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At Which Age is Education the Great Equalizer? A Causal Mediation Analysis of the (In-)Direct Effects of Social Origin over the Life Course

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Abstract

The mechanisms linking parental resources to their children's opportunities are of fundamental interest to sociologists. This study is the first to provide a dynamic life course assessment of the origin–education–destination triangle using causal mediation analysis. While the *age-as-equalizer hypothesis* suggests that for the highly educated, direct effects of social origin are high at young ages and decrease over the life course, the *age-as-stratifier hypothesis* suggests that for individuals with low educational attainment, direct effects of social origin are low at young ages and increase over the life course. Findings using panel data from the German Socio-Economic Panel Study are largely consistent with these hypotheses for various measures of social origin and social destination. Overall, this study demonstrates how causal mediation analysis provides precise effect definitions that allow scholars to assess mechanisms when status transmission processes depend on educational attainment.

Introduction

Why are life chances transmitted from parents to their children? This question is currently a hot topic in the public discourse. Focusing on wealth inequality, Piketty's influential book (2013) has increased public interest in issues surrounding the reproduction of inequality in Europe and the United States. To understand inequality in contemporary societies, profound knowledge of the channels through which inequalities are generated is fundamentally important. This study employs a dynamic life course perspective to investigate the importance of the main channel, educational attainment, through which the transmission of life chances from parents to their children occurs. We focus on classical sociological dimensions of inequality: Parental education, parental Erikson–Goldthorpe–Portocarero (EGP) class (Erikson, Goldthorpe and Portocarero, 1979), and parental occupational prestige [Treiman occupational prestige scale (SIOPS), Treiman, 1977 and International Socio-Economic Index of occupational status (ISEI), Ganzeboom, De Graaf and Treiman, 1992] to capture social origin, as well as two measures of occupational prestige (SIOPS and ISEI) to represent children's life chances (destination).

The assessment of the mechanisms linking parental resources to their children's opportunities (e.g. Blanden, Gregg and Macmillan, 2007; Hillmert, 2011, 2015;

Bukodi and Goldthorpe, 2013; Bukodi, Erikson and Goldthorpe, 2014; Manzoni, Härkönen and Mayer, 2014; Jacob, Klein and Iannelli, 2015; Gregg *et al.*, 2017) is a defining topic for sociological research since classical studies of status attainment (Blau and Duncan, 1967; Featherman and Hauser, 1978). In meritocratic societies, educational attainment is chief among the mechanisms explaining why children of higher status parents achieve higher occupational prestige themselves (e.g. Treiman, 1970; Ishida, Muller and Ridge, 1995; Breen, 2004; Breen and Jonsson, 2007; Kuha and Goldthorpe, 2010; Bernardi and Ballarino, 2016; Gugushvili, Bukodi and Goldthorpe, 2017). The assessment of education as an intervening mediating mechanism largely relies on path-analytic notions that have become known as the Baron and Kenny (1986) framework. The sociological status attainment literature distinguishing indirect effects of social origin (via educational attainment) from direct effects (net of educational attainment) relies almost entirely on this conventional decomposition framework. As of 7 December 2021, 108,123 citations on Google Scholar indicate that the reliance of existing status attainment research on the Baron and Kenny (1986) framework is the rule rather than the exception in the interdisciplinary research community.

Recent voices have become louder in criticizing how the scientific community assesses mechanisms linking a cause to an effect (Imai *et al.*, 2011; VanderWeele, 2015; Acharya, Blackwell and Sen, 2016; Pearl and Mackenzie, 2018; Lundberg, Johnson and Stewart, 2021). One central criticism is that conventional path analytic notions to decompose total into direct and indirect effects cannot handle situations in which the strength of a treatment or exposure depends on the level at which intervening mediating mechanisms are fixed. Thus, if the direct effects of parental resources on prestige vary depending on the level of educational attainment of the child, these notions are not adequately equipped. This is an important shortcoming, as classical sociological debates discussing whether a college degree serves as the 'great equalizer' (e.g. Hout, 1984, 1988; Hauser and Logan, 1992; Torche, 2011; Pfeffer and Hertel, 2015; Karlson, 2019; Zhou, 2019 for the United States; Vallet, 2004 for France, and Grätz and Pollak, 2016 for Germany) are centred around arguments of whether the strength of status transmission depends on the obtained level of education.

This study assesses direct effects (net of educational attainment) and indirect effects (via educational attainment) of different measures of social origin on different measures of social destination. It suggests that these

direct effects depend on educational level and life course stage. As such fine-grained hypotheses cannot be tested with conventional decomposition approaches, we outline estimands, effect definitions, identification assumptions, and estimation strategies that allow us to test these hypotheses. We overcome a static perspective by analysing life course variation in the status attainment process using multi-cohort panel data [German Socio-Economic Panel Study (GSOEP)] and a theory-guided restriction to control for period and cohort effects.[1]

Variation in Direct Effects of Social Origin Over the Life Course

Cumulative (dis-)advantage theory (Merton, 1973, 1988; DiPrete and Eirich, 2006) and cumulative inequality theory (Ferraro, Shippee, and Schafer, 2009) predict a fanning-out pattern of inequality over the life course (Kratz, 2021b). Because structural advantages help individuals not only at the beginning of their professional careers but also throughout their career progression (Jackson, Goldthorpe and Mills, 2005; Manzoni, Härkönen and Mayer, 2014; Witteveen and Attewell, 2017; Warren, Sheridan and Hauser, 2002), early disadvantage increases the exposure to risk, and early advantage increases the exposure to opportunity (Kratz and Patzina, 2020; Kratz, 2021a). This notion of an accumulation of advantage and disadvantage suggests that the total social origin effect increases over the life course. While theoretical predictions for age variations of the total social origin effect are rather unambiguous, life course processes of status transmission may well depend on the obtained level of education (see Figure 1).

Resources of highly educated parents such as networks (Corak and Piraino, 2011; Kramarz and Skans, 2014) and informational capital (Breen and Goldthorpe, 2001; Goldthorpe and Jackson, 2008; Bukodi and Goldthorpe, 2013; Jacob, Klein and Iannelli, 2015) are more valuable when their children attain a high level of education themselves (Jackson, Goldthorpe and Mills, 2005; Schulz and Maas, 2012; Jacob, Klein and Iannelli, 2015). Due to social homophily (McPherson, Smith-Lovin and Cook, 2001), highly educated parents are more likely to have highly educated network connections. These networks may be especially beneficial if their children are also highly educated. Moreover, highly educated parents may be better informed of and have easier access to career opportunities for highly educated job seekers. Furthermore, horizontal stratification may result in a comparative advantage of individuals with an advantaged family background (Zhou, 2019). Individuals with high levels of parental resources may
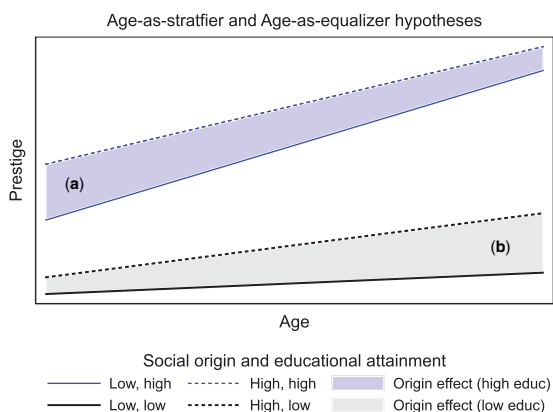
Figure 1. Theoretical predictions of the (a) age-as-equalizer and the (b) age-as-stratifier hypotheses

attend more prestigious universities and obtain degrees in fields of study that provide access to more prestigious occupations (Schindler and Reimer, 2011).

A further mechanisms consistent with the mechanism of maximally maintained inequality (Lucas, 2001; Netz and Finger, 2016) may be especially relevant in the German context. As Netz and Finger (2016) outline, the mechanism of maximally maintained inequality suggests that with educational expansion and thus higher shares of the population obtaining university-level degrees, higher social classes are pushed to distinguish themselves in other ways. With increased globalization and internationalization of companies, international experiences during the academic career have become increasingly relevant to the job seeking process (Petzold, 2017). Furthermore, these experiences often constitute the key to accessing prestigious, highly paid jobs in large and multinational companies (Kratz and Netz, 2018). At the same time, access to international student mobility depends heavily on parental resources (Kratz, 2012; Lörz, Netz and Quast, 2016).

Parental informational capital and networks of highly skilled parents should thus have a higher value for children that obtain educational levels that provide access to the highly qualified labour market. Furthermore, parental resources help their children acquire costly signals, in particular throughout the course of higher education (e.g. certificates of international student mobility, prestigious unpaid internships), which enable them to distinguish themselves at the beginning of the working career. As a result of these mechanisms, we assume that the higher the educational level of the child, the stronger the direct effect of social origin at the beginning of the working career.

Whether this 'happy start' for individuals with high levels of education from advantaged family backgrounds also results in steeper prestige trajectories and a subsequent fanning out pattern—as predicted by the strict form of cumulative (dis-)advantage theory (DiPrete and Eirich, 2006)—is not obvious. The labour market may be more meritocratic for the highly educated than for those with lower educational attainment (Breen and Jonsson, 2007; Torche, 2011; Zhou, 2019), implying that promotions more closely follow job performance. Furthermore, within the group of the highly educated, those from disadvantaged families constitute a positively selected group with respect to motivation and ability (Mare, 1981; Torche, 2011, Hout, 1988; Zhou, 2019). To put it more succinctly: Those who 'make it' despite struggling with adversities are more likely to be highly motivated and highly skilled than those who receive various forms of support to achieve an educational title.

In line with this selection explanation, the finding that status transmission is especially low for those with a college degree (in the US context) can be explained by the favourable selection of graduates with low social origin (Zhou, 2019). Further evidence that can be interpreted as support for this mechanism is the finding that individuals with the lowest probability of obtaining a higher education certificate profit most from it (Brand and Xie, 2010). It is highly likely that this favourable self-selection requires some time to manifest itself as occupational prestige after educational completion. While parental information and networks as well as costly signals obtained throughout the educational career of those from advantaged family backgrounds may overshadow the higher level of skill and motivation of those from disadvantaged families at the beginning of the working career, a more meritocratic labour market could work to their advantage, with their exemplary skill and motivation becoming more visible over time. This reasoning provides a rationale for the *age-as-equalizer hypothesis*, which suggests that for the highly educated, direct effects of social origin are high at young ages and decrease over the life course (Figure 1a).

In contrast, the *age-as-stratifier hypothesis* suggests that for those with low educational attainment, direct effects of social origin are low at young ages and increase over the life course (Figure 1b). As previously argued, parental resources such as networks and informational capital of highly educated parents may be less valuable for children who attain low educational levels that provide access to un- or semi-qualified labour market segments. Furthermore, due to social homophily, recruiters in blue collar professions (that stem from low social origins) may prefer candidates with similar social origins.

These mechanisms are expected to result in a relatively small direct social origin effect for the low educated at young ages that may increase over the life course.

Both a motivational and a resource mechanism suggest an increasing direct social origin effect for the low educated with an increase in age. The motivational mechanism mirrors the classical status attainment reasoning that the motivation for status attainment is higher for those with high social origin (Breen and Goldthorpe, 1997). If children with high social origins achieve low levels of education, they are expected to display particular motivation for rapid status progression (Mastekaasa, 2009; Diewald, Schulz and Baier, 2015; Gugushvili, Bukodi and Goldthorpe, 2017). Beyond this motivational mechanism, their parents' information and networks offer further support, especially when climbing the status ladder and when achieving occupations that resemble those of their high status parents. Both the motivation and the resource mechanism suggest that controlled direct effects for the lower educated increase over the life course.

Data, Measures and Methods

Data
We employ data from version 34 of the GSOEP, covering the years 1984–2017 (Goebel *et al.*, 2019), restricted to men and women working in western Germany. Furthermore, we exclude respondents younger than 30 and older than 60 to limit observations to the working career. By age 30, the majority has completed schooling and any further academic and/or vocational training. After age 60, both men and women start to retire. Finally, observations with missing values on the variables used in the analysis are excluded, resulting in an analytical sample of 193,682 person-year observations stemming from 26,129 individuals. As missing data may be an issue, in particular for the social origin variables, different imputation techniques were employed to check whether the results are sensitive to the missing data strategy. While the qualitative pattern remains robust for all imputation techniques, the results of listwise deletion are presented here, as these are the most conservative regarding the research hypotheses. The number of respondents at each age varies between 4,383 (at age 60) and 7,326 (at age 45). Details on the sample sizes at each age are reported in Supplementary Table S1.

Measures

Occupational prestige
Social destination is measured using the SIOPS (Treiman, 1977), an internationally standardized scale that measures the prestige of various occupations (Goldthorpe and Hope, 1972). Because of its notably stable rankings across time (Hout and DiPrete, 2006), it is an attractive measure for these analyses. SIOPS scores vary between 13 and 78 in our sample: 78 corresponds to occupations including medical doctors and dentists, and 13 to street services elementary occupations (Ganzeboom and Treiman, 1996). The ISEI is also used as an alternative measure of prestige (see Supplementary Material), and the qualitative conclusions remained unaffected. Results of the SIOPS scale are presented here as the ISEI also includes the level of education. Although the results are very similar for both prestige scales, we feel more comfortable not including a mediator as part of the outcome.

Social origin
Parental education, SIOPS, EGP, and ISEI are used to construct measures of social origin, and the results are independent of the operationalization approach. We present the results of parental education as a measure of social origin in the main text (with the other analyses in the Supplementary Material) for the following reasons: First, parents' educational level during their children's adulthood is mostly time-constant. Therefore, and second, it is less affected by measurement errors than other parental status variables. Third, education is highly correlated with later life prospects such as income and social status. Fourth, there are less missing values for the parental education variable than for the other measures of social origin. Using the dominance principle (Erikson, 1984), we distinguish respondents with at least one parent with a higher degree (*Mittlere Reife* or *Abitur*), the 'high social origin' group, from respondents whose parents have no or a lower school leaving certificate (no degree or *Hauptschule*), the 'low social origin' group.

Educational attainment
We distinguish between nine levels of educational attainment based on the CASMIN classification: (i) no completed education, (ii) general elementary, (iii) basic vocational, (iv) intermediate general, (v) intermediate vocational, (vi) general maturity, (vii) vocational maturity, (viii) lower tertiary, and (ix) higher tertiary.

Control variables
Due to different labour market participation and career development between men and women, we run separate models for each gender. Linear and quadratic cohort trends are included to capture different circumstances in various historical periods. We capture period effects by

including the unemployment rate, the GDP growth rate, and the growth rate of real disposable income for each survey wave.

Estimands

Rooted in the potential outcome framework (see e.g. Imbens and Rubin, 2015; Morgan and Winship, 2015), causal (or counterfactual) mediation analysis translates counterfactual questions into precise effect definitions (Pearl and Mackenzie, 2018). Let *HOrig* denote having an advantaged family background, whereas *LOrig* indicates a disadvantaged family. Furthermore, let the potential outcome $Y_{it}(HOrig)$ represent the prestige of respondent i at age t had they grown up in an advantaged family, and $Y_{it}(LOrig)$ the prestige of respondent i at age t had they previously been exposed to a disadvantaged family background. Similarly, let $M_{it}(HOrig)$ and $M_{it}(LOrig)$ represent the level of education that respondent i would subsequently obtain at time t under prior exposure to family advantage or disadvantage, respectively. Because education is also affected by social origin, the mediator is also formulated as a potential outcome.

The formulations $Y_{it}(HOrig) = Y_{it}(HOrig, M_{it}(HOrig))$ and $Y_{it}(LOrig) = Y_{it}(LOrig, M_{it}(LOrig))$ indicate that the potential outcomes are defined as functions of both treatment and the value of the mediator under treatment. $Y_{it}(HOrig) = Y_{it}(HOrig, M_{it}(HOrig))$ represents the prestige for respondent i at age t under conditions of an advantaged family background and the level of education the respondent would attain as a result of growing up in an advantaged family.

In the counterfactual framework, each individual is conceived to have a set of potential outcomes corresponding to all possible values of treatment (here 'low' and 'high'), and contrasts between these potential outcomes define the causal effects of interest (Wodtke and Parbst, 2017). The average total effect at age t is defined as:

$$ATE_t = E[Y_{it}(HOrig) - Y_{it}(LOrig)].$$

ATE_t is the expected difference in prestige at age t had respondents previously grown up under the level of family advantage given by *HOrig* rather than *LOrig*. Direct and indirect components add up to the average total effect as follows:

$$
\begin{aligned}
E[Y_{it}(HOrig) &- Y_{it}(LOrig)] \\
&= E[Y_{it}(HOrig,\ M_{it}(HOrig)) - Y_{it}(LOrig,\ M_{it}(LOrig))] \\
&= E[Y_{it}(HOrig,\ M_{it}(LOrig)) - Y_{it}(LOrig, M_{it}(LOrig))] \\
&\quad + E[Y_{it}(HOrig,\ M_{it}(HOrig)) - Y_{it}(HOrig,\ M_{it}(LOrig))].
\end{aligned}
$$

The first term in this decomposition is the average natural direct effect at age t,

$$NDE_t = E\left[Y_{it}\Big(HOrig, M_{it}(LOrig)\Big) - Y_{it}\Big(LOrig, M_{it}(LOrig)\Big)\right].$$

NDE_t denotes the expected difference in prestige at age t under the level of family (dis-) advantage given by *HOrig* rather than *LOrig*, if each individual subsequently obtained the level of education they would achieve under the family circumstances given by *LOrig*. For each individual, we look at what value education would have taken if that person's parents had few resources, then we fix education for each individual at that value and set the parents' resources from 'low' to 'high' and measure the difference. Thus, we compare a situation in which the individual's parents have a large amount of resources to a situation in which the parents have a lesser amount of resources, and maintain the individual's education level at the value it would naturally have taken if the parents had had few resources during the individual's childhood.

The second term in the decomposition stands for the natural indirect effect (NIE) at age t:

$$
\begin{aligned}
NIE_t = E[&Y_{it}(HOrig, M_{it}(HOrig)) \\
&- Y_{it}(HOrig, M_{it}(LOrig))].
\end{aligned}
$$

NIE_t indicates the expected difference in prestige when growing up under the level of family (dis-) advantage given by *HOrig* if each individual subsequently obtained the level of education they would obtain as a result of growing up under family conditions given by *HOrig* rather than *LOrig*. Here, we fix the parents' resources at a 'high' level and compare individuals with the educational attainment that naturally occurs when parental resources are high with the educational attainment had the parents possessed fewer resources. Consequently, no direct effect of parental resources is present, as resource level is fixed at 'high'.

$$CDE_t(Educ) = E[Y_{it}(HOrig, Educ) - Y_{it}(LOrig, Educ)]$$

$CDE_t(Educ)$ is the expected difference in prestige had respondents previously been exposed to the level of family advantage given by *HOrig* rather than *LOrig* if the respondent reaches a specific educational level. For example, $CDE_t(general\ elementary)$ answers the question: How does prestige differ when parents have a large amount of resources compared to if parents had fewer resources in the case that the individual achieves a general elementary level of education? Similarly, $CDE_t(higher\ tertiary)$ answers the question: How does prestige differ when parents have a large amount of resources compared to if parents had fewer resources in the case that the individual achieves a higher tertiary

level of education? These effects of social origin are called controlled direct effects when education as the mediator cannot affect occupational prestige as it is fixed at a specific level.

Identification

In addition to providing clear definitions of direct and indirect effects that also apply in the presence of inter-action effects between social origin and education, causal mediation analysis has clarified the assumptions behind the estimation of different effects. Not all of the effects outlined previously rest on the same confounding assumptions.

Figure 2 illustrates the relationships between social origin, education, and social destination using a Directed Acyclical Graph (DAG) (Elwert, 2013). The often overlooked fact that total effects, controlled direct effects, and natural direct and indirect effects rest on different confounding assumptions is crucial (VanderWeele, 2015). The total effect of social origin on social destination is identified when no unmeasured confounders between social origin and the prestige are present (Figure 2, Confounder 1). The controlled direct effects (CDEs) of social origin on prestige, net of education, are identified if there are no unmeasured confounders between social origin and prestige (Figure 2, Confounder 1) and no unmeasured confounders between education and prestige (Figure 2, Confounder 2).

The identification of the natural direct effect (NDE) and the natural indirect effect (NIE) of social origin on prestige via education rests on even stronger assumptions. Here, we must assume that there are no unmeasured confounders linking social origin to prestige (Figure 2, Confounder 1), no unmeasured confounders between education and prestige (Figure 2, Confounder 2), and no unmeasured confounders between social origin and education (Figure 2, Confounder 3). We additionally need assumption 3, because we need to
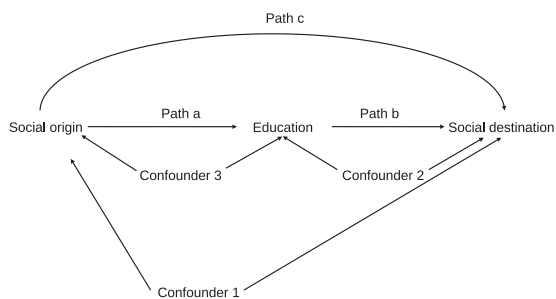
Figure 2. Types of confounding variables in the relationship between social origin, education, and social destination

estimate also a mediator regression to get estimates how education changes when social origin is modified from low to high. This estimate is not needed for the controlled direct effects.

Few intergenerational mobility research has considered that the identification of direct and indirect social origin effects rests on stronger assumptions than the identification of total social origin effects (for a recent exception, see Zhou [2019]). By stratifying via educational level, scholars open a backdoor-path and must additionally consider Confounder 2. If not, this special form of endogenous selection bias (Elwert and Winship, 2014; Torche, 2015; Breen, 2018; Kratz and Patzina, 2020; Grätz, 2022) can severely bias the estimated direct effects (VanderWeele, 2015; Acharya, Blackwell and Sen, 2016; Zhou and Wodtke, 2019).[2]

Estimation

First, we estimate a mediator regression to estimate the total effect of social origin on education:

$$Educ_{it} = \beta_0 + \beta_1 HOrig_i + \beta'_1 c_{it} + \varepsilon_i \qquad (1)$$

$Educ_{it}$ captures the level of education of respondent i at age t, while $HOrig_i$ is a measure of social origin. To estimate the dynamic development of the total origin effect, 31 separate regressions are estimated for each age t={1,...,31}. This approach captures every further education that leads to a new educational level ('life-long learning'). The control variables include a vector of individual-level characteristics and a vector of period and cohort characteristics.

Next, we estimate a full outcome regression model:

$$\begin{aligned} Prestige_{it} = \theta_0 + \theta_1 HOrig_i + \theta_2 Educ_{it} \\ + \theta_3 HOrig_i Educ_{it} + \beta'_1 c_{it} + \varepsilon_i \end{aligned} \qquad (2)$$

$Prestige_{it}$ captures the social destination of respondent i at age t. This full model includes not only the mediator (education), but also an interaction term between education and social origin. If this term is zero, the standard Baron and Kenny (1986) approach obtains the direct and indirect effect (under the assumption of no unmeasured confounding variables). However, both theory and empirical evidence suggest that this is not the case. Again, 31 separate regressions are estimated for each age.

With the results from the full outcome regression, the age-specific controlled direct effects at different educational levels can be calculated:

$$\begin{aligned} CDE_t(Educ) = E[Prestige_{it}(HOrig, Educ) \\ - Prestige_{it}(LOrig, Educ)|C_{it}] \\ = \theta_1 + \theta_3 Educ \end{aligned} \qquad (3)$$

The proportion of the total effect of social origin that would be eliminated (VanderWeele, 2015) if education were to be fixed at a specific level can then be assessed:

$$PE_t(Educ) = \frac{ATE_t - CDE_t(Educ)}{ATE_t} \qquad (4)$$

In contrast to the controlled direct effect (in which we fix education at the same level for each individual), the natural direct effect (NDE_t) fixes education at the value it would have assumed, for that individual, if social origin remained at the 'low' level:

$$
\begin{aligned}
NDE_t = & E[Prestige_{it}(HOrig, M(LOrig)) \\
& - Prestige_{it}(LOrig, M(LOrig))|C_{it}] \\
= & \theta_1 + \theta_3(\beta_0 + \beta_2'c)
\end{aligned}
\qquad (5)
$$

In the absence of interactions between social origin and education, the controlled direct effects at every level of education equal the NDE. In turn, the NIE expresses how much an individual's level of prestige would change if social origin was fixed at 'high' [*HOrig*] and the level of education was modified from the level it would have assumed if social origin were modified from 'low' [*LOrig*] to 'high' [*HOrig*]. The NIE is therefore calculated as follows:

$$
\begin{aligned}
NIE_t = & E[Prestige_{it}(HOrig, M(HOrig)) \\
& - Prestige_{it}(HOrig, M(LOrig))|C_{it} \\
= & (\theta_2\beta_1 + \theta_3\beta_1)
\end{aligned}
\qquad (6)
$$

In the absence of an interaction between social origin and education, this NIE equals the indirect effect returned by the decomposition as suggested by Baron and Kenny (1986). When inserting 0 for θ_3 in Equation (6), $\theta_2\beta_1$ remains; the estimate traditionally returned by the 'product method' of mediation analysis (Baron and Kenny, 1986).

The natural direct effect has the favourable analytical property of resulting in the total effect when combined with the NIE, even in the presence of interactions:

$$TE_t = NDE_t + NIE_t \qquad (7)$$

The proportion mediated (PM_t) indicates the relative strength of the indirect path through the mediator at age t:

$$PM_t = \frac{NIE_t}{NDE_t + NIE_t} \qquad (8)$$

This measure expresses the reduced share of the total effect of social origin if the path through the mediator were to be blocked (VanderWeele, 2015). The NDE, NIE and CDE are evaluated with the 'paramed'.ado (Emsley and Liu, 2013; Valeri and VanderWeele, 2013). We report standard errors calculated with the delta method (Sobel, 1982; Kohler, Karlson and Holm, 2011). Results are fully robust when standard errors are calculated using bootstrapped bias-corrected standard errors.

Results

Conventional decomposition approach

Figure 3 shows results of a conventional decomposition analysis. The findings indicate that the lion's share of the total social origin effect arises through origin-specific differences in educational attainment. Life course patterns comport with the idea of accumulating advantage and disadvantage for women; for men, effects remain largely stable over the life course.

While underscoring the pivotal role of educational attainment for status transmission processes, these findings remain ambiguous as to whether status transmission processes depend on educational level. How large is the direct effect at different educational levels? How much of the total social origin effect is eliminated when education is fixed at a specific level? As this approach cannot be used to answer our research questions and test the hypotheses that life course patterns of social origin effects depend on the obtained level of education, the next section presents controlled direct effects and the proportion eliminated.

Controlled direct effects and proportion eliminated

To investigate the *age-as-equalizer hypothesis* and the *age-as-stratifier hypothesis*, we present age variation in controlled direct effects at different educational levels for women (Figure 4) and men (Figure 5).[3] In addition, to understand how much of the total social origin effect is eliminated when individuals attain a specific level of education, the proportion eliminated is also presented.

For women, three main patterns appear (Figure 4). For low and basic educational levels (i.e. 'not completed' to 'intermediate general qualification'), controlled direct effects increase and the proportion eliminated decreases substantively over the life course. For women who did not complete their education, the proportion eliminated by education is 100 per cent at age 30; in other words, no direct effect exists. At ages 55 and 60, the proportion eliminated is 60 per cent, meaning that a large direct effect of 40 per cent has emerged. Thus, for women with low educational levels, these patterns are consistent with the *age-as-stratifier hypothesis*: Direct social origin effects are small at younger ages and increase over the life course.
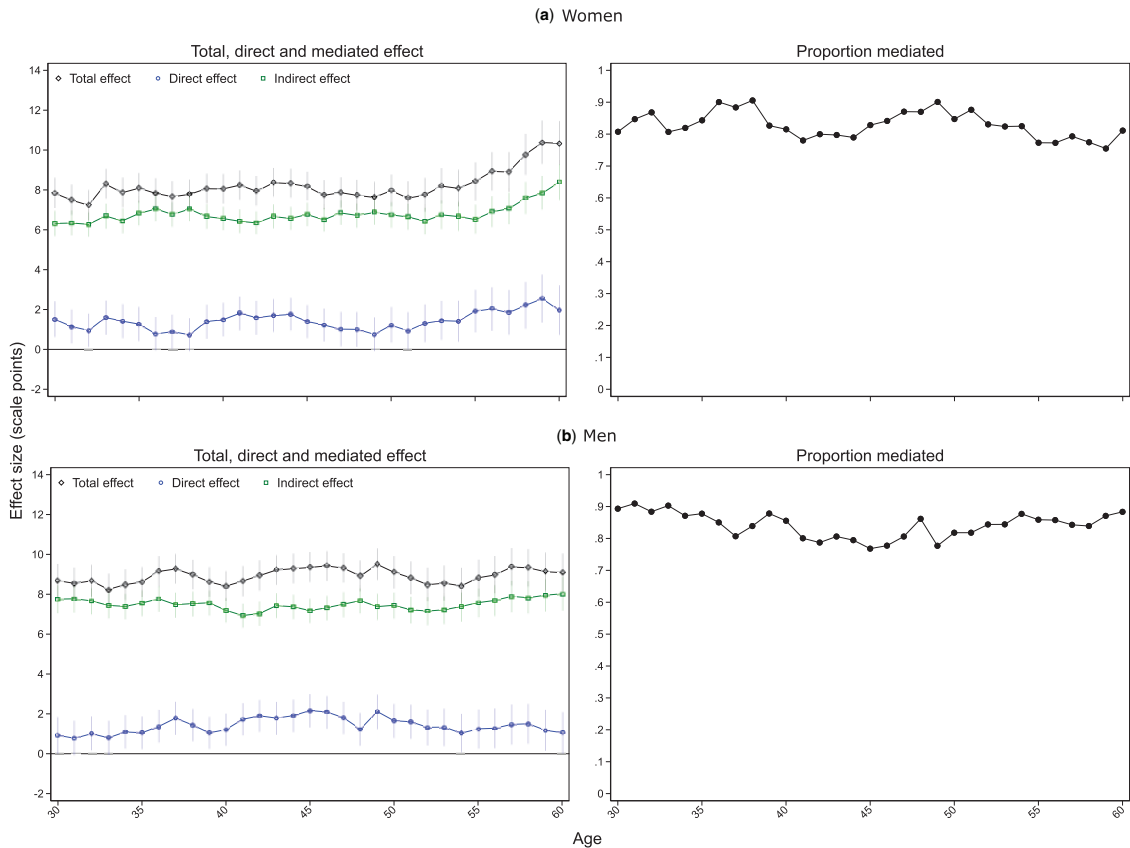
Figure 3. Total, (in-)direct effects and proportion mediated (for women and men separately)

Note: Separate models for each age; social origin is measured with parental education. Education is measured with the CASMIN scale. Control variables in all models: birth cohort, unemployment rate, GDP growth rate, growth rate of real disposable income, and a dummy variable for years of economic crisis.

For intermediate educational levels (i.e. 'intermediate vocational' to 'vocational maturity'), both controlled direct effects and the proportion eliminated remain stable over the life course. For higher educational levels (i.e. 'lower tertiary' and 'higher tertiary'), controlled direct effects decrease while the proportion eliminated increases substantially over the life course from roughly 60 per cent at age 30 to roughly 90 per cent at age 60. In other words: By the end of the labour market career, the direct effect of social origin has mostly disappeared. For women with high educational levels, these patterns are in line with the *age-as-equalizer hypothesis*: Direct social origin effects are high at younger ages and decrease over the life course.

For men with low and basic educational levels, controlled direct effects increase (and the proportion eliminated decreases) until age 43 and remain stable thereafter (Figure 5). These changes are relatively large.

For instance, men with a general elementary education exhibit negative direct effects of social origin between ages 30 and 35, after which the proportion eliminated decreases to roughly 80 per cent between the ages of 40 and 60. For men with low educational levels, these patterns corroborate the *age-as-stratifier hypothesis*: Direct social origin effects are negative at younger ages and increase during early adulthood. The pattern during this life course period also aligns with cumulative (dis-)advantage theories.

For intermediate educational levels (i.e. 'intermediate vocational' to 'vocational maturity'), controlled direct effects remain stable over the life course. The proportion eliminated remains constant at roughly 80 per cent over the entire labour market career. For higher educational levels (i.e. 'lower tertiary' and 'higher tertiary'), controlled direct effects decrease over the life course. For the highest levels of education, the proportion
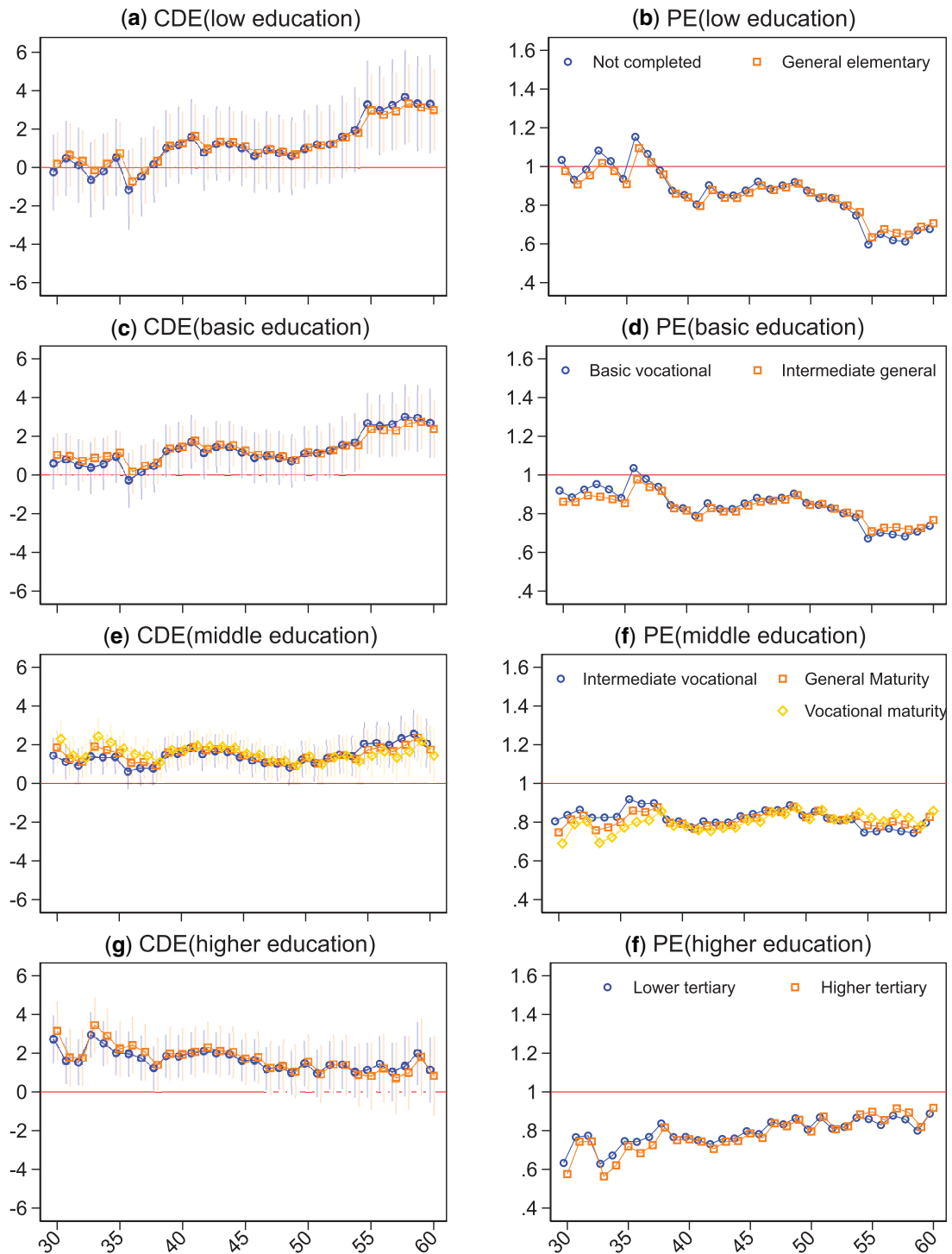
Figure 4. Controlled direct effects and proportion eliminated at different educational levels by age (women)

Note: Separate models for each age; social origin is measured with parental education. Bias-corrected bootstrap confidence intervals are used. Education is measured with the CASMIN scale. Mediator is fixed at different levels. Control variables in all models: birth cohort, unemployment rate, GDP growth rate, growth rate of real disposable income, and a dummy variable for years of economic crisis.
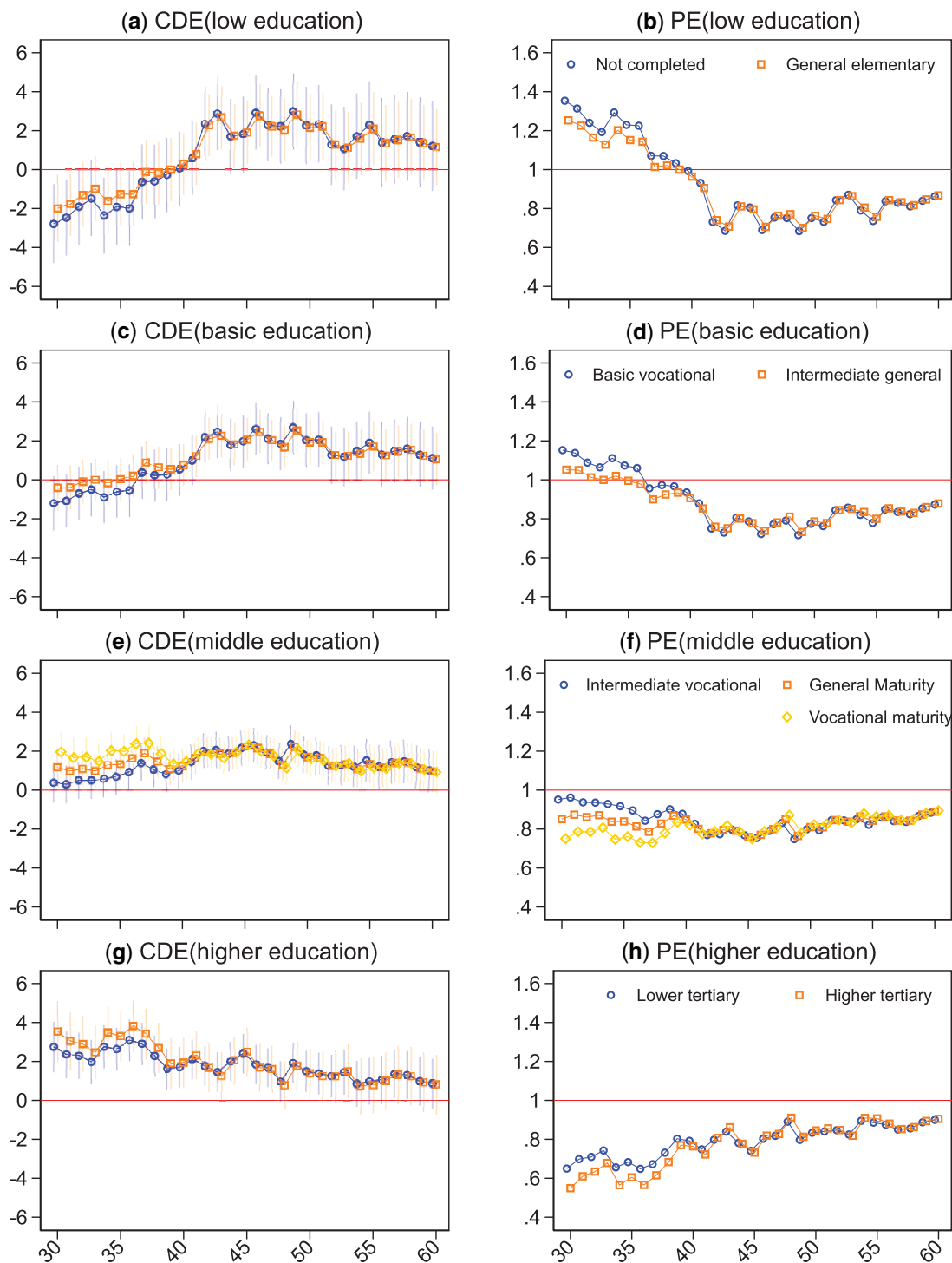
Figure 5. Controlled direct effects and proportion eliminated at different educational levels by age (men)

Note: Separate models for each age; social origin is measured with parental education. Bias-corrected bootstrap confidence intervals are used. Education is measured with a grouped version of the CASMIN scale. Control variables in all models: birth cohort, unemployment rate, GDP growth rate, growth rate of real disposable income, and a dummy variable for years of economic crisis.

eliminated increases over the life course for men. At age 30, the proportion eliminated is around 60 per cent and increases up to 90 per cent by age 60. For men with high educational levels, these patterns support the *age-as-equalizer hypothesis*.

Natural Direct and Indirect Effects

To test the notion of an accumulation of advantage and disadvantage, Figures 4 and 5 report total, natural indirect and natural direct effects for both women and men, respectively. The picture is completed by the proportion of the total effect that arises through origin-specific educational differences (proportion mediated).

For women, these results show that all three effects (i.e. total effect, indirect effect mediated by education, and direct effect of social origin) are remarkably stable until age 55, and increase thereafter (Figure 6). Consequently, the proportion mediated is largely stable over the life course. Thus, for women, the fanning-out pattern of the total and direct effect at older age corroborate the notion of accumulating advantage and disadvantage over the life course.

The pattern is slightly different for men (Figure 6): Whilst the total and the indirect effects of social origin remain constant over the life course, the direct effect increases up to age 43. Consequently, the proportion mediated decreases from 100 per cent at age 30 to 80 per cent at age 43. Between 43 and 60, the natural direct effect and the proportion mediated remain largely constant. Thus, for men, only the pattern of the direct effect during early adulthood is in line with the assumption of exacerbating inequalities and thus predictions of cumulative (dis-) advantage and cumulative inequality theories.

Sensitivity Analysis

As the intergenerational mobility literature employs diverse measures to operationalize social origin and destination, we assess whether the observed empirical pattern depends on the social origin or social destination measure. We re-estimated all models with different measures of these main theoretical concepts, and the full results are depicted in the Supplementary Material.

First, different measurements were employed to capture social origin. A median split version of the SIOPS scale was used to operationalize parents' occupational prestige. To capture parents' social class, we use a binary version of the EGP scale. A median spilt version of the ISEI was used to operationalize parents' occupational status. Results show that the pattern of total, indirect, and (controlled and natural) direct effects is remarkably

similar for all measures of social origin (see Supplementary Figures S1–S12).

Second, the ISEI is used as an alternative measurement of social destination to capture respondents' occupational status. Results show the same patterns of total, indirect, and (controlled and natural) direct effects (see Supplementary Figures S13–S16). In a last step, we apply the ISEI as a measurement of both social origin and social destination and find, again, the same pattern for all educational groups (see Supplementary Figures S17–S20).

Conclusion and Discussion

Which role does educational attainment play in the status attainment process? How much of the total effect of parental status on their children's status arises through education-specific differences (i.e. the indirect effect mediated by education), and how much arises from the direct effect of social origin? These questions have preoccupied sociologists for at least half a century. Although knowledge about inequality-generating mechanisms in the status attainment process has accumulated, some questions have not yet been answered due to question formulation and estimation approaches used thus far.

What is the precise meaning of 'direct effect'? A direct effect is an unexplained residual effect. Until it is clearly defined which intervening mediating mechanism is fixed at which level, the meaning of 'direct effect' remains ambiguous (Lundberg, Johnson and Stewart, 2021). Counterfactual thinking helps to ask questions that clarify which mechanism is held constant and how. Precise counterfactual research questions lead to subtle nuances in effect definitions that enabled us to test our theoretical arguments about how status transmission processes vary at different educational levels and over the life course. This would not have been possible with conventional mediation analyses that mask the fact that transmission processes depend on the level at which the education measure is fixed.

For women and men with low levels of education, direct social origin effects are small (or even negative) at younger ages and increase over the life course. We termed this pattern, which is consistent with the notion of an accumulation of advantage and disadvantage, the *age-as-stratifier hypothesis*. This finding may be explained with either a resource or a motivational mechanism. The motivational explanation assumes that individuals from high social origins with low levels of education are especially ambitious to progress in their working career. The resource mechanism suggests that

(a) Women

(b) Men
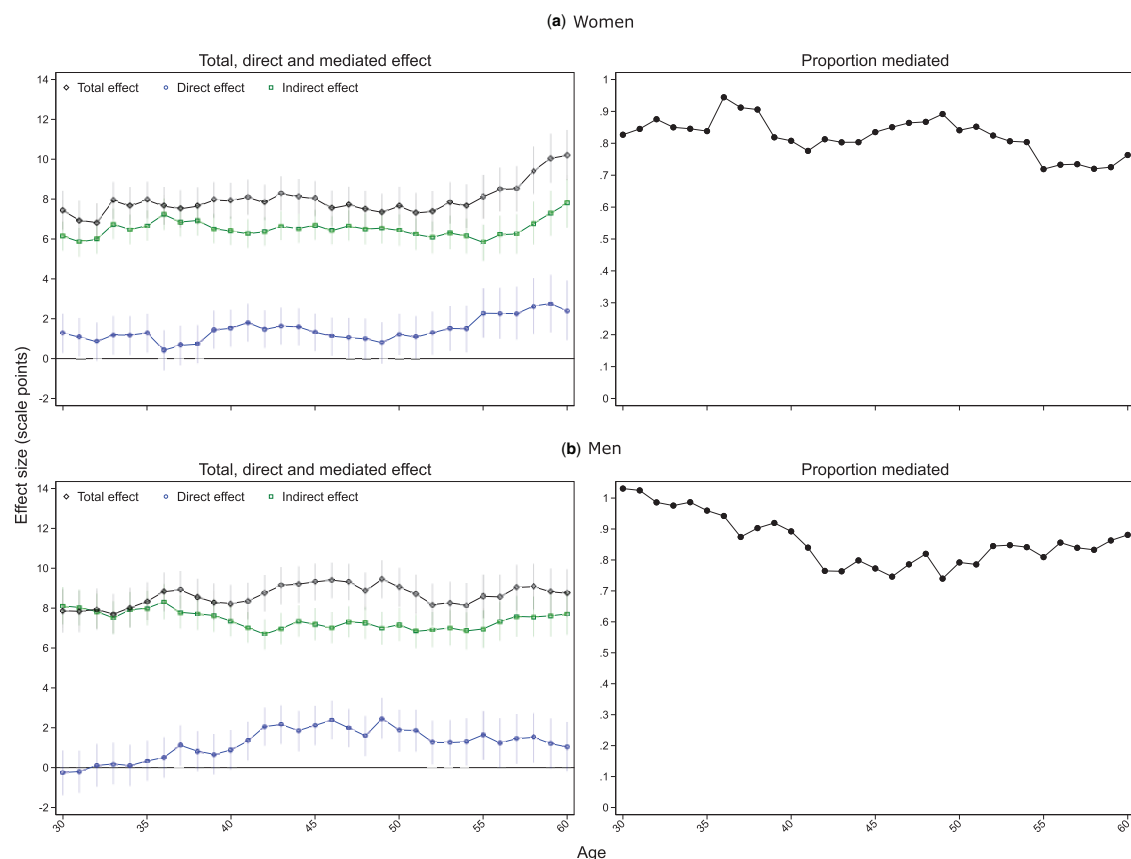
Figure 6. Total, natural (in-)direct effects, and proportion mediated (for women and men separately)

Note: Separate models for each age; social origin is measured with parental education. Bias-corrected bootstrap confidence intervals are used. Education is measured with the CASMIN scale. Control variables in all models: birth cohort, unemployment rate, GDP growth rate, growth rate of real disposable income, and a dummy variable for years of economic crisis.

when children from high social origins obtain low levels of education that provide access to the un- or semi-qualified labour market, parental resources appear to be less valuable at the beginning of their working career. When these individuals grow older and their working career progresses, parental resources become increasingly relevant as they support access to skilled labour markets.

The life course pattern for highly educated women and men is decidedly different. At higher educational levels, parental resources (such as informational capital or networks) and costly signals (e.g. unpaid internships and international student mobility) appear to be especially important at the beginning of the working career. Over time, the especially high levels of motivation and skills of individuals who achieved high levels of education despite childhood adversity (Mare, 1981; Torche, 2011; Hout, 1988; Zhou, 2019), in combination with the meritocratic principles in the highly educated labour

market (Breen and Jonsson, 2007; Torche, 2011; Zhou, 2019), result in decreasing origin effects with increasing age. This pattern, termed the *age-as equalizer hypothesis*, has important implications for the field of status attainment research. First, it suggests that time spent in the labour market is essential for higher education to function as the 'great equalizer'. Second, it implies that the pattern of individuals with low levels of social origin obtaining higher education 'against all odds' profiting most from educational attainment (Brand and Xie, 2010) becomes more pronounced over the life course.

Overall, this study demonstrates the importance of dispelling widespread myths about total and direct effects. The common perception is that it is only meaningful to assess direct effects if there is a significant total effect, but this perception is clearly incorrect. For example, the Baron and Kenny's approach (1986) here returns a small (not significant) direct effect for men at

age 30. At the same time, there is a strong (significant) positive direct effect of social origin for individuals who obtain a high level of education, and a strong (significant) negative direct effect for those who attain a low level of education. This important finding would have been masked by a conventional decomposition approach; the key to transparency is to clarify subtle nuances in different versions of direct effects.

This empirical analysis is not without limitations. First, we cannot completely rule out the possibility that age effects are affected by period or cohort effects, or a mixture of both. We tackled this issue by using multi-cohort panel data: This data structure enabled us to use a theory-guided restriction to control for period effects whilst controlling for linear and quadratic cohort trends. This approach rests on the assumption that the included macro-level variables adequately capture period effects. While this assumption may be debated, this approach reflects a growing consensus in the age-period-cohort literature that theory-guided solutions are best suited to tackling the age-period-cohort identification problem (Glenn, 2005; Fienberg, 2013; Bell and Jones, 2018; Kratz and Brüderl, 2021).

Second, this analysis focused solely on one issue with traditional mediation analyses, namely interactions between treatment (here: social origin) and mediator (here: education) variables. However, causal mediation analysis has outlined more drawbacks that require attention, for example the issue of time-dependent confounding when identifying direct effects (VanderWeele, 2015; Acharya, Blackwell and Sen, 2016; Zhou and Wodtke, 2019).

Finally, this study relies on German data. While the presented theoretical arguments are not specific to the German context, future research would clearly profit from analysing international variations. The extent to which status transmission processes depend on the obtained educational level may depend on (i) the type of welfare state, (ii) the strength of origin-specific educational inequality, and (iii) the strength of the link between educational attainment and profession. The degree to which education-specific transmission processes vary over the life course may be influenced by the degree of technological change and the permeability of the labour market. Asking counterfactual questions, defining precise estimands, clarifying subtle nuances in effect definitions, disclosing identification assumptions, and choosing expedient estimation strategies will help to unleash the full potential of inequality research.

Supplementary Data

Supplementary data are available at *ESR* online.

Notes

1 For a recent exception, see Cheng and Song (2019), who model income mobility trajectories and also report models in which they conditioned on education and occupation (i.e. estimate direct effects of social origin) over the life course. At the same time, they do not consider interactions between social origin and education.

2 Note that all counterfactually defined measures are based on cross-world assumptions, as they involve thought experiments for individuals. Averaged effects (usually denoted by inserting an 'a' before the measure) are necessary to estimate these counterfactuals. For simplicity's sake, this notation has been suppressed.

3 All tables (used for Figures 3–6) are available in the Supplementary Material. Supplementary Table S2 shows the natural direct and indirect effect and the controlled direct effects.

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