Hummer RA. Demographic and socioeconomic links to cigarette smoking. *Social Biology*. 1995; 42:1-21. [PubMed: 7481913]
- Rogers RG, Powell-Griner E. Life expectancies of cigarette smokers and nonsmokers in the United States. *Social Science and Medicine*. 1991; 10:1151-1159. [PubMed: 2068598]
- Ross CE. Walking, exercise, and smoking: does neighborhood matter? *Social Science and Medicine*. 2000; 51:265-274. [PubMed: 10832573]
- Ross CE, Wu C. The links between education and health. *American Sociological Review*. 1995; 60:719-745.
- Rozin P. The process of moralization. *Psychological Science*. 1999; 10:218-221.
- Ryder NB. The cohort as a concept in the study of social change. *American Sociological Review*. 1965; 30:843-861. [PubMed: 5846306]
- Schrijvers CT, Stronks K, van de Mheen HD, Mackenbach JP. Explaining educational differences in mortality: the role of behavioral and material factors. *American Journal of Public Health*. 1999; 89:535-540. [PubMed: 10191797]
- Simmel, G. Fashion. In: Levine, D., editor. *George Simmel: On Individuality and Social Forms*. University of Chicago Press; Chicago: 1971[1904]. p. 294-323.
- Shyrock, HS.; Siegel, JS. *The Methods and Materials of Demography*. US Department of Commerce; Washington, DC: 1975.
- Strang D, Soule SA. Diffusion in organizations and social movements: from hybrid corn to Poison Pill. *Annual Review of Sociology*. 1998; 24:265-290.
- US Bureau of the Census. *Historical Statistics*. US Department of Commerce; Washington, DC: 1980.
- US Bureau of the Census. *Statistical Abstract 1999*. US Department of Commerce; Washington, DC: 1999.
- Veblen, T. *Transaction*. New Brunswick, NJ: 1992[1899]. *Theory of the Leisure Class*.
- Viscusi, WK. *Smoking: Making the Risky Decision*. Oxford University; New York: 1992.
- Wilkinson, R. *Unhealthy Societies: The Afflictions of Inequality*. Routledge; London: 1996.
- Williams DR, Collins C. US socioeconomic and racial differences in health: patterns and explanations. *Annual Review of Sociology*. 1995; 21:349-386.

- Willis TA, Cleary SD. The validity of self-reports of smoking: analysis by race/ethnicity in a school sample of urban adolescents. *American Journal of Public Health*. 1997; 87:56–61. [PubMed: 9065227]
- Winship C, Radbill L. Sampling weights and regression analysis. *Sociological Methods and Research*. 1994; 23:230–257.
- Wray LA, Herzog AR, Willis RJ, Wallace RB. The impact of education and heart attack on smoking cessation among middle-aged adults. *Journal of Health and Social Behavior*. 1998; 39:271–294. [PubMed: 9919852]
- Zhu B, Giovino GA, Mowery PD, Eriksen MP. The relationship between cigarette smoking and education revisited: implications for categorizing persons' educational status. *American Journal of Public Health*. 1996; 86:1582–1589. [PubMed: 8916524]

Fig. 1. Predicted now smokes logits for values of independent variables at early and late stages of cigarette diffusion. Early stage refers to the value on the measure of change in cigarette consumption that is two standard deviations below the mean, while late stage refers to the values two standard deviations above the mean. Predicted values are calculated from equations for coefficients in column 3 of Table 3.

Table 1
Percentage smokers and education-smoking correlations by race and cohort, GSS 1978–1994^a

Race and birth cohort ^b	Sample size		% Ever smoked		% Now smoked		<i>r</i> Education and ever smoked		<i>r</i> Education and now smoked	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
<i>Whites</i>										
1889–1914	475	892	80	41	36	22	.02	.12*	-.05	.07*
1915–1922	494	738	84	67	48	41	-.09*	.04	-.07	-.06
1923–1930	580	736	85	71	55	47	-.15*	-.02	-.17*	-.04
1931–1938	524	662	85	71	61	48	-.13*	-.03	-.14*	-.11*
1939–1944	529	658	83	65	63	45	-.26*	-.12*	-.31*	-.19*
1945–1949	633	694	79	62	64	48	-.17*	-.15*	-.17*	-.21*
1950–1953	547	646	74	56	62	43	-.30*	-.20*	-.27*	-.25*
1954–1957	537	667	68	56	57	45	-.31*	-.25*	-.28*	-.23*
1958–1961	485	622	62	58	52	47	-.27*	-.35*	-.30*	-.39*
1962–1976	593	662	50	51	41	40	-.26*	-.31*	-.24*	-.31*
<i>Blacks</i>										
1889–1914	43	95	85	38	59	21	-.11	.02	-.01	.13
1915–1922	65	103	86	59	53	37	.04	-.08	-.06	.01
1923–1930	71	114	88	65	70	47	-.01	.08	-.22	-.05
1931–1938	83	127	84	68	61	50	-.01	.02	-.05	-.04
1939–1944	63	106	84	72	76	57	-.18	.17	-.24	-.01
1945–1949	74	121	76	65	70	52	-.12	-.14	-.13	-.16
1950–1953	72	131	80	64	68	53	-.17	-.17	-.13	-.17
1954–1957	67	163	77	60	69	48	-.22	-.25*	-.14	-.26*
1958–1961	80	143	71	54	69	50	-.17	-.32*	-.18	-.32*
1962–1976	110	164	41	35	32	27	-.34*	-.24*	-.31*	-.26*

^a Statistics are computed using weights that adjust for the early death of smokers.

^b Birth cohort is categorized for presentation so that each group is of roughly similar size.

$p < .05$
*

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 2

Coefficients and *T*-ratios for multilevel multinomial logit models of cigarette smoking, individual-level additive determinants, GSS 1978–1994^a

Variable	Once ^b			Now ^b			Once ^b			Now ^b		
	<i>b</i>	<i>t</i>		<i>b</i>	<i>t</i>		<i>b</i>	<i>t</i>		<i>b</i>	<i>t</i>	
Intercept	-.764	-31.90		-.301	-14.41		-.704	-28.17		-.234	-9.68	
Year	.006	1.16		-.028	-5.76		.008	1.53		-.033	-6.64	
Age	.094	8.59		.128	12.96		.094	8.49		.149	14.26	
Age ²	-.001	-8.15		-.002	-16.33		-.001	-7.98		-.002	-16.66	
Married (= 1)	.179	3.47		-.243	-5.48		.162	3.12		-.272	-6.03	
City size (log)	-.006	-0.45		-.004	-0.37		-.003	-0.25		-.000	-0.03	
Family income	.001	.55		-.007	-5.88		.000	0.22		-.007	-6.31	
Education	-.058	-6.64		-.152	-18.45		-.072	-6.10		-.170	-12.70	
Father's education	.004	0.57		-.009	-1.43		.012	1.65		.004	0.62	
Family income age 16	.021	0.71		.092	3.57		.024	0.81		.098	3.78	
City size age 16 (log)	.344	8.02		.415	10.67		.323	7.49		.376	9.59	
Male (= 1)	.855	18.32		.746	18.06		.868	18.49		.774	18.46	
White (= 1)	.297	3.86		.161	2.63		.298	3.87		.150	2.43	
Cigarette diffusion	-2.239	-2.21		-2.722	-2.87		-1.640	-1.58		-.047	-0.04	
× Education							-1.398	-5.04		-2.480	-7.77	
Variance components ^c												
Intercept	.016	267.73		.019	323.33		.031	221.00		.097	313.78	
Education							.058	163.16		.085	202.91	

^a Sample sizes: 14,274 individuals, 88 cohorts (estimates are weighted to adjust for the early death of smokers).

^b Once = contrast between once smoked and never smoked; now = contrast between now smokes and never smoked.

^c Coefficients under *b* refer to standard deviations of the level-2 error terms and coefficients under *t* refer to χ^2 statistics.

Table 3

Coefficients and *T*-ratios for multilevel multinomial logit models of cigarette smoking, cross-level interactions, GSS 1978–1994^a

Variables ^d	Separate interactions ^b			Combined interactions ^b		
	Once ^c		Now ^c	Once ^c		Now ^c
	<i>b</i>	<i>t</i>	<i>b</i>	<i>b</i>	<i>t</i>	<i>b</i>
Education	-.072	-6.10	-.170	-12.70	-6.16	-.165
×Cigarette diffusion	-1.398	-5.04	-2.480	-7.77	-1.298	-4.44
Father's education	.005	.60	-.008	-1.04	.014	.008
×Cigarette diffusion	-.507	-2.74	-1.150	-6.87	-.141	-.67
Family income age 16	.018	.56	.084	3.11	.032	.101
×Cigarette diffusion	-1.753	-2.31	-3.957	-6.09	-.504	-.62
City size age 16 (log)	.351	6.73	.391	8.77	.357	.398
×Cigarette diffusion	-1.030	-.83	-4.695	-4.47	-.591	-.45
Male (= 1)	.941	10.85	.931	12.70	.995	10.58
×Cigarette diffusion	-14.152	-6.72	-10.690	-6.06	-13.549	-5.93
White (= 1)	.303	3.71	.168	2.58	.309	.137
×Cigarette diffusion	-.476	-.25	.095	.06	1.928	0.91
						3.055
						1.78

^aSample sizes: 14,274 individuals, 88 cohorts (estimates are weighted to adjust for the early death of smokers).

^bSeparate interactions = each interaction term added alone in a separate equation; combined interactions = all interactions terms added together in a single equation.

^cOnce = contrast between once smoked and never smoked; now = contrast between now smokes and never smoked.

^dIncludes controls for year of survey, age, age squared, marital status, current city size of residence, and current family income (as in Table 2).