ORIGINAL ARTICLE

Social origin and political participation: does education compensate for or reinforce family advantages and disadvantages?

Vardan Barsegyan[1] · **Antonie Knigge[1]** · **Ineke Maas[1,2]**

Abstract

Whether educational attainment compensates for or reinforces family disadvantages in political participation is currently a debated topic. Previous research has shown a consistent relationship between social origin and political participation in Western societies: individuals originating from low-socioeconomic-status families participate in politics less than those from high-socioeconomic-status families, which violates the democratic requirement of equality of political voice. In this paper, we investigate whether secondary education compensates for or reinforces the political inequality shaped by social origin. We used a German representative sample of 1012 identical twins aged 21–25 and applied family fixed effects regression models, which allowed us to control for measured and unmeasured social and genetic confounding. We found a positive effect of educational attainment on participation, which is most likely causal. Family disadvantage resulting from low parental education is compensated for by children finishing the academic track (*Gymnasium*) as opposed to the lower vocational track (*Hauptschule*). At the same time, family advantage originating from high parental occupational status is reinforced for children completing the academic track. We found no advantage nor disadvantage, compensation nor reinforcement, related to parental income. We conclude that compensation and reinforcement of family disadvantage may remain unnoticed if components of parental SES are not distinguished.

Keywords Political participation · Social origin · Educational attainment · Family fixed effect · Twin data

✉ Vardan Barsegyan
v.m.barsegyan@uu.nl

[1] Department of Sociology, Utrecht University, Padualaan 14, 3584 CH Utrecht, The Netherlands

[2] Department of Sociology, Vrije Universiteit Amsterdam, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands

Introduction

Political equality requires that political participation (voting, protesting, signing petitions, etc.) is independent of an individual's social origin (Lijphart 1996; Dahl 2006; Schlozman et al. 2018). However, the vast majority of research has shown that political participation is strongly stratified by social origin in Western societies: individuals originating from high-socioeconomic-status (SES) families, defined by high levels of education, occupational status, and income, participate in politics to a greater extent than individuals from low-SES families (Milbrath and Goel 1977; Verba et al. 1995, 2003, 2005; Schlozman et al. 2012, 2018).

Political socialization in school has been thought to be a means to solve the problem of political inequality, as education is seen as a 'universal solvent' for many social problems (Converse and Campbell 1972; Putnam 2000). More theoretical educational tracks and longer education increase students' ability to understand complex political issues, which would, in turn, increase their political participation (Converse and Campbell 1972; Jackson 1995; Verba et al. 1995; Nie et al. 1996; Hillygus 2005; Campbell 2006; Lewis-Beck et al. 2008). Longer schooling and attending theoretical educational tracks also means longer and higher-level political socialization in school, for example through civic education, which would also positively influence political participation.

For education to solve the problem of political inequality by social origin, it should, first, have a causal effect on political participation (*resource effect*) (Lindgren et al. 2019). If this is the case, political inequality by social origin can be reduced in two different ways. First, inequality will decrease with educational expansion, because—due to a ceiling effect for children from high-SES families—educational expansion will especially benefit children from low-SES families. Or second, inequality will decrease if education especially increases the political participation of individuals from low-SES families (*compensation effect*). Otherwise, education either does not affect political participation, or it affects participation but does not reduce political inequality. Education may increase political inequality even further if it especially encourages participation of individuals from high-SES families (*reinforcement effect*). Reinforcement can occur when more intense political socialization in the parental family—which is more likely in high-SES families—makes political socialization in school more effective. Or if children from low-SES families are hardly affected by political socialization in school, because they have no incentive to participate in politics [the "*left-behind*" effect (Neundorf et al. 2016)]. We focus in this study on testing the resource effect as well as the compensation and reinforcement effects. Our data do not allow us to test the mechanism of educational expansion.

Whether there is a causal effect of education on political participation is part of the 'causal versus proxy' debate (Kam and Palmer 2008; Persson 2015). It has been argued that the effect of education on political participation is spurious because it reflects the effects of social and genetic factors. Both educational attainment and political participation can be influenced by family environment (Cesarini et al. 2014). For example, parents can treat their children in a way that

increases or decreases both educational attainment and political participation (Conley and Bennett 2000; Conley 2004). Similarly, the same genes responsible for attaining a higher level of education can also increase political participation (Ahlskog 2020). Thus, it is crucial to use data and methods that allow us to take into account both social and genetic confounding influences. Some scholars used control variables (Finkel 2002; Bovens and Wille 2010; Condon 2015). However, control variables cannot take into account the effects of unmeasured confounding variables. Other studies applied causal research designs: exogenous variation in schooling (Mettler 2002; Milligan et al. 2004; Sondheimer and Green 2010; Berinsky and Lenz 2011; Persson et al. 2016; Henderson 2018; Dang 2019; Lindgren et al. 2019), longitudinal or panel data and score matching (Kam and Palmer 2008; Persson 2012, 2014; Janmaat et al. 2014; Ma 2017), sibling data design (Gidengil et al. 2019; Burden et al. 2020), or identical twin-pairs' design (Dinesen et al. 2016)—but their conclusions are not unequivocal. It seems education has a causal effect mostly in the US, and the effect of education is (with few exceptions) spurious in Europe (see Online Appendix A for an overview of the literature). The European studies, however, focus mainly on countries with either a comprehensive educational system, in which students are not tracked in academic versus vocationally oriented tracks, or with educational systems where tracking occurs at a relatively late age (15–16), while in Germany it occurs at around age 10–11. Because academic tracks are both longer and more theoretical than vocationally oriented tracks, the causal effect of education on political participation may be stronger in a more stratified educational system.

The second issue is whether education compensates for or reinforces the relationship between social origin and political participation. Theoretical arguments have been proposed for both effects (Almond and Verba 1963; Inglehart 1977; Neundorf et al. 2016). To the best of our knowledge, however, there are few studies that have investigated this empirically (by using both causal and non-causal designs). There seems to be some support for compensation in studies on voter turnout, political activism, and intention to vote (Mettler 2002; Campbell 2008, 2009, 2019; Ma 2017; Lindgren et al. 2019; Deimel et al. 2020). A reinforcing effect has not been found for political participation, but it has been found for political sophistication: a longer period of education increases political knowledge and tolerance, especially for individuals from highly educated environments (Campbell 2009).

Our study asks (1) whether education has a causal effect on political participation, addressing and contributing to the 'causal vs proxy' debate, and (2) whether the effect of parental SES decreases with education (compensation effect) or increases with education (reinforcement effect). Our specific contributions to the literature are twofold. First, we use an identification strategy that reveals an effect that approaches a causal effect by estimating family fixed effects (FFE) models on data on identical twins (Neale and Cardon 1992; Allison 2005). The use of twin data for studying causal effects on political outcomes is becoming a more widely utilized methodological approach (Dinesen et al. 2016; Robinson 2019; Ahlskog and Brännlund 2021; Weinschenk et al. 2021). However, to the best of our knowledge, this is the first study that tests compensation and reinforcement effects of education on political participation using this approach. We thus provide a strong test of these effects.

Secondly, we study inequality in political participation in Germany, a country characterized by a strictly stratified educational system. At age 10 or 11 children are separated into three tracks: *Hauptschule* (lower vocational track), *Realschule* (intermediate track), and *Gymnasium* (academic track)—which differ in length, their theoretical versus vocational orientation, and in the duration and complexity of civic education (Bacia and Abs 2017; Kavadias et al. 2020). A recent study found that young German adults who attended vocational training are less interested in politics and are less inclined to vote compared to those who attended academic upper secondary education (Savage et al. 2021). Because of the stratified secondary education system, we expect the differences in political outcomes to be more profound in Germany compared to, for example, the US and Sweden, where most similar studies have been conducted, and where secondary education is not formally stratified (US) or stratification occurs much later at age 15–16 (Sweden).

We analyze the first wave of the German TwinLife Study, which contains 1012 identical twins aged 21–25 raised together (Hahn et al. 2016; Diewald et al. 2022). An advantage of these data is that the twins were surveyed in their formative years after finishing school. At later ages, there will be many alternative predictors of political participation because of further education, new sources of political knowledge and interest, and people increasingly entering networks unrelated to their family of origin and school. This makes it difficult to single out the effect of secondary education from other effects.

Theory

The influence of parents and education on political participation

Parental political socialization includes all the ways in which parents serve as role models for political participation, teach their children about politics, transmit political values, and encourage them to become politically active. Parental political socialization increases children's interest in politics, political knowledge, and political participation. It has been theorized that children from high-SES families receive more parental political socialization than children from low-SES families (Verba et al. 2003, 2005; Schlozman et al. 2012, 2018). This is because high-SES parents participate in politics more actively than low-SES parents (Campbell et al. 1960; Verba and Nie 1972; Milbrath and Goel 1977; Verba et al. 1978, 1995, 2003; Dalton 2017; Quaranta 2018; Wilford 2020). High-SES individuals do so because they have more resources (money, knowledge, social skills) and motivation to participate than low-SES individuals (Brady et al. 1995; Verba et al. 1995). As a consequence, the costs of participation are lower and the potential losses of not participating are higher for high-SES than for low-SES individuals (Downs 1957; Riker and Ordeshook 1968; Kahneman 2011). Parents in turn transmit their political beliefs, attitudes, and behavior to their children (Bandura and Walters 1977; Plutzer 2002; Verba et al. 2005; Jennings et al. 2009). It is argued that higher parental SES is associated with higher political participation among the next generation (Verba et al. 2003, 2005; Schlozman et al. 2012, 2018). Recent empirical results are in line with

this expectation (Gidengil et al. 2016; Lindgren and Oskarsson 2022; Oskarsson et al. 2022). In Germany, family background is a significant predictor of political participation (Kiess 2021), and of the political knowledge and intended electoral participation of young adults (Deimel et al. 2022). Because this is not the main question in our study, we do not formulate an explicit hypothesis relating to this, but we will show in the results section that higher parental SES is also associated with higher political participation of the children in our study.[1]

The influence of education on political participation is more controversial. Several mechanisms have been proposed through which education could affect political participation. First, political socialization in school is thought to increase students' political knowledge, encourage their interest in politics, and enhance their sense of civic duty (e.g., through civic education). As a result, individuals who received more political socialization in school would become more politically active (Verba et al. 1995; Galston 2001; Hillygus 2005). Second, more theoretical educational tracks would enhance political participation because they increase students' cognitive ability and help develop their capacity for abstract and theoretical thinking, which in turn allows students to understand better complex political issues and decreases the costs of political participation (Jackson 1995; Verba et al. 1995; Lewis-Beck et al. 2008; Lindgren et al. 2017). Third, educational institutions include students in networks of highly educated individuals, which could multiply the effect of the two previously mentioned mechanisms (Nie et al. 1996). Being surrounded by people who have an interest in and knowledge of politics and who are politically active is likely to have a positive effect on one's own interest, knowledge, and political participation. The longer the political socialization in school and the higher the level of educational attainment, the more influential these three mechanisms should be.

Civic education is a systematic part of the school curriculum in Germany and is taught as either a separate subject, within social science courses, or integrated with all subjects taught at school (European Commission/EACEA/Eurydice 2017; Schulz et al. 2018, p. 31). Detjen et al. (2012) described how civic education can increase students' ability to analyze a societal problem and evaluate solutions, their ability to communicate their political opinions and reach a compromise, and their interest in politics and subjective political competence. Civic education begins in grades 7–8 in all tracks (Torney-Purta et al. 1999), but students in higher educational tracks have more hours of civic education, and topics are more advanced compared to lower tracks (Bacia and Abs 2017; Savage et al. 2021). Moreover, teachers are less likely to have proper qualifications in lower tracks (Manzel et al. 2017; Deimel et al. 2022). It has been shown that differences in the curriculum of civic education between tracks can explain part of the inequality in civic outcomes (Kavadias et al. 2020). Differences between tracks are more pronounced in countries with early tracking, such as Germany. However, Hoskins et al. (2011) conclude that in stable democracies civic

---

[1] It is worth noting though that part of the association between parental SES and children's political participation may not be causal but instead due to genetic similarity between parents and children. This issue is outside the scope of our paper because it would require different data and methods, such as a children-of-twins design.

education does not seem to facilitate an orientation toward democratic participation. Most studies do not apply a causal design, however. It thus remains a question to what extent civic education translates into political action. We hypothesize that:

The higher an individual's level of educational attainment, the more politically active they are (H1).

Compensation and reinforcement effects on political participation

In this section, we theorize how education affects the relationship between parental SES and political participation. The compensation hypothesis predicts that education weakens this relationship, thus that it increases political participation especially of individuals from low-SES families. When compensation occurs, political inequality decreases. Neundorf et al. (2016) proposed the *ceiling effect* mechanism through which compensation can occur. Parental political socialization is common in high-SES families. Many children from these families already have access to a network of politically interested and active individuals through their family. Therefore, they have all the prerequisites to become politically active and are already active even without political socialization in school. Their already high level of political participation leaves little scope for participation to be further increased even when being exposed to political socialization in school. At the same time, a low level of parental political socialization and the absence of politically active network members in low-SES families makes it easier for political socialization in school to increase political participation among children from low-SES families. Following this reasoning, it can be expected that education increases the political participation especially of children from low-SES families:

The higher an individual's level of educational attainment, the weaker the positive relationship between family SES and political participation (H2.1).

On the other hand, education can also be expected to increase or *reinforce* the relationship between parental-SES and political participation. When reinforcement occurs, education especially increases the political participation of children from high-SES families. Reinforcement further increases political inequality among individuals. The political culture theory proposes that high-SES individuals possess particular "activistic" norms and values that encourage them to participate actively (Almond and Verba 1963; Neundorf et al. 2016). Similarly, Inglehart (1977) proposes that high-SES individuals possess post-materialistic values and are more concerned about political and societal issues than low-SES individuals, who are struggling with more materialistic problems. The transmission of norms is thought to be more effective if individuals are socialized by multiple actors transmitting similar norms and values (Centola and Macy 2007). In other words, for children from high-SES families, political socialization in school falls on "fertile ground" because they already possess "activistic" or "post-materialistic" norms and values (Inglehart 1977). By the same token, children from low-SES families will be less receptive to internalizing the norms and values that they are exposed to in school because these are less likely to be congruent with the norms and values at home. Because of this

different receptibility, longer socialization in school will only serve to increase the gap in political participation between those from low- and high-SES families. Based on this, it can be expected that:

The higher an individual's level of educational attainment, the stronger the positive relationship between family SES and political participation (H2.2).

Data

We used data from the first wave of the German Twin Family Panel (TwinLife, version 6-1-0) (Diewald et al. 2022). TwinLife is a longitudinal representative study that started in 2014, investigating the development of social inequality in Germany (Hahn et al. 2016; Mönkediek et al. 2019). The data contain information on 4,097 families with same-sex twins reared together from four birth cohorts: 1991/1992, 1997/1998, 2003/2004, and 2009/2010. The sample was collected in two steps (Brix et al. 2017; Lang and Kottwitz 2017). First, 500 communities with more than 5,000 inhabitants were randomly selected from 11,900 German communities. Second, a random sample of twin families (per birth cohort) was derived in collaboration with the municipal registration offices. The study contains data on the first- and second-born twins, at least one of their biological parents, and, if applicable, one non-twin sibling of the twins, partners of parents, and partners of the twins. Since 2014, five data collections have been conducted: three face-to-face interviews and two computer-assisted telephone interviews. We focus on the face-to-face interviews in 2014–2016 and the telephone interviews in 2015–2017. During the first and second data collection, the same families were surveyed. The interview held in the second data collection consisted of a subset of the questions asked in the first. The overall response rate for the face-to-face interviews was 37%, which is satisfactory and comparable to other family studies in Germany (Spinath and Wolf 2006; Hahn et al. 2016). The response rate for the telephone interviews was about 65% (Mönkediek et al. 2019). Although TwinLife covers families from all socioeconomic strata, families from a high socioeconomic background are slightly overrepresented. However, this overrepresentation applies mostly to the youngest cohort, which we do not include in our study (Lang and Kottwitz 2017). Weinschenk et al. (2021) conducted an external validity analysis by comparing the TwinLife Study datasets to nationally representative samples in Germany and concluded that the results are comparable.

We mainly used the data from the first data collection (face-to-face interview) in which political participation was measured for the first time. When appropriate, we used data from the second data collection to reconstruct missing values in the first data collection. For our analysis, we chose the oldest cohort of identical twins, their parents, and partners of parents (if applicable). Younger cohorts were excluded from the analysis either because they were not asked about their political participation or because they had not yet finished secondary education. The twins in our selected sample were aged 21–25 years at the time of the first data collection, 59.5% were female. We excluded from the dataset the twins for whom we lack information on

zygosity ($N_{families} = 4$). The final sample consisted of 1012 identical twin pairs and their parents (and stepparents).

Measurements

Dependent variable

We conceptualize *political participation* as a latent propensity to take political action. As a political action we understand an "action by ordinary citizens directed toward influencing some political outcome" (Brady 1999). We consider the following forms: *voter turnout*, *participating in political meetings / discussions / demonstrations*, *signing online petitions*, and *boycotting*. Although this set of actions is rather conservative and does not include some of the newer forms of political participation (e.g., online participation), it contains the core forms of political participation that are included in all old and new conceptualizations of political participation (Ekman and Amnå 2012; Hooghe and Marien 2013; Deth 2014, 2016; Theocharis and Deth 2017). Participants were asked whether they had voted in the previous parliamentary elections. Respondents could choose "yes" (1), "no" (0), or "not eligible". We excluded individuals not eligible to vote from the analysis ($N = 20$), and we found that 80.8% of twins voted. The other three items were measured by the question: "Which of the following activities did you take part in within the last 12 months?". Three forms of participation were listed: (1) "Taken part in a political meeting/a discussion event/a demonstration"; (2) "Taken part in an online petition/a signature collection"; (3) "Boycotted a company or products for political or ethical reasons or on environmental grounds, e.g. did not buy products or avoided them". Participants could choose either "yes" (1) or "no" (0) for each form of participation. 16.3% of the twins participated in political meetings/protests, 34.2% signed petitions, and 33.9% boycotted (Table 1).

We used item response theory (IRT) to construct the latent variable *political participation* (Clinton et al. 2004; Fowler et al. 2008). An advantage of IRT compared to classic measurement theory (CMT) models is that IRT takes into account the difficulty and the discriminatory power of each item, while CMT models assume that all items are equally "difficult". The item characteristic curves for political participation are presented in Online Appendix B. They confirm that the items differ with respect to difficulty (participation in political meetings/a discussion event/a demonstration being the most difficult), and discriminatory power (highest for signing petitions). We calculated the final variable only for cases with non-missing data in all four items. If an item had a missing value, we assigned a missing value to political participation for this observation and included it for multiple imputation (MI). Because the method used in this paper relies especially on within-twin-pairs variance (see the methods section), it is important to mention that of 1008 twins with complete data, 624 twins (61.90%) differ in political participation from their co-twin. More detailed information on the size and magnitude of within-twins-pairs differences is presented in Online Appendix C.

Table 1 Descriptive statistics for identical twins, $N = 1012$

Variable	Descriptive statistics				
	N_{twins}	Mean	SD	Min	Max
Political participation, IRT	1009	− 0.010	0.761	− 1.071	1.480
Voter turnout	1007	0.808		0	1
Political meetings/protests	994	0.163		0	1
Signing petitions	992	0.342		0	1
Boycotting	998	0.339		0	1
Education					
Hauptschule	985	0.070		0	1
Realschule	985	0.399		0	1
Gymnasium	985	0.531		0	1
Parental education[a]	1012	− 0.046	1.015	− 2.197	1.306
Log parental occupational status[b]	896	− 0.013	0.406	− 1.116	0.600
Log parental income[b]	926	− 0.016	0.592	− 3.191	2.008
Parental SES, factor score[a]	1012	− 0.046	1.009	− 2.313	1.635
Birth weight	933	2.399	0.542	0.700	4.010
First born	1012	0.500		0	1

[a]We standardized parental educational level and parental SES

[b]We first calculated natural logarithms of parental occupational status and net family income, and then centered these variables. The variables' means are not exactly zero because we centered the variables on the pooled data of identical and non-identical twins and applied the multiple imputation procedure to the pooled data to increase the imputation precision

Independent variables

Educational attainment is measured on a categorical scale. If the data on a twin were missing in the first data collection, we reconstructed the data from the second data collection ($N_{repaired} = 32$). We used the *highest level of secondary education obtained*. Only those who finished secondary education were included. We constructed a variable with the categories: "Hauptschule"—0 (primary/lower secondary school-leaving certificate), "Realschule"—1 (intermediate secondary school-leaving certificate), and "Gymnasium"—2. Those who finished technical secondary schools and obtained diplomas that allowed them to enter universities for applied sciences were assigned *Realschule* as their level of educational attainment because of the similarity in the theoretical level of education and similarity in civic education curricula. A detailed explanation on the measurement and operationalization of educational attainment is presented in Online Appendix D. A substantial component of the total variance in educational attainment lies within identical twin pairs—24.01% (Online Appendix C).

Parental educational level was measured using a hierarchically structured educational scale developed by the Comparative Analysis of Social Mobility in Industrial Nations (CASMIN) project (Brauns et al. 2003). The scale contains nine levels and ranges from "inadequately completed general education" to "higher tertiary

education". We treated this variable as continuous and standardized it before including it in the models.

Parental occupation was coded into the International Standard Classification of Occupations 2008 (ISCO-08). From the ISCO-08, parental occupational status was derived in accordance with the International Socioeconomic Index of occupational status (ISEI) (Ganzeboom et al. 1992). We used the logged (natural logarithm) and centered highest parental occupational status on the ISEI scale per family as the final parental occupational status. The logged variable takes into account the fact that the interaction effect of parental status might be non-linear. Differences at the bottom of the status scale will have more impact than similar-sized differences at the top of the status scale (in line with the results of Lindgren et al. (2019).

Parental income was measured as a net equivalent household income based on the modified OECD scheme (OECD 2011). If both face-to-face and CATI data were available, we calculated the mean of them. Otherwise, we used only one measurement. To normalize the variable, we calculated the natural logarithm of the raw parental income and centered it.

Parental SES is a single variable based on parental educational level, log occupational status, and log parental income. We created the parental SES variable as factor scores after confirmatory factor analysis (CFA) and standardized the variable. Scale reliability (Cronbach alpha) is 0.757, and the eigenvalue of the factor is 1.523. Online Appendix E presents a more detailed description of the CFA.

Control variables

Pre-birth factors influence educational level and political participation (Cesarini et al. 2014). Birth weight and birth order can be used as proxies for these pre-birth factors (Kramer 1987, p. 198; Richards et al. 2001). Because birth weight and birth order are twin-specific variables, they are not covered by shared genetic and social effects and their confounding is not taken into account by the FFE regression. We therefore included these variables in all models to control for pre-birth characteristics of twins.

Birth weight was measured in grams. We recoded grams to kilograms by dividing the original values by 1000. We excluded twins with extremely unrealistic birth weights of 0.3 kg and lighter, or 6 kg and heavier ($N=3$).

First-born reflects whether a child was a first-born twin (1) or a second-born twin (0).

Methods

Family fixed effects regression model

We estimated FFE regression models (Allison 2005; Hamaker and Muthén 2020). These models eliminate the effects of unmeasured confounders shared by children from the same family. These confounders include social characteristics

such as parental status, family composition, and quality of the neighborhood. However, research has shown that political participation and educational attainment also partly depend on the same genetic influences (Ahlskog 2020). This genetic confounding is not taken into account with regular FFE, because children from the same family share only part of their genes. Applying FFE to identical twins is especially beneficial since it takes into account both social and genetic confounding, because identical twins were raised together and have identical genes. Since we have exactly two twins per family, the FFE model can be formally represented with the "difference scores" approach (Allison 2005). The models for the twins look like this:

$$y_{f1} = \mu_1 + \boldsymbol{\beta}\boldsymbol{x}_{f1} + \boldsymbol{\gamma}\boldsymbol{z}_f + \alpha_f + \varepsilon_{f1} \tag{1}$$

$$y_{f2} = \mu_2 + \boldsymbol{\beta}\boldsymbol{x}_{f2} + \boldsymbol{\gamma}\boldsymbol{z}_f + \alpha_f + \varepsilon_{f2} \tag{2}$$

where y_{f1} and y_{f2} are the scores on the dependent variable (political participation) of the first- and second-born twin in a family f. μ_1 and μ_2 are intercepts that may differ for twin 1 and twin 2. $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are row vectors of coefficients. $\boldsymbol{x}_{f1}$ and $\boldsymbol{x}_{f2}$ are vectors of measured twin-specific independent variables (e.g., educational attainment, birth weight). $\boldsymbol{z}_f$ stands for measured independent variables shared by twins from the same family (e.g., parental SES), α_f stands for all the unobserved effects shared by twins from the same family (e.g., unmeasured genetic and social effects), and ε_{f1} and ε_{f2} are twin-specific residuals. To obtain the formal representation of the difference scores for two children per family, the first equation is subtracted from the second.

$$y_{f2} - y_{f1} = (\mu_2 - \mu_1) + \boldsymbol{\beta}(\boldsymbol{x}_{f2} - \boldsymbol{x}_{f1}) + (\varepsilon_{f2} - \varepsilon_{f1}) \tag{3}$$

All the measured (z_f) and unmeasured shared effects (α_f) are "differenced out" (Allison 2005). This model gives exactly the same estimation of the β-coefficients as would be obtained by using other fixed effects approaches, for example the dummy variables approach or clustered means approach (Hamaker and Muthén 2020).

Although the main effects of family-specific variables cannot be estimated by FFE regression models, it is possible to estimate interaction effects between measured family-specific and twin-specific variables (Allison 2005). In the next equation, we included an interaction effect between a twin-specific (educational attainment) and a family-specific variable (parental SES):

$$y_{f2} - y_{f1} = (\mu_2 - \mu_1) + \beta(\boldsymbol{x}_{f2} - \boldsymbol{x}_{f1}) + \varphi z_f^{SES}(\boldsymbol{x}_{f2}^{EDU} - \boldsymbol{x}_{f1}^{EDU}) + (\varepsilon_{f2} - \varepsilon_{f1}) \tag{4}$$

where φ stands for the interaction effect of parental SES (z_f^{SES}) and twin-specific educational attainment (x_{f2}^{EDU} and x_{f1}^{EDU}). Equation 4 shows that although the main effect of the twin invariant variable parental SES is differenced out, it still contributes to the interaction effect. That is why the main effect of parental SES does not show up in the resulting tables. To show that a positive relationship between parental SES and political participation exists, we also estimated a random effects model.

Analytic strategy

First, we tested whether parental education, occupational status, and income—separately as well as combined in a single parental SES measurement—are positively related to children's political participation. Second, we estimated the main effect of educational attainment on political participation (*Hypothesis 1*). Third, we tested whether educational attainment compensates for or reinforces family advantages or disadvantages in political participation by including interaction terms of education with parental education, occupation, income—separately as well as a single parental SES measurement (*Hypotheses 2.1* and *2.2*).

To reconstruct missing values, we applied multiple imputation by chained equations (MICE) (Schafer 1997; Rubin 2004; Stuart et al. 2009). To be able to impute data for one twin based on data for the other twin within families, we first reshaped data from long to wide. Then we imputed missing data for all dependent and independent variables. To increase the imputation accuracy, we used some additional variables in the imputation model. The detailed explanation of the MI process is presented in Online Appendix F. MI decreases bias in the estimations. To explore the bias, we additionally conducted an analysis on complete data only, without MI (Online Appendix G). We found that results without MI considerably biased the results towards larger coefficients. The conclusions, however, are exactly the same for both sets of analyses. For data handling and estimations, we used *STATA* version 15.1 ('Stata Statistical Software v.15.1' 2017). The figures in the appendix were created in R (R Core Team 2017; Posit team 2022).

Results

The relationship between parental SES and children's political participation

Models 1–3 in Table 2 show that there are positive and significant associations between children's political participation and parental educational level (b = 0.158, p < 0.001) and log parental occupational status (b = 0.371, p < 0.001). The association with log parental income is not significant. Model 4 shows that when including all parental variables in one model only the association with parental educational level remains statistically significant (b = 0.107, p = 0.021). When analyzing a single parental SES measure composed of the three items, we find a positive and significant association with children's political participation (b = 0.164, p < 0.001, Model 5). Our results suggest that family background is a significant predictor of children's political participation in Germany. However, this is mostly due to parental education.

Table 2 Relationships between parental education, occupational status, parental income and children's political participation, random effects

	Educational level	Log occupation	Log income	All together	SES, single measure
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Educational level	0.158***			0.107*	
	(0.028)			(0.046)	
Log occupational status		0.371***		0.192	
		(0.069)		(0.110)	
Log income			0.062	− 0.050	
			(0.052)	(0.054)	
SES, factor score					0.164***
					(0.029)
Intercept	− 0.003	0.012	− 0.009	0.005	− 0.003
	(0.029)	(0.029)	(0.030)	(0.029)	(0.029)
N	1012	1012	1012	1012	1012
SD between	0.531	0.533	0.554	0.530	0.530
SD within	0.522	0.522	0.522	0.522	0.521

Standard errors in parentheses. *$p<0.05$; **$p<0.01$; ***$p<0.001$. Parental educational level and SES (factor score) were standardized. We first took the natural logarithm of parental occupational status and income and then centered around the mean

The effect of educational attainment on political participation

We expected educational attainment to have a positive effect on political partici-pation. The results are presented in Table 3. Model 1 shows that when apply-ing FFE to identical twins, the effect of educational attainment is positive and significant for *Gymnasium* compared with *Hauptschule* (b = 0.352, p = 0.033). No significant difference in political participation has been found between *Reals-chule* and *Hauptschule* (b = 0.261, p = 0.075) and between *Gymnasium* and *Reals-chule* (b = 0.092, p = 0.289, not in tables). The results mean that attending *Gym-nasium*—the longest and most theoretical track—as opposed to *Hauptschule*–the most practical track—increases political participation by 0.352 points. The effect size is 67.56% of the within-twins-pairs standard deviation in political participa-tion (SD $_{within}$ = 0.521, not in tables). The effect, which comes close to the causal effect, is considerable. Thus, *Hypothesis 1* is supported for the educational tracks *Gymnasium* as opposed to *Hauptschule*.

The interaction effects of education and parental SES on political participation

We expected educational attainment either to compensate for or to reinforce initial parental disadvantages in political participation. Models 2–4 in Table 3 show that

Table 3 Fixed effects regression models of political participation on educational attainment and parental education, occupation, and income, identical twins

	Main effects	Interaction effects				
	Educational attainment	Parental education	Parental occupation	Parental income	All together	SES, single
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Hauptschule	Ref					
Realschule	0.261	0.253	0.348	0.233	0.292	0.290
	(0.146)	(0.184)	(0.193)	(0.157)	(0.206)	(0.190)
Gymnasium	0.352*	0.341	0.472*	0.329	0.438*	0.387
	(0.164)	(0.199)	(0.208)	(0.174)	(0.221)	(0.204)
Birth weight	0.124	0.126	0.118	0.124	0.128	0.122
	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)
First born	− 0.011	− 0.012	− 0.008	− 0.011	− 0.006	− 0.010
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Hauptschule × parental education[a]		Ref				
Realschule × parental education		− 0.009			− 0.289	
		(0.142)			(0.259)	
Gymnasium × parental education		− 0.029			− 0.623*	
		(0.166)			(0.294)	
Hauptschule × parental occupation			Ref			
Realschule × parental occupation			0.202		0.739	
			(0.326)		(0.587)	
Gymnasium × parental occupation			0.485		1.618*	
			(0.374)		(0.651)	
Hauptschule × parental income				Ref		
Realschule × parental income				− 0.120	− 0.148	
				(0.316)	(0.331)	

Table 3 (continued)

	Main effects	Interaction effects				
	Educational attainment	Parental education	Parental occupation	Parental income	All together	SES, single
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Gymnasium × parental income				− 0.033	− 0.068	
				(0.359)	(0.370)	
Hauptschule × parental SES						Ref
Realschule × parental SES						0.031
						(0.143)
Gymnasium × parental SES						0.069
						(0.166)
Intercept	− 0.592*	− 0.584*	− 0.678*	− 0.572*	− 0.621*	− 0.622*
	(0.259)	(0.281)	(0.280)	(0.262)	(0.286)	(0.284)
N	1012	1012	1012	1012	1012	1012
SD between	0.645	0.649	0.634	0.648	0.729	0.636
SD within	0.520	0.521	0.520	0.521	0.518	0.520

Standard errors in parentheses, $*p < 0.05$; $**p < 0.01$; $***p < 0.001$ (two-sided)

[a]In fixed effects models, the main effects of the components of parental SES are omitted because twins from the same family do not differ on parental SES (i.e., within family variance on the variable equals zero)

the interaction effects of parental educational level, occupational status, and income considered separately are statistically not significant. However, when including all interaction effects in Model 5, this changes. Model 5 shows that attending *Gymnasium* instead of *Hauptschule* decreases the effect of parental education by 0.623 units (p = 0.034). The differences between *Realschule* and *Hauptschule* as well as between *Realschule* and *Gymnasium* are not statistically significant. That the level of educational attainment decreases the effect of level of parental education is in line with the compensation hypothesis.

The interaction effect of educational attainment and parental occupational status is positive and statistically significant for *Gymnasium* versus *Hauptschule* (b = 1.618, p = 0.013). A positive interaction effect implies that the effect of parental occupational status increases with education, which is in line with the reinforcement hypothesis. Given that occupational status was logged, it implies that the interaction effect is non-linear. It is stronger at lower levels of occupational status. When we repeated the analysis with regular (non-logged) measures of occupational status, we found no linear interaction effect of parental occupational status and children's education. The interaction effect of educational attainment with income is statistically not significant.

Thus, we reject the null hypothesis in favor of the compensation hypothesis (*H2.1*) for parental education, and we reject the null hypothesis in favor of the reinforcement hypothesis for parental occupational status (*H2.2*). With regard to parental income, we do not reject the null hypothesis.

We also conducted an analysis using a single measure of parental SES and found no interaction effects of educational attainment with the single SES variable (Model 6 in Table 3). In light of the previous results, this should not be surprising, given that, apparently, educational attainment affects the associations with level of parental education and occupational status in different directions. However, we should interpret the results cautiously, because the estimates of uncertainty presented in Table 3 are rather high.

We did not find effects on political participation of either birth weight or birth order, which are supposed to reflect pre-birth features of twins.[2]

Conclusions and discussion

Whether educational attainment decreases political inequality originating from family disparities in political participation is a topic of ongoing debate. The classic optimistic zeitgeist of the last quarter of the twentieth century states that education can be a solution for almost everything, especially political inequality (Converse

---

[2] We also performed analyses for the four forms of political participation separately. We could not use standard fixed-effects logistic regression models for this because of the low within-twin-pairs variation on the separate items (see Figure C.2 in Online Appendix C). However, we ran fixed-effects linear probability models (Online Appendix H). The conclusions remain unchanged, but it becomes clear that the results in the main analysis are to a large extent driven by differences in participation in political meetings/protests and to some extent by signing petitions.

and Campbell 1972; Putnam 2000). However, that education can solve the political inequality problem is not so obvious. To be a solution for political inequality, school education should have a causal effect on political participation. In combination with either educational expansion, or a stronger influence of education on the political participation of individuals from low-socioeconomic-status families, education could decrease political inequality. Our aim was to test whether education has a causal effect, and whether this effect varies with parental SES. We applied FFE models to a representative German dataset of young identical twins, which allowed us to control for measured and unmeasured social and genetic confounding effects.

Our first conclusion is that, in the population we studied, education very likely has a causal effect on participation. The political participation of young people who attended *Gymnasium* (academic track) is higher than the political participation of those who finished *Hauptschule* (lower vocational track). It is worth noting that we did not find evidence that political participation differs between individuals who finished *Realschule* (the intermediate track) compared with those who completed the academic or lower vocational tracks. This conclusion is in line with the negative effect of attending the upper-secondary vocational track in Germany on the intent to vote, political interest, and other political outcomes found by Savage et al. (2021). It also confirms the conclusions of studies that operationalized education differently: as years of education in the US and finishing high school in Denmark (Dinesen et al. 2016), years of schooling in Ireland (Ma 2017), and educational level (high school, associate degree, bachelor, and graduate degrees) in Finland (Gidengil et al. 2019).

However, our conclusion contradicts recent papers that also applied a causal design and did not find that academic educational track versus vocational track had an effect on voter turnout in Sweden (Persson 2012). Nor did other studies find an effect on political participation, but they used different operationalizations of education: years of education, finishing high school, and finishing college in Sweden (Dinesen et al. 2016), the lengthening of vocational upper secondary education from two to three years in Sweden (Lindgren et al. 2019), or as one additional year of schooling regardless of the track in Greece, Norway, Slovenia, and Sweden (Persson et al. 2016).

Persson's study (2012) is directly comparable with ours because he also used a causal design and compared school tracks, but he found no difference between the tracks in Sweden. A potential explanation of the discrepancy between the results of these two studies can be that tracking occurs much earlier in Germany (at about age 10) compared to Sweden (at age 15–16). The amount and complexity of civic education that students of different tracks experienced therefore differs more in Germany than in Sweden. Besides, due to early tracking school-related networks are more segregated in Germany, potentially reinforcing the educational effect. Thus, it is not unexpected that the consequences of tracking for political participation are more pronounced in Germany. Although the rest of the causal literature shows results both supporting and contrasting with our study, they cannot be directly compared because education is operationalized differently.

Our second conclusion is that the political disadvantage of having parents with a low level of education is smaller for children with higher levels of educational attainment, which is in line with the compensation hypothesis. Some other studies

that used parental education as a proxy for parental SES also found a compensation effect for intended political participation in the US and Ireland (Mettler 2002; Campbell 2008; Ma 2017). Other researchers used more complex measurements of parental SES based on parental education, income, and occupation, and found a compensation effect in Sweden, Denmark, Germany, and the Netherlands (Lindgren et al. 2019; Deimel et al. 2020).

However, we also found that the political advantage of having higher occupational status parents is stronger for higher-educated children. Thus, educational differences reinforce the political participation gap between children from different status background. These results indicate that components of parental SES affect political participation in different ways. Children of less-educated parents may lack political knowledge and interest, which can be repaired by political socialization in school. On the other hand, parents with a high occupational status may be more convinced that political participation is a way to change society or to protect their privileged position and transfer these beliefs to their children. This may become especially relevant if these children obtain a privileged position as well, for which completing a higher educational track is a first step. If they do not, they may actually become averse to political participation. Such a reinforcing effect of education is a threat especially for political equality because children from high-SES families are more likely to be enrolled in higher educational tracks. With educational expansion, however, these enrollment differences become smaller.

This study has some limitations. It is still possible that the effect of educational attainment is overestimated. Although we took into account unmeasured social effects and genetic effects that are shared by twins, this is not the case for non-shared social effects and gene-environment interaction, which may confound the relationship between education and political participation. For example, if one twin becomes sick for a long time and the other does not, this may lead to a difference between the twins in both their educational attainment and political participation. On the other hand, we may also have underestimated the effect of educational attainment. The variation in educational attainment and political participation within twin pairs is considerable, but not too high. If the study is underpowered, it is difficult to find an effect, even if it exists. The variation in political activity and educational attainment may be small also because siblings from the same family can influence each other (Neale and Maes 2004; Dinesen et al. 2016; Robinson 2019). More highly educated siblings may, for instance, convince their less educated siblings to join them in their political activities. Therefore, the possibility that the causal influence of education is even stronger in the population than our analyses suggest cannot be completely excluded.

Furthermore, the differential effects of attending a higher educational track on political inequality with respect to parental education (compensating) and parental occupational status (reinforcing) only become visible in a model containing six interaction effects. In combination with the fact that our sample size and the within-twins-pairs variation in our dependent and independent variables are only moderate, one cannot exclude the possibility that these findings are due to chance. A replication of our study, with a similar causal design, is therefore needed.

In the meantime, we conclude that in the tracked educational system of Germany education remains an important predictor of political participation. Our study also suggests that it compensates for initial parental disadvantages in political participation for children from low educated families. But, at the same time, education seems to reinforce political inequality due to parental occupational status. Given these indications for differential effects of the components of parental SES, future research should not combine them, but examine particular mechanisms of why this happens.

Data availability TwinLife Study data and documents are only released for academic research and teaching after the data depositor's written authorization. For this purpose the Data Archive obtains a written permission with specification of the user and the analysis intention. Data can be requested from the GESIS deposiroty: https://search.gesis.org/research_data/ZA6701.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Ahlskog, R. 2020. Education and voter turnout revisited: Evidence from a Swedish twin sample with validated turnout data. *Electoral Studies*. https://doi.org/10.1016/j.electstud.2020.102186.

Ahlskog, R., and A. Brännlund. 2021. Uncovering the source of patrimonial voting: Evidence from Swedish twin pairs. *Political Behavior*. https://doi.org/10.1007/s11109-020-09669-4.

Allison, P.D. 2005. *Fixed effects regression methods for longitudinal data using SAS*. Cary: SAS Institute.

Almond, G.A., and S. Verba. 1963. *The civic culture: Political attitudes and democracy in five nations*. Princeton: Princeton University Press.

Bacia, E., and H.J. Abs. 2017. Politische und zivilgesellschaftliche Bildung in Kernlehrplänen. In *Das politische Mindset von 14 -Jährigen. Ergebnisse der International Civic and Citizenship Education Study 2016*, ed. H.J. Abs and K. Hahn-Laudenberg, 27–46. Münster: Waxmann. https://www.waxmann.com/?eID=texte&pdf=3737Volltext.pdf&typ=zusatztext.

Bandura, A., and R.H. Walters. 1977. *Social learning theory*. Englewood Cliffs: Prentice-Hall.

Berinsky, A.J., and G.S. Lenz. 2011. Education and political participation: Exploring the causal link. *Political Behavior* 33 (3): 357–373. https://doi.org/10.1007/s11109-010-9134-9.

Bovens, M., and A. Wille. 2010. The education gap in participation and its political consequences. *Acta Politica* 45 (4): 393–422. https://doi.org/10.1057/ap.2010.7.

Brady, H. 1999. Political participation. In *Measures of political attitudes*, ed. J.P. Robinson, P.R. Shaver, and L.S. Wrightsman 738–801. San Diego: Academic Press.

Brady, H.E., S. Verba, and K.L. Schlozman. 1995. Beyond SES: A resource model of political participation. *American Political Science Review* 89 (2): 271–294. https://doi.org/10.2307/2082425.

Brauns, H., Scherer, S. and Steinmann, S. (2003) The CASMIN educational classification in international comparative research. In *Advances in cross-national comparison: A European working book for demographic and socio-economic variables*, ed. J.H.P. Hoffmeyer-Zlotnik and C. Wolf, 221–244. Boston: Springer. https://doi.org/10.1007/978-1-4419-9186-7_11.

Brix, J., et al. 2017. *A longitudinal twin family study of the life course and individual development (TWINLIFE): Data collection and instruments of wave 1 face-to-face interviews*. 05, p. 132. Bielefeld: University of Bielefeld. https://pub.uni-bielefeld.de/record/2914569.

Burden, B.C., et al. 2020. Education, early life, and political participation: New evidence from a sibling model. *Research & Politics* 7 (3): 2053168020958319. https://doi.org/10.1177/2053168020958319.

Campbell, A., et al. 1960. *The American voter*. Chicago: The University of Chicago Press.

Campbell, D.E. 2006. What is education's impact on civic and social engagement? In *Proceedings of the Copenhagen symposium, OECD. Measuring the effects of education on health and civic engagement*, Copenhagen, pp. 25–126.

Campbell, D.E. 2008. Voice in the classroom: How an open classroom climate fosters political engagement among adolescents. *Political Behavior* 30(4): 437–454. https://doi.org/10.1007/s11109-008-9063-z.

Campbell, D.E. 2009. Civic engagement and education: An empirical test of the sorting model. *American Journal of Political Science* 53 (4): 771–786. https://doi.org/10.1111/j.1540-5907.2009.00400.x.

Campbell, D.E. 2019. What social scientists have learned about civic education: A review of the literature. *Peabody Journal of Education* 94 (1): 32–47. https://doi.org/10.1080/0161956X.2019.1553601.

Centola, D., and M. Macy. 2007. Complex contagions and the weakness of long ties. *American Journal of Sociology* 113 (3): 702–734. https://doi.org/10.1086/521848.

Cesarini, D., M. Johannesson, and S. Oskarsson. 2014. Pre-birth factors, post-birth factors, and voting: Evidence from Swedish adoption data. *American Political Science Review* 108 (1): 71–87. https://doi.org/10.1017/S0003055413000592.

Clinton, J., S. Jackman, and D. Rivers. 2004. The statistical analysis of roll call data. *The American Political Science Review* 98 (2): 355–370.

Condon, M. 2015. Voice lessons: Rethinking the relationship between education and political participation. *Political Behavior* 37 (4): 819–843. https://doi.org/10.1007/s11109-015-9301-0.

Conley, D. 2004. *The Pecking order: Which siblings succeed and why*. New York: Pantheon.

Conley, D., and N.G. Bennett. 2000. Is biology destiny? Birth weight and life chances. *American Sociological Review* 65 (3): 458–467. https://doi.org/10.2307/2657467.

Converse, P.E., and A. Campbell. 1972. Change in the American electorate. In *The human meaning of social change*, 263–338. New York: Russell Sage Foundation.

Dahl, R.A. (2006) *On political equality*. London: Yale University Press. http://www.jstor.org/stable/j.ctt1npjxz. Accessed 26 Oct 2020.

Dalton, R.J. 2017. *The participation gap: Social status and political inequality*. Oxford: Oxford University Press.

Dang, T. 2019. Quasi-experimental evidence on the political impacts of education in Vietnam. *Education Economics* 27 (2): 207–221. https://doi.org/10.1080/09645292.2018.1554101.

Deimel, D., B. Hoskins, and H.J. Abs. 2020. How do schools affect inequalities in political participation: Compensation of social disadvantage or provision of differential access? *Educational Psychology* 40 (2): 146–166. https://doi.org/10.1080/01443410.2019.1645305.

Deimel, D., et al. 2022. Civic education and social interactions at school as drivers of intended electoral participation: Similarities and differences in four European school systems. *Education, Citizenship and Social Justice*. https://doi.org/10.1177/17461979221114549.

Detjen, J., et al. 2012. *Politikkompetenz—ein Modell*. Wiesbaden: Springer Fachmedien. https://doi.org/10.1007/978-3-658-00785-0.

Diewald, M., et al. 2022. TwinLife. *GESIS, Köln. ZA6701 Datenfile Version 6.1.0* [Preprint]. https://doi.org/10.4232/1.13987.

Dinesen, P.T., et al. 2016. Estimating the impact of education on political participation: Evidence from monozygotic twins in the United States, Denmark and Sweden. *Political Behavior* 38 (3): 579–601. https://doi.org/10.1007/s11109-015-9328-2.

Downs, A. 1957. An economic theory of political action in a democracy. *Journal of Political Economy* 65 (2): 135–150.

Ekman, J., and E. Amnå. 2012. Political participation and civic engagement: Towards a new typology. *Human Affairs* 22 (3): 283–300. https://doi.org/10.2478/s13374-012-0024-1.

European Commission/EACEA/Eurydice. 2017. *Citizenship education at school in Europe*. Eurydice Report. Luxembourg: Publications Office of the European Union. https://doi.org/10.2797/536166. Accessed 21 Nov 2022.

Finkel, S.E. 2002. Civic education and the mobilization of political participation in developing democracies. *Journal of Politics* 64 (4): 994–1020. https://doi.org/10.1111/1468-2508.00160.

Fowler, J.H., L.A. Baker, and C.T. Dawes. 2008. Genetic variation in political participation. *American Political Science Review* 102 (2): 233–248. https://doi.org/10.1017/S0003055408080209.

Galston, W.A. 2001. Political knowledge, political engagement, and civic education. *Annual Review of Political Science* 4 (1): 217–234. https://doi.org/10.1146/annurev.polisci.4.1.217.

Ganzeboom, H.B.G., P.M. De Graaf, and D.J. Treiman. 1992. A standard international socio-economic index of occupational status. *Social Science Research* 21 (1): 1–56. https://doi.org/10.1016/0049-089X(92)90017-B.

Gidengil, E., H. Wass, and M. Valaste. 2016. Political socialization and voting: The parent–child link in turnout. *Political Research Quarterly* 69 (2): 373–383. https://doi.org/10.1177/1065912916640900.

Gidengil, E., et al. 2019. Turnout and education: Is education proxying for pre-adult experiences within the family? *Political Science Research and Methods* 7 (2): 349–365. https://doi.org/10.1017/psrm.2017.32.

Hahn, E., et al. 2016. What drives the development of social inequality over the life course? The German TwinLife study. *Twin Research and Human Genetics* 19 (6): 659–672. https://doi.org/10.1017/thg.2016.76.

Hamaker, E.L., and B. Muthén. 2020. The fixed versus random effects debate and how it relates to centering in multilevel modeling. *Psychological Methods* 25 (3): 365–379. https://doi.org/10.1037/met0000239.

Henderson, J.A. 2018. Hookworm eradication as a natural experiment for schooling and voting in the American south. *Political Behavior* 40 (2): 467–494. https://doi.org/10.1007/s11109-017-9408-6.

Hillygus, D.S. 2005. The MISSING LINK: Exploring the relationship between higher education and political engagement. *Political Behavior* 27 (1): 25–47. https://doi.org/10.1007/s11109-005-3075-8.

Hooghe, M., and S. Marien. 2013. A comparative analysis of the relation between political trust and forms of political participation in Europe. *European Societies* 15 (1): 131–152. https://doi.org/10.1080/14616696.2012.692807.

Hoskins, B.L., et al. 2011. Comparing civic competence among European youth: Composite and domain-specific indicators using IEA civic education study data. *Comparative Education Review* 55 (1): 082–110. https://doi.org/10.1086/656620.

Inglehart, R. 1977. *The silent revolution: Changing values and political styles among western publics*. Princeton: Princeton University Press. https://doi.org/10.2307/j.ctt13x18ck.

Jackson, R.A. 1995. Clarifying the relationship between education and turnout. *American Politics Quarterly* 23 (3): 279–299.

Janmaat, J.G., T. Mostafa, and B. Hoskins. 2014. Widening the participation gap: The effect of educational track on reported voting in England'. *Journal of Adolescence* 37 (4): 473–482. https://doi.org/10.1016/j.adolescence.2014.03.011.

Jennings, M.K., L. Stoker, and J. Bowers. 2009. Politics across generations: Family transmission reexamined. *The Journal of Politics* 71 (3): 782–799. https://doi.org/10.1017/S0022381609090719.

Kahneman, D. 2011. *Thinking, fast and slow*, 1st ed. New York: Farrar, Straus and Giroux.

Kam, C.D., and C.L. Palmer. 2008. Reconsidering the effects of education on political participation. *The Journal of Politics* 70 (3): 612–631. https://doi.org/10.1017/S0022381608080651.

Kavadias, D., E.V. Nohemi Jocabeth, and K. Hemmerechts. 2020. Inequality, civic education and intended future civic engagement: An examination of research in western democracies. In *The Palgrave handbook of citizenship and education*, ed. A. Peterson, G. Stahl, and H. Soong, 583–597. Cham: Springer. https://doi.org/10.1007/978-3-319-67828-3_21.

Kiess, J. 2021. Class against democracy? Family background, education, and (youth) political participation in Germany. In *Youth and politics in times of increasing inequalities*, ed. M. Giugni and M. Grasso, 29–56. Cham: Springer (Palgrave Studies in Young People and Politics). https://doi.org/10.1007/978-3-030-63676-0_2.

Kramer, M.S. 1987. Determinants of low birth weight: Methodological assessment and meta-analysis. *Bulletin of the World Health Organization* 65 (5): 663–737.

Lang, V., and A. Kottwitz. 2017. *The sampling design and socio demographic structure of the first wave of the TwinLife panel study: A comparison with the Microcensus*. 03, p. 28. Bielefeld: University of Bielefeld. https://pub.uni-bielefeld.de/publication/2913250.

Lewis-Beck, M.S., et al. 2008. *The American voter revisited*. Ann Arbor: University of Michigan Press. https://doi.org/10.3998/mpub.92266.

Lijphart, A. 1996. (1997) Unequal participation: Democracy's unresolved dilemma presidential address, American Political Science Association. *American Political Science Review* 91 (1): 1–14. https://doi.org/10.2307/2952255.

Lindgren, K.-O., and S. Oskarsson. 2022. The perpetuity of the past: Transmission of political inequality across multiple generations. *American Political Science Review*. https://doi.org/10.1017/S0003055422001113.

Lindgren, K.-O., S. Oskarsson, and C.T. Dawes. 2017. Can political inequalities be educated away? Evidence from a large-scale reform. *American Journal of Political Science* 61 (1): 222–236. https://doi.org/10.1111/ajps.12261.

Lindgren, K.-O., S. Oskarsson, and M. Persson. 2019. Enhancing electoral equality: Can education compensate for family background differences in voting participation? *American Political Science Review* 113 (1): 108–122. https://doi.org/10.1017/S0003055418000746.

Ma, Y. 2017. Civic returns to education: Voter turnout in Ireland. *The Economic and Social Review* 48 (2): 145–169.

Manzel, S., K. Hahn-Laudenberg, and F.E. Zischke. 2017. Lehrervoraussetzungen. In *Das politische Mindset von 14-Jährigen. Ergebnisse der International Civic and Citizenship Education Study 2016*, ed. H.J. Abs and K. Hahn-Laudenberg, 325–353. Münster: Waxmann. https://www.waxmann.com/?eID=texte&pdf=3737Volltext.pdf&typ=zusatztext.

Mettler, S. 2002. Bringing the state back in to civic engagement: Policy feedback effects of the G.I. Bill for World War II Veterans. *American Political Science Review* 96 (2), 351–365. https://doi.org/10.1017/S0003055402000217.

Milbrath, L.W., and M.L. Goel. 1977. *Political participation: How and why do people get involved in politics?* Chicago: Rand McNally College Pub. Co.

Milligan, K., E. Moretti, and P. Oreopoulos. 2004. Does education improve citizenship? Evidence from the United States and the United Kingdom. *Journal of Public Economics* 88 (9): 1667–1695. https://doi.org/10.1016/j.jpubeco.2003.10.005.

Mönkediek, B., et al. 2019. The German Twin family panel (TwinLife). *Twin Research and Human Genetics* 22 (6): 540–547. https://doi.org/10.1017/thg.2019.63.

Neale, M., and L. Cardon. 1992. *Methodology for genetic studies of twins and families*. Dordrecht: Springer (Nato Science Series D). https://www.springer.com/gp/book/9780792318743. Accessed 18 Apr 2019.

Neale, M.C., and H.H.M. Maes. 2004. *Methodology for genetic studies of twins and families*. Dordrecht: Kluwer.

Neundorf, A., R.G. Niemi, and K. Smets. 2016. The compensation effect of civic education on political engagement: How civics classes make up for missing parental socialization. *Political Behavior* 38 (4): 921–949. https://doi.org/10.1007/s11109-016-9341-0.

Nie, N.H., A.P.J. Junn, and K. Stehlik-Barry. 1996. *Education and democratic citizenship in America*. Chicago: University of Chicago Press.

OECD. 2011. *Divided we stand: Why inequality keeps rising*, 390. Paris: OECD. https://doi.org/10.1787/9789264119536-en.

Oskarsson, S., et al. 2022. Persistent inequalities: The origins of intergenerational associations in voter turnout. *The Journal of Politics* 84 (3): 1337–1352. https://doi.org/10.1086/716296.

Persson, M. 2012. Does type of education affect political participation? Results from a panel survey of Swedish adolescents. *Scandinavian Political Studies* 35 (3): 198–221. https://doi.org/10.1111/j.1467-9477.2012.00286.x.

Persson, M. 2014. Testing the relationship between education and political participation using the 1970 British cohort study. *Political Behavior* 36 (4): 877–897. https://doi.org/10.1007/s11109-013-9254-0.

Persson, M. 2015. Education and political participation. *British Journal of Political Science* 45 (3): 689–703. https://doi.org/10.1017/S0007123413000409.

Persson, M., K.-O. Lindgren, and S. Oskarsson. 2016. How does education affect adolescents' political development? *Economics of Education Review* 53: 182–193. https://doi.org/10.1016/j.econedurev.2016.03.015.

Plutzer, E. 2002. Becoming a habitual voter: Inertia, Resources, and growth in young adulthood. *American Political Science Review* 96 (1): 41–56. https://doi.org/10.1017/S0003055402004227.

Posit team. 2022. RStudio: Integrated development environment for R. Posit Software. Boston: PBC. http://www.posit.co/.

Putnam, R.D. 2000. *Bowling alone: The collapse and revival of American community*. New York: Simon and Schuster.

Quaranta, M. 2018. Repertoires of political participation: Macroeconomic conditions, socioeconomic resources, and participation gaps in Europe. *International Journal of Comparative Sociology* 59 (4): 319–342. https://doi.org/10.1177/0020715218800526.

R Core Team. 2017. *R: A language and environment for statistical computing*. https://www.R-project.org/. Vienna: R Foundation for Statistical Computing.

Richards, M., et al. 2001. Birth weight and cognitive function in the British 1946 birth cohort: Longitudinal population based study. *BMJ* 322 (7280): 199–203. https://doi.org/10.1136/bmj.322.7280.199.

Riker, W.H., and P.C. Ordeshook. 1968. A theory of the calculus of voting*. *American Political Science Review* 62 (1): 25–42. https://doi.org/10.1017/S000305540011562X.

Robinson, D. 2019. Education, family background, and political knowledge: A test of the compensation hypothesis with identical twins. *Political Studies*. https://doi.org/10.1177/0032321719848901.

Rubin, D.B. 2004. *Multiple imputation for nonresponse in surveys*. New York: Wiley-Interscience.

Savage, C., M. Becker, and J. Baumert. 2021. Unequal civic development? Vocational tracking and civic outcomes in Germany. *AERA Open*. https://doi.org/10.1177/23328584211045397.

Schafer, J.L. 1997. *Analysis of incomplete multivariate data*, 1st ed. Boca Raton: Chapman and Hall/CRC.

Schlozman, K.L., H.E. Brady, and S. Verba. 2018. *Unequal and unrepresented: Political inequality and the people's voice in the new gilded age*. Princeton: Princeton University Press. https://doi.org/10.2307/j.ctvc7772p.

Schlozman, K.L., S. Verba, and H.E. Brady. 2012. *The unheavenly chorus: Unequal political voice and the broken promise of American Democracy*. Princeton: Princeton University Press.

Schulz, W., et al. 2018. *Becoming citizens in a changing world: IEA international civic and citizenship education study 2016 international report*. Cham: Springer. https://doi.org/10.1007/978-3-319-73963-2.

Sondheimer, R.M., and D.P. Green. 2010. Using experiments to estimate the effects of education on voter turnout. *American Journal of Political Science* 54 (1): 174–189. https://doi.org/10.1111/j.1540-5907.2009.00425.x.

Spinath, F.M., and H. Wolf. 2006. CoSMoS and TwinPaW: Initial report on two new German twin studies. *Twin Research and Human Genetics* 9 (6): 787–790. https://doi.org/10.1375/twin.9.6.787.

StataCorp LLC. 2017. *Stata Statistical Software v.15.1*. College Station: StataCorp LLC.

Stuart, E.A., et al. 2009. Multiple imputation with large data sets: A case study of the children's mental health initiative. *American Journal of Epidemiology* 169 (9): 1133–1139. https://doi.org/10.1093/aje/kwp026.

Theocharis, Y., and J.W. van Deth. 2017. *Political participation in a changing world*, 1st ed. New York: Routledge.

Torney-Purta, J., J. Schwille, and J.-A. Amadeo. 1999. *Civic education across countries: Twenty-four national case studies from the IEA civic education project*. Amsterdam: IEA Secretariat. https://eric.ed.gov/?id=ED431705. Accessed 17 Mar 2021.

van Deth, J.W. 2014. A conceptual map of political participation. *Acta Politica* 49 (3): 349–367. https://doi.org/10.1057/ap.2014.6.

van Deth, J.W. 2016. What is political participation? In *Oxford research encyclopedia of politics*. Oxford: Oxford University Press. https://doi.org/10.1093/acrefore/9780190228637.013.68.

Verba, S., N. Burns, and K.L. Schlozman. 2003. Unequal at the starting line: Creating participatory inequalities across generations and among groups. *The American Sociologist* 34 (1): 45–69. https://doi.org/10.1007/s12108-003-1005-y.

Verba, S., and N.H. Nie. 1972. *Participation in America: Political democracy and social equality*. New York: Harper & Row.

Verba, S., N.H. Nie, and J. Kim. 1978. *Participation and political equality: A seven-nation comparison*. Cambridge: Cambridge University Press.

Verba, S., K.L. Schlozman, and H.E. Brady. 1995. *Voice and equality: Civic voluntarism in American politics*. Cambridge: Harvard University Press.

Verba, S., K.L. Schlozman, and N. Burns. 2005. Family ties: Understanding the intergenerational transmission of political participation. In *The Social logic of politics: Personal networks as contexts for political behavior*, 95–114. Philadelphia: Temple University Press.

Weinschenk, A.C., et al. 2021. The relationship between political attitudes and political participation: Evidence from monozygotic twins in the United States, Sweden, Germany, and Denmark. *Electoral Studies* 69: 102269. https://doi.org/10.1016/j.electstud.2020.102269.

Wilford, A.M. 2020. Understanding the competing effects of economic hardship and income inequality on voter turnout. *Politics & Policy* 48 (2): 314–338. https://doi.org/10.1111/polp.12344.

Vardan Barsegyan is postdoctoral researcher at the Department of Sociology of Utrecht University and member of the Interuniversity Center for Social Science Theory and Methodology (ICS). His research interests include political participation, political and social inequality, educational inequality, applications of behavioral genetic (twin) data and methods in social sciences. His works have been published in peer-reviewed journals such as *Polis*. *Political Studies* (Russian), *Political Science (RU)*, and The *Journal of Sociology and Social Anthropology* (Russian).

Antonie Knigge is assistant professor in the Department of Sociology at Utrecht University and member of the Interuniversity Center for Social Science Theory and Methodology (ICS). His research interests are social stratification and mobility. He currently studies sources of sibling and twin (dis)similarity and the interplay between genes and the environment. He has published in *American Sociological Review*, *American Journal of Sociology*, and *Demography*.

Ineke Maas is professor at the Departments of Sociology of Utrecht University and Vrije Universiteit Amsterdam. Her main research interests are international and historical comparisons of intergenerational mobility, career mobility, and marital mobility. In addition, she has published on the integration of immigrants, inequality of educational opportunities, and gender inequality. Her work appeared in the *American Journal of Sociology*, *American Sociological Review*, *Annual Review of Sociology*, *European Sociological Review*, *Research in Social Stratification and Mobility*, and *Social Networks*.