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Does the long arm of childhood conditions only become visible later in life?

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**Intergenerational educational mobility and health satisfaction across the life course:**

**Does the long arm of childhood conditions only become visible later in life?**

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1 **Intergenerational educational mobility and health satisfaction across the life course: Does the long arm of**  
2 **childhood conditions only become visible later in life?**

3 **Abstract**

4 The contemporaneous association of socioeconomic status (SES) with health is well-established, whereas much  
5 less is known about the health-related effects of social mobility (i.e., movements across different SES). This  
6 study investigates the impact of SES in childhood and adulthood on *health satisfaction* across the life course.  
7 Using data from the German Socio-Economic Panel (SOEP) and *education* as a central marker of SES, we test  
8 whether parental education (i.e., childhood SES) affects adult health satisfaction, directly and/or indirectly  
9 through own educational attainment (i.e., adult SES) as a mediating variable. Moreover, we apply *diagonal*  
10 *reference models* to disentangle the independent effect of intergenerational educational mobility. Our findings  
11 show that parental education has both direct and indirect effects. Yet, the relative weight of parents' education as  
12 a predictor of health satisfaction is found to depend on when in the life course health satisfaction is measured:  
13 parental education shows an increasing relevance as a predictor of health satisfaction at higher ages. On top of  
14 (additive) effects of parental and own education, we find significant mobility effects in earlier adulthood: upward  
15 educational mobility is conducive to health satisfaction and the reverse for downward educational mobility.

16 **Introduction**

17 A higher socioeconomic status (SES) is conducive to health and healthy ageing; the better educated, those in  
18 higher occupational positions, and those who can dispose of greater financial resources tend to enjoy better  
19 health at all ages. Whereas this positive relationship between current SES and health is well-established (Eikemo  
20 et al., 2008; Mackenbach et al., 2008; Marmot and Wilkinson, 1999; Sanderson and Scherbov, 2014), much less  
21 is known about the health effect of socioeconomic trajectories across the life course. Most available research on  
22 the impact of childhood SES suggests that childhood conditions matter a great deal for adult health. Children of  
23 parents at a low SES are at a higher risk of an earlier onset and a faster progression of functional health problems  
24 in later life (Agahi et al., 2014) and of developing and dying from adult cardiovascular disease (Blackmore and  
25 Ozanne, 2015; Galobardes et al., 2006; Poulton et al., 2002). The mortality risk from some cancers is also higher

1 among those of lower SES in childhood (Galobardes et al., 2008). Based on such observations, Hayward and  
2 Gorman (2004) put forward the notion of a ‘long arm of childhood’, i.e., of an enduring influence of early life  
3 conditions on adult morbidity and mortality. While the statistical association between childhood SES and adult  
4 health is undisputed, a crucial question is whether childhood conditions have a *direct* and lasting effect on adult  
5 health, or whether the impact of childhood conditions is only *indirect*, insofar as SES in childhood has a defining  
6 impact on later life-course trajectories and health exposures. Prior research shows mixed findings. Whereas some  
7 studies do not find an independent effect of childhood SES once they control for adult SES (Marmot et al.,  
8 2001), others support an accumulation model, in which both childhood SES and adult SES are relevant for health  
9 and mortality (Galobardes et al., 2008, 2004; Gilman et al., 2002; Luo and Waite, 2005; Turrell et al., 2002).

10 There is also disagreement in the literature about the health consequences of *social mobility*, i.e., the impact of a  
11 movement between different SES across the life course. A major limitation of existing research is that most  
12 studies use linear models that are unable to disentangle the mobility effect. The methodological challenge lies in  
13 the fact that indicators of mobility are linearly dependent on childhood SES and adult SES (this is similar to the  
14 challenge of disentangling age, period and cohort effects); hence not all three of these variables can be tested  
15 simultaneously in linear models. With some recent exceptions (Präg and Richards, 2019; Gugushvili et al., 2019;  
16 Schuck, 2019), methods that are able to disentangle the effect of intergenerational mobility from the effects of  
17 parental SES and one’s own SES in adulthood (such as Sobel’s *diagonal reference models*) have hardly been  
18 used in prior research on health-related outcomes (cf. van der Waal et al., 2017, p. 1030).

19 This study uses cross-sectional data from the German Socio-Economic Panel to investigate the impact of  
20 socioeconomic trajectories between childhood and adulthood on *health satisfaction* in early and later adulthood  
21 (using education as a central marker of SES). Using diagonal reference models (Sobel, 1981; van der Waal et al.,  
22 2017), we estimate the *relative weight* of parental education and own education as predictors of health  
23 satisfaction across the life course and disentangle the independent effect of intergenerational educational  
24 mobility. In contrast to most prior research that has focused on later-life health, we look at health satisfaction at  
25 different points in the life course. The questions are: Does the effect of parental education vary across the life

1 course? Can we identify an effect of the social mobility experience that goes beyond the mere effect of having  
2 spent different amounts of time at certain levels of SES throughout our lives? And does the effect of the mobility  
3 experience vary across the life course and by gender? The inclusion of younger adults into our sample of  
4 analysis is one of the reasons why this study is among the first to show significant intergenerational social  
5 mobility effects on a health-related outcome, using *diagonal reference models*.

## 6 **Theoretical models**

### 7 *Direct and indirect effects of childhood conditions*

8 Socioeconomic status in childhood (abbreviation: 'C-SES' in the following) tends to be measured with indicators  
9 such as parental education, occupation, or income. A low C-SES and the associated childhood conditions may  
10 show *direct* or *indirect* effects on health in later life (Hayward and Gorman, 2004; Preston et al., 1998). A direct  
11 effect is observed when a low C-SES is associated with early exposures to unhealthy conditions (e.g., poor  
12 nutrition or environmental conditions) which *causally* increase the risk for developing chronic health conditions  
13 and diseases in later life. Poor maternal nutrition and a low birth weight have for example been linked to the  
14 development of diabetes and cardio-vascular disease later in life ('fetal origins of adult disease', cf. Barker,  
15 1990,1994; Thornburg, 2015). Based on such observations, the *biological programming* model posits that the  
16 physiological development in-utero determines the maximum functional capacity that can be attained and  
17 maintained in later life (Blane et al. 2007). The effect of a low C-SES may be direct, but it need not be  
18 immediate. Especially in the case of chronic diseases, that aggravate slowly and trigger co-morbidities at later  
19 stages, the effect of early health exposures may be felt only many decades later (Ben-Shlomo and Kuh, 2002).

20 In contrast to models that predict direct and irreversible effects of health scars in early life on health in later life,  
21 epidemiological *pathway models* posit that a low C-SES has mostly *indirect* effects on health in later life through  
22 its impact on the chances of adult socioeconomic attainment (Case et al., 2005; Haas, 2006). Against the  
23 backdrop of limited chances for intergenerational social mobility, children of low SES parents face a high risk of  
24 low SES attainment in adulthood and in turn exposures to less healthy living and working conditions throughout  
25 adult life (Marmot et al., 2001). The effect of a low C-SES is considered *indirect* in this case, since it is mediated

1 by the SES in adulthood (abbreviation: 'A-SES' in the following). Another mechanism through which a low C-  
2 SES can indirectly affect adult health is through socialization: Parenting shapes health behaviors and preferences  
3 and may thus affect health exposures in adulthood (e.g., nutrition, physical activity, smoking, alcohol  
4 consumption, cf. Singh-Manoux and Marmot, 2005). Since unhealthy behaviors learnt in childhood may be hard  
5 to change irrespective of socioeconomic attainment in adulthood, this kind of *indirect* effect is less likely to be  
6 mediated by A-SES. Finally, we may also observe *positive indirect* effects of a low C-SES: Due to a selection  
7 process, this can occur when investigating health in later life. Those who survive to old ages, despite exposure to  
8 a low SES in childhood, are likely to be positively selected on robustness (Preston et al., 1998).

#### 9 *Life-course models in epidemiological research*

10 The dominant theoretical models applied in life-course epidemiology (critical period model, pathway model,  
11 accumulation models) entail different predictions for the relative importance of direct and indirect effects of C-  
12 SES. Crucial questions are whether C-SES shows an enduring and irreversible effect on adult health and whether  
13 it still shows an effect once we account for adult conditions and behaviors.

14 The *critical period model* holds that prenatal and postnatal childhood are developmentally salient years and that  
15 health exposures during this period have direct effects on health across the whole life course (Kuh and Ben-  
16 Shlomo, 1997). In this model, socioeconomic disadvantage in childhood can have lagged effects on health in  
17 later life, when chronic diseases start to accumulate. Based on the assumption that exposure in early life leads to  
18 *irreversible* damages to body systems (Kuh and Ben-Shlomo, 1997), it predicts that a low C-SES shows negative  
19 effects on adult health *regardless* of subsequent attainment and of any subsequent health exposures in adulthood  
20 (Haas, 2008, p. 850). The model emphasizes direct effects but does not rule out additional indirect effects.

21 The *pathway model* by contrast assumes C-SES to have *only* indirect effects. The crucial assumption is that early  
22 exposure to socioeconomic disadvantage sets children on a pathway to later exposures that eventually cause their  
23 health to deteriorate (etiologically important exposures occur in adulthood). The model predicts that C-SES only  
24 shows a pathway effect via the socioeconomic attainment in adulthood which acts as a mediator (e.g., Marmot et  
25 al., 2001). In other words, C-SES is not relevant for adult health anymore once A-SES is taken into account.

1 *Accumulation models* do not favor either direct or indirect effects. They posit that later-life health is shaped by  
2 health exposures in all stages of the life course and that *all of these exposures are equally relevant* (Kuh and  
3 Ben-Shlomo, 1997; Singh-Manoux et al., 2004). The accumulation of exposures across life causes health to  
4 gradually decline. The more pessimistic *cumulative insult model* assumes a lack of intergenerational mobility  
5 and an accumulation of disadvantages across the life course. Those at a low SES in childhood are prone to be  
6 exposed to health hazards throughout their lives (Dannefer, 2003; Ferraro and Shippee, 2009). Based on the  
7 assumption that lower socioeconomic attainment in adulthood is a central mechanism by which adverse  
8 childhood conditions affect adult health, the model predicts that an observed association of a low C-SES with  
9 poor adult health is weakened — yet remains significant and substantial — when A-SES is taken into account  
10 (partial mediation, e.g., Haas 2008). The less deterministic *cumulative exposure model* allows for the possibility  
11 that the impact of early exposures may be ameliorated by more healthy exposures in adulthood (Luo and Waite,  
12 2005). It predicts that an observed association of a low C-SES with poor adult health is either attenuated (low A-  
13 SES) or strengthened (upward mobility) when taking later conditions into account.

#### 14 *Social mobility models*

15 In contrast to the accumulation models, *social mobility models* not only account for whether or not individuals  
16 change their SES over the course of their lives; they furthermore posit that the *mobility experience itself* has an  
17 effect on the well-being of individuals – on top of cumulative effects of SES across the life course.

18 The classic *dissociative thesis* suggests that social mobility is a stressful experience (Sorokin, 1959), because  
19 socially mobile individuals enter a social class that is not as familiar as the one they have been socialized into.  
20 Growing accustomed to the new norms of behavior and the expectations in the new social class may be  
21 experienced as a stressful adaption process and may thus have negative health implications. Sociological studies  
22 have indeed portrayed the upwardly mobile as socially isolated individuals who are unable to form satisfactory  
23 personal relationships in their new social environment (Ellis and Lane, 1967; Kessin, 1971). At the same time  
24 social mobility may entail rifts in relations with the family and community of origin (Mallman, 2017). Friedman

1 (2016, p. 132) depicts the socially mobile as being caught in a ‘*position of social limbo, of “double isolation”*  
2 *from both their origin and destination class*’ with negative consequences for their mental health.

3 Newman (1999) argued that downward mobility in particular is a disruptive and stressful experience because it  
4 may be associated with feelings of personal failure to meet significant others’ expectations (*‘falling from grace*  
5 *thesis*’). The contention is that moving down the social ladder (such as failing to maintain the level of education  
6 attained by one’s parents) has negative implications, *over and above* the effects of landing in a lower SES in  
7 adulthood compared to one’s childhood. The qualitative research available on the subjective experience of social  
8 mobility supports such contentions, suggesting that whereas the upwardly mobile more easily come up with a  
9 linear narrative of their life histories, the downwardly mobile experience the reconstruction of their life histories  
10 as hurtful and humiliating and show signs of mental distress (Miles et al., 2011).

11 Applying these propositions to health research, we may assume that socially mobile individuals – and the  
12 downwardly mobile in particular – are exposed to chronic stress built up in the course of their constant  
13 adaptation efforts (e.g., feelings of uprooting, social isolation, insecurity, anxiety). In line with such contentions  
14 the downwardly mobile have been found to be more likely to show symptoms of depression (Gugushvili et al.,  
15 2019). The repeated activation of their bodies’ stress response system may increase mobile individuals’  
16 *allostatic load*, which accumulates as an individual is exposed to chronic stress, and can lead to a dysregulation  
17 of bodily systems and eventually to manifest health problems (Juster et al., 2010; Präg and Richards, 2019).

18 An alternative perspective suggests that upward mobility may actually be conducive to lower levels of chronic  
19 stress and greater well-being (Goldthorpe, 1980; Schuck and Steiber, 2018; Gugushvili et al., 2019). Subjective  
20 well-being may be defined as a function of discrepancies between one’s aspirations and actual achievements. If  
21 individuals succeed in fulfilling their socioeconomic aspirations — and the expectations of significant others  
22 such as their parents — they enjoy lower levels of mental stress and therefore greater levels of well-being  
23 (*‘fulfilled aspirations thesis*’; cf. Schuck and Steiber 2018). Moreover, self-directed movement out of less  
24 advantaged socioeconomic conditions may boost a sense of self-control and self-efficacy among the upwardly  
25 mobile and thus confer psychological well-being gains (*‘rising from rags argument*’, cf. Gugushvili et al. 2019).



1 The notable feature of social mobility models is their attempt to gauge the independent effect of social mobility  
2 (*moving* between different SES positions) after having accounted for the effects of *being* in different SES across  
3 the life course. For example, positive health effects of upward mobility would not be attributed to the fact that  
4 the upwardly mobile had a shorter exposure to the less healthy conditions associated with their SES in childhood  
5 compared to those who remained at the lower SES throughout their lives. Such effects are described by simple  
6 accumulation models, whereas social mobility models aim to disentangle the impact of the mobility experience,  
7 *over and above* the cumulative exposures to different SES across life. Figure 1 illustrates social mobility models  
8 (right hand side) as compared to pathway and accumulation models (left hand side). The former are based on the  
9 premise that pathway and accumulation models are underspecified, fail to account for the independent effect of  
10 social mobility, and therefore derive confounded effects of C-SES and A-SES (omitted variables bias).

#### 11 **State of knowledge and methodological advances**

12 Research findings regarding social mobility effects on health strongly depend on the modeling approach used. A  
13 major share of epidemiological studies concerned with the relative contribution of C-SES and A-SES as  
14 predictors of health in later life use *simple linear models* estimated in a stepwise fashion. Testing for direct and  
15 indirect effects of C-SES in this framework involves the estimation of a basic model that only includes C-SES  
16 and a second model that controls for A-SES (e.g., Hayward and Gorman, 2004; Luo and Waite, 2005). Findings  
17 from this type of research are inconsistent. Whereas some studies identify direct effects of C-SES by showing  
18 that adult health is still affected by C-SES after A-SES attainment is accounted for (Gilman et al., 2002; Haas,  
19 2008; Luo and Waite, 2005; Turrell et al., 2002), other studies suggest that C-SES effects are mostly indirect  
20 (Hayward and Gorman, 2004; Marmot et al., 2001; Pakpahan et al., 2017).

21 Life-course epidemiologists emphasize the importance of *social mobility* as a factor shaping health (Kuh and  
22 Ben-Shlomo, 1997) and a substantial amount of research has attempted to gauge its effects on health in later life.  
23 Much of this research has retained a linear modeling approach and tests the statistical association of predefined  
24 social mobility trajectories with health in later life. Basic intergenerational mobility trajectories are typically  
25 constructed from categorical SES variables measured in childhood and adulthood. A common approach is then

1 to categorize the study population into *upwardly mobile*, *downwardly mobile*, and *non-mobile* individuals and to  
2 test for health differences between these groups, either not controlling for C-SES nor A-SES (e.g., Luo and  
3 Waite, 2005; Yang et al., 2017) or controlling for *either* C-SES *or* A-SES (e.g., Blane et al., 1999; Campos-  
4 Matos and Kawachi, 2015). The methodological bottleneck of such an approach is the *linear dependency* of  
5 mobility indicators on C-SES and A-SES. The findings based on this modeling approach are very mixed, not  
6 least due to the fact that the direction of estimated mobility effects depends on whether models control for C-  
7 SES *or* A-SES (cf. Schuck and Steiber, 2018, p. 1239). Researchers are likely to find a negative association of  
8 downward mobility with health when only controlling for the social status of origin, whereas they may find a  
9 positive one when controlling for the social status in adulthood, instead (Blane et al., 1999, p. 64).

10 A commonly applied (yet equally problematic) solution to the methodological challenge presented by the linear  
11 dependency of mobility indicators on C-SES and A-SES is the *estimation of interaction effects* between C-SES  
12 and A-SES. Numerous public health studies have estimated ‘mobility effects’ by comparing the average health  
13 of individuals in each cell of a mobility table that cross-classifies C-SES and A-SES positions (e.g., Hart et al.,  
14 2008; Hoven et al., 2019; Waldhauer et al., 2019). Yet, this approach is unable to separate out the effect of the  
15 mobility experience. For example, if we compare non-mobile individuals at a low level of SES with a group of  
16 downwardly mobile individuals (high C-SES and low A-SES) in terms of their average health, we may find the  
17 latter group to be either in better health due to their higher C-SES or in worse health due to the stressful mobility  
18 experience. The average health difference between these two groups remains a hard-to-disentangle compound of  
19 positive C-SES and (potentially) negative mobility effects.

20 The only available method able to disentangle status from mobility effects are non-linear *diagonal reference*  
21 *models* developed by Sobel (1981). The basic idea of these models is that those who remain at the same SES  
22 throughout their lives serve as the benchmark (De Graaf et al., 1995) and the socially mobile show outcomes that  
23 are somewhere between the social class they were born into and the social class they joined as adults (details in  
24 methods section). Health research using this type of model is still scarce and most studies do not find evidence  
25 for social mobility effects (Houle and Martin, 2011; Monden and de Graaf, 2013; van der Waal et al., 2017; Präg

1 and Richards, 2019). Exceptions are Johnsson et al. (2017) who find that intragenerational upward mobility can  
2 reduce stress-related health problems, Schuck and Steiber (2018) who identify significant well-being effects of  
3 intergenerational educational mobility, and Gugushvili et al. (2019) who find intergenerational upward mobility  
4 to be associated with fewer symptoms of depression (reverse for downward mobility).

5 Since most available studies focus on later-life health, we have some knowledge about the relative importance of  
6 socioeconomic conditions in childhood for shaping health in later life, but we lack knowledge about their  
7 relative importance for health in younger adulthood and mid-life. Another important open question is whether  
8 the strength of mobility effects varies with age. Do potential health implications of intergenerational social  
9 mobility remain constant across the life course or do they wane when people become accustomed to their new  
10 SES position? Moreover, hardly any prior research has considered gender differences in the effects of  
11 intergenerational mobility on health (Gugushvili et al., 2019: p. 5).

## 12 **Hypotheses**

13 As pointed out by life-course epidemiologists, the dominant life-course models are not mutually exclusive and  
14 they are difficult to distinguish empirically (Kuh and Ben-Shlomo 1997: 3). For example, failure to ‘explain  
15 away’ an initial association of C-SES with later-life health by including controls for A-SES may render support  
16 to the *critical period model* (i.e., the assumption that the development of chronic diseases is biologically  
17 programmed in early childhood), while it is also perfectly in line with the predictions of *accumulation models*.

18 Some leverage in the empirical distinction between life-course models may be obtained when we take *time* into  
19 consideration. *Accumulation models* suggest that life time exposure is the relevant predictor of adult health. This  
20 would imply that later-life health is more strongly affected by A-SES given that at higher ages relatively more  
21 time has been spent in A-SES compared to C-SES (increasingly longer exposure to A-SES). The *critical period*  
22 *model*, by contrast, holds that exposures early in life are the more relevant ones, yet it may not be until much  
23 later that early health insults manifest themselves in the development of health problems. From this perspective,  
24 we would expect the importance of C-SES as a predictor of adult health to increase with the age at which health

1 is measured. More specifically, C-SES may increase in importance at the point in the life course when chronic  
2 diseases start being felt — earlier in life, current SES may be a stronger predictor of health than C-SES.

3 Also for social mobility effects, the *time* dimension may be relevant. As outlined above, a social mobility  
4 experience may cause mental strain due to the challenges posed by adaptation processes (Sorokin, 1959; Präg  
5 and Richards, 2019). However, if we assume that for those with sufficient coping resources, mental strains and  
6 the higher risk of social isolation associated with social mobility are transitory, we may expect intergenerational  
7 mobility to mostly affect health-related outcomes in earlier adulthood. Little effect may be seen for later-life  
8 health, due to the *greater time distance to the mobility experience*. Available research renders some support to  
9 this contention: most studies that use diagonal reference models and find significant social mobility effects on  
10 well-being are in fact based on younger samples (Jonsson et al. 2017; Schuck and Steiber 2018; but Gugushvili  
11 et al. 2019). In sum, consideration of *time* (age at which health is measured) leads to the following hypotheses:

12 H1: The relative strength of A-SES effects increases with age (*accumulation model*)

13 H2: The strength of C-SES effects increases with age (*critical period model*)

14 H3: The strength of social mobility effects decreases with age (*social mobility model*)

15 In this context, some research suggests that women are less capable of adapting to new social environments than  
16 men and are for this reason more likely to report stress and suffer from depression (Nolen-Hoeksema, 2001).  
17 Moreover, women have been argued to be more prone to attribute failure – such as downward mobility – to a  
18 lack of ability or effort (internal attribution), whereas men are purportedly more likely to attribute failure to  
19 factors that were beyond their control and only success to their own merits (Frieze et al., 1982). If this was true,  
20 we may expect women to be more strongly affected by downward mobility (H4a) and benefit less from upward  
21 mobility than men (H4b). Others have argued that for women their own educational attainment is relatively more  
22 important for SES attainment in adulthood (i.e., occupational position, income, and other factors that mediate the  
23 association of education with favorable health exposures) than for men, who are more strongly affected by their  
24 social class of origin and social mobility (Gugushvili et al., 2019). This would lead to the counter-hypothesis that  
25 C-SES and social mobility are more important predictors for men's than women's health (H4c).

## 1 **Data and methods**

### 2 *Data and sample*

3 We use cross-sectional data from the German Socio-Economic Panel (SOEP), collected in 2014, to estimate how  
4 individuals' *satisfaction with their own health status* is affected by their socioeconomic status in childhood (C-  
5 SES), their socioeconomic status in adulthood (A-SES), and their intergenerational mobility experience. The  
6 focus is on *education* as a central marker of SES and the health implications of intergenerational *educational*  
7 mobility (see also Schuck and Steiber, 2018; Gugushvili et al., 2019). Parental education is a good marker of  
8 childhood conditions that is associated with parents' economic resources but also with their health knowledge  
9 and health-related behaviors (Hayward and Gorman, 2004). Own educational attainment is one central indicator  
10 of A-SES, alongside occupation or income. Education has several advantages. In contrast to income, education  
11 also captures knowledge-related assets of individuals (e.g., health knowledge, cf. Cutler and Lleras-Muney,  
12 2006). Moreover, in contrast to occupation or income, education can more easily be measured across the life  
13 course, also at times when individuals are out of the labor force (e.g., those who are retired or unemployed) and  
14 for those who have not yet had a job. The inclusion of those currently out of work allows for a more  
15 representative view of the social class structure (Duke and Edgell, 1987). We focus on the population aged 30-79  
16 (N=18,972). The lower age cap is chosen, because health satisfaction is uniformly high at lower ages (lack of  
17 variation) and the higher cap helps avoiding positive selection on robustness at high ages (Preston et al., 1998).

### 18 *Measurements*

19 We use the International Standard Classification of Education (ISCED) to measure educational attainment. To be  
20 able to compare respondents' attainment with their parents' we use ISCED-1997. Respondents' own education is  
21 available in the data in the ISCED-1997 format, whereas for the parental generation we follow Fuchs and Sixt  
22 (2007) and assign an ISCED-1997 level based on two variables: mothers' and fathers' formal schooling level  
23 and their vocational training level. We classify attainment into three categories: the low-educated have at most a  
24 lower secondary education (levels 1 and 2), the medium-educated are those with upper secondary education  
25 (level 3), and the high-educated attained post-secondary or tertiary levels of education (levels 4-6). In line with

1 the dominant approach in the literature, we classify parental education according to the level of the parent who  
2 had achieved the higher qualification. In terms of intergenerational mobility we differentiate between  
3 *reproduction* (same level of education as parents), *upward mobility* (higher level than parents) and *downward*  
4 *mobility* (lower level than parents). In auxiliary analyses, we consider alternative indicators of intergenerational  
5 mobility: using the attainment level of the parent of the same sex as an indicator of parental education and  
6 defining downward mobility relative to *both* parents. The results, that are substantially very similar to the ones  
7 reported in the main analysis, are available in the online supplementary material.

8 We use individuals' satisfaction with their own health measured on an 11-point scale (*How satisfied are you with*  
9 *your health?*) ranging from 0 (completely dissatisfied) to 10 (completely satisfied) as our outcome variable.  
10 Although it is subjective, this variable has been widely used as a proxy for global health status that combines  
11 physical and mental health (e.g., Frijters et al., 2005; Gebel and Voßemer, 2014) and in line with other measures  
12 of self-assessed health (Idler and Benyamini, 1997) it has high predictive power for mortality (Frijters et al.,  
13 2011). The correlation between health satisfaction and the 5-point self-rated health (SRH) indicator (*How would*  
14 *you describe your current health?* 1-very good, 2-good, 3-satisfactory, 4-poor, 5-bad) is very high in our sample  
15 of analysis (0.77) and does not vary with age or education. We use the 11-point health satisfaction measure as  
16 our outcome variable instead of the 5-point SRH measure (or both) for methodological reasons. The non-linear  
17 *diagonal reference models* employed in the analysis do not converge using the 5-point or dichotomized SRH  
18 measure as the dependent variable. Conceptually, the two measures are thought to be similar (e.g., Jones and  
19 Schurer 2011, p. 557): The average level of satisfaction with one's own health declines over the life course in  
20 parallel with self-rated health (see Easterlin 2016, p. 85). Moreover, both measures are shaped by age-specific  
21 health expectations and the comparison of one's own health with the health of age peers, with the result that they  
22 tend to decline somewhat less quickly than objective health status (Wright, 1985; Jylhä, 2009).

23 We use listwise deletion for cases with missing information on health satisfaction (0.1% of the sample), own  
24 education (1.1%), or parental education (12.4%). The final sample of analysis includes 18,972 individuals. Since  
25 it is more likely for migrant populations to have missing information on parental education, our sample is

1 somewhat biased toward native Germans. The share of cases with missing information on parental education  
 2 does not vary across the sex or age of the respondent — the potential selectivity of the sample is thus unlikely to  
 3 affect the age pattern of findings reported. We refrain from imputing missing values on parental education  
 4 because the missing at random (MAR) assumption cannot be justified: own education, which is strongly  
 5 predictive of missing data, cannot be included in the imputation model (i.e., risk of tautological analysis).

6 Table 1 gives an overview of the number of cases and the mean level of health satisfaction in each of the cells of  
 7 a contingency table classified by the row factor C-SES (parental education) and the column factor A-SES (own  
 8 education). Those who reproduced their parents' attainment are represented in the diagonal cells (N=10,324;  
 9 about 54% of the sample). The average score difference between non-mobile individuals at a low versus a high  
 10 level of education is about one point on the 11-point scale (corresponding to an effect size of about 0.5 standard  
 11 deviations). Upward educational mobility (N=6,343; about 33% of sample) is more prevalent than downward  
 12 educational mobility (N=2,305; about 12% of sample). In line with the concept of 'gradient constraint' (Blane et  
 13 al., 1999), the average health satisfaction of mobile individuals falls in-between the non-mobile group they left  
 14 and the non-mobile group they joined.

#### 15 *Diagonal reference models*

16 Diagonal reference models (DRM) estimate the health satisfaction of mobile individuals as a function of the  
 17 values of the diagonal cells and two weight parameters that reflect mobile individuals' resemblance to their  
 18 status of origin and their status of destination (Sobel, 1981; Hendrickx et al., 1993). In other words, DRM model  
 19 the health satisfaction of the socially mobile to lie somewhere between the average health satisfaction in their  
 20 social class of origin (C-SES) and the average health satisfaction in their adult social class (A-SES).

21 Applied to our empirical specification, DRM model the health satisfaction score  $Y_{ijk}$  of individual  $k$  in cell  $ij$  in a  
 22 contingency table of C-SES  $i$  by A-SES  $j$  as the weighted sum of the estimated mean scores in the non-mobile  
 23 group at the SES in childhood ( $\mu_{ii}$ ) and in the non-mobile group at the SES in adulthood ( $\mu_{jj}$ ). The weights are  
 24 represented by the non-linear product terms  $q$  and  $(1-q)$  and denote the *relative* strength of influence of C-SES

1 and A-SES. They are constrained to sum to one and to be non-negative. Moreover, DRM estimate *diagonal*  
 2 *effects* ( $\mu_{11}$   $\mu_{22}$   $\mu_{33}$ ) that pertain to the educational gradient for non-mobile individuals.

$$3 \quad Y_{ijk} = q \times \mu_{ii} + (1 - q) \times \mu_{jj} + \sum \beta x_{ijkl} + e_{ijk}$$

4 Accounting for A-SES and C-SES by non-linear terms allows for the additional estimation of social mobility  
 5 effects. Mobility indicators (e.g., the contrast between reproduction, upward and downward mobility) can simply  
 6 be added as covariates  $x_{ijkl}$  to the model – and their effects can be interpreted just like regression coefficients.

### 7 *Analytical strategy*

8 In a first step, we estimate linear models (to allow for a comparison with prior research). The most basic model  
 9 tests the association of C-SES (i.e., parental education) with health satisfaction (OLS-1). In a second model, we  
 10 control for A-SES (i.e., own education) to test for mediation (OLS-2). In a second step, we run a basic diagonal  
 11 reference model to estimate the relative strength of C-SES and A-SES effects (DRM-1) and an extended model  
 12 to test for mobility effects (DRM-2). The following basic control variables are included in all four models: sex,  
 13 age (in years), and nativity (1=born in Germany).

14 Given that the core interest is in the overall (gross) effects of education and educational mobility, we do not  
 15 control for variables that mediate the relationship between education and health satisfaction such as labor market  
 16 status or income. Employing such a parsimonious modeling strategy is important to avoid *overcontrol bias*  
 17 (Elwert and Winship, 2014, p. 36) that would result in downwardly biased estimates of education effects  
 18 (Schuck and Steiber 2018: 1246). Robustness analyses that include controls for the most recent SES of the  
 19 respondents (ISEI – International Socio-Economic Index) are available in the online supplementary material  
 20 (Table A4). All results reported in the main analysis remain substantially unaffected by this additional control.

21 To test for differences in results depending on the age at which health satisfaction is measured, each model is run  
 22 for five different age groups (i.e., stratifying the sample by age into those in their 30s, 40s, 50s, 60s, and 70s).  
 23 Although there are many different ways of subdividing the older population, we follow prior work (e.g., von  
 24 Humboldt and Leal 2014) and define the ‘young-old’ as those aged 60-69 and the ‘middle-old’ as those aged 70-



1 79. This choice of age brackets is supported by ancillary analyses (see online supplementary material, p. 2). To  
2 test for the significance of differences across age groups, we run a pooled DRM that is based on all individuals  
3 aged 30-79 and that includes interaction effects of age with the weight parameters and mobility effects. To  
4 explore gender differences, we run separate DRM for women and men. To test for the significance of gender  
5 differences, we interact weight parameters and mobility effects with sex. DRM are estimated using the 'drm'  
6 command in Stata V.15 (Kaiser, 2018). We use the Akaike Information Criterion (AIC) to assess model fit.

## 7 **Results**

### 8 *Linear models*

9 The first models with health satisfaction as the outcome and parental education (C-SES) as the sole predictor  
10 (OLS-1) show a gradual increase in the strength of C-SES effects with age (Table 2). The second set of models  
11 (OLS-2), which control for own education (A-SES) estimate that one's own educational attainment (A-SES) is  
12 important for health satisfaction at all ages but especially in mid-life. At this stage in the life course, a high  
13 education (A-SES) confers almost one point more on the 11-point health satisfaction scale compared to a low  
14 education (A-SES). The effect of one's own educational attainment (A-SES) is comparatively small in people's  
15 70s. The effects of parental education (C-SES), by contrast, attain greater levels of absolute and relative strength  
16 at higher ages. Whereas no significant effect of parental education (C-SES) is found for the health satisfaction of  
17 people below age 60, high parental education shows a beneficial effect of substantial size later in life.

### 18 *Diagonal reference models*

19 In line with the results from the OLS-2 model, the findings of DRM-1 show that the relative weight of parental  
20 education (C-SES) increases with age from below 0.10 for individuals in their 30s, 40s and 50s, through 0.32 for  
21 those in their 60s, to 0.50 for those in their 70s (Table 3). In other words, later in life, the impact of parental  
22 education (C-SES) grows to be equally strong as the one of one's own education (A-SES). Figure 2, which plots  
23 estimated diagonal effects multiplied by the weight parameters, shows that the absolute and relative importance  
24 of parental education (C-SES) effects increases with age. In earlier adulthood up to mid-life, own attainment (A-  
25 SES) appears to be of predominant importance, whereas in later life, parental education (C-SES) attains equal

1 importance as a predictor of health satisfaction. An ancillary model that interacts the weight parameters with age  
2 shows that the difference in C-SES effects across age groups is statistically significant. Results from DRM-1 are  
3 similar for women and men (the interaction of weight parameters with sex is not significant in any of the age-  
4 stratified models).

5 The second set of DRM includes mobility indicators as additional predictors (DRM-2). Significant effects of  
6 educational mobility are found for the three youngest age groups, but model fit statistics (AIC) suggest that  
7 DRM-2 is a better fit to the data than DRM-1 only in the case of individuals aged 30-39. For this group, we find  
8 a significant negative effect of downward mobility, alongside relatively weak diagonal effects and a weight  
9 parameter for parental education (C-SES) of 0.66.

10 Overall, this suggests that in early adulthood, social inequality in health satisfaction is still relatively modest;  
11 parental education (C-SES) is of somewhat greater importance than own education (A-SES), and an experience  
12 of downward mobility shows a negative effect. The mobility effect is estimated to be of equal magnitude as the  
13 diagonal effect comparing low-educated individuals with high-educated ones. In an ancillary, more fine-grained  
14 analyses of mobility effects for those aged 30-39 the two most common downward mobility trajectories (i.e.,  
15 scaling down from high to medium education and from medium to low education) show similar effects (-0.29 at  
16  $p < 0.01$  and -0.37 at  $p < 0.01$ , respectively, see online supplementary material, Table A3). Scaling down from  
17 high to low education is a trajectory of minor empirical relevance (less than 1% of the sample, cf. Table 1).

18 Robustness analyses show that mobility effects reported in the main analysis (Table 3) are slightly reduced in  
19 size, but remain statistically significant when we control for additional dimensions of SES in adulthood (i.e., the  
20 most recent score on the International Socio-Economic Index, see online supplementary material, Table A4).

21 Separate models for women and men (Tables 4 and 5) suggest that similar conclusions for both sexes can be  
22 drawn for health satisfaction measured in the fourth decade of life (ages 30-39): We find significant negative  
23 effects of downward mobility for both women and men. In a pooled model for women and men aged 30-39 an  
24 interaction effect of the mobility indicators with sex is not significant. Measuring health satisfaction in the fifth  
25 decade of life (ages 40-49) we find significant mobility effects for women but not for men. Women in their 40s

1 who experienced upward mobility report significantly more health satisfaction compared with the non-mobile,  
2 whereas their counterparts who experienced downward mobility report significantly less health satisfaction. The  
3 difference in results between women and men in this age bracket is confirmed by a pooled model that shows a  
4 significant interaction effect of social mobility with sex.

5 When we use gender-specific mobility indicators that define mobility relative to the parent of the same sex  
6 (online supplementary material, Table A5), results for women are similar to the ones reported in the main  
7 analysis, whereas we do not find significant mobility effects for men. However, differences in results between  
8 the standard and the gender-specific approach to defining mobility need to be interpreted with caution, since  
9 rates of mobility are much lower when defined using a gender-specific approach (cf. notes below Table A5).

10 When we subdivide the group of downwardly mobile individuals into those who are less educated than both of  
11 their parents (about 4.2% of the sample) and those who are less educated than the higher educated parent (8.0%  
12 of the sample), we find that compared to the standard approach — that pools the two groups — such a refined  
13 approach may be advantageous: At ages 30-39 we find significant negative downward mobility effects only for  
14 those who have attained less education than both their parents (online supplementary material, Table A6). Yet,  
15 for an age-stratified analysis, this approach has a limitation, namely that mobility rates defined relative to both  
16 parents strongly vary across age groups and are of minor relevance at higher ages (cf. notes below Table A6).

## 17 **Interpretation**

18 Our results from linear models (OLS-2) support the *pathway model* which predicts that socioeconomic  
19 conditions in childhood show no association with adult health once we control for adult attainment — but *only*  
20 when health satisfaction is measured earlier in life (below age 60). For health satisfaction measured later in life  
21 (at age 60 and above), by contrast, our results from OLS-2 would conventionally be taken as evidence for the  
22 existence of *direct* effects of childhood conditions. Findings from OLS-2 and DRM-1 suggest that the strength of  
23 parental education effects increases with age. This renders support to the *critical period model* (hypothesis H2)  
24 — and can arguably be interpreted as a lagged influence of childhood conditions on later-life health satisfaction.  
25 It supports the notion of a *long arm of childhood conditions* that remains invisible beyond mid-life and shows an

1 effect on health satisfaction only later in life when chronic diseases start being felt. The predictions of  
2 *accumulation models* are partially supported: The relative strength of the effect of one's own education (A-SES)  
3 increases with age (cf. hypothesis H1) but only until mid-life, after which its relative strength decreases again.

4 In line with hypothesis H3, we find the impact of intergenerational mobility to be restricted to younger  
5 adulthood, when the mobility experience is more recent. Later in their lives people may have adapted to their  
6 new social environment so that mobility does not matter anymore. If this interpretation is correct, we may  
7 conclude that social mobility constitutes a transitory source of distress without long-lasting effects.

8 We find some gender differences: Similar mobility effects are found for women and men in their 30s, but only  
9 for women are mobility effects found to extend to the fifth decade of life. Among women aged 40-49 upward  
10 mobility is associated with more health satisfaction and downward mobility with less health satisfaction. A  
11 tentative interpretation of this gender difference is that women take longer to 'digest' negative mobility  
12 experiences than men (cf. hypothesis H4a) while they benefit more from positive mobility experiences.

13 Overall, we may conclude that the applicable model of social mobility effects varies across the life course: In  
14 younger adulthood, differences in health satisfaction across socioeconomic groups are still relatively modest, but  
15 at this age a negative mobility experience may undermine well-being. In mid-life, we find a gender differentiated  
16 pattern. For men, it is mainly own attainment (A-SES) that matters for inequality in health satisfaction, whereas  
17 hardly any effect of parental education (C-SES) can be seen and the mobility experience does not appear to  
18 matter. For women, we find a dominance of parental education (C-SES) effects combined with a significant  
19 impact of the mobility experience. Eventually, later in life (age 60+), the importance of childhood conditions is  
20 borne out for both sexes and we find no evidence for long-term mobility effects for either women or men.

21 What are the implications of our findings for explaining health inequalities across the life course? In early  
22 adulthood, models omitting mobility as a co-determinant suggest that own attainment (A-SES) is of predominant  
23 importance for explaining disparities in health satisfaction across socioeconomic groups. Yet, DRM that  
24 condition on mobility effects suggest that inequalities in health satisfaction in the earlier life course are shaped  
25 by a combination of the socioeconomic conditions in childhood and the mobility experience. In fact, we find

1 similar health satisfaction levels comparing those who reproduced the low education of their parents and those  
2 who had high educated parents but experienced downward mobility. In this sense, intergenerational educational  
3 mobility acts as an equalizer (gradient constraint). For men and women in mid-life (50s), social gradients in  
4 health satisfaction are predominantly affected by adult attainment levels (A-SES), leading to the highest levels of  
5 social inequality in health satisfaction at this point in the life course, whereas later in life, health disparities  
6 according to own attainment somewhat diminish and those according to childhood conditions (C-SES) emerge.

## 7 **Conclusions**

8 We addressed three specific research questions: What is the impact of SES on health satisfaction in different  
9 stages of the life course? Does SES in childhood affect health satisfaction later in life directly or only indirectly  
10 through some pathway that involves one's own attainment in adulthood? Can we identify an effect of the  
11 intergenerational mobility experience itself that goes beyond the mere effects of having spent different amounts  
12 of times at certain levels of SES throughout our lives? We find that in younger adulthood parental education  
13 (i.e., our measure of SES in childhood) and the mobility experience are the main predictors of health satisfaction,  
14 whereas in mid-life one's own attainment (i.e., our measure of SES in adulthood) plays the dominant role. For  
15 younger adulthood, this implies that policies that help to mitigate early disadvantage and that prevent downward  
16 educational mobility are important for improving health satisfaction in early adulthood. For mid-life, our results  
17 suggest that parental education mainly has *indirect* effects. Since childhood conditions set the path to adult  
18 attainment and later health exposures, this again implies that policies that help to mitigate early disadvantage are  
19 of central importance. Given that effects of low parental education on health satisfaction in mid-life are *not*  
20 found to be direct and irreversible, one may argue that later intervention can ameliorate earlier disadvantage.  
21 Yet, such conclusions may be called into question in the light of our findings for later-life health satisfaction:  
22 although the health implications of a low SES in childhood may not yet be visible in mid-life, childhood  
23 conditions can still show a lagged effect on health satisfaction in later life, when chronic diseases start being felt.  
24 Overall, our results thus suggest that the best time for interventions is *childhood* — to improve socioeconomic

1 conditions and health-relevant environments in early life, to lay the foundation for positive SES trajectories, and  
2 to mitigate early causes of later-life health problems.

3 This study has several strengths but it is also not without limitations. It combines an analysis of large-scale data  
4 that allow for a fine-grained stratification by age and sex with the development of a life-course model that helps  
5 to conceptually and empirically distinguish between different models of disease causation. A core strength of the  
6 study is its attempt to mitigate the omitted variables bias that occurs when health is co-determined by social  
7 mobility, by using diagonal reference models that have hardly been applied in public health research. The use of  
8 linear models is still the dominant modeling approach, but gradually “*consensus is emerging in the literature*  
9 *that the diagonal reference model is superior to other modelling approaches*” (Präg and Richards, 2019, p. 104).

10 Three limitations should be noted. First, the study used a subjective measure of health (respondents’ satisfaction  
11 with their own health) as the outcome of interest, and it is important to interpret the results of this study with the  
12 nature of this measure in mind. Although it is well-established that subjective measures of this kind are strongly  
13 associated with more objective health indicators and highly predictive of mortality, there is some evidence that  
14 self-assessed health becomes less strongly associated with physical health and more strongly associated with  
15 mental health as age progresses (French et al., 2012; Zajacova and Woo, 2016). Health satisfaction may be more  
16 strongly affected by health norms and comparison standards than self-rated health or objective health status:  
17 Remaining in better health than a typical member of the reference group (such as one’s peers of similar age) has  
18 for instance been shown to improve individual health satisfaction (Thiel, 2014). This quality of the measure does  
19 however not undermine its value for analyses of inequalities in subjective health within age groups.

20 Second, a methodological bottleneck in age-stratified analysis is selective attrition. In interpreting our results we  
21 need to be aware that older individuals in our sample – especially those with low educated parents – are likely to  
22 be positively selected in terms of health resilience. This potential bias of our sample towards older individuals  
23 who have lived into their 70s despite unfavorable conditions in their childhood may lead to an underestimation  
24 of inequality in health satisfaction and of parental education effects in this age group. Our results thus represent a  
25 conservative estimate of the increasing relevance of parental education with age.

1 Third, our life-course models are tested with cross-sectional data and we cannot claim identifying causal effects.  
2 We cannot disregard the possibility of health selection (reverse causation), i.e. that more healthy children are  
3 more likely to attain higher levels of education and surpass their parents' attainment level (Dahl and Kjærsgaard,  
4 1993). Conversely, the downwardly mobile may already have differed from the non-mobile in terms of their  
5 health satisfaction before they obtained their highest qualification. Although prior research suggests that strong  
6 health selection is an unlikely mechanism linking downward mobility to worse health (Claussen et al., 2005;  
7 Ritsher et al., 2001), and although we find mobility effects to be confined to early adulthood, we cannot rule out  
8 that some degree of health selection biases our estimates of education and mobility effects.

9 In any case, our study contributes to research on the health-related effects of social mobility in that it describes  
10 important empirical associations of health satisfaction with parental education (C-SES), own education (A-SES)  
11 and educational mobility trajectories using state-of-the-art methods — and in that it provides novel insights by  
12 establishing important variations in these associations with the age at which health satisfaction is measured.

13 Granting all study limitations, our findings can have important implications for future research. They render  
14 some support to the claim that some models of life-course health such as the *critical period model* are potentially  
15 less relevant for health disparities earlier in life but more relevant for inequality in chronic disease morbidity  
16 later in life (Blane et al. 2007). Conversely, *social mobility models* that hold the mobility experience to exert an  
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Table 1: Mean health satisfaction by parental and own educational attainment

Parents' education (C-SES)	Own education (A-SES)		
	<i>Low</i>	<i>Medium</i>	<i>High</i>
<i>Low</i>	6.06 (612)	6.29 (1,190)	6.53 (523)
<i>Medium</i>	6.09 (1,104)	6.46 (6,735)	6.88 (4,630)
<i>High</i>	6.29 (128)	6.70 (1,073)	7.09 (2,977)

Notes: Number of respondents in parentheses.

Table 2: Estimates from linear models (OLS) predicting health satisfaction at different ages

	30-39		40-49		50-59		60-69		70-79											
	OLS-1	OLS-2	OLS-1	OLS-2	OLS-1	OLS-2	OLS-1	OLS-2	OLS-1	OLS-2										
	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.										
<b>C-SES: Parental education (ref: low educated)</b>																				
Medium	-0.06 (0.11)		-0.18 (0.12)		0.10 (0.10)		-0.03 (0.10)		0.28 (0.11)	**	0.16 (0.11)		0.30 (0.12)	*	0.20 (0.12)		0.19 (0.12)		0.13 (0.14)	
High	0.16 (0.12)		-0.09 (0.12)		0.36 (0.11)	**	0.05 (0.12)		0.42 (0.13)	**	0.11 (0.13)		0.54 (0.14)	***	0.35 (0.15)	*	0.59 (0.16)	***	0.42 (0.15)	**
<b>A-SES: Own education (ref: low educated)</b>																				
Medium			0.28 (0.11)	**			0.47 (0.11)	***			0.49 (0.14)	***			0.52 (0.14)	***			0.13 (0.12)	
High			0.60 (0.11)	***			0.87 (0.11)	***			0.97 (0.14)	***			0.71 (0.15)	***			0.42 (0.16)	*
<b>Controls</b>																				
Female	-0.18 (0.06)	**	-0.19 (0.06)	**	-0.15 (0.06)	**	-0.13 (0.06)	*	-0.13 (0.07)		-0.09 (0.07)		-0.16 (0.08)	*	-0.09 (0.08)		-0.23 (0.09)	**	-0.14 (0.09)	
Age	-0.04 (0.01)	***	-0.05 (0.01)	***	-0.05 (0.01)	***	-0.05 (0.01)	***	-0.05 (0.01)	***	-0.05 (0.01)	***	0.01 (0.01)		0.02 (0.01)		-0.11 (0.02)	***	-0.10 (0.02)	***
Born in Germany	-0.35 (0.07)	***	-0.37 (0.07)	***	-0.07 (0.08)		-0.12 (0.08)		0.12 (0.11)		0.14 (0.11)		0.14 (0.13)		0.11 (0.13)		0.11 (0.19)		0.12 (0.19)	
Intercept	9.03 (0.38)	***	8.98 (0.39)	***	9.20 (0.47)	***	8.83 (0.47)	***	8.88 (0.67)	***	8.33 (0.67)	***	4.96 (0.94)	***	4.42 (0.95)	***	13.66 (1.21)	***	13.25 (1.23)	***
R <sup>2</sup>	0.01		0.02		0.01		0.02		0.01		0.03		0.01		0.01		0.03		0.03	
N	4,308		4,308		5,326		5,326		3,960		3,960		2,877		2,877		2,501		2,501	

Notes: Standard errors in parentheses. Sig. \*\*\*p<.001; \*\*p<.01; \*p<.05.



Table 3: Estimates from diagonal mobility models predicting health satisfaction at different ages, men and women

	<b>30-39</b>		<b>40-49</b>		<b>50-59</b>		<b>60-69</b>		<b>70-79</b>											
	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2		
	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.		
<b>Diagonal (ref: low educated)</b>																				
Medium	0.26 (0.11)	*	0.01 (0.14)		0.50 (0.12)	***	0.31 (0.11)	**	0.56 (0.16)	***	0.67 (0.17)	***	0.72 (0.17)	***	0.73 (0.18)	***	0.26 (0.16)		0.20 (0.18)	
High	0.63 (0.12)	***	0.43 (0.14)	**	0.95 (0.13)	***	0.82 (0.13)	***	1.08 (0.18)	***	1.11 (0.17)	***	1.04 (0.18)	***	1.07 (0.19)	***	0.84 (0.18)	***	0.81 (0.19)	***
<b>Weights of parental education (C-SES) and own education (A-SES)</b>																				
C-SES (q)	0.08 (0.16)		0.66 (0.27)	*	0.09 (0.11)		0.92 (0.37)	*	0.09 (0.12)		0.53 (0.27)		0.32 (0.12)	**	0.18 (0.26)		0.50 (0.14)	***	0.42 (0.32)	
A-SES (1-q)	0.92 (0.16)	***	0.34 (0.27)		0.91 (0.11)	***	0.08 (0.37)		0.91 (0.12)	***	0.47 (0.27)		0.68 (0.12)	***	0.82 (0.26)	**	0.50 (0.14)	***	0.58 (0.32)	
<b>Mobility (ref: non-mobile)</b>																				
Upward			0.11 (0.12)				0.41 (0.19)	*			0.33 (0.16)	*			-0.09 (0.17)				-0.11 (0.19)	
Downward			-0.37 (0.11)	**			-0.43 (0.18)	*			-0.17 (0.20)				0.09 (0.21)				-0.09 (0.19)	
Female	-0.19 (0.06)	**	-0.19 (0.06)	**	-0.13 (0.06)	*	-0.13 (0.06)	*	-0.09 (0.07)		-0.09 (0.07)		-0.09 (0.08)		-0.09 (0.08)		-0.14 (0.09)		-0.14 (0.09)	
Age	-0.05 (0.01)	***	-0.05 (0.01)	***	-0.05 (0.01)	***	-0.05 (0.01)	***	-0.05 (0.01)	***	-0.05 (0.01)	***	0.02 (0.01)		0.02 (0.01)		-0.10 (0.02)	***	-0.10 (0.02)	***
Born in DE	-0.39 (0.07)	***	-0.37 (0.07)	***	-0.13 (0.08)		-0.11 (0.08)		0.16 (0.11)		0.13 (0.11)		0.10 (0.13)		0.11 (0.13)		0.12 (0.19)		0.13 (0.19)	
Intercept	9.16 (0.37)	***	9.27 (0.37)	***	9.28 (0.45)	***	9.31 (0.46)	***	8.93 (0.66)	***	8.87 (0.66)	***	5.01 (0.94)	***	5.02 (0.94)	***	13.61 (1.21)	***	13.66 (1.21)	***
AIC	17851		17848		22935		22936		17383		17384		12625		12628		10997		11000	
N	4,308		4,308		5,326		5,326		3,960		3,960		2,877		2,877		2,501		2,501	

Notes: Diagonal effects estimate the educational gradient for non-mobile individuals. Standard errors in parentheses. Sig. \*\*\*p<.001; \*\*p<.01; \*p<.05.

Table 4: Estimates from diagonal mobility models predicting health satisfaction at different ages, women

	<b>30-39</b>		<b>40-49</b>		<b>50-59</b>		<b>60-69</b>		<b>70-79</b>											
	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2										
	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.										
<b>Diagonal (ref: low educated)</b>																				
Medium	0.43 (0.16)	**	0.14 (0.18)		0.63 (0.16)	***	0.36 (0.15)	*	0.76 (0.22)	**	0.92 (0.24)	***	0.90 (0.22)	***	0.96 (0.21)	***	0.09 (0.21)		0.06 (0.21)	
High	0.69 (0.18)	***	0.49 (0.19)	*	1.16 (0.18)	***	0.99 (0.17)	***	1.16 (0.23)	***	1.23 (0.23)	***	0.94 (0.24)	***	1.13 (0.25)	***	0.87 (0.26)	**	0.87 (0.25)	**
<b>Weights of parental education (C-SES) and own education (A-SES)</b>																				
C-SES (q)	0.04 (0.23)		0.93 (0.67)		0.07 (0.13)		1.00 (c)		0.17 (0.14)		0.36 (0.22)		0.26 (0.15)		0.00 (c)		0.68 (0.17)	***	0.78 (0.29)	**
A-SES (1-q)	0.96 (0.23)	***	0.07 (0.67)		0.93 (0.13)	***	0.00 (c)		0.83 (0.14)	***	0.64 (0.22)	**	0.74 (0.15)	***	1.00 (c)		0.32 (0.17)		0.22 (0.29)	
<b>Mobility (ref: non-mobile)</b>																				
Upward			0.18 (0.24)				0.63 (0.10)	***			0.26 (0.17)				-0.24 (0.15)					-0.02 (0.24)
Downward			-0.43 (0.20)	*			-0.48 (0.13)	***			0.10 (0.23)				0.35 (0.20)					-0.20 (0.19)
Age	-0.04 (0.01)	**	-0.04 (0.01)	**	-0.04 (0.01)	*	-0.04 (0.01)	**	-0.03 (0.02)		-0.03 (0.02)		-0.01 (0.02)		-0.01 (0.02)		-0.08 (0.02)	**	-0.08 (0.02)	**
Born in DE	-0.41 (0.09)	***	-0.43 (0.20)	*	-0.11 (0.11)		-0.07 (0.11)		0.35 (0.16)	*	0.32 (0.16)	*	0.18 (0.18)		0.18 (0.18)		0.06 (0.28)		0.08 (0.28)	
Intercept	8.83 (0.49)	***	8.95 (0.52)	***	8.29 (0.63)	***	8.32 (0.63)	***	7.55 (0.91)	***	7.41 (0.92)	***	6.19 (1.31)	***	6.27 (1.31)	***	11.85 (1.73)	***	11.83 (1.73)	***
AIC	10833		10836		12874		12871		9368		9369		6557		6555		5566		5569	
N	2,572		2,572		2,943		2,943		2,109		2,109		1,484		1,484		1,254		1,254	

Notes: Diagonal effects estimate the educational gradient for non-mobile individuals. (c) The larger one of the weights has been constrained to 1 to preclude negative weights. Standard errors in parentheses. Sig. \*\*\*p<.001; \*\*p<.01; \*p<.05.

Table 5: Estimates from diagonal mobility models predicting health satisfaction at different ages, men

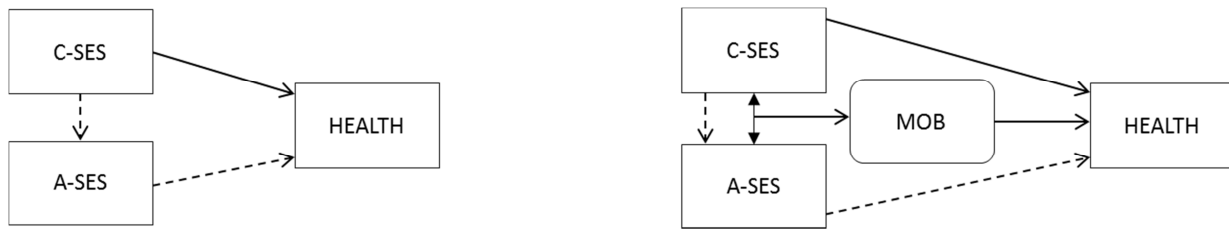
	<b>30-39</b>		<b>40-49</b>		<b>50-59</b>		<b>60-69</b>		<b>70-79</b>											
	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2	DRM-1	DRM-2										
	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.	$\beta$ (SE)	Sig.										
<b>Diagonal (ref: low educated)</b>																				
Medium	-0.02 (0.19)		-0.30 (0.22)		0.28 (0.19)		0.21 (0.22)		0.35 (0.21)		0.36 (0.43)		0.42 (0.29)		0.48 (0.22)	*	0.53 (0.30)		0.27 (0.31)	
High	0.52 (0.17)	**	0.27 (0.21)		0.65 (0.20)	**	0.59 (0.22)	**	0.98 (0.21)	***	0.99 (0.37)	**	0.96 (0.31)	**	0.98 (0.25)	***	0.96 (0.30)	**	0.77 (0.34)	*
<b>Weights of parental education (C-SES) and own education (A-SES)</b>																				
C-SES (q)	0.17 (0.17)		0.46 (0.19)	*	0.13 (0.21)		0.14 (0.72)		0.00 (c)		0.40 (0.70)		0.26 (0.18)		0.76 (0.59)		0.34 (0.19)		0.00 (c)	
A-SES (1-q)	0.83 (0.17)	***	0.54 (0.19)	**	0.87 (0.21)	***	0.86 (0.72)		1.00 (c)		0.60 (0.70)		0.74 (0.18)	***	0.24 (0.59)		0.66 (0.19)	**	1.00 (c)	
<b>Mobility (ref: non-mobile)</b>																				
Upward			0.05 (0.13)				-0.07 (0.27)				0.22 (0.48)				0.26 (0.35)					-0.25 (0.15)
Downward			-0.35 (0.14)	**			-0.16 (0.29)				-0.34 (0.34)				-0.41 (0.37)					-0.12 (0.31)
Age	-0.05 (0.02)	**	-0.05 (0.02)	**	-0.08 (0.01)	***	-0.08 (0.01)	***	-0.08 (0.01)	***	-0.08 (0.02)	***	0.04 (0.02)		0.04 (0.02)		-0.13 (0.02)	***	-0.13 (0.02)	***
Born in DE	-0.36 (0.10)	***	-0.34 (0.10)	**	-0.13 (0.11)		-0.13 (0.11)		-0.06 (0.15)		-0.07 (0.16)		0.06 (0.19)		0.02 (0.19)		0.17 (0.26)		0.21 (0.26)	
Intercept	9.25 (0.55)	***	9.42 (0.55)	***	10.28 (0.65)	***	10.34 (0.65)	***	10.42 (0.94)	***	10.49 (0.94)	***	3.72 (1.33)	**	3.80 (1.34)	**	15.37 (1.67)	***	15.53 (1.67)	
AIC	7008		7007		10045		10048		8005		8010		6070		6073		5434		5435	
N	1,736		1,736		2,383		2,383		1,851		1,851		1,393		1,393		1,247		1,247	

Notes: Diagonal effects estimate the educational gradient for non-mobile individuals. (c) The larger one of the weights has been constrained to 1 to preclude negative weights. Standard errors in parentheses. Sig. \*\*\*p<.001; \*\*p<.01; \*p<.05.

Table 6: Summary of results

	<i>All</i>	<i>Women</i>	<i>Men</i>
H1: Strength of A-SES effects increases with age (accumulation)	no	no	no
H2: Strength of C-SES effects increases with age (critical period)	yes	yes	yes
H3: Strength of mobility effects decreases with age (social mobility)	yes	yes	yes
Gender difference: H4a-H4c	Some support to H4a		

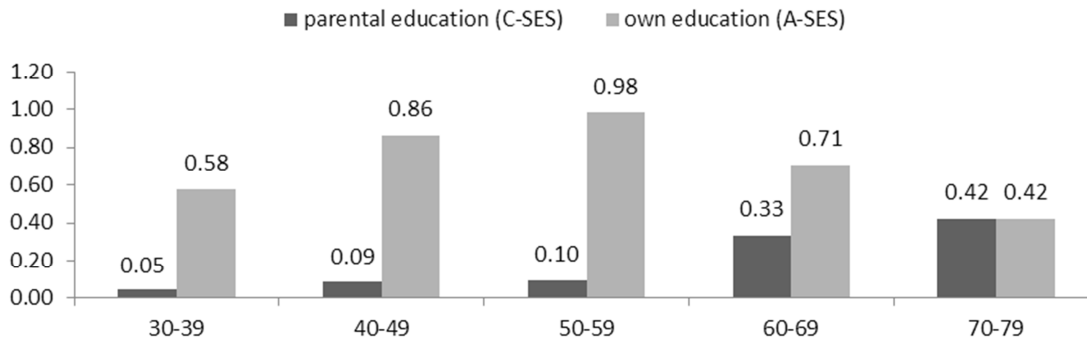
Fig. 1: Conceptual models: social stratification and social mobility effects on health



*Notes:* solid arrows pertain to direct effects of C-SES; dashed arrows pertain to indirect effects of C-SES via A-SES.

*Abbreviations:* C-SES: socioeconomic status in childhood, A-SES: socioeconomic status in adulthood; MOB: intergenerational social mobility between C-SES and A-SES.

Fig. 2: Effects of high C-SES and A-SES on health satisfaction at different ages, results from DRM



*Notes:* The y-axis shows education effects calculated as the product of estimated diagonal effects with estimated weight parameters  $q$  and  $(1-q)$  based on estimates from age-stratified DRM (Table 3, DRM-1). The can be interpreted as effect sizes, comparing the average health satisfaction (0-10) between low SES and high SES individuals.

## Highlights

- We study health-related effects of intergenerational educational mobility.
- The outcome of interest is health satisfaction measured across the life course.
- Diagonal reference models are used to analyze data for 18,972 individuals.
- The relevance of parental education for health satisfaction increases with age.
- Social mobility is associated with health satisfaction only in young adulthood.