Cohort changes in educational disparities in smoking:
France, Germany and the United States

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ABSTRACT

This study investigates the evolution of educational disparities in smoking uptake across cohorts for men and women in three countries. Nationally representative surveys of adults in France, Germany and the United States in 2009–2010 include retrospective measures of age of uptake that are compared for three cohorts (born 1946–1960, 1961–1975, and 1976–1992). Discrete logistic regressions and a relative measure of education are used to model smoking histories until age 34. The following patterns are found: a strengthening of educational disparities in the timing of uptake from older to younger cohorts; an earlier occurrence of the strengthening for men than women and for the United States than France or Germany; a faster pace of the epidemic in France than in the United States, and; a divide between the highest level of education and the others in the United States, as opposed to a gradient across categories in France. Those differences in smoking disparities across cohorts, genders and countries help identify the national and temporal circumstances that shape the size and direction of the relationship between education and health and the need for policies that target educational disparities.

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As a major determinant of chronic disease and premature mortality, tobacco use remains central to individual and population health. The WHO estimates that in 2004 25% of male deaths and 7% of female deaths in the European region and 23% of deaths for both men and women in the United States came from tobacco use (WHO, 2012). Smoking and exposure to tobacco smoke harms people at all ages, causing respiratory diseases during childhood, increased cardiovascular disease in middle age, and higher rates of cancer at older ages. It remains the leading risk for disease in high-income North America and Western Europe (Lim et al., 2012).

Given its importance for health, the substantial decline in the prevalence of tobacco use in Western Europe, the United States, and many other countries throughout the world has been encouraging (Fiori and Baker, 2009) and in part reflects the success of anti-tobacco campaigns and public health programs (Joossens and Raw, 2006; Wilson et al., 2012). At the same time, smoking has increasingly become concentrated among lower socioeconomic status (SES) groups in high-income nations (Cavelaars et al., 2000; Giskes et al., 2005; Huisman et al., 2005; Pampel, 2002a). Of particular importance, the decline in smoking has occurred fastest among high educational groups, thus widening the gap with lower educational groups and contributing to growing educational disparities in mortality more generally (Jha et al., 2006). Widening inequality in tobacco use and its harm present a public health problem in protecting those who can least afford its financial or health costs.

Educational disparities in smoking reflect the lack of resources among disadvantaged groups but involve a diverse set of mechanisms (Cutler and Lleras-Muney, 2010). The fewer resources of disadvantaged groups produce a set of cumulative consequences: they increase stress that makes smoking an attractive coping strategy, limit access to health information, give groups with high mortality risks overall less incentive to avoid the harm of smoking, are associated with more limited time horizons, reduce the social capital available for help in avoiding smoking, and make it harder to
1. Study framework

The temporal pattern of change posited by the epidemic and diffusion model implies variation across cohorts, genders, and countries. The adoption of smoking is strongly influenced by cohort membership and the smoking environment at the time a cohort reaches late adolescence and early adulthood (Preston and Wang, 2006). High education groups appear more likely to take up the habit when it is relatively rare but reject the habit when it is relatively common, whereas low education groups tend to do the opposite (Legleye et al., 2011a; Pampel, 2005). Hence, older cohorts should show a weak positive SES-smoking gradient and, reflecting a reversal in the direction of disparities, newer cohorts should show a strong negative SES-smoking gradient. Moreover, since women tend to adopt smoking later than men, the cohort shift in the gradient should occur more recently among females than males.

Arguments about the diffusion of tobacco use apply to both uptake dynamics and cessation dynamics as contributors to smoking prevalence inequalities. However, the two processes differ substantially, with cessation proving more difficult and requiring more resources than initiation. Although educational disparities in cessation are strong (Reid et al., 2010), initiation is an important contributor to the patterns of educational inequality in adult smoking (Maralani, 2013). Despite calls for more study of initiation (Schaap and Kunst, 2009), however, most studies examine disparities in uptake for one nation (e.g., (Legleye et al., 2011a; Schulze and Mons, 2006)). We focus on cross-national comparisons of the timing of initiation, an event that precedes cessation in temporal order and provides a context for other studies of the timing of cessation.

The focus on initiation across cohorts, genders, and nations adds to the more typical study of educational disparities in smoking prevalence. Studies of prevalence find greater disparities among younger than older cohorts in single nations (e.g., Pampel, 2005) and in international comparisons (Cavelaars et al., 2000; Giskes et al., 2005; Huisman et al., 2005; Pampel, 2002). While prevalence mixes initiation and cessation, measures of the age of initiation capture additional information on timing.

Cross-national studies of smoking typically rely on education as a measure of socioeconomic position (Cavelaars et al., 2000; Giskes et al., 2005; Huisman et al., 2005), as education more strongly predicts smoking than income or occupation (Barbeau et al., 2004). Since smoking begins early in life, uptake should be more influenced by success in school, academic goals, and completed education than by later occupational and income attainment. While education remains stable for most after young adulthood, occupation and income change greatly over the life course and are less easily measured for those not working. Further, the International Standard Classification of Education (ISCED) allows for meaningful comparisons across nations (UNESCO, 2006).

2. Research hypotheses

Specific hypotheses may be formulated in relation with the relative degree of advancement in the epidemic of the three countries subjected to comparison.

1. Timing of emergence of a negative gradient and size of disparities.

Based on the timing of the smoking epidemic, countries differ in cohort changes in smoking disparities (van der Heyden et al., 2009). The sooner the epidemic begins in a country, the farther it advances over time and the larger the disparities will be. Given its location as a source of tobacco farming, the invention of machines to mass
produce cigarettes, and aggressive advertising by tobacco companies (Kluger, 1996), the United States began the tobacco epidemic relatively early. Additionally, due to special commercial efforts, female consumption was especially valued and encouraged in the United States in the 1920’s, leading to an early and rapid development of tobacco smoking among women (Amos and Haglund, 2000). In Germany and France, smoking was adopted to large numbers later. As evidence, figures on sales of manufactured cigarettes (Forey et al., 2013) show a peak in 1963 for the United States, 1976 for Germany, and 1985 for France. Another measure takes advantage of the divergence of male and female smoking in early stages and the convergence in later stages (Gallus et al., 2006). Using figures in (Eriksen et al., 2012), the ratio of female to male smoking-attributable mortality equals 0.20 in France (5% versus 25%), 0.41 in Germany (9% versus 22%), and 1.00 in the United States (23% versus 23%). Given the earlier start of the epidemic in the United States, we can expect to see a negative educational gradient in smoking emerge earlier than in France and Germany. The peak year in cigarette sales suggests that Germany will fall between the United States and France in the size of the disparities.

2. Pace of change across countries and across genders

The variation across countries in timing of the epidemic suggests another component of the diffusion process: The rate of change in the cycle may be faster for countries that start later. The early rise of cigarette use in the United States, which occurred well before a scientific consensus on the harm of tobacco emerged, may extend the process of change in disparities. The later start in France and Germany means that the process of change occurred in an environment of more extensive knowledge of the harm of smoking, which should speed the decline in tobacco use among the highly educated and the growth of disparities. Also, policies in the United States emerged slowly in a decentralized fashion, whereas they occurred later but more quickly and comprehensively in Europe under the guidance of the Framework Convention on Tobacco Control (Eriksen and Cerak, 2008). Along with earlier emergence of the negative gradient in the United States, then, we can expect to see a slower pace of change in the strengthening of the gradient than in France or Germany. Also based on an earlier start, men should show a slower pace of change than women.

3. Pattern of educational disparities

The pattern of cohort change in educational disparities in smoking may be influenced as well by the structure of the educational systems. In the United States, a college education tends to define a strong dividing line for a wide variety of outcomes (Fisher and Hout, 2006). The high proportion of the population 25 and over attaining tertiary education (38.3% for men and 39.9% for women (UNESCO, 2013) may serve to downgrade the value of other degrees and create a gap between the college educated and others that can affect smoking. In France, where university attendance is more selective and attainment of a tertiary education less common (24.2% of men and 24.7% of women (UNESCO, 2013), intermediate positions in the hierarchy may moderate differences between college graduates and others. Tertiary educational attainment in Germany resembles that in France but with a larger gender difference (29.6% of men and 19.2% of women complete tertiary education (UNESCO, 2013)). Thus, we expect a stronger contrast between college graduates and other groups in the United States and a more continuous gradient in educational disadvantage in France and perhaps in Germany, especially for women in this latter country.

3. Data and methods

Data come from three comparable surveys: 1) the French Health Barometer 2010, a representative nationwide telephone survey of the non-institutionalized population aged 15—85 (Beck et al., 2011), 2) the 2009 German Epidemiological Survey of Substance Abuse, a representative survey of the German-speaking non-institutionalized civilian population aged 18—64 that uses a mixture of paper-and-pencil questionnaires, telephone interviews and internet questionnaires (Kraus and Pabst, 2010), and; 3) the 2010 U.S. National Health Interview Survey Adult Sample, a representative nationwide face-to-face survey of individuals ages 18 and older within households and non-institutional group quarters (National Center for Health Statistics, 2013). For the population studied here, men and women at ages 18—64 with complete education and smoking data, the sample sizes equal 21,504 in France, 21,818 in the United States, and 7887 in Germany.

In France, the survey used a two-stage simple random sample: household (with random digital dialing and including mobile and internet phones) and then one person within the household (Kish method based on the age and gender composition of the household). The response rate was 60.5%. Weights adjust for survey design, non-response and the proportion of mobile phones and use a calibration process based on age, sex, diploma, employment status and region to match the distribution of the last national Labor Force Survey. In Germany, the survey used two-stage probability sampling, first with the selection of communities proportional to population size and second with the selection of individuals from residents’ registration office. The design oversampled younger birth cohorts. The response rate was 50.1%. Weights adjust for sampling design and the national distribution of age, gender, federal state, and size of the community. In the United States, the survey used a stratified multistage procedure that oversamples minority groups. The response rate was 60.8%. Weights adjust for design, non-response, and post-stratification adjustment (to match the age-sex-race/ethnicity distribution in the census).

3.1. Measures

Each data set includes measures of the age at smoking uptake for those who had ever smoked regularly. In the French data, uptake refers to regular smoking with a follow-up probe on daily smoking for uncertain respondents (“A quel age avez-vous commence à fumer régulièrement, i.e. tous les jours?”). This question was asked to current regular or former regular smokers (who had been smoking at least six months). In the German data, uptake refers to age of starting to smoke daily (“Wie alt warenSie, alsSiebegonnenhabentäglichzurauchen?”). This was asked to individuals who had smoked at least 100 cigarettes in their lives. In the U.S. data, uptake refers to regular smoking; “How old were you when you FIRST started to smoke fairly regularly?” This question was asked to current or former smokers (who had smoked 100 cigarettes in their lifetime). In addition, the French and German data sets, but not the U.S. data set, have measures of age first tried smoking, a precursor to regular smoking.

Age in 2010 is used to define three cohorts for comparison: ages 50—64 (born 1946—1960), ages 35—49 (born 1961—1975), and ages 18—34 (born 1976—1992). Cohorts born earlier and excluded from the analysis are subject to recall problems and high levels of differential mortality. To make the comparisons of smoking meaningful across cohorts, the ages of initiation for the older cohorts are restricted to age 34, the upper bound of the youngest cohort. Initiation after those ages is considered censored. To control for the sometimes different smoking patterns of immigrants, two
To both depict and summarize the educational gradients in initiation across cohorts and nations, the figures list the odds ratios for the ridit measure of education (or the RII) from the multivariate discrete-time survival models that adjust for the covariates. The full tables for the logistic regressions are included in Supplementary Tables S2–S4 and the results for interactions of country, cohort and gender -and other three-ways interactions combining gender, education, cohort and country- are shown in Supplementary Table S5.

4. Results

4.1. Uptake of regular smoking

The hazard curves by cohort, gender, and country reveal differences in the educational gradient in uptake of regular smoking. For the oldest cohort of men in France, the curve rises fastest for the least educated group and slowest for the highest educational group (Fig. 1). The cumulative hazard of smoking uptake increases quickly during adolescence but changes little after age 20. For the youngest cohort of men in France, the hazard curves reveal the emergence of a strong gradient. By the early twenties, the cumulative hazard for the lowest educational group reaches a plateau of nearly 70% of ever smokers compared to a maximum of 32% for the highest educational group.

The odds ratio for relative education summarizes the change in the educational gradient. For the oldest cohort of men in France, the odds ratio for the lowest to the highest education level of 1.53 shows a modest gradient. For younger cohorts, odds of uptake of regular smoking are 4.97 times higher for the lowest educational group than the highest. In Germany (Fig. 2), the gradient in uptake of regular smoking changes little across cohorts, staying at relatively low levels for men of 1.69, 2.15, and 1.38.

In the United States (Fig. 3), a pattern of change similar to that found for France appears, but the odds ratios for education is higher for the oldest cohort in the United States (2.97) than in France (1.53). For the youngest cohort, the gradient is similarly large in the United States (5.18) as in France (4.97).
For smoking uptake among women, the gradient of the oldest cohort in France is in the opposite direction of men. The odds ratio for education of 0.57 indicates faster uptake among more educated women rather than less educated women (Fig. 1). However, the positive gradient shifts across cohorts to favor more educated women. For the youngest cohort, the odds in France are 3.68 times higher for the least educated than the most educated women. The cohort pattern for women in Germany (Fig. 2) resembles that for France. The odds ratio increases from near one for the oldest cohort to 2.15 for the youngest cohort. In the United States, the gradient for women changes in the same direction but differs from the other two countries for the oldest cohort (Fig. 3). Unlike France and Germany, the odds ratio for the oldest cohort of 1.96 reveals a greater hazard among less educated women. For the youngest cohort, the odds ratio of 3.82 for the United States is similar to the odds ratio of 3.68 for France and larger than the odds ratio of 2.15 for Germany.

Comparisons across countries reveal noticeable differences. Among both men and women in the youngest cohort in France, a gradient appears with each educational trajectory being roughly equidistant from the one below and above. Among the youngest cohort of men and women in the United States, the three lowest education groups cluster together, defining a large gap with the highest category. For Germany, the pattern is mixed with some cohorts showing a large gap and others showing a gradient.

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Another difference emerges across countries such that the epidemic appears more compressed in France than the United States. In France, the education odds ratio for the youngest cohort is much larger than for the oldest cohorts (4.97 versus 1.53). In the United States, the education odds ratio for the youngest cohort is larger than for the oldest cohort (5.18 versus 2.97) but not to the same extent as in France. The cohort-based disparities thus appear to rise more quickly in France, where the epidemic is more recent. However, the results for Germany show relatively little change in the magnitude of disparities across cohorts compared to the situation for either France or the United States.

### 4.2. Gender differences in smoking uptake

To make gender comparisons more precise, Figs. 1–3 each list two more coefficients at the bottom: the odds ratio for men relative to women (labeled OR Gender (M/F)) and the odds ratio of the effect of relative education for men relative to that for women (labeled OR Gender*RII).

First, for gender differences in smoking uptake, the odds are significantly higher for males than females in all cohorts and countries. However, the odds ratio for the oldest cohort in France (2.14) indicates a large gender gap in uptake. In contrast, the odds ratios of 1.83 for Germany and 1.62 for the United States indicate a greater hazard for men than women but a smaller gap than for France. For the youngest cohorts, gender differences in smoking decline in all the nations to 1.15 in France, 1.19 in Germany and 1.46 in the United States. However, gender convergence in smoking uptake across cohorts occurs most clearly and quickly in France and Germany.
Second, for the educational gradient in smoking uptake, the largest difference between men and women occurs again for the oldest cohort in France. The odds ratio for education is 2.84 times greater for men than women in France. The corresponding odds ratios for Germany and the United States are, respectively, 1.95 and 1.57. For the youngest cohorts, the gradients for men and women show in odds ratios of 1.33 for France, 0.83 for Germany and 1.59 for the United States. In Germany, the effects of education on smoking tend to be opposite in males than females in the youngest cohort. Gender convergence in the association of smoking with education occurs across cohorts more clearly and quickly for France and Germany than the United States.

5. Discussion

Given the damage of tobacco use to health, the persistently high prevalence among socioeconomically disadvantaged groups relative to advantaged groups has become a serious public health problem. To help understand macro-level sources of tobacco disparities in education, we examined gender and cohort-based changes in tobacco uptake by education in France, Germany, and the United States. The effort extends existing comparative research by focusing on the timing of starting to smoke rather than prevalence and by making explicit comparisons across three nations with different starting points for the epidemic, rates of change in educational disparities, and educational divisions in smoking.

The results for uptake give evidence of strengthening educational disparities across cohorts in France and the United States for both men and women. In Germany, the same strengthening of disparities in uptake appears for women but less consistently for men. Despite the exception, the results generally match arguments that the adoption of smoking begins with higher educational groups but is followed by diffusion of smoking to lower educational groups and rejection of the habit by higher educational groups. For men, the data on cohorts do not go back far enough historically to capture the earliest stage of diffusion when uptake was consistently greater among high educational groups. Yet, the shift from a weak negative gradient to a strong negative gradient is consistent with the expected pattern of change. For women, the oldest cohorts show earlier uptake among the highest educational group in France, after which the gradient shifts direction as well as strengthens. The lag in emergence of the negative gradient shows that less educated women initiate more slowly and less often than more educated women. In most cases, differences between men and women in the timing of uptake and educational gradient in uptake converge across cohorts.

Regarding research hypothesis 1 (timing of emergence of a negative gradient and size of disparities) our expectations are confirmed, as the results generally show earlier emergence and strengthening of disparities in uptake in the United States than France and Germany. For uptake among the oldest cohorts, the educational gradient is larger in the United States than the other two countries for both men and women. This result is consistent with the more advanced stage of diffusion. For the youngest cohorts, the patterns get closer as the epidemic in France and Germany catches up to that in the United States. For these cohorts, the
United States and France have similarly large gradients for both men and women, while Germany has a smaller gradient.

Regarding research hypothesis 2 (pace of change across countries and across genders), our expectations are confirmed. The growth of the disparities appears to have occurred faster in France than the United States, offering some evidence of the compression for one country that started the epidemic later. The difference in the rate of change may stem from recent policy efforts to reduce smoking, the exposure of younger generations to widespread publicity about the harm of smoking, or factors unique to the countries. Although Germany does not fit the pattern, the results suggest some value from studying the varying lengths of the epidemic across countries.

Regarding research hypothesis 3 (pattern of educational disparities), country divisions in the nature of educational differences in smoking appear in the results. France shows more of a gradient in educational differences in uptake of regular smoking, while the United States shows a gap between the highest level of education and the other three levels. Germany shows a mixed pattern that for some cohorts and genders resembles the United States and for others resembles France. Our findings therefore suggest that the divide occurs at the highest level of tertiary education (High-long) in the United States rather than at entry into college as initially expected.

Additionally, our results show that despite a convergence of the trends in educational gradients toward stronger inequalities in smoking in both genders but more gender-balanced prevalence across cohorts in the three countries, the current remaining differences between genders in the youngest cohort are meaningful. The difference in smoking uptake between genders are currently higher in the United States than in France or Germany. This reflects the ranking of these countries according to the Gender Inequality Index produced by the United Nation Development Programme: among all nation members, Germany is 6, France is 9, and the United States is only 42 (UNDP, 2013). This ranking is in contrast with the lower level of use in the United States, the initially more gender balanced prevalence in the older cohorts, and the earlier development of smoking among women there. It may be that the social value of cigarette and its place in the claim for gender equality is more important in the European countries. In this perspective, gender differences in smoking are an element reflecting global gender inequalities.

Similar results have been shown for adolescent alcohol use in Europe (Legleye et al., 2011b). In spite of this, the gender difference in the educational gradient diminished in France and Germany (but not in the USA) and then converged in the three countries, meaning that education now affects genders in much the same way in regard to tobacco uptake.

The findings on initiation for cohorts, genders, and nations add to previous studies of educational disparities in smoking prevalence. They similarly support diffusion arguments but also add additional information on timing that is not captured by measures of current smoking. The results of this study show that cohort changes begin with differences in the uptake of smoking during younger ages. Consistent results across studies of prevalence and ages of starting are encouraging. Nonetheless, future research on uptake that includes additional countries would allow a more
thorough test of the epidemic and diffusion arguments and comparison of country historical and policy differences.

This pattern of change relates to the characteristics of tobacco initiation and cessation as innovations. Initiation has high trialability (Rogers, 2003), or ease of experimentation and low need for resources. The special characteristics of initiation may help speed the eventual adoption of cigarettes by all SES groups, including those with few resources. In contrast, cessation requires more effort and resources and has lower trialability. The need for more resources to quit smoking may lead to larger SES differences at later stages of the epidemic. The differences between initiation and cessation mean that additional research is needed to compare nations on educational disparities in the timing of cessation.

Given the importance of smoking to mortality and health, the findings have implications for understanding the broader relationship between education and health. Jha et al. (2006) report for 4 countries that up to 50% of educational disparities in mortality can be attributed to smoking. Our results show that the relationship between education and uptake of regular smoking—a key to tobacco harm—varies systematically across cohorts, genders, and countries and depends in good part on the stage of the cigarette epidemic. The implication is that the historical circumstances of cohorts that determine the start and peak of the epidemic shape disparities in both tobacco use and health overall. When attempting to understand the source of disparities, scholars need to take account of the macro-context of smoking defined in part by the stage of the smoking epidemic.

The cross-national comparisons present a perspective that complements more individual-oriented explanations of disparities. As already stated, those with less education and lower socioeconomic status may smoke because of greater stress, less understanding of the harm of smoking, shorter time horizons, and fewer economic, social, and cultural resources to help avoid uptake and ease cessation. While important, these factors cannot explain the widening of inequalities over time in all three countries or the country and gender difference in timing of the widening. Individual motivations and resources operate within a context of broader macro-level, education-based changes in smoking.

Two key strategies of reducing smoking, raising cigarette prices and banning smoking in public places (Wilson et al., 2012), are based partly on the view that disadvantaged groups will respond most to the policies because they can least afford the added expense and inconvenience of higher prices and smoking restrictions (Thomas et al., 2008). Yet, disparities have grown rather than declined since the introduction of these policies (Pampel, 2009; Peretti-Watel et al., 2009). Given our results, policies may need to consider the stage of the tobacco epidemic in targeting education groups and devising strategies that appeal to the different circumstances and resources of the educational groups.

The analysis benefited from the use of a measure of education that adjusts for differences across cohorts, genders, and countries in the structure of education. The ridit measures each individual’s educational attainment relative to that of persons in the same cohort, gender, and country. It thus controls for expansion of the educational system for younger cohorts, differences in educational opportunities for men and women, and the varied educational programs in France, Germany, and the United States. The results for Germany fit less clearly into the pattern apparent for the United States and France. For men in particular, disparities grew from the older to the middle cohort but surprisingly then decline. The reunification of Germany may have produced some idiosyncratic changes in educational disparities in smoking. In their study of smoking prevalence, Westphal and Dohlhammer (2012) find differences between the former East and West Germany in the trends in the educational gradient of women but not men. Our ability to check for differences is limited by the sample size, but a preliminary analysis suggests that the effects for the total sample are comparable to those obtained when restricting the analyses to West Germany. Still, different cultures of smoking in East and West Germany could limit the ability to identify a coherent pattern of change.

Limitations of the findings relate to the cross-sectional data. First, the self-reported retrospective measures of age of uptake may be biased by recall error. Although self-report measures of current tobacco use are generally found to be reliable (Kenkel et al., 2003), differences in recall by age could affect the cohort comparisons of age of onset. Colby et al. (2012) find high reliability of questions on age of onset but use a special series of questions to identify smoking milestones. Bright and Soulakova (2013) find that the time elapsed from smoking onset tends to increase the reported age, and Brigham et al. (2010) find mixed evidence for the accuracy of recall. We control for age at time of survey to adjust for potential bias, but older cohorts may overstate the age at which they started and thereby minimize cohort differences. Reporting on never having smoked is more accurate, with more than 90% of subjects giving consistent responses as youth when questioned 19.5 years later (Brigham et al., 2010).

Second, the cross-sectional nature of the data makes it hard to disentangle the causal relationships between education and smoking uptake. Many youth begin smoking before completing their education, requiring longitudinal data to draw causal conclusions about the relationship. It is clear, however, that the association is strong and has changed in meaningful ways.

Third, the cross-sectional samples of the populations at older ages exclude those who died at younger ages, a group disproportionately composed of smokers and those with less education. Although differential mortality may bias comparisons to the oldest cohort, limiting the analysis to persons under age 65 minimizes the problem (Christopoulos et al., 2011). Fourth, the data cannot separately account for the independent influences of age, period, and cohort. Analysis of the effects requires combined consecutive cross-sectional surveys. Fifth, differences in the surveys could account for some cross-country differences. The surveys vary somewhat in method of interview (phone, face-to-face, mixture) and measures of smoking (age of starting regular smoking among those ever smoking 100 cigarettes in the United States, the age of starting regular smoking among those having smoked 6 months in France, and the age of starting daily smoking in Germany among those who smoked at least 100 cigarettes). Although these differences in methods may affect estimates of prevalence, they are unlikely to account for the pattern of findings. The bias would need to vary systematically across educational groups, genders, cohorts, and countries to spuriously produce the findings in support of the hypotheses.

Even with the limitations, the results offer a perspective from which to better understand the influence of public policies on smoking. We also checked that including the age at first cigarette use (in France and USA), a strong predictor of future tobacco addiction, did not alter the results (Supplementary Tables available on demand). At earlier stages of the epidemic, when disparities are weaker, smokers are a less select group. Policies addressing disparities at the early stage can be addressed with population-wide measures that can be expected to have broad effects across the population of smokers most prone to quit. At later stages of the epidemic, the lower prevalence and larger disparities in tobacco use suggest that smokers, particularly those with less education, are more strongly committed to tobacco. These “hard-core” smokers represent a challenge for tobacco control efforts (Emery et al., 2000). Policies may need to be targeted more specifically.
on the high-risk, less educated groups (Frolich and Potvin, 2008; Peretti-Watel et al., 2009). General strategies of advertising, tax increases, and restrictions on public smoking have had clear benefits but thus far are associated with reduced smoking among more disadvantaged groups. According to the Tobacco Atlas (Eriksen et al., 2012), the relative price for a pack of cigarettes (calculated as a percentage of annual per capita income needed to purchase 100 packs of cheapest cigarettes) is highest in France (1.68) and Germany (1.53), and lowest in the United States (1.32). Similarly, the percentage of excise taxes in the price of a pack of cigarettes is 64.3% in France, 60.7% in Germany, and 39.9% in the United States. Despite these differences in policies, educational disparities among the youngest cohorts are similarly large in the three nations. If disparities persist despite varied taxes on cigarettes, other policies targeted toward helping low socioeconomic groups to reduce their smoking will be needed.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2014.06.033.

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