Education and Health Across Lives and Cohorts: A Study of Cumulative Advantage in Germany

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Introduction

Education is one of the most important predictors of health and mortality (Kitagawa and Hauser 1973; Winkleby et al. 1992). Beneficial effects of higher education and adverse effects of lower education on health are transmitted via health-related resources such as work environments, economic means, social support, and health behaviors, as well as the abilities to self-regulate and to cope with stressors (Chandola et al. 2006; Ross and Mirowsky 2003). Over the past decades, the relationship between education and health has been intensely studied and found to be pronounced in all advanced societies (Mackenbach 2012).

This clear picture becomes more complicated, however, when put into life-course context. Initial studies of age effects on educational health differences yielded contradictory findings of divergence, persistence, or even convergence over the life course (Ross and Wu 1996; House et al. 1994; Clark and Maddox 1992). This puzzle was later resolved by studies that situated the educational health gradient more accurately within the socio-historical context in which it unfolds. These studies have provided compelling evidence against persistent and convergent trajectories, suggesting that many of these findings emerged as artifacts from analyses that ignored cohort patterns and their interactions with age and education (Lynch 2003). By considering these effects, more recent investigations have produced consistent results: Health differences between educational levels were found to increase over the life course, supporting the cumulative advantage hypothesis which predicts initial health-related advantages and disadvantages to accumulate with age (Willson et al. 2007).

Moreover, this divergence was found to be most pronounced among recent birth cohorts, a result that has been termed “rising importance” of education for health (Goesling 2007; Kim 2008; Mirowsky and Ross 2008). The rising importance hypothesis directs attention to changes in the socio-historical and institutional context in which educational health trajectories develop. In the U.S. context, this hypothesis emphasizes the increasing importance of education to attain higher socio-economic positions and to benefit from advances in health knowledge and medical progress.

From a cross-national comparative perspective, empirical support for the hypotheses of cumulative advantage and rising importance is very limited in scope. Studies that have adequately addressed educational health differences from a life course perspective, thus disentangling age and cohort effects, are almost exclusively based on U.S. data. Evidence from other countries is scarce (Chen et al. 2010; van Kippersluis et al. 2010). As a result, it remains unclear whether U.S. findings on cumulative advantage and rising importance can be generalized to other developed societies.

In this regard, Germany represents a particularly interesting national context to shed new light on both hypotheses. On the one hand, Germany has one of the most selective and stratifying educational systems, inhibiting social mobility and strongly determining socio-economic positions over the life course (Allmendinger 1989). In this regard, the educational system figures as an exceptionally powerful “sorting machine” (Spring 1976). Compared with the U.S., this system forms an even more fertile breeding ground for the accumulation of initial advantages and disadvantages in all health-related resources. Moreover, these forces of accumulation could have gained additional momentum among more recent cohorts of German people, as education became more important to achieving intermediate and higher socioeconomic positions (Solga 2002).

On the other hand, there are good reasons to assume that processes of cumulative advantage are much less pronounced or even entirely absent in Germany. Compared with the U.S., Germany is characterized by far less social inequality in the distribution of material means, quality of living conditions, and access to health care. In cases of public support after negative life events, it ranks among the most protective societies. Under these conditions, the process of accumulation might be suppressed or even entirely offset.

Health inequality in Germany, thus, is shaped by two opposing social forces: an educational system that strongly connects social origin to social destination, hence promoting the accumulation of initial advantages and disadvantages; and conversely, a welfare state designed to alleviate the resulting inequalities, comprising various measures that might inhibit divergence in educational health trajectories.

Results from previous studies of educational health inequality in Germany suggest that the second force prevails, as educational health gaps were found to remain stable (Schöllgen et al. 2010) or even to decline with age (Schmidt et al. 2012). This line of research, however, has remained largely disconnected from U.S. studies and their recent conceptual and methodological advances. Most importantly, the use of cross-sectional designs precludes the separation of age and cohort effects. As a result, it remains unclear whether the current lack of empirical support for the hypotheses of cumulative advantage and rising importance reflects (a) substantive factors such as the protective role of the welfare state, or (b) methodological shortcomings that have previously plagued U.S. studies on educational health inequality over the life course.

In view of that, the present study aims to disentangle life-course and cohort processes in the study of educational health inequality in Germany. Specifically, we test the two pertinent hypotheses of cumulative advantage and rising importance in the German context, asking whether educational health inequality increased with age, and whether this divergence – if present – became more pronounced across cohorts. We also explore gender differences in these processes, as several characteristics of the German context suggest that the predictions of both hypotheses fit more closely with men's life courses.

To address these issues, we estimated hierarchical linear models using data from the German Socio-economic Panel Study (SOEP). In these large-scale, long-run panel data, information about self-rated health is collected since 1992, allowing us to trace educational health trajectories of 4,648 respondents (born between 1930 and 1968) across an observation window of up to 21 annual waves.

The Cumulative Advantage Hypothesis

According to cumulative advantage theory (Merton 1968; DiPrete and Eirich 2006), socioeconomic background and education are resources that structure the distribution of advantages and disadvantages as well as the onset and duration of exposure to environmental and social risks among individuals. By the mechanisms of path dependence and cumulative exposure, this leads to an increase of initial disparities over the life course (Elder 1998; Dannefer 1987, 2003; O'Rand 1994, 2001). With regard to health, advantages such as material and psychosocial resources as well as disadvantages such as risky health behaviors accumulate over the life course, enforcing a steady increase of initial differences (Hayward and Gorman 2004; O'Rand 2005).

Education plays a central role in this process as it stratifies all kinds of initial and later health-related resources between social groups (Ross and Mirowsky 2010; Ross and Wu

1996). In its role as a "sorting machine", education reproduces and magnifies early advantages and disadvantages of social background and strongly determines income, occupational status and wealth in later life (Spring 1976; Kerckhoff 1995). Depending on social background, children grow up in stable or unstable families, attend better or worse schools, and reach higher or lower occupational positions which, in turn, protect them from or expose them to unfavorable working conditions and the "allostatic load" of stress associated with economic hardship (McEwen 1998).

Moreover, education, or the lack thereof, promotes or impedes the acquisition of health-related resources such as learned effectiveness (Mirowsky and Ross 2003, 2005). In this regard, a large body of research has demonstrated that education improves health outcomes by selecting individuals on the basis of their cognitive skills and sense of personal control and enhancing these abilities, thus encouraging healthy lifestyles over the life course (Goldman and Smith 2002; Mirowsky and Ross 1998). As a combined result of these processes, the cumulative advantage hypothesis expects educational health differences to diverge over the life course.

Does educational health inequality increase, decrease or persist over the life course?

The cumulative advantage hypothesis has long been contested both on theoretical and on empirical grounds. Although it received some support in pioneering studies of health inequality over the life course (e.g., Ross and Wu 1996), many findings were inconsistent with the expected divergence of health trajectories between educational groups. Instead, patterns of continuity or even convergence were found (e.g., Clark and Maddox 1992; Herd 2006; House et al. 1994). This conflicting evidence fueled an intense debate in the U.S. literature on health inequality over the life course.

Analysts who reported persistent or converging health gaps advanced the competing hypothesis of "age as leveler". This hypothesis postulates that educational differences in health increase throughout earlier and middle periods of the life course, persist up to old age, but decrease thereafter (House 1994). This late-life convergence is mainly attributed to two factors: first, selective attrition and mortality among the lower educated who experience elevated rates of mortality and health decline (Kitagawa and Hauser 1973; Wilkinson 1986); second, policy interventions directly targeted at improving living conditions after individuals reach the official retirement age of 65. These include Medicare, providing almost universal access to health care, and Social Security, ensuring a minimum standard of living among the disadvantaged. Taken together, selection processes and social policy measures constitute potent counterbalancing factors which – according to the age-as-leveler hypothesis – prevail over the forces of accumulation (Herd 2006; Hoffmann 2011).

Empirical analyses focused mainly on the selection mechanism proposed by this hypothesis. These studies have largely reconciled observed patterns of persistence or convergence with the cumulative advantage hypothesis (Beckett 2000; Lynch 2003). This research has concluded that differential mortality coupled with selective attrition among the lower educated compresses some of the estimated differences in health between educational groups (Noymer 2001). Many of the empirical findings in support of the age-as-leveler hypothesis, thus, may result from the use of inadequate cross-sectional or short-term (two-wave) longitudinal designs. In such investigations, older respondents of lower education constitute a highly selective group of robust individuals which is not representative of the total population of low-educated older individuals. This suggests that potentially diverging health trajectories among younger and middle-aged people could have been suppressed by the cross-sectional nature of the data.

More importantly, however, cross-sectional designs also confound age and cohort effects. This problem is not only a methodological issue. Most notably, such designs disregard the fact that lives of individuals from different birth cohorts unfold in different socio-historical contexts. This gives rise to *actual* – rather than selection-driven – cohort differences in educational health trajectories. Reviewing demographic research from the past decades, Lynch (2003) has convincingly shown that health trajectories of educational groups vary markedly across cohorts. In fact, the expectation of identical trajectories across cohorts invokes a laboratory setting in which social conditions remain essentially unchanged over time. Although this assumption appears preposterous on a theoretical level, it is implicit in empirical designs that examine age effects on health while ignoring cohort patterns (Lynch 2003).

The key implication of these considerations is that an adequate test of the cumulative advantage hypothesis must disentangle age and cohort effects. This analytical separation takes account of the context in which educational health disparities develop. In statistical models, this hypothesis is typically tested by an interaction between education and age. A positive interaction term is consistent with cumulative advantage, signifying increasing health disparities with age. To clear this term of potential cohort confounders, however, the analysis must account for three additional possibilities: (1) interactions between age and cohort, as individuals from more recent cohorts might show different levels of average health; (2) interactions between education and cohort, as the average effect of education on health might change across cohorts; (3) a threefold interaction between education, age, and cohort, as the shape of educational health trajectories over the life course might also change across cohorts. Disregarding these interactions will bias results on the cumulative advantage hypothesis if the distribution of health-related advantages and disadvantages between educational groups has changed across cohorts. If divergence increases in recent cohorts, for example, cross-sectional estimations will deliver the opposite result, indicating convergence with age (Lynch 2003). Recent U.S. studies based on research designs that disentangled age and cohort effects have provided unequivocal support for the cumulative advantage hypothesis (Willson et al. 2007; Mirowsky and Ross 2008).

The Rising Importance Hypothesis

The cumulative advantage hypothesis conceives of accumulation as a process that evolves within one birth cohort. An obvious follow-up question is to ask whether and in what direction this process has changed across cohorts. In this regard, a growing body of demographic and public health research on cohort-specific and periodic change of social disparities in health and mortality has suggested that educational health inequality increases (Lauderale 2001; Elo and Preston 1995). Although these studies devoted little attention to life course patterns, their results reverberated through the U.S. literature in medical sociology, leading to the formulation of the "rising importance" hypothesis (Goesling 2007; Mirowsky and Ross 2008). This hypothesis states "that education's relationship to the rate of decline in health is greater in newer cohorts" (Mirowsky and Ross 2008: 96f). This implies that the divergent pattern proposed by the cumulative advantage hypothesis has become more pronounced among the more recently born.

The rising importance hypothesis is based on three main argument. Importantly, each of these arguments highlight features that are specific to the U.S. context. The first focuses on change in the distribution health-related resources, explaining the widening of the educational health gap by the concurrent rise in economic inequality. This argument stresses the fact that the relationship between education and income in the U.S. has intensified. This is visible in the enormous increase in terms of economic returns to college education since the 1980s (Hout 2012). In the absence of a strong welfare state, quality of living, exposure to various stressors, and access to high quality health care are highly dependent on individual financial means (Lynch 2006). Consequently, the gap in these health related resources between higher and lower educated might have increased proportionally to the increase of income differences between educational groups, leading to stronger divergence among more recent cohorts (Goesling 2007).

Second, among American people, education became more important for health-related behaviors. As a consequence of the epidemiologic transition from infectious to chronic diseases from the 1960s onward, the stock of available information about health and preventive behaviors has expanded greatly and complex treatments of diseases have been developed. Presumably because of their higher cognitive abilities, sense of control and greater economic and social capital, the highly educated were much more successful compared to disadvantaged groups in implementing this knowledge and translating it into health benefits (Link and Phelan 1995; Mirowsky and Ross 2003). Higher educated individuals in the U.S. have not only disproportionally improved their health behaviors by optimizing their diet, exercising more, and smoking less, but also take more advantage of new health services and medical technology (Harper and Lynch 2007; Lleras-Muney and Lichtenberg 2002).

The third argument emphasizes compositional change and selection. With educational expansion and upward mobility, the group of lower educated individuals is constantly shrinking. This process is particularly consequential for the analysis of health inequality in meritocratic countries. In these equal-opportunity societies, the relationship between education and productivity is stronger (Hout and Dohan 1996). As a result, lower educational groups might represent an increasingly negative selection of individuals on characteristics such as early health condition, cognitive ability, and sense of control (Haas 2006). The rising importance of education for health in the U.S. might, thus, be attributable to compositional change of health-relevant characteristics within educational groups.

Results of recent U.S. studies are in line with the rising importance hypothesis, reporting greater rates of divergence in more recent cohorts (Lynch 2003; Mirowsky and Ross 2008; Kim 2008; Willson et al. 2007). Furthermore, the data provided were consistent with the main explanations that have been proposed for this trend, suggesting that widening health gaps emerge from distributional change in health-related resources (Lynch 2006), as well as compositional change of educational groups (Goesling 2007).

The German Context

As noted, initial research on the cumulative advantage hypothesis has largely ignored the context in which health trajectories unfold. Although recent studies situated within the rising importance framework have highlighted the context-dependent nature of this process, knowledge about educational health trajectories over the life course and across cohorts remains almost exclusively limited to the U.S. context. Obviously, these findings cannot be simply generalized to other developed societies.

Instead, it is important to consider whether the social forces that shape health trajectories across lives and cohorts apply to a lesser, similar, or even greater extent in other countries. For the German context of the present investigation, extant research suggests marked differences compared with the U.S. In Table 1, we provide a summary of these differences with regard to pertinent arguments advanced by the hypotheses of cumulative advantage and rising importance. As shown in the table, some of these arguments fit more closely with the German context (DE > US), whereas the reverse (DE < US) in true for others.

– Table 1 –

Cumulative advantage of education for health in Germany

As noted, the role of education as a sorting machine is a fundamental tenet of the cumulative advantage hypothesis. This role is particularly salient in Germany. In contrast to the U.S., Germany is a textbook example for a selective and rigid school system, which translates educational degrees into occupational positions. These conditions favor the reproduction of initial advantages and disadvantages related to social origin, and stratify economic outcomes in later life along educational lines (Allmendinger 1989; Shavit and Müller 1998).

These properties are mainly attributed to early educational tracking in the German school system and to the strong vocational orientation of education. Based on children's performance upon completion of the 4th grade, they are tracked into three hierarchically structured educational pathways: lower secondary (Hauptschule), intermediate secondary (Realschule) and higher secondary (Gymnasium). Because performance at this young age is highly dependent on learning environments in families, this system strongly reproduces initial advantages and disadvantages of family background and exacerbates initial differences in cognitive ability, self-regulation, and economic means, suggesting pronounced accumulation of health-relevant resources throughout the early life course.

These early disparities are intensified by the vocational orientation of the German educational system and its close connection to the labor market (Shavit and Müller 1998). Unlike in the U.S. where employers rely more strongly on individuals' performance on the job, vocational qualifications are crucial for attaining occupational positions in Germany (Müller et al. 1998). Less than 50% of Americans, for instance, report that their educational degree matches the educational requirements of their occupation. In Germany, this applies to 80% of the workforce (Daly et al. 2000). Moreover, the German level of occupational mobility over the life course is exceptionally low. Consequently, individuals remain exposed to favorable or unfavorable working conditions associated with higher or lower occupational positions throughout their working lives (Manzoni et al. 2014; Mayer et al. 2009).

Compared with the U.S., these characteristics of the German educational and occupational systems create an even more fertile breeding ground for the accumulation of initial advantages and disadvantages in health-related resources between educational groups. The reverse picture, however, emerges for the remaining arguments behind the cumulative advantage hypothesis. These arguments pertain to the steady increase of educational disparities in health-related resources over the life course. As shown in Table 1, all of these arguments fit more closely with the U.S. context. Regarding labor market factors, studies from the U.S. have highlighted material means as a driving force of cumulative health inequality (Lynch 2006). Less attention, however, has been devoted to the fact that the link between material means and health is tightened by institutional characteristics that are specific to this context. In the absence of social protection against risks, the level of living, access to health care, and the degree of stress associated with negative life events strongly depends on material means. Moreover, the distribution of these resources is highly unequal, rendering those who are most susceptible to adverse events unable to respond adequately.

In Germany, income inequality between educational groups is considerably smaller (Freeman 1994), and income is less strongly linked to health (Klein and Unger 2001). The German welfare state ensures a relatively high standard of living regardless of economic means. Furthermore, employment protection is strong, payments in case of unemployment, long-term sickness or disability are generous (DiPrete 2002), health insurance is mandatory, and access to health care is universal (Knesebeck et al. 2003).

Finally, educational gaps in a variety of health behaviors and related competencies are also more pronounced in the U.S. than in Germany. For instance, Mirowsky and Ross (2007) have shown that in the U.S., educational differences in sense of personal control increase markedly across the main stages of adulthood. No such effect was found in a replication of this analysis with data from West Germany (Specht et al 2013). Related to that, highly educated individuals in the U.S. lead much healthier lifestyles with regard to smoking, physical activity, and preventive health care than their lower educated counterparts. These differences are less pronounced in Germany (Cockerham et al. 1986, 1988; Pampel 2010).

Taken together, consideration of these factors suggests that the life course pattern postulated by the cumulative advantage hypothesis – a steady increase of educational health disparities – may not apply to the German context. Unlike in the U.S., where social policy measures that may reduce health disparities take effect only in older age, the German welfare state may level health inequality throughout all major stages of adult life.

Previous evidence from Germany is consistent with this assertion. In fact, not a single study has provided robust empirical evidence in support of the cumulative advantage hypothesis (Schöllgen et al. 2010; Knesebeck 2005). This picture, however, is based on cross-sectional data. As noted above, in the presence of divergence with age (cumulative advantage) and increasing divergence across cohorts (rising importance), these processes might offset each other in the estimation if age and cohort effects are not carefully separated. In other words, if the cumulative advantage *and* the rising importance hypothesis are true, cross-sectional analyses are unlikely to find evidence for either of them. Consequently, the current empirical picture of continuous or even converging educational health gaps in Germany might be explained by inadequate empirical designs, rather than successful intervention of the welfare state.

Rising importance of education for health in Germany

The rising importance hypothesis emphasizes two key factors: (1) increasing inequality in the distribution and use of health-related resources, and (2) compositional change of educational groups. As shown in Table 1, the first factor applies more strongly in the U.S. than in Germany, whereas the reverse is true for the second factor.

With regard to cross-cohort change in the distribution and use of health-related resources, the U.S. have witnessed a steep rise of inequality in economic returns to education. In Germany, this trend is less pronounced, but still evident, as educational returns such as income, employment protection, and risk of unemployment have shifted across cohorts. Compared to pre-war and war cohorts, those born after the war and the baby boomers have experienced declining returns to education in terms of income and job security across all educational levels (Bookmann and Steiner 2006). These changes, however, were most pronounced among the lower educated, whereas the higher educated maintained comparatively high and stable educational returns (Brückner and Mayer 2005).

Unlike in the U.S., however, changes in the distribution of economic resources between educational groups have not been accompanied by growing disparities in health-related behaviors. Studies from Germany have reported educational differences in smoking and drinking behaviors as well as in physical exercise and obesity to remain largely stable across cohorts. A slight increase of educational differences in these health-related behaviors was found only among the most recent cohorts (Icks et al. 2007; Kroll 2010; Schulze and Moons 2006).

In contrast, cross-cohort trends in Germany might fit more closely with the second factor advanced by the rising importance hypothesis, compositional change of educational groups. In the U.S., size and the composition of both groups – higher educated and lower educated individuals – has changed considerably across cohorts. In Germany, this trend was largely one-sided: Higher education expanded only modestly, and mainly among those born after the war. After this initial increase, the share of those obtaining tertiary degrees has remained largely constant, amounting to approximately 20 percent (Becker 2003), as compared to about 40 percent in the U.S. (Goldin and Katz 2009). In sharp contrast, the group of lower educated individuals (i.e., up to lower secondary degrees with vocational training) shrank dramatically from over 70 percent among those born before the war to about 20 percent among those born in the 1970s (Solga 2002). This development is commonly attributed to the expanding service sector and "skill-biased technological change" (Autor et al. 1998), implying that jobs increasingly require higher levels of cognitive ability and knowledge. Since the 1980s, intermediate and, increasingly, higher secondary school certificates became a requirement for accessing most vocational tracks in Germany (Klein 2011). The group of those who fail to reach these levels, thus, is increasingly composed of the most disadvantaged people in terms of family background, cognitive skills, and other health-relevant resources. The group of higher educated, in contrast has remained largely unchanged in these respects (Jürges et al. 2011).

These considerations suggest that the cross-cohort pattern postulated by the rising importance hypothesis applies equally to the national contexts of the U.S. and Germany. The reasons behind these changes, however, should differ. In the U.S., the rising importance of education for health has been primarily attributed to the fact that high levels of education can be particularly beneficial to health, as they generate increasing economic returns and improvements of health behaviors. Therefore, cross-cohort changes in health are centered, at least to some degree, in this group. In Germany, the reverse pattern may hold: The higher educated have remained relatively stable with regard to educational returns, health behaviors, and compositional characteristics. The group of lower educated people, in contrast, have experienced serious declines in returns to education and become more negatively selected on health-relevant characteristics. This invokes the expectation of stronger divergence in more recent cohorts because of steeper health declines among the lower educated, rather than flatter health declines among the higher educated.

Gender differences

The analysis of gender differences is a relatively recent addition to the study of health inequality across lives and cohorts. Although the general formulations of the cumulative advantage and rising importance hypotheses are “unisex”, U.S. studies have provided evidence that their predictions might not hold equally for men and women. These studies have shown that among women, the life-course divergence of educational health differences is less pronounced (Ross and Mirowsky 2010), although the gap has widened more rapidly over the past decades (Liu and Hummer 2007). In the German context of the present investigation, consideration of potential gender differences is particularly important, as the structure of the life course is deeply divided along gender lines, particularly in older cohorts.

In West Germany, the main arguments behind the cumulative advantage hypothesis fit much more closely with men’s life courses. Most notably, two critical links between education and health – labor-market outcomes and health behaviors – are much stronger among men than among women (Boockmann and Steiner 2006). These differences have emerged within a welfare state that has long been organized around a “male-breadwinner” model (DiPrete 2002). This model combines tax incentives that strongly encourage gender-specialization with low coverage rates of public childcare. Under these conditions, women either left the labor force after motherhood or returned to the labor market only on a part-time basis (Blossfeld and Jaenichen 1992). Moreover, upward marriage was common among women in older cohorts, thus weakening the link between their level of education and their social position (Blossfeld 2009).

With regard to risky health behaviors, educational gradients are similar among men and women in the U.S., but vastly different in Germany, where these gaps are much smaller among women. For instance, 20% of highly educated German women smoke, compared to 28% of low educated women. These differences amount to 30% versus 56% among German men (Pampel 2010).

With regard to the rising importance hypothesis in the German context, however, it is important to note that these gender differences have declined across cohorts. First, the share of women who obtained tertiary degrees has increased steadily from less than 5% among those born in the 1930s to almost 20% among those born in the 1970s (Becker 2003). This development has been accompanied by increasing rates of female labor force participation (Fitzenberger et al. 2004). Second, educational differences in health behaviors, especially in smoking, have widened among women, but not among men (Schulze and Mons 2006). Overall, these considerations suggest that although the cumulative advantage hypothesis applies primarily to male life courses in Germany, more recent cohorts of women might approach similar patterns of divergent health trajectories across educational groups.

Data and Method

Sample

Our analysis is based on data from the German Socio-Economic Panel Study (SOEP), a large-scale, representative household and individual study (Wagner et al. 2007). In 1984, the SOEP started in West Germany with a sample population of approximately 12,000 individuals living in 6,000 households. Since 1992, the SOEP collects data about self-rated health at each annual wave.[1] Our analysis draws on these data from an observation period between 1992 and 2012, yielding up to 20 measurements of self-rated health per individual.

In the 1992 wave of the SOEP – the anchor year of our study – the sample consisted of 13,197 individuals. From this sample, we excluded immigrants as well as persons from the Former GDR, limiting the study population to West Germans. These sample restrictions ensured that individuals shared a common context with regard to key factors such as educational degrees, returns to those degrees, and life conditions associated with cohort membership. The sample was further constrained to persons born between 1930 and 1968. We excluded individuals born before 1930, because those who were enlisted to fight in the war might constitute a particularly selective group of survivors. The upper bound of 1968 marked the end of the baby boom cohorts. After all restrictions, our analytic sample consisted of 4,648 individuals aged 24 to 62 in the anchor year of 1992, comprising a total of 67,067 panel observations.

The SOEP data used in this study combine a large range of cohorts with an extensive window of panel observations. A major benefit of these data is that they allow for two types of analyses: First, a joint model in which cross-cohort change is captured by interactions with age and education. This approach is common in analyses of cumulative advantage (see Willson et al. 2007). Second, separate models in which educational health trajectories are

[1] The only exception is the 1993 wave in which no information about self-rated health is available.

analyzed for different groups of cohorts. Given the large age overlaps between cohorts in our sample, this approach yields a more nuanced picture of cohort effects, allowing for non-linear patterns of change. For the separate models, we assigned respondents to groups of birth cohorts: (1) *pre-war and war cohorts* born between 1930 and 1945, (2) *post-war cohorts* born between 1946 and 1956, and (3) *baby boom cohorts* born between 1957 and 1968. These cohort groups are not equal in span, but constitute meaningful groups of individuals in the sense that their life courses were shaped by similar socio-historical conditions.

Measures

Table 2 presents descriptive statistics for the total sample and separately by the three groups of birth cohorts. For the multivariate analyses of the total sample, we centered the *cohort* variable at the mean age of entry, equaling zero for those who were initially observed at the age of 41 in the year 1992 (i.e., born in 1951). Consequently, higher values of the centered cohort variable denote older cohorts (see Willson et al. 2007). *Age* was measured in years and averaged at 49 across all observations, ranging from 24 to 82. For the analysis of the total sample, we centered the age variable at the grand median of 48 years. In the separate analysis for cohort groups, age ranged from 47 to 82 in the pre-war and war cohort, from 36 to 66 in the post-war cohort, and from 24 to 54 in the baby boom cohort, hence yielding considerable age overlaps between cohorts. For the cohort-specific analyses, we centered age at the minimum of each cohort. In all multivariate models for total sample and separately by cohort groups, a linear function provided the best representation of age effects on health trajectories. (see Willson et al. 2007; Lynch 2003) . Therefore, we included the centered age variables only in linear form.

– Table 2 –

In U.S. studies of health inequality, *education* is commonly measured in years of schooling (e.g., Lynch 2003; Mirowsky and Ross 2008; Willson et al. 2007). In the present study, we chose a different operationalization, using indicator variables for educational degrees. There are two reasons for this. First, a growing body of literature suggests that incremental increases in years of education do not translate into similar benefits for health. The relationship between years of education and health, thus, appear to be non-linear (Zajacova et al. 2012). Second, and more importantly, in the German context of this study, meaningful differences are better captured by educational degrees than by years of education. Due to educational tracking of students into three separate school forms, individuals who attended different tracks (but might have studied for a similar number of years) will often differ substantially in health-relevant characteristics such as family resources and cognitive ability. Moreover, as explained above, institutional characteristics such as entry requirements in the labor market render degrees and especially vocational qualifications much more important than years of schooling for economic outcomes in adult life (Bookman and Steiner 2006).

– Figure 1 –

We measured educational degrees by the CASMIN (Comparative Analysis of Social Mobility in Industrial Nations) classification (Brauns et al. 2003). This variable indicates the *highest* educational degree reported by respondents within the observation period. Figure 1 shows the distribution of educational degrees in the three cohort groups separately by gender. We grouped the nine CASMIN[2] categories as follows: the bottom category comprised those holding lower secondary degrees with completed vocational qualification or less (CASMIN

[2] The CASMIN categories are as follows: 1a – inadequately completed low secondary education, 1b – low secondary education (Hauptschule), 1c – low secondary education with vocational qualification, 2a – intermediate vocational qualification or intermediate secondary education (Realschule) with vocational qualification, 2b – intermediate secondary education, 2c_gen – higher secondary education (Gymnasium), 2c_voc – higher secondary education with vocational qualification, 3a – lower tertiary education (university of applied sciences), 3b – higher tertiary education (university degree).

1a–1c); intermediate education ranged from intermediate secondary degrees to higher secondary degrees with vocational qualification (CASMIN 2a–2c); the top category included respondents who had obtained tertiary degrees (CASMIN 3a–3b). In the multivariate models, we omitted lower education as a reference category from the equation.

As described above, it is important to consider that educational expansion in post-war Germany involved a shift primarily from lower to intermediate levels of education, whereas change in the proportion of higher educated individuals was less pronounced. These trends are clearly recognizable in Figure 1. This compositional change is a relevant factor in cross-cohort comparisons of health trajectories between educational groups: From older to younger cohorts of German people, the relative size of the lower-educated group has declined markedly, possibly involving compositional changes in health-relevant characteristics. Figure 1 also shows gender differences in these developments. With regard to tertiary education, the proportion of women tripled from a very low level of 5% to 15%. Among men, this proportion remained almost unchanged, increasing only slightly from 18% to 20%.

To control for non-random *dropout* associated with poor health, we applied the method suggested by Chen, Yang, and Liu (2010), introducing direct controls for panel attrition. To accomplish this, we constructed two time-constant indicator variables for whether respondents (a) had left the panel or (b) had died before the most recent wave of 2012. We included these controls in the estimation to account for the possibility that later dropouts were in worse health compared to those remaining in the panel over the entire observation period (Chen et al. 2010: 135). As shown in Table 1, eight percent of respondents selected in 1992 died across the observation period until 2012. Another 58% left the panel for other reasons. The average number of annual observations per respondent was 14.

Our outcome variable, *self-rated health* (SRH), is widely regarded as a valid measure of health. This measure is highly correlated with morbidity and functional limitations. It also constitutes a potent predictor of mortality (Idler and Benyamini 1997). In the SOEP, data about SRH are based on the annual survey question “How would you describe your current health?” Respondents answered on a scale from 1 (very good) to 5 (bad). We reverse-coded this variable so that lower values indicated worse health. In Table 3, we present detailed descriptive information about SRH, showing age-related declines in the overall sample and separately by cohorts.

– Table 3 –

Analytic strategy

We estimated change in SRH across the observation period from 1992 until 2012 using hierarchical linear models (HLM) (Raudenbush and Bryk 2002). Our data included up to 21 observations per person, measured at yearly intervals. In terms of hierarchical data structure, these repeated observations (level 1) were nested within persons (level 2). The HLM estimation accounts for heterogeneity in health trajectories, allowing individual trajectories to differ in their starting levels (random intercepts) and rates of change (random slopes). The estimation of HLM provided information about mean health trajectories (growth curves) as well as individual variation around the average curves. The equations for the model are located in the appendix.

Our main interest was in the effects of education on health trajectories. To test the hypotheses of cumulative advantage and rising importance, we assessed (a) whether these effects increased, decreased or remained constant with age, and (b) whether these age patterns differed across cohorts. As discussed above, observed age patterns may be biased if the cohort pattern is ignored, and vice versa (Lynch 2003). This point is particularly relevant in the German context of the present study, as previous investigations were unable to model age and cohort effects appropriately: data were either cross-sectional, thus precluding the separation of age and cohort effects (Schöllgen et al. 2010; Schmidt et al. 2012), or the analysis controlled for cohort but ignored potential interactions between age, cohort, and education (Becker 1998). As demonstrated by Lynch (2003), these incomplete specifications are likely to produce statistical artifacts.

An appropriate analytical strategy to estimate change in the relationship between education and health is to account simultaneously for change with age, change across cohorts, and their interactions (Lynch 2003; Willson et al. 2007; Mirowsky and Ross 2008). This approach translates into an empirical model that includes age, cohort, and education as well as two-fold and three-fold interactions between these variables.

Although our data track individuals over an exceptionally long period of time, they do not cover the entire life courses of different birth cohorts. Hence, the model for the overall sample combines individual trajectories which start and end at different ages into one extrapolated cohort to estimate change in health across the entire age range. Although cohort effects are modeled by interactions, differences can only emerge within the parametric constraints of a joint model. To overcome this restriction, we estimated a further set of HLM models separately for the three cohort groups. This approach allowed for more flexible age trajectories within each cohort, and for non-linear patterns of change across cohorts.[3]

As noted, there are strong theoretical reasons to expect gender differences in the extent to which processes of cumulative advantage shape health trajectories, especially in the German context. To gain insight into such differences, we complemented the analysis by separate models for men and women.

[3] A further benefit of this approach is that it allows for a pattern of early and mid-life increase followed by late-life decrease of educational health gaps, as postulated by the of age-as-leveler hypothesis. The parametric restrictions of an aggregated model would preclude the detection of such a pattern.

Results

Table 4 presents the results of the analysis of the total sample (Model 1), and separately for men (Model 2) and for women (Model 3). These models provide answers to the guiding questions of our analysis, namely whether the cumulative advantage and rising importance hypotheses hold for educational health trajectories in Germany.

– Table 4 –

Results on the cumulative advantage hypothesis

As noted, the key prediction of the cumulative advantage hypothesis – diverging health gaps between educational groups – is tested by interaction terms between educational degrees and age. The estimates of Model 1 are consistent with this hypothesis, as health gaps between lower educated and higher educated individuals increased with age. These findings contradict previous cross-sectional evidence for Germany which has indicated continuous or converging patterns. In contrast to these studies, our model controls for cohort effects and their interactions with age and education, as well as for possible selection effects due to panel attrition and death.

– Figure 2 –

Figure 2 provides a graphical illustration of the results from Model 1. The figure shows model predictions indicating how health differences between high and low educated individuals develop with age. This graph pertains to the “average cohort” (born 1951) of our sample, as we fixed all variables at their means. The estimated health gap shows a fourfold increase across the age range under study, widening from approximately 0.1 scale points at the minimum age of 24 to 0.5 points at the age of 80. To evaluate the size of this effect, it is instructive to compare the age at which educational groups reach levels of SRH that are worse than “acceptable” (i.e., below the value of 3). Based on these predictions, lower educated individuals reach this threshold already in their late 50s, higher educated individuals only in their mid-70s – more than 15 years later.

Next, we tested for gender differences in the process of cumulative advantage, as theoretical considerations suggested that factors that tighten the link between education and health might apply more strongly to the life courses of German men. This idea was supported by separate models estimated for men (Model 2) and women (Model 3) in Table 4. These models revealed striking gender differences. Compared with the total model, the size of the interaction effect between age and higher education doubled in Model 2, suggesting that cumulative advantage was much more pronounced among men. As shown in Model 3, cumulative advantage was, in fact, *limited to men*. Among women, the interaction terms between education and age were not significantly different from zero.

– Figure 3 –

Figure 3 illustrates these gender differences with regard to the cumulative advantage of education for health, displaying predicted trajectories of SRH for lower and higher educated men and women (all covariates of Model 2 and Model 3 fixed at their means). A comparison between the curves provides clear evidence that the overall pattern of cumulative advantage shown in Figure 2 was attributable only to men's trajectories. In this group, the educational health gap widened at a rapid pace: Based on the predicted trajectories, lower educated men reach the level of "acceptable" health already in their late 50s. Higher educated men reach this level in the beginning of their 80s – more than 20 years later.

Among women, in contrast, educational health gaps narrowed with age, although this convergence was slight and statistically insignificant. Importantly, the absence of cumulative advantage among women was not attributable to slower health declines among lower educated women, but to steeper health declines among higher educated women. This suggests that in the cohorts covered by our data, only men reaped the health benefits of higher education.

Results on the rising importance hypothesis

Next, we turn to the test of our second guiding hypothesis, which postulated a rising importance of education for health. Among men, the signs of the coefficients for interaction terms between cohort, age and high education (Model 2) were consistent with this hypothesis, indicating that health gaps were smaller and increased at a lower rate among older cohorts. The interaction between high education and cohort was negative and statistically significant, indicating a slightly smaller health gap in older cohorts.[4] The key estimate for a test of the rising importance hypothesis within an extrapolated cohort model – the threefold interaction between age, education, and cohort – also pointed into the expected direction. However, this negative point estimate was not statistically significant. Yet, as noted, the extrapolated cohort approach is limited to capturing linear change across cohorts. In Figure 4, we examine the rising importance hypothesis among men in more detail, comparing health trajectories of pre-war and war cohorts to post-war cohorts and baby boom cohorts. The models from which we derived the curves of Figure 4 are shown in Table 5.

– Figure 4 –

– Table 5 –

With regard to the rising importance hypothesis, Figure 4 shows three notable patterns. First, health trajectories between lower and higher educated men diverged in every cohort. Second, the extent of this divergence was similar in the post-war and baby boom cohort. However, there was a divide between these cohorts and the oldest cohorts in which the pattern of divergence was less pronounced. Third, in line with our theoretical considerations, the

[4] This gap amounted to 0.0114 scale points at the median age of 48.

rising importance of cumulative advantage from the oldest cohort to the younger cohorts was produced by steeper health declines among the lower educated. Lower educated men who belonged to the post-war and baby boom cohorts fell below the level of "acceptable" health (value 3) already in their mid-50s. In the oldest cohort of lower educated men, this occurred approximately 10 years later in the life course, around their mid-60s. Predicted trajectories of higher educated men, in contrast, remained almost identical across cohorts. Overall, these findings lend qualified support to the rising importance hypothesis, suggesting that the rate of cumulative advantage accelerated among men born in the post-war years, and that this shift was centered around the lower educated who experienced steeper health declines.[5]

In a final step, we examined the rising importance hypothesis among women. Although Model 3 did not yield evidence for cumulative advantage, these results do not necessarily contradict the rising importance hypothesis, as an extrapolated cohort model might suppress a trend that emerges only among the most recently born. In view of that, we tested whether the absence of cumulative advantage among women pertained to all of our study cohorts: In these analyses (not shown), we examined women's health trajectories separately for the three cohort groups. In the oldest (pre-war and war) cohort, the low number of women who had obtained higher education (n = 26) precluded a reliable estimation of health differences between this

[5] U.S. research has suggested that these results might emerge from selective dropout, rather than substantive change emphasized by the rising importance hypothesis. This might occur if the lower educated of older cohorts represent unusually robust individuals who are positively selected on health. Although we controlled for potentially worse health associated with subsequent panel dropout, older respondents might still constitute a selective group already at the start of our observation period in 1992. Because a substantial proportion of our sample had been recruited already in 1984, our data allowed us to test whether selection into our initial sample was related to health and education. To explore this possibility, we followed the procedure suggested by Willson and colleagues (2007), calculating a propensity score for respondents who had been initially recruited by the SOEP in 1984 and estimating a logistic regression model, which predicted inclusion of individuals from the oldest cohort in the analytic sample of 1992. Predictor variables included education, age and various indicators for health such as satisfaction with health, doctor and hospital visits, sickness absence, and disability. Respondents from the oldest cohort were aged between 39 and 54 at panel entry in 1984 – an age range at which selection due to health problems is unlikely. Unlike in the analysis of Willson and colleagues (2007), the chance of sample inclusion was not related to health in 1984; neither did inclusion of the propensity score alter the effect of education on health, net of other controls for dropout. These results suggest that selection processes prior to the anchor year of 1992 were unlikely to affect our results.

group and lower educated women.[6] In post-war and baby boom cohorts, sufficient case numbers were available to compare health trajectories of lower and higher educated women. However, we found no evidence for cumulative advantage of education for health in either of these groups – even among the most recent of our study cohorts. Our results for women, thus, were inconsistent with the cumulative advantage as well as the rising importance hypothesis.

Discussion

According to cumulative advantage theory, health gaps between social groups emerge from broader patterns of social inequality. In this process, education is seen to play a central role, reproducing initial social disparities and shaping health trajectories as individuals age. A key tenet of this perspective is the expectation of divergent health gaps between educational groups over the life course. In recent years, tests of the cumulative advantage hypothesis have been refined by greater attention to the social conditions in which individual health trajectories unfold. This line of research has not only led to important methodological advances but also generated new theoretical perspectives such as the rising importance hypothesis, which predicts increasing divergence of educational health gaps among more recent cohorts.

Although the context-specific nature of these processes is generally acknowledged, rigorous empirical tests of the cumulative advantage and rising importance hypotheses have been almost entirely limited to U.S. studies. Drawing on theoretical and methodological advances from this literature, the present investigation examined health inequality over the adult life course in Germany, testing both hypotheses within a previously understudied national context.

[6] In further analyses for the oldest cohort, we compared women with low education to women holding intermediate degrees. This comparison also yielded no evidence for divergent health trajectories.

Compared with the U.S., theoretical considerations suggested three notable differences. First, educational health inequality in Germany is shaped by countervailing forces: on the one hand, a highly stratifying educational system that promotes the accumulation of initial advantages and disadvantages; on the other, welfare state interventions that inhibit divergence in educational health trajectories across the adult life course. Second, the expectation of rising importance of education for health is centered around increasingly adverse conditions among the lower educated, rather than increasing benefits among the higher educated. Third, with regard to the mechanisms that create the link between education and health, the cumulative advantage hypothesis fits more closely with men’s life courses, suggesting that educational trajectories of health inequality in Germany are divided along gender lines.

Our empirical analyses lend qualified support to the cumulative advantage hypothesis. Overall, health gaps between higher and lower educated individuals increased markedly over the life course. Gender-specific analyses revealed, however, that this divergence was limited to health trajectories in men. Among women, we found no evidence for cumulative advantage of education for health. These vast gender differences appear to be specific to the German context, although U.S. findings have pointed in the same direction, indicating that the pattern of cumulative advantage was less pronounced among women (Ross and Mirowsky 2010).

Although we were unable to gain insight into the mechanisms that differentially shape educational health trajectories in men and women, our findings make sense in light of long-standing differences in the structure of men’s and women’s life courses in Germany. In the cohorts covered by our sample, critical links between education and health – in particular labor market outcomes and health behaviors – were much stronger among men, suggesting that processes of cumulative advantage gained more leverage in this group. As these differences have leveled off across cohorts, however, the absence of divergent health trajectories even among the baby boom cohorts of women remains puzzling and points to a fruitful area for future investigation. In this regard, it is important to note that in previous research on health inequality, theoretical formulations and empirical tests of the cumulative advantage hypothesis have been largely gender-blind. In view of our findings, greater attention to such differences appears warranted, particularly in studies that examine whether evidence from the U.S. can be generalized to other national contexts.

Our second objective was to examine whether cumulative advantage of education for health, if present, has increased across cohorts, as predicted by the rising importance hypothesis. Because we observed cumulative advantage only among men, our test of this hypothesis focused on this group. Although a joint model did not indicate a statistically significant linear trend across the entire range of cohorts, more detailed analyses revealed a divide between those born before and those born after the end of the war. Cumulative advantage of education for health emerged to a lesser extent among pre-war and war cohorts, as lower educated men remained in relatively good health. This changed in post-war and baby boom cohorts, indicating a rising importance of education for health. Notably, this trend was entirely attributable to steeper health declines among the lower educated. This finding contrasts with evidence from the U.S., where the pattern of rising importance emerged as a combined outcome of slower health declines among the higher educated and faster health declines among the lower educated (Mirowsky and Ross 2008). These differences highlight the potential for comparative research on the rising importance hypothesis, as this trend may take very different forms, depending on the context in which it unfolds.

Similar to cumulative advantage, it was beyond the scope of our study to explore the mechanisms governing the rising importance of education for health. As obvious candidates, we discussed changes in returns to education and compositional change in terms of health-relevant characteristics. In contrast to U.S. patterns, both characteristics remained largely unchanged across our study cohorts of higher educated men. The lower educated, in contrast, became more negatively selected and faced substantial declines in returns to education. Although these shifts are broadly consistent with our pattern of findings, more precision is necessary to unravel whether, and to what extent, these mechanisms led to an increasing importance of education for health. A promising approach in this regard is to include measures such as episodes of economic hardship to capture changes in educational returns, as well as measures of cognitive ability and sense of personal control to capture compositional changes in health-relevant characteristics.

Considering the rising importance hypothesis, we further note that although processes of cumulative advantage have spared our study cohorts of women, this might change among the more recently born. Especially among women born in the 70s and 80s, education became more relevant to various domains of the life course. Examples are the narrowing gender gap in labor force participation (Fitzenberger et al. 2004) and women's increasing economic returns to education (Fitzenberger and Wunderlich 2003). Moreover, the proportion of higher educated women surged upward in these cohorts, whereas the group of lower educated women shrank, suggesting increasingly negative selection on health-relevant characteristics. In view of these shifts, we consider it important to explore whether processes of cumulative advantage of education for health have commenced among recent cohorts of German women.

There are further limitations to this study. For instance, the anchor year of our study – 1992 – is situated within the turbulent historical period of reunification of East and West Germany. Moreover, the subsequent years covered by our observation window were characterized by further uncertainty introduced by globalization processes (Blossfeld et al. 2005). In the absence of a reliable method to disentangle age, period, and cohort effects (Luo 2013), we were unable to assess the extent to which this periodic context has shaped the health trajectories observed in our study. We note, however, that these period effects might have primarily affected people outside our range of study cohorts, namely younger adults who had to establish their lives under unstable conditions.

Looking at the overall picture of current life course research on health inequality, this study's theoretical perspective and empirical results suggest that despite the broad empirical support for cumulative advantage of education for health, this process is a context-specific phenomenon rather than a universal principle. In this regard, we have outlined a theoretical scheme which applies two pertinent hypothesis that have emerged from the U.S. context – cumulative advantage and its rising importance – to another national context. As comparative evidence remains scarce (Chen et al. 2010; van Kippersluis et al. 2010), future research along these lines holds great potential to advance our understanding of health inequality across lives and cohorts. For instance, does the principle of cumulative advantage also apply in the egalitarian welfare regimes of Scandinavia? Compared to Germany and the U.S., these countries offer more generous social policies and more equal chances in the educational and occupational systems.

The need for comparative studies of health inequality is even more obvious with regard to the rising importance hypothesis. The most robust support for this hypothesis has been found in the U.S. where the trend of increasingly divergent health gaps is strong and clearly discernible (Kim 2008; Mirowsky and Ross 2008). A recent cohort study from China, however, has reported the reverse pattern: although health trajectories diverged in every cohort, the extent of this divergence declined across cohorts (Chen et al. 2010).

Again, it appears worthwhile to look at Scandinavian countries in future tests of the rising importance hypothesis. In cross-sectional assessments of health inequality, these countries revealed the most sizable health gaps across various measures of socioeconomic position. Moreover, gaps did not narrow over time (Mackenbach 2012). These findings, currently discussed as the "Nordic paradox", might constitute a fruitful puzzle to address from a rising importance perspective: although counter-intuitive at first glance, the rising importance of education for health in egalitarian countries – if present – could be attributable to the principle of meritocracy and the associated high level of intergenerational mobility. If family background becomes less important for social positioning, the groups of higher and lower educated people might become increasingly homogenous with regard to health-relevant characteristics such as cognitive ability and sense of personal control. A study of this process would be particularly instructive when compared to countries such as Germany where social background more strongly determines educational and occupational outcomes. As high quality longitudinal data are now available in many countries, studies along these lines will cast more light on how processes of cumulative advantage unfold in cohort and country contexts and help resolve the remaining puzzles of research on health inequality over the life course.

References

Allmendinger, J. 1989. “Educational systems and labor market outcomes.” *European Sociological Review*. 5: 231–250.

Autor, D. H., L. F. Katz, & A. B. Krueger. 1998. “Computing inequality: Have computers changed the labor market?” *The Quarterly Journal of Economics*. 113: 1169–1213.

Becker, R. 1998. “Bildung und Lebenserwartung in Deutschland-Eine empirische Längsschnittuntersuchung aus der Lebensverlaufsperspektive.” *Zeitschrift für Soziologie*. 27: 133–150.

Becker, R. 2003. “Educational Expansion and Persistent Inequalities of Education: Utilizing Subjective Expected Utility Theory to Explain Increasing Participation Rates in Upper Secondary School in the Federal Republic of Germany.” *European Sociological Review*. 19: 1–24.

Beckett, M. 2000. “Converging health inequalities in later life--an artifact of mortality selection?” *Journal of Health & Social Behavior*. 41: 106–119.

Blossfeld, H.-P. & U. Jaenichen. 1992. “Educational Expansion and Changes in Women's Entry into Marriage and Motherhood in the Federal Republic of Germany.” *Journal of Marriage and Family*. 54: 302-315.

Blossfeld, H.-P. 2009. “Educational Assortative Marriage in Comparative Perspective” *Annual Review of Sociology*. 35: 513-530.

Blossfeld, H.-P., E. Klijzing, M. Mills & K. Kurz (eds.). 2005. *Globalization, uncertainty and youth in society,* London: Routledge.

Boockmann, B. & V. Steiner. 2006. “Cohort effects and the returns to education in West Germany.” *Applied Economics*. 38: 1135–1152.

Brauns, H., S. Scherer, & S. Steinmann. 2003. “The CASMIN Educational Classification in International Comparative Research.” Pp. 221–244, in *Advances in Cross-National Comparison,* edited by J. Hoffmeyer-Zlotnik and C. Wolf. New York: Springer.

Brückner, H. & K. U. Mayer. 2005. “De-Standardization of the Life Course: What it Might Mean? And if it Means Anything, Whether it Actually Took Place*?” Advances in Life Course Research*. 9: 27–53.

Chandola, T., P. Clarke, J. N. Moris, & D. Blane. 2006. “Pathways Between Education and Health: A Causal Modelling Approach.” *Journal of the Royal Statistical Society A*. 116: 337–359.

Chen, F., Y. Yang, & G. Liu. 2010. "Social Change and Socioeconomic Disparities in Health over the Life Course in China: A Cohort Analysis." *American Sociological Review*. 75: 126–150.

Clark, D. O. & G. L. Maddox. 1992. "Racial and Social Correlates of Age-Related Changes in Functioning." *The Journals of Gerontology: Social Sciences.* 47: S222–S232.

Cockerham, W. C., G. Kunz, , G. Leuschen & J. L Spaeth. 1986. Symptoms, social stratification and self-responsibility for health in the United States and West Germany." *Social Science & Medicine.* 22: 1263–1271.

Cockerham, W. C., G. Kunz, & G. Leuschen. 1988. "On concern with appearance, health beliefs, and eating habits: a reappraisal comparing Americans and West Germans." *Journal of Health and Social Behavior.* 29: 265–269.

Daly, M. C., F. Bu, & G. J. Duncan. 2000. "Premiums and penalties for surplus and deficit education Evidence from the United States and Germany" *Economics of Education Review.* 19: 169–178.

Dannefer, D. 1987. "Aging as Intracohort Differentiation: Accentuation, the Matthew Effect, and the Life Course." *Sociological Forum*. 2: 211–237.

Dannefer, D. 2003. "Cumulative Advantage/Disadvantage and the Life Course: Cross Fertilising Age and Social Science Theory." *The Journals of Gerontology: Social Sciences*. 58: 327–337.

Deutsches Krebsforschungszentrum. 2004. *Rauchen und soziale Ungleichheit – Konsequenzen für die Tabakkontrollpolitik*: Heidelberg.

DiPrete, T. A. 2002. "Life Course Risks, Mobility Regimes, and Mobility Consequences: A Comparison of Sweden, Germany, and the United States." *American Journal of Sociology.* 108: 267–309.

DiPrete, T. A., G. M. Eirich, K. S. Cook, & D. S. Massey. 2006. "Cumulative advantage as a mechanism for inequality: A Review of Theoretical and Empirical Developments." *Annual Review of Sociology*. 32: 271–297.

Dustmann, C., J. Ludsteck, & U. Schönberg. 2009. "Revisiting the German Wage Structure." *The Quarterly Journal of Economics*. 124: 843–881.

Ehlert, M. 2012. "Buffering Income Loss Due to Unemployment. Family and Welfare State Influences on Income after Job Loss in the United States and western Germany." *Social Science Research*. 41: 843–860.

Elder, G. H. 1998. "The Life Course as Developmental Theory." *Child Development*. 69: 1–12.

Elo, I. T. & S. H. Preston. 1996. "Educational differentials in mortality: United States, 1979–1985." *Social Science & Medicine*. 42: 47–57.

Esping-Andersen, G. 1994. "Welfare States and the Economy." Pp. 711-732 in *Handbook of Economic Sociology*, edited by N. J. Smelser and R. Swedberg: Princeton University Press.

Fitzenberger, B., R. Schnabel & G. Wunderlich. 2004. "The gender gap in labor market participation and employment: A cohort analysis for West Germany." *Journal of Population Economics*. 17: 83–116.

Fitzenberger, B. & G. Wunderlich. 2003. "Gender Wage Differences in West Germany: A Cohort Analysis." *German Economic Review*. 3: 379–414.

Freeman, R. B. 1994. "*Working Under Different Rules*." New York: Russell Sage Foundation.

Icks, A., S. Moebus, A. Feuersenger, B. Haastert, K-H. Jöckel, A. Mielck, & G. Giani. 2007. "Widening of a social gradient in obesity risk? German national health surveys 1990 and 1998." *European Journal of Epidemiology*. 22: 685–690.

Gangl, M. 2004. "Welfare States and the Scar Effects of Unemployment: A Comparative Analysis of the United States and West Germany." *American Journal of Sociology*. 109: 1319-1364.

Goldin, C. D. & L. F. Katz. 2009. "*The Race between Education and Technology*." Cambridge: Harvard University Press.

Goldman, D. P. and J. P. Smith. 2002. "Can Patient Self-Management Help Explain the SES Health Gradient?" *Proceedings of the National Academy of Science*. 99: 10929–10934.

Goesling, B. 2007. "The Rising Significance of Education for Health?" *Social Forces*. 85: 1621–1644.

Haas, S. A. 2006. "Health Selection and the Process of Social Stratification: The Effect of Childhood Health on Socioeconomic Attainment." *Journal of Health and Social Behavior*. 47: 339–354.

Harper, S. & J. Lynch. 2007. "Trends in Socioeconomic Inequalities in Adult Health Behaviors Among U.S. States, 1990–2004." *Public Health Reports*. 122: 177–189.

Hayward, M. D. & B. K. Gorman. 2004. "The Long Arm of Childhood: The Influence of Early-Life Social Conditions on Men's Mortality." *Demography*. 41: 87–107.

Herd, P. 2006. "Do Functional Health Inequalities Decrease in Old Age? Educational Status and Functional Decline Among the 1931-1941 Birth Cohort." *Research on Aging*. 28: 375–392.

Hoffmann, R. 2011. "Illness, Not Age, Is the Leveler of Social Mortality Differences in Old Age." *The Journals of Gerontology: Social Sciences*: 66B: 374–379.

House, J. S., J. M. Lepkowski, A. M. Kinney, R. P. Mero, R. C. Kessler, & R. A. Herzog. 1994. "The Social Stratification of Aging and Health." *Journal of Health & Social Behavior*. 35: 213–234.

Hout, M. & D. P. Dohan. 1996. "Two paths to educational opportunity: class and educational selection in Sweden and the United States." Pp. 207-232 in: *Can Education Be Equalized?* edited by R. Erikson and J.O. Jonsson: Boulder, CO: Westview.

Hout, M. 2012. "Social and Economic Returns to College Education in the United States." *Annual Review of Sociology*. 38: 379-400.

Idler, E. L. & Y. Benyamini. 1997. "Self-Rated Health and Mortality: A Review of Twenty-Seven Community Studies." *Journal of Health and Social Behavior*. 38: 21–37.

Jürges, H., S. Reinhold, & M. Salm. 2011. "Does schooling affect health behavior? Evidence from the educational expansion in Western Germany." *Economics of Education Review: Special Issue on Education and Health*. 30: 862–872.

Kerckhoff, A. C. 1995. "Institutional Arrangements and Stratification Processes in Industrial Societies." *Annual Review of Sociology.* 21: 323–347

Kim, J. 2008. "Intercohort Trends in the Relationship Between Education and Health." *Journal of Aging and Health*. 20: 671–693.

Kim, J. & E. Durden. 2007. "Socioeconomic status and age trajectories of health." *Social Science & Medicine*. 65: 2489–2502.

Kitagawa, E. M. & P. M. Hauser. 1973. "*Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*." Cambridge: Harvard University Press.

Klein, M. 2011. "Trends in the association between educational attainment and class destinations in West Germany: Looking inside the service class." *Research in Social Stratification and Mobility*. 29: 427–444.

Klein, T. & R. Unger. 2001. "Einkommen, Gesundheit und Mortalität in Deutschland, Grossbritannien und den USA. " *Kölner Zeitschrift für Soziologie und Sozialpsychologie.* 53: 96-110.

Knesebeck, O. v. d., P. E. Verde, & N. Dragano. 2006. "Education and health in 22 European countries." *Social Science & Medicine*. 63: 1344–1351.

Knesebeck, O. v. d., G. Lüschen, W. C. Cockerham, & J. Siegrist. 2003. "Socioeconomic status and health among the aged in the United States and Germany: A comparative cross-sectional study." *Social Science & Medicine*. 57: 1643–1652.

Knesebeck, O. v. d. 2005. "*Soziale Einflüsse auf die Gesundheit alter Menschen. Eine deutsch-amerikanische Vergleichsstudie.* " Bern: Verlag Hans Huber.

Kroll, L. E. 2010. "*Sozialer Wandel, soziale Ungleichheit und Gesundheit. Die Entwicklung sozialer und gesundheitlicher Ungleichheiten in Deutschland zwischen 1984 und 2006*." Wiesbaden: VS Verlag.

Lauderdale, D. S. 2001. "Education and Survival: Birth Cohort, Period, and Age Effects." *Demography*. 38: 551–561.

Link, B. G. & J. Phelan. 1995. "Social Conditions As Fundamental Causes of Disease." *Journal of Health and Social Behavior*. 35: 80–94.

Liu, H., & R. A. Hummer. 2008. "Are Educational Differences in U.S. Self-Rated Health Increasing? An Examination by Gender and Race." *Social Science & Medicine*. 67: 1898–1906.

Lleras-Muney, A., & F. R, Lichtenberg. 2002. "The Effect of Education on Medical Technology Adoption: Are the More Educated More Likely to Use New Drugs?" NBER Working Paper No. 9185.

Luo, L. 2013. "Assessing Validity and Application Scope of the Intrinsic Estimator Approach to the Age-Period-Cohort Problem." *Demography.* 50: 1945–1967.

Lynch, S. M. 2003. "Cohort and Life-Course Patterns in the Relationship Between Education and Health: A Hierarchical Approach." *Demography*. 40: 309–331.

Lynch, S. M. 2006. "Explaining Life Course and Cohort Variation in the Relationship between Education and Health: The Role of Income." *Journal of Health & Social Behavior*. 47: 324–338.

Mackenbach, J. P. 2012. "The persistence of health inequalities in modern welfare states: The explanation of a paradox." *Social Science & Medicine*. 75: 761–769.

Manzoni, A., J. Härkönen, & K.U. Mayer. 2014. "Moving On? A Growth-Curve Analysis of Occupational Attainment and Career Progression Patterns in West Germany." *Social Forces*. 92: 1285–1312.

Mayer, K. U. 2009. "Whose Lives? How History, Societies, and Institutions Define and Shape Life Courses." *Research in Human Development*. 1: 161–187.

McEwen, B. S. 1998. "Stress, Adaptation, and Disease: Allostasis and Allostatic Load." *Annals of the New York Academy of Sciences.* 840: 33–44.

Merton, R. K. 1968. "The Matthew Effect in Science." *Science*. 159: 56–63.

Mirowsky, J., & C. E. Ross (eds.). 2003. *Education, Social Status and Health.* New Brunswick, NJ: Aldine.

Mirowsky, J. & C. E. Ross. 2005. “Education, Learned Effectiveness and Health”. *London Review of Education*. 3: 205–220.

Mirowsky, J. & C. E. Ross. 2008. “Education and Self-Rated Health: Cumulative Advantage and Its Rising Importance.” *Research on Aging*. 30: 93–122.

Mirowsky, J. & C. E. Ross. 1998. “Education, Personal Control, Lifestyle and Health: A Human Capital Hypothesis.” *Research on Aging.* 20: 415–449.

Mirowsky, J. & C. E. Ross. 2007. “Life Course Trajectories of Perceived Control and Their Relationship to Education.” *American Journal of Sociology*. 112: 1339–1382.

Müller, W., S. Steinmann, & R. Ell. 1998. “Education and labour-market entry in Germany.” Pp. 143–188 in: *From school to work. A comparative study of educational qualifications and occupational destinations,* edited by Y. Shavit and W. Müller. Oxford: Clarendon Press.

Noymer, A. 2001. “Mortality Selection and Sample Selection: A Comment on Beckett.” *Journal of Health and Social Behavior.* 42: 326–327.

O’Rand, A. M. 1996. “The Precious and Presocious: Understanding Cumulative Disadvantage and Cumulative Advantage over the Life Course.” *The Gerontologist*. 36: 230–238.

O’Rand, A. M. 2001. “Stratification and the life course: The forms of life course capital and their interrelationships.” Pp. 197–216, in *Handbook of aging and the social sciences,* edited by R. H. Binstock and L. K. George. New York: Academic Press.

O’Rand, A. M. & J. Hamil-Luker. 2005. “Process of Cumulative Adversity Linking Childhood Disadvantage to Increased Risk of Heart Attack across the Life Course.” *The Journal of Gerontology: Social Sciences.* 60*:* 117–124.

Pampel F. 2010. “Divergent Patterns of Smoking Across High-Income Nations.” Pp. 132–163, in *International Differences in Mortality at Older Ages: Dimensions and Sources*, edited by E.M. Crimmins, S.H. Preston and B. Cohen. Washington (DC): National Academies Press.

Phelan J.C., B. G. Link, A. Diez-Roux, I. Kawachi & B. Levin. 2004. “Fundamental Causes of Social Inequalities in Mortality: A Test of the Theory.” *Journal of Health and Social Behavior*. 45: 265-285.

Raudenbush, S. & A. Bryk. 2002. *Hierarchical Linear Models: Applications and data analysis methods.* Thousand Oaks: SAGE.

Ross, C. E. & C.-L. Wu. 1996. “Education, Age, and the Cumulative Advantage in Health.” *Journal of Health & Social Behavior*. 37: 104–120.

Ross, C.E. & J. Mirowsky. 2010. “Why Education is the Key to Socioeconomic Differences in Health”. Pp. 33–51, in *Handbook of medical sociology,* edited by C. E. Bird, P. Conrad, and A. M. Fremont. Nashville: Vanderbilt University Press.

Ross, C. E., & J. Mirowsky. 2010. “Gender and the Heath Benefits of Education.” *The Sociological Quarterly 51*: 1–19.

Schmidt, S., F. Petermann, & E. Brähler. 2012. “Social inequality, mental and physical health – how much is influenced by age?” *Zeitschrift für Psychiatrie, Psychologie und Psychotherapie*. 60: 205–215.

Schöllgen, I., O. Huxhold, & C. Tesch-Römer. 2010. “Socioeconomic status and health in the second half of life: findings from the German Ageing Survey.” *European Journal of Ageing*. 7: 17–28.

Shavit, Y., & W. Müller. 1998. “*From school to work: a comparative study of educational qualifications and occupational destinations.*” New York: Clarendon Press.

Schulze, A., & U. Mons. 2006. “The evolution of educational inequalities in smoking: a changing relationship and a cross-over effect among German birth cohorts of 1921–70.” *Addiction.* 7: 1051–1056.

Solga H. 2002. “‘Stigmatization by Negative Selection’: Explaining Less-Educated People’s Decreasing Employment Opportunities.” *European Sociological Review.* 18: 159–178.

Specht, J., B. Egloff, & S. C. Schmukle. 2013. “Everything under control? The effects of age, gender, and education on trajectories of perceived control in a nationally representative German sample.” *Developmental Psychology*. 49: 353–364.

Spring, J. H. 1976. *The Sorting Machine.* New York: David McKay.

Unger, R. & S., Alexander. 2013. “Can We Really (All) Work Longer? Trends in Healthy Life Expectancy According to Social Stratum in Germany.” *Comparative Population Studies.*

van Kippersluis, H., O.O. Donnell, E. van Doorslaer, & T. van Ourti. 2010. “Socioeconomic differences in health over the life cycle in an Egalitarian country.” *Social Science & Medicine.* 70: 428–438.

Wagner, G. G., J. R. Frick, & J. Schupp. 2007. “The German Socio-Economic Panel Study (SOEP) - Scope, Evolution and Enhancements.” *Schmollers Jahrbuch.* 127: 139–169.

Willson, A. E., K. M. Shuey, & G. H. Elder Jr. 2007. “Cumulative Advantage Processes as Mechanisms of Inequality in Life Course Health.” *American Journal of Sociology*. 112: 1886–1924.

Wilkinson, R. G. 1986. "*Class and Health: Research and Longitudinal Data*." London: Tavistock.

Winkleby, M. A., D. E. Jatulis, E. Frank, & S. P. Fortmann. 1992. "Socioeconomic Status and Health: How Education, Income, and Occupation Contribute to Risk Factors for Cardiovascular Disease." *American Journal of Public Health.* 82: 816–820.

Wysong, J. A., & T. Abel. 1990. "Universal health insurance and high-risk groups in West Germany: implications for U.S. health policy." *The Milbank Quarterly*. 68: 527–560.

Zajacova, A., R. G. Rogers, & V. Johnson-Lawrence. 2012. "Glitch in the gradient: Additional education does not uniformly equal better health." *Social Science & Medicine*. 75: 2007–2012.

TABLE 1. CUMULATIVE ADVANTAGE AND RISING IMPORTANCE IN GERMANY AND THE US

Hypothesis	Argument	DE		US	Empirical evidence
Cumulative advantage					
Education	School as a sorting machine		>		Allmendinger 1989 Blossfeld et al. 1993 Shavit and Müller 1998
	Education as a predictor of SES across the life-course		>		
Labor market factors	Inequality in income		<		Freeman 1994
	Inequality in unemployment risks		<		Gangl 2004
	Lack of social protection against risks		<		Ehlert 2012 Esping-Andersen 1994
Health care	Inequality in access		<		Wysong and Abel 1990 Knesebeck et al. 2003
Psychosocial factors	Inequality in stress from life events		<		DiPrete 2002 Mayer 2009
Health behaviors	Inequality in smoking and physical activity		<		Cockerham et al. 1986 Cockerham et al. 1988 Pampel 2010
Health-relevant competencies	Inequality in sense of personal control		<		Mirowky and Ross 2007 Specht et al. 2013
Rising Importance					
Distribution and use of health- related resources	Rising inequality in economic returns to education		<		Dustmann et al. 2009 Freeman 1994 Solga 2002
	Rising inequality in health knowledge and the ability to benefit from medical progress		<		Link and Phelan 2004 Schulze and Mons 2006
Compositional change	Increasing selectivity of educational groups		>		Goldin and Katz 2009 Solga 2002

TABLE 2. DESCRIPTIVE STATISTICS: TOTAL SAMPLE AND SEPARATELY BY COHORTS

	Total				Pre-war and war cohorts 1930-45				Post war cohorts 1946-56				Baby boom cohorts 1957-68			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Self-rated health[a]	3.28	0.92	1	5	2.99	0.91	1	5	3.24	0.90	1	5	3.57	0.85	1	5
Age	49.2	12.6	24	82	62.6	7.16	47	82	49.2	6.74	36	66	37.7	6.83	24	55
Median-centered	1.2	12.6	-24	34												
Minimum-centered					15.6	7.16	0	35	13.2	6.74	0	30	13.7	6.83	0	31
Cohort																
Year of birth	1951	11.3	1930	1968	1937.8	4.31	1930	1945	1951	3.16	1946	1956	1963	3.41	1957	1968
Age in 1992	41	11.3	24	62												
Mean-centered	0	11.3	-19	19												
Education[b]																
Low	0.52		0	1	0.67		0	1	0.53		0	1	0.38		0	1
Intermediate	0.33		0	1	0.22		0	1	0.30		0	1	0.43		0	1
High	0.16		0	1	0.11		0	1	0.17		0	1	0.19		0	1
Male	0.49		0	1	0.49		0	1	0.49		0	1	0.50		0	1
Dropout																
Died	0.09		0	1	0.20		0	1	0.05		0	1	0.02		0	1
Left panel	0.57		0	1	0.51		0	1	0.57		0	1	0.60		0	1
Obs. per individual	14.4	6.90	1	21	14.4	7.01	1	21	14.6	6.86	1	21	14.4	6.84	1	21
N (observations)	67,067				22,417				18,471				26,179			
N (individuals)	4,648				1,562				1,269				1,817			

Note: SOEP, release 2013. [a] 5-point scale, reverse coded (1 = bad, 5 = very good). [b] Low education = up to lower secondary vocational degree (CASMIN 1a-c). Intermediate education = up to higher secondary degree plus vocational training (CASMIN 2a-c). High education = lower and higher tertiary degree (CASMIN 3a-b).

TABLE 3. MEANS OF AGE AND SELF-RATED HEALTH (SRH) ACROSS SURVEY YEARS

Wave	Pre-war and war cohorts 1930-45		Post-war cohorts 1946-1956		Baby boom cohorts 1957-1968		Total 1930-68	
	Age	SRH	Age	SRH	Age	SRH	Age	SRH
1992	54	3.20	41	3.63	29	3.89	41	3.59
1994	56	3.09	43	3.40	31	3.66	43	3.40
1995	57	3.08	44	3.39	32	3.65	44	3.39
1996	58	3.04	45	3.37	33	3.66	45	3.37
1997	59	3.01	46	3.36	34	3.66	46	3.36
1998	60	3.03	47	3.34	35	3.65	47	3.36
1999	61	2.99	48	3.29	36	3.61	48	3.32
2000	62	2.99	49	3.22	37	3.56	49	3.28
2001	63	3.00	50	3.24	38	3.57	50	3.29
2002	64	2.96	51	3.17	39	3.51	51	3.24
2003	65	2.96	52	3.18	40	3.51	52	3.24
2004	66	2.92	53	3.11	41	3.51	53	3.20
2005	67	2.86	54	3.08	42	3.46	54	3.15
2006	68	2.86	55	3.04	43	3.47	55	3.15
2007	69	2.91	56	3.04	44	3.45	56	3.16
2008	70	2.87	57	3.06	45	3.42	57	3.13
2009	71	2.90	58	3.01	46	3.39	58	3.12
2010	72	2.90	59	3.02	48	3.39	59	3.12
2011	73	2.86	60	3.00	49	3.31	60	3.07
2012	74	2.87	61	3.09	50	3.34	61	3.11
Total	62.6	2.99	49	3.24	38	3.57	49	3.28
N (observations)	22,417	20,877	18,471	17,217	26,179	24,444	67,067	62,538
N (individuals)	1,562	1,559	1,269	1,268	1,817	1,815	4,648	4,642

Note: SOEP, release 2013. Self-rated health measures on a 5-point scale, reverse coded (1 = bad, 5 = very good).

TABLE 4: HIERARCHICAL LINEAR MODELS FOR SELF-RATED HEALTH: TOTAL SAMPLE, MEN, AND WOMEN

	Model 1: Total	Model 2: Men	Model 3: Women
Intercept	3.216**	3.264**	3.241**
	(150.54)	(119.35)	(121.67)
Age[a]	-0.027**	-0.031**	-0.024**
	(-27.85)	(-21.98)	(-17.34)
Intermediate education[b] (ref.: low)	0.179**	0.179**	0.173**
	(7.20)	(4.80)	(5.16)
High education[b] (ref.: low)	0.298**	0.315**	0.286**
	(9.45)	(7.83)	(5.48)
Intermediate education x Age	0.001	0.001	-0.001
	(0.34)	(0.51)	(-0.52)
High education x Age	0.006**	0.012**	-0.003
	(2.81)	(4.69)	(-0.95)
Cohort (mean-centered)	0.005**	0.008**	0.003
	(3.51)	(3.64)	(1.28)
Age x Cohort (/100)	0.008	0.016	-0.004
	(0.98)	(1.41)	(-0.37)
Intermediate education x Cohort	0.003	0.006+	0.002
	(1.45)	(1.78)	(0.74)
High education x Cohort	-0.006+	-0.011**	0.003
	(-1.84)	(-2.91)	(0.55)
Interm. education x Age x Cohort (/100)	-0.017	-0.005	-0.018
	(-1.32)	(-0.27)	(-1.02)
High education x Age x Cohort (/100)	-0.0014	-0.019	0.020
	(-0.08)	(-0.84)	(0.68)
Male	0.070**		
	(3.46)		
Variance components			
Residual (Level 1)	0.354**	0.335**	0.371**
Intercept	0.357**	0.360**	0.352**
Age	0.001**	0.001**	0.001**
Covariance of intercept and age	0.002**	0.002**	0.002*
N (individuals)	4,648	2,288	2,360
N (observations)	62,538	30,214	32,324

Note: SOEP, release 2013. *t*-statistics in parentheses. All models control for panel attrition due to nonresponse and death. [a]Centered on the grand median. [b]Low = CASMIN 1a-c (up to lower secondary vocational degree); intermediate = CASMIN 2a-c (up to higher secondary plus vocational training); high = CASMIN 3a-b (lower and higher tertiary). [c]Centered on the mean age of sample entry, age 41 (i.e., birth cohort of 1951). ** p < 0.01, * p < 0.05, + p < 0.10.

TABLE 5: HIERARCHICAL LINEAR MODELS FOR SELF-RATED HEALTH: THREE COHORTS OF MEN

	Pre-war and war cohorts 1930-45	Post-war cohorts 1946-56	Baby-boom cohorts 1957-68
Intercept	3.477**	3.622**	3.973**
	(57.04)	(63.64)	(78.43)
Age[a]	-0.027**	-0.036**	-0.030**
	(-10.38)	(-12.16)	(-11.60)
Intermediate education[b]	0.234*	0.143+	0.061
	(2.26)	(1.82)	(0.98)
High education[b]	0.132	0.179*	0.115+
	(1.28)	(2.04)	(1.66)
Intermediate education x Age	-0.001	0.006	-0.001
	(-0.11)	(1.22)	(-0.15)
High education x Age	0.007	0.014**	0.012**
	(1.40)	(2.58)	(2.91)
Variance components			
Residual (Level 1)	0.333**	0.337**	0.321**
Intercept	0.828**	0.478**	0.438**
Age	0.002**	0.001**	0.001**
Cov. of intercept and age	-0.025**	-0.014*	-0.012*
N (individuals)	760	621	907
N (observations)	9,902	8,417	11,895

Note: SOEP, release 2013. *t*-statistics in parentheses. All models control for panel attrition due to nonresponse and death. [a]Centered on the minimum age. [b]Low = CASMIN 1a-c (up to lower secondary vocational degree); intermediate = CASMIN 2a-c (up to higher secondary plus vocational training); high = CASMIN 3a-b (lower and higher tertiary). ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$.

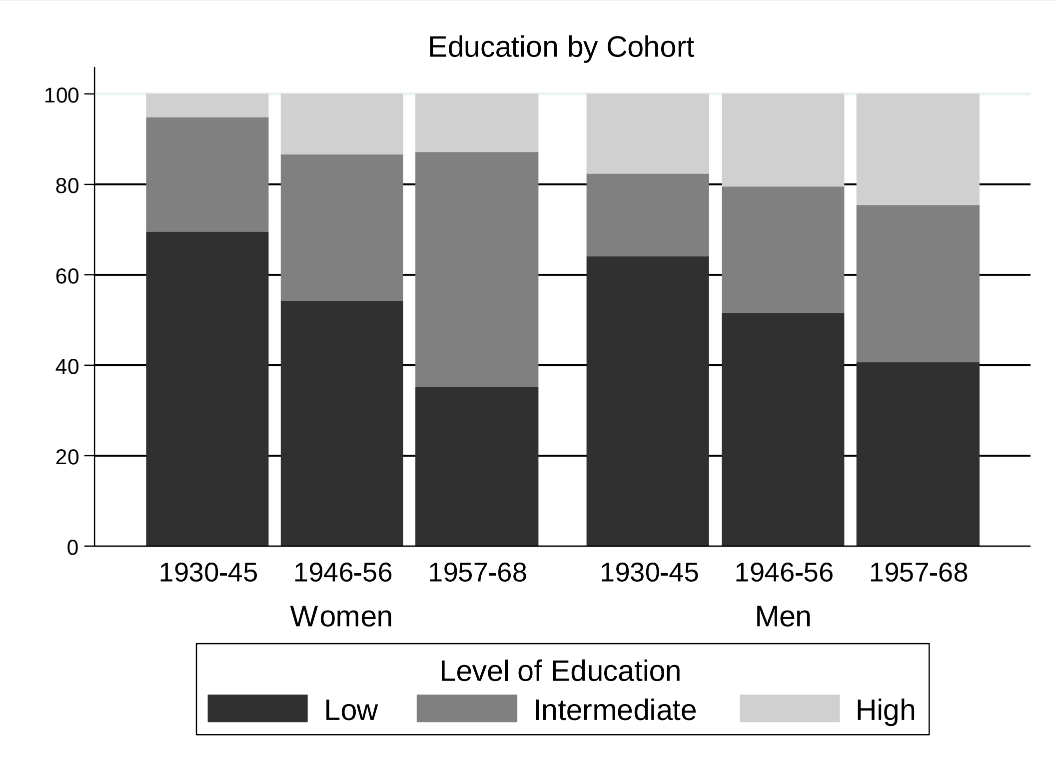

FIGURE 1: Distribution of Educational Levels by Cohort

SOEP, release 2013. *N* = 4,648. Low education = up to lower secondary vocational degree (CASMIN 1a-c). Intermediate education = up to higher secondary degree plus vocational training (CASMIN 2a-c). High education = lower and higher tertiary degree (CASMIN 3a-b).

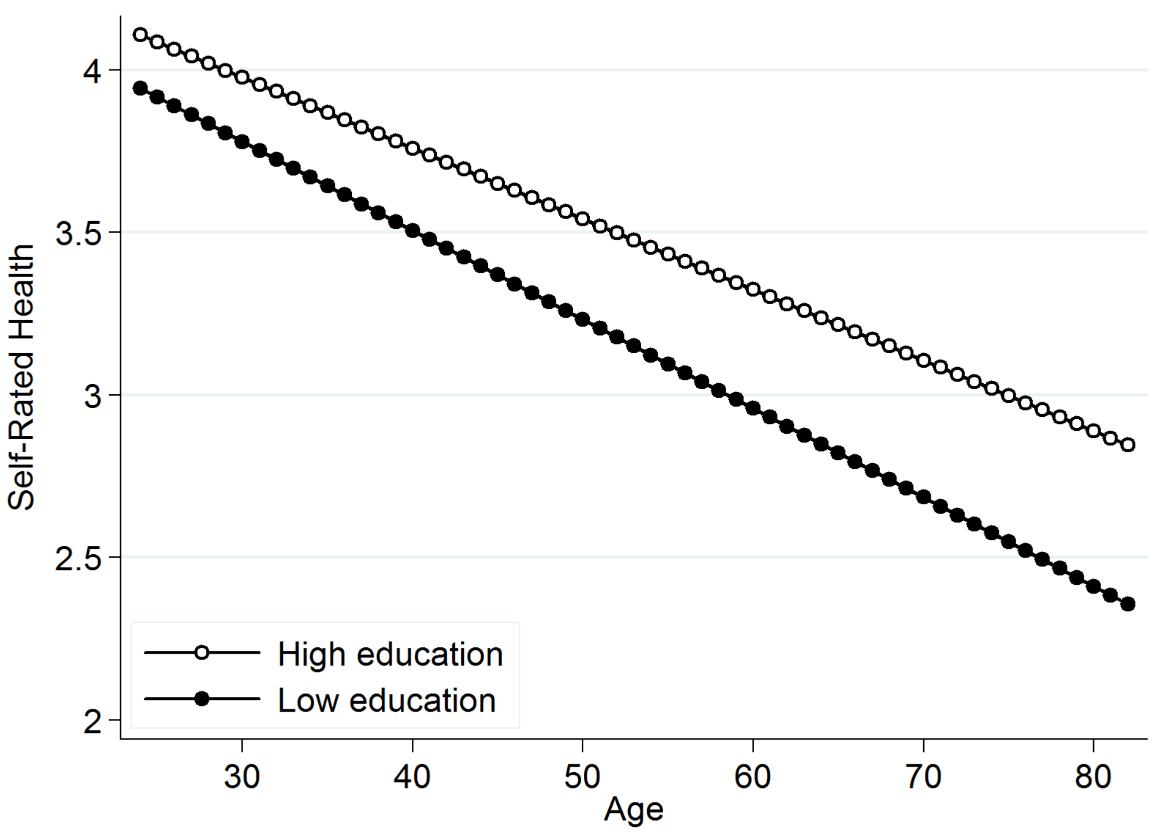

FIGURE 2: Predicted Trajectories of Self-Rated Health

SOEP, release 2013. Predictions based on Model 1, Table 4. Cohort centered at 1951, remaining covariates set to zero (i.e., male, no dropout). Low education = up to lower secondary vocational degrees (CASMIN 1a-c). High education = lower and higher tertiary degrees (CASMIN 3a-b).

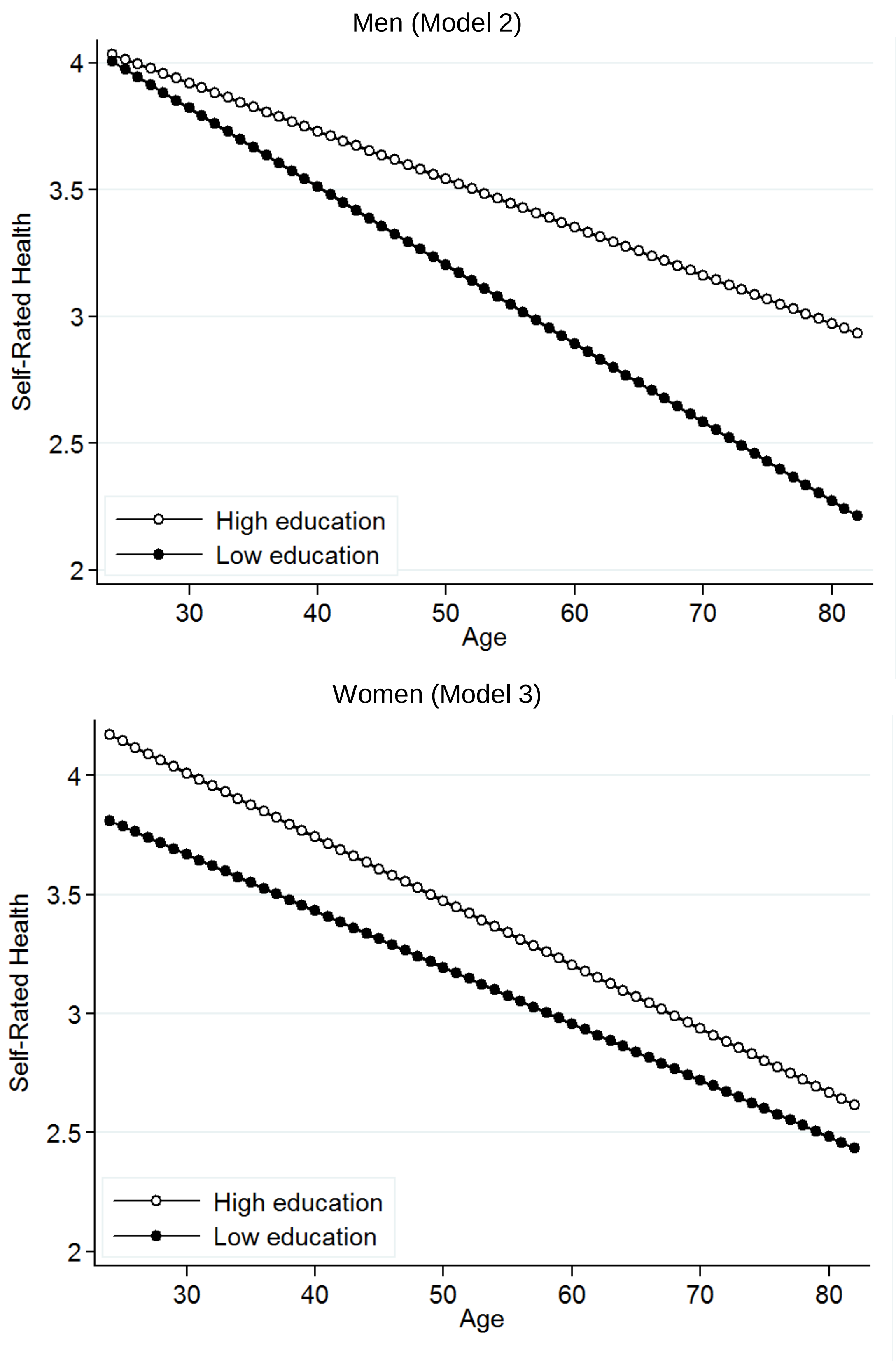

FIGURE 3: Predicted Trajectories of Self-Rated Health: Men and Women

SOEP, release 2013. Predictions based on Model 2 (men) and Model 3 (women). See Table 4 for details on the estimation. Cohort centered at 1951, remaining covariates set to zero (i.e., no dropout). Low education = up to lower secondary vocational degrees (CASMIN 1a-c). High education = lower and higher tertiary degrees (CASMIN 3a-b).

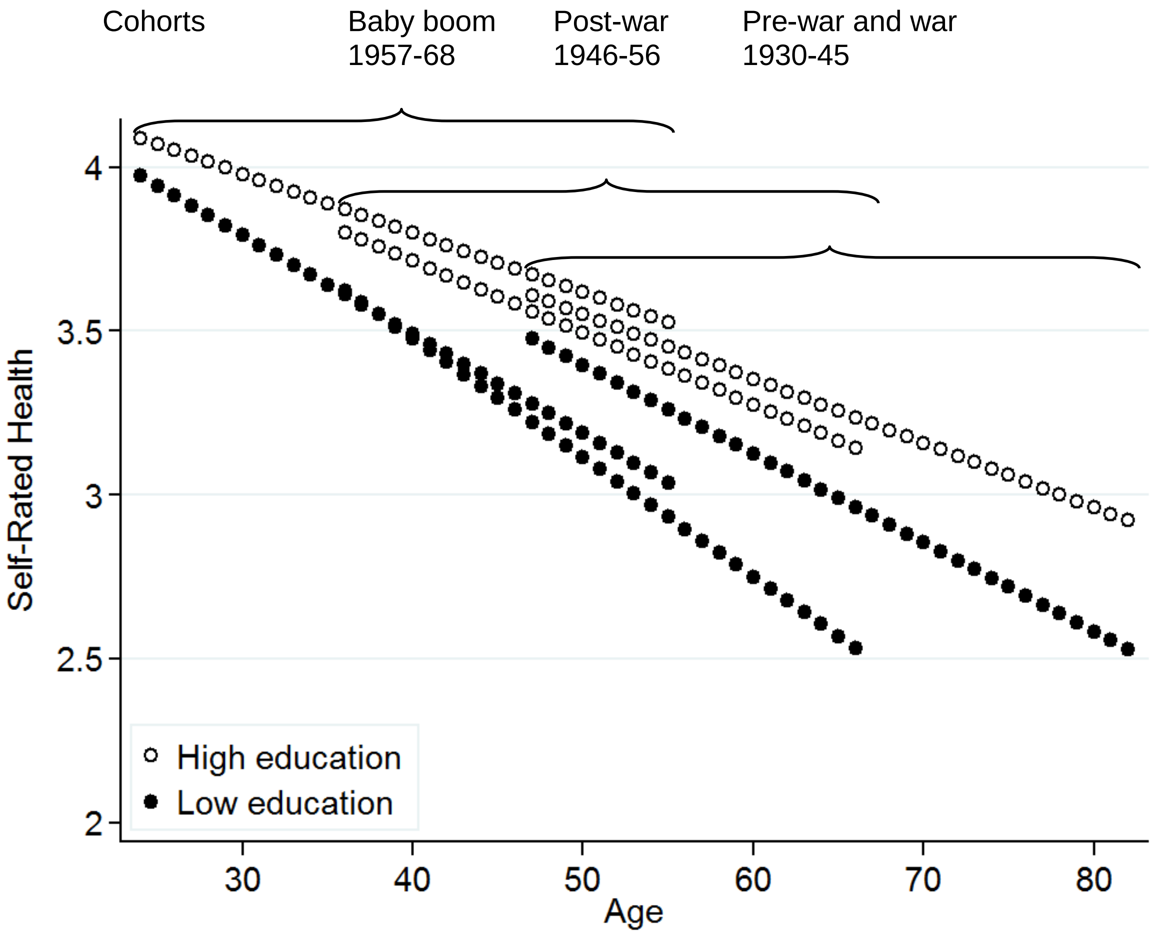

FIGURE 4: Predicted Trajectories of Self-Rated Health in Three Cohorts of Men

SOEP, release 2013. Predictions based on Model 4 (pre-war and war cohorts), Model 5 (post-war cohorts), and Model 6 (baby boom cohorts). See Table 5 for details on the estimation. Age centered at cohort-specific minimum values, other covariates set to zero (i.e., no dropout). Low education = up to lower secondary vocational degrees (CASMIN 1a-c). High education = lower and higher tertiary degrees (CASMIN 3a-b).

Appendix

The growth curves for self-rated health (SRH) of respondent *i* at time *t* are as follows (see Willson et al. 2007):

Level 1:

(1)

$$SRH_{ti} = \pi_{0i} + \pi_{1i} age_{ti} + e_{ti}$$

$i = 1, \ldots, N$ persons in the sample,
π_{0i} is an individual-specific intercept,
π_{1i} is the growth rate for person *i*.

The model estimates effects of individual characteristics on the intercepts (π_{0i}) and slopes π_{1i} of Level-1 variables:

Level 2:

(2)

$$\pi_{oi} = \beta_{00} + \beta_{01}\, intermediate\ education_i + \beta_{02}\, high\ education_i + \beta_{03}\, cohort_i + \beta_{04}\, cohort_i\ x\ intermediate\ education_i + \beta_{05}\, cohort_i\ x\ high\ education_i + \beta_{0q}\, controls_i + r_{0i},$$

$$\pi_{1i} = \beta_{10} + \beta_{11}\, intermediate\ education_i + \beta_{12}\, high\ education_i + \beta_{13}\, cohort_i + \beta_{14}\, cohort_i\ x\ intermediate\ education_i + \beta_{15}\, cohort_i\ x\ high\ education_i + r_{1i}$$

β_{pq} are the effects of individual characteristics on intercept π_{oi} and slope π_{1i},
r_{pi} are error terms for unmeasured time-constant characteristics of individual *i*.

Combining (1) and (2) yields the following equation for our models shown in Table 4:

(3)

$$SRH_{ti} = [\beta_{00} + \beta_{10} age_{ti} + \beta_{01}\, intermediate\ education_i + \beta_{02}\, high\ education_i + \beta_{03}\, cohort_i + \beta_{04}\, cohort_i\ x\ intermediate\ education_i + \beta_{05}\, cohort_i\ x\ high\ education_i + \beta_{0q}\, controls_i + \beta_{11}\, age_{ti}\ x\ intermediate\ education_i + \beta_{12}\, age_{ti}\ x\ high\ education_i + \beta_{13}\, age_{ti}\ x\ cohort_i + \beta_{14}\, age_{ti}\ x\ intermediate\ education_i\ x\ cohort_i + \beta_{15}\, age_{ti}\ x\ high\ education_i\ x\ cohort_i] + [e_{ti} + r_{0i} + r_{1i} age_{ti}]\ .$$