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The relationship between education and political knowledge: evidence from discordant Danish twins

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ABSTRACT
Many studies have shown that there is a positive relationship between education and political knowledge. However, some scholars have recently challenged this idea, arguing that the positive correlation between education and knowledge may disappear once confounding variables are considered. In this paper, we replicate a recent study that used the discordant twin design to examine the association between education and political knowledge. More specifically, we analyze the relationship between education and political knowledge within monozygotic (MZ) twin pairs, which enables us to bypass sources of confounding of the relationship (i.e. genes and socialization) because MZ twins reared together share both. Using data from a 2019 survey of twins from the Danish Twin Registry, we find that, consistent with earlier work, after accounting for familial factors, the relationship between education on political knowledge is small and not statistically significant.

Introduction[1]

Political knowledge is an important concept in the political science literature. Much research has explored levels of political knowledge (i.e. whether the public is well or poorly informed) as well as the consequences and

antecedents of political knowledge (Luskin 1990; Galston 2001; Delli Carpini and Keeter 1996; Highton 2009).[2] One of the most well-documented findings from research on political knowledge is a strong, positive relationship between educational attainment and knowledge (Jackson 1995; Nie, Junn, and Stehlik-Barry 1996; Delli Carpini and Keeter 1996; Niemi and Junn 2005; Rasmussen 2016). While some scholars have looked at the direct relationship between education and political knowledge (e.g. Delli Carpini and Keeter 1996), others have focused on possible intermediate mechanisms (e.g. peer discussion) for education's positive effect (e.g. Klofstad 2011, 2015). Importantly, studies in both of these areas have indicated that measures of education are positively related to political knowledge. Barabas et al. (2014) summarize the literature succinctly by noting that "As far as explanatory variables go, education is the '800-pound gorilla' in research on political knowledge" (842).

Over the past decade or so, scholars have started to take a more critical look at the nature of the relationship between education and political knowledge (Highton 2009; Rasmussen 2016; Weinschenk and Dawes 2019; Robinson 2020).[3] Indeed, some have wondered whether the relationship between education and knowledge is influenced by other variables. In short, education may be a proxy for factors like genetic predispositions, personality traits or cognitive ability (which are partially heritable), family background (e.g. socioeconomic status), and/or socialization experiences (Highton 2009; Weinschenk and Dawes 2019; Robinson 2020). A number of lines of research suggest that confounding is a possibility. For example, studies have shown that both education (Branigan, McCallum, and Freese 2013) and political knowledge are partially heritable (Arceneaux, Johnson, and Maes 2012; Hannagan, Littvay, and Popa 2014) and Arceneaux, Johnson, and Maes (2012) find that there is at least some genetic overlap between these traits in a U.S. sample. Research has also shown that some of the same psychological traits that are correlated with educational attainment (van Eijck and de Graaf 2004) are also correlated with political knowledge (Gerber et al. 2011). As another example, family socioeconomic status has been shown to influence educational attainment (Melby et al. 2008) and political knowledge (McIntosh, Hart, and Youniss 2007). Taken together,

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[2]We will use the term political knowledge in this paper but note that this variable has also been called political sophistication, awareness, and expertise.

[3]To be fair, Luskin (1990) speculated about some of the factors that education might be proxying for, noting that "Arguments for education effects are often really arguments of intelligence, interest, sophistication, or occupation effects. It is time to unconfound these variables" (350). Only in the past ten years or so have political scientists started to empirically examine the nature of the relationship between education and knowledge and to address the issue of confounding. We should note that scholars have devoted considerable attention to the confounding of the the relationship between education and political participation (see, e.g. Gidengil et al. 2019; Dinesen et al. 2016; Burden et al. 2020; Berinsky and Lenz 2011; Mayer 2011; Kam and Palmer 2008; Hillygus 2005; Henderson and Chatfield 2011; Kam and Palmer 2011; Persson 2012, 2014; Burden 2009).

these studies point to some of the factors that could be jointly related to both variables. As Luskin (1990) has noted, "Education may be taking credit for other variables' work" (349). Although some of the possible confounding variables are difficult to observe or measure (e.g. genes), one recent study by Weinschenk and Dawes (2019) attempted to circumvent factors like genes and the early family environment by examining the association between education and knowledge within monozygotic (MZ) twin pairs raised together. This approach, which is called the discordant twin design, is valuable because it allows researchers to examine the relationship between two variables net of confounding factors rooted in genetic predispositions and the early rearing environment since MZ twins share both. Weinschenk and Dawes (2019) found that after accounting for shared familial factors, the association between education and political knowledge was very small and not statistically significant, which suggests that the relationship is highly confounded.

In this research note, our goal is to replicate Weinschenk and Dawes' analysis using a newly available dataset on twins. Given that Weinschenk and Dawes used data from just one sample, we believe it is worthwhile to examine the relationship between education and political knowledge in a different sample. To our knowledge, there are only two datasets that contain samples of monozygotic twins, measures of political knowledge, and measures of education. One such dataset is the Minnesota Twins Political Survey (collected in 2008–2009), which Weinschenk and Dawes (2019) used. When their study was conducted, this was the only dataset available that contained a sample of MZ twins and the necessary measures. Here, we make use of a new dataset collected through the Danish Twin Registry that enables an additional analysis of the relationship between education and political knowledge within monozygotic twin pairs. Importantly, this allows us to examine whether results based on a U.S. twin sample hold up in a different context.

Overview of the discordant twin design

Political scientists have become increasingly interested in using data on twins to study the genetic and environmental basis of political variables.[4] Typically, such studies are based on comparisons between MZ twins, who share all of their genes, and DZ twins, who share, on average, half of their genes. Twin studies have been used to study a wide range of measures, including ideology and other identities (Alford, Funk, and Hibbing 2005; Hatemi et al. 2014; Weber, Johnson, and Arceneaux 2011), political participation (Fowler, Baker, and Dawes 2008; Klemmensen et al. 2012a), political attitudes (Klemmensen et al. 2012b; Loewen and Dawes 2012), and political discussion (York 2019) and media

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[4]For a detailed overview of this area of research, see Littvay (2020).

consumption (York and Haridakis 2021). We note that twin studies have also been used to estimate the heritability of political knowledge (Arceneaux, Johnson, and Maes 2012; Hannagan, Littvay, and Popa 2014; Kalmoe and Johnson 2021).[5] In this study, rather than using twin data to compare MZ and DZ twin correlations and obtain heritability estimates (e.g. to see how much of the variation in knowledge is to due genetic factors), we use twin data in a different way (and for a different purpose). Following Weinschenk and Dawes (2019), we employ the discordant twin design and focus our analysis on MZ twins. The key idea is to examine the relationship between within twin-pair differences in education and within twin-pair differences in political knowledge. Importantly, within twin-pair estimates of the relationship between education and knowledge are not biased by unmeasured family factors because MZ twins share all of their genes and, if they have been brought up together, also share a rearing environment. An easy way to think about the twin-pair estimates is that they correspond to including a dummy variable (fixed-effect) for each family in the regression model. Additional details about the discordant twin design are provided in the Online Appendix.

The process for examining the extent of confounding between education and political knowledge is fairly straightforward. We first generate what we call "naïve" estimates. In short, we estimate models where the fact that twins in a pair are related is ignored. We then estimate twin-pair fixed-effects models. Here, all of the factors that are shared by twins in a pair are differenced out. By comparing the naïve and fixed-effects estimates, we can see how much the association between education and knowledge is influenced by factors rooted in the family. If we find that the naïve and fixed-effects estimates are the same, this would be evidence that the relationship between the two variables is not confounded by familial factors. On the other hand, if we find that the fixed-effects estimates are substantially smaller than the naïve estimates, this would tell us that the relationship is influenced by familial variables and would provide support for the idea that education is proxying for various pre-adult variables such as genetic predispositions and/or socialization experiences.

Data & measures

Danish Twin Registry

In this paper, we use data from the Danish Twin Registry (DTR) at the University of Southern Denmark. The participants we use in this study were drawn

[5]We note that Kalmoe and Johnson (2021) use twin data to examine political sophistication but their primary interest is in whether the heritability of ideology varies depending on levels of political sophistication. They do, however, report a heritability estimate for political sophistication in their paper (48% heritable).

from the Danish Twin Registry's younger cohort of twins born in the years 1970–1989. The data we use here was collected via a survey fielded in 2019. In total, our analysis is based on 380 MZ twins (or 190 complete MZ twin pairs). In the 2019 survey, participants were asked about their educational attainment and several questions designed to measure their knowledge about politics. Before proceeding, we want to make two points about the external validity of our data. First, evidence shows that participants in the Danish Twin Registry mirror the general Danish population quite well (see Klemmensen et al. 2012c). Second, we examined the relationship between education and knowledge in a representative sample of the Danish population ($N = 2450$) and found that the relationship is quite similar to what we observe in the twin sample (models are included in the Online Appendix).[6] This leads us to believe that the estimates obtained from our twin sample are externally valid to at least some extent.

Dependent variable

We measure political knowledge by using a number of factual items that were included in the survey. Respondents were asked three questions about Danish politics: Which parties are part of the current government? Which party does Troels Lund Poulsen belong to? Which party does Dan Jørgensen belong to? [7] For each question, respondents were provided a number of answers to choose from; "don't know" was also a possible response for each question. We coded correct answers as "1" and incorrect answers as "0." Don't know response were coded as "0." This is the same approach used by Weinschenk and Dawes (2019).[8] To generate the overall knowledge measure, we summed correct responses to the three questions and then divided each respondent's score by the maximum possible value (the measure is therefore on a 0–1 scale).[9] The overall measure is fairly reliable (Kuder-Richardson coefficient of reliability is 0.6921). We note that although

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[6]We note that the twins are a bit more educated than those born from 1970–1989 in the representative sample, which likely explains the slightly larger education coefficients in the twin models.

[7]Troels Lund Poulsen has held various positions in Danish politics. He was Minister for Employment (2016-2019), Minister for Commerce, Business and Growth (2015-2016), Minister for Education (2011), Minister for Taxation (2010-2011), and Minister for the Environment (2007-2010). He is currently a member of the parliament (and belongs to the Venstre party). Dan Jørgensen is a Social Democrat in the Danish parliament and Minister of Climate and Energy and Public Utilities. He has been the Minister for Food, Agriculture and Fisheries and also served as a member of the European Parliament.

[8]Within the literature on the measurement of political knowledge, there has been discussion about what "don't know" (DK) responses to knowledge questions mean and how to handle them. For example, some have argued that DKs mask a good deal of knowledge (see, e.g. Mondak 1999; Mondak and Anderson 2004), while others have provided evidence that DK responses do not seem to mask political knowledge (see, e.g. Luskin and Bullock 2011). As a robustness check of our approach to handling DK responses, we estimated models where 1=correct, 0=incorrect, and DK (don't know) responses are omitted (rather than included as zeros). We report the results of those models below.

[9]In terms of the distribution of correct answers, 10% got zero correct, 11.6% got 1 correct, 21.6% got 2 correct, and 56.8% got all 3 correct.

MZ twins are alike in terms of political knowledge (Arceneaux, Johnson, and Maes 2012), we do find that there is within-pair variation in political knowledge. The mean absolute difference in knowledge is 0.186 (SD=0.246). Put another way, 42.63% of pairs differ in their levels of political knowledge. In short, there is quite a bit of within-twin pair variation in political knowledge for us to try to explain with our statistical models.

Independent variable

To measure education, we make use of two questions that ask respondents about their schooling and vocational training. Consistent with Weinschenk and Dawes (2019), we operationalize education in two ways.[10] Our first measure is an ordinal item that is coded to run from 0 to 5 where 0 represents the lowest educational level (10th grade or less) and 5 represents the highest level (over four years of higher education, e.g. doctor, economist, lawyer, civil engineer). Our second measure is a dichotomous item indicating whether a respondent is in either of the two highest categories in our ordinal measure (i.e. those with 3–4 years of higher education and those with over four years of higher education). We code respondents in the two categories as "1" and those who fall into the remaining categories as "0." Delli Carpini and Keeter (1996) have noted that "All education, but especially college, has a powerful effect on political knowledge through the development of skills and orientations that make it easier for the well-schooled to comprehend and retain political information" (192–193). Thus, we believe it is worthwhile to examine the relationship between a dichotomous measure and political knowledge.

Since the discordant twin design uses just within-twin variation to examine the relationship between the independent and dependent variable, it is important to note that there needs to be sufficient variation in education between twins in a pair. We note that while MZ twins are similar in terms of their educational attainment (Branigan, McCallum, and Freese 2013; Arceneaux, Johnson, and Maes 2012), we do see within-pair variation in education

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[10]It is worth mentioning that measurement error in education could lead to a bias toward no effect in the fixed-effects models (Oskarsson et al. 2017; McGue, Osler, and Christensen 2010; Ashenfelter and Krueger 1994; Griliches 1979). Although we do not have access to, e.g. registry-based measures of educational attainment that we could use to compare to the self-reported educational attainment measure, we note that one recent study on the association between education on generalized trust (which also used the discordant twin design) in Sweden found that correcting education (using data from national Swedish registers) for measurement error did not alter the estimated within twin-pair relationship between education and trust. They noted that "This suggests that the absence of effect of education on social trust in the twin-pair models does not reflect possible measurement error" (Oskarsson et al. 2017, 524). This finding provides some comfort, as it suggests that the use of self-reported measures of education in fixed-effects models may not be too problematic. We encourage future researchers to collect twin datasets that allow for comparisons between self-reported survey responses and administrative measures. This would allow for a more comprehensive analysis of the role of measurement error in influencing within twin-pair estimates.

in our sample. When it comes to the ordinal measure of education, the average absolute difference in education between twins is 0.721 (SD=1.160). Put in a different way, we find that 36.32% of pairs differ on the ordinal measure of education. In terms of the dichotomous item, we find that in our sample 15.79% of the pairs differ on this measure. The challenges of limited within variation for independent variables in fixed-effect models are well known and to be expected since this is essentially a feature of such models. We note that the reduction in variation from the OLS model to the fixed-effect model here is comparable to a recent overview of findings comparing OLS and fixed-effects models (Mummolo and Peterson 2018). For example, a quick analysis shows that the standard deviation for our ordinal education measure is 1.54 for the OLS model and is 0.68 for the fixed effect education variation (i.e. the twin-demeaned estimate).[11]

Results

The results of our statistical models are shown in Table 1. For each education measure, we present two sets of estimates. We first present the naïve estimates (i.e. where membership in a twin pair is ignored). We then present the twin-pair fixed-effects estimates. These estimates show the within-pair relationship between education on political knowledge. Following Weinschenk and Dawes (2019), we estimate all naïve models using OLS regression (with controls for birth year and sex) and all twin-pair models using OLS fixed-effects regression. We note, though, that the results are very similar if ordered logistic regression models are employed rather than OLS models.[12]

There are a number of interesting findings in Table 1. Turning first to the ordinal measure of education, the naïve OLS estimate indicates that there is a strong, positive relationship between education and political knowledge.[13] The coefficient is 0.072 [.047, .096], which is statistically significant at the $p < .001$ level. A comparison between the OLS estimate and the fixed-effects estimate, however, indicates that the OLS estimates are biased upward and once confounding variables rooted in the family are taken into account, the education coefficient drops substantially. Indeed, it is 0.008 [−.024, .041] in the fixed-effects model and is not statistically significant ($p = 0.605$). It is worth noting that a difference of coefficients test reveals that the naïve and fixed-effects coefficients are significantly different from each

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[11]The maximum change is two and a half years of education so we do also observe empirically nontrivial counterfactual shifts in levels of education.

[12]Results from the ordered logit models are discussed below.

[13]The marginal effects indicate that the predicted level of political knowledge (on our 0–1 knowledge scale) is 0.490 for those with the lowest level of educational attainment but it is considerably higher at 0.848 for those with the highest level of education.

Table 1. The Relationship Between Education and Political Knowledge, Comparison of OLS and Fixed-Effects Estimates

	OLS b/[c.i.]	FE b/[c.i.]	OLS b/[c.i.]	FE b/[c.i.]
Ordinal Education	0.072*** [0.047, 0.096]	0.008 [−0.024, 0.041]		
Dichotomous Education			0.218*** [0.129, 0.306]	0.011 [−0.100, 0.122]
Birth Year	−0.008* [−0.014, −0.001]		−0.007* [−0.014, −0.000]	
Male	0.209*** [0.140, 0.278]		0.215*** [0.144, 0.285]	
Constant	15.583* [2.319, 28.847]	0.720*** [0.600, 0.840]	14.574* [0.889, 28.260]	0.743*** [0.659, 0.826]
N	380	380	380	380
R^2	0.189	0.086	0.166	0.061

*p<.05, **p<.01, ***p<.001, two-tailed.

other (t=3.20, $p = 0.001$). Overall, the size of the coefficient decreases by 88% when we move from the OLS model to the fixed-effects model.[14] We note that this is fairly similar to what Weinschenk and Dawes (2019) reported when examining an ordinal measure of education. More specifically, they found that the coefficient for education decreased by 72% when moving from an OLS to fixed-effects model.

In the models that use the dichotomous measure of education, we find a similar pattern. In the OLS model, the coefficient is 0.218 [.129, .306], which is statistically significant at the $p < .001$ level.[15] In the fixed-effects specification, the coefficient decreases to 0.011 [−.100, .122] and is not statistically significant ($p = 0.844$). We conducted a difference of coefficients test and found that the naïve and fixed-effects coefficients are significantly different from each other (t=2.86, $p = 0.004$). In terms of the change in the size of the education coefficient, there is a 95% decrease in the size of the coefficient when we move from OLS to fixed-effects.[16] Again, our results are very similar to

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[14]As a robustness check, we re-estimated the models using ordered logistic regression. Overall, we find that the education coefficient is statistically significant at the $p < .001$ level when using ordered logit to estimate the naïve model. When we add twin-pair fixed-effects, the coefficient is not statistically significant ($p = 0.534$). The size of the coefficient decreases by about 70% when moving from the naïve to fixed-effects context. In addition, as another robustness check, we estimated models where the knowledge measure is coded so that 1=correct, 0=incorrect, and don't know responses are omitted (as opposed to being included as zeros). Although the sample size decreases a bit when we use this approach, comfortingly we find a similar pattern of results. In the OLS model, education has a statistically significant effect on knowledge. However, the effect is not statistically significant in the fixed-effects context.

[15]The marginal effects indicate that the predicted level of political knowledge (on our 0–1 knowledge scale) is 0.593 for those with scores of zero on the dichotomous education measure but it is considerably higher at 0.810 for those with scores of one on the measure.

[16]Again, as a robustness check, we re-estimated the naïve model using ordered logit and the within twin pair model using ordered logit with fixed-effects for family. In the naïve model, the education variable is statistically significant at the $p < .001$ level. But, the measure is not significant ($p = 0.951$) in the fixed-effects context. The magnitude of the coefficient decreases by 96% when moving from the

Weinschenk and Dawes (2019). When they examined a similar dichotomous measure of education, they found that the size of the education coefficient decreased by 90% when moving from an OLS model to a fixed-effects model. It appears that the relationship between education and knowledge is confounded by variables rooted in the family.

Discussion & conclusion

In this paper, we re-examined the relationship between education and political knowledge. According to many studies (Nie, Junn, and Stehlik-Barry 1996; Delli Carpini and Keeter 1996; Niemi and Junn 2005; Jackson 1995), education has a positive relationship with political knowledge. Recently, however, Weinschenk and Dawes (2019) used the discordant twin design and a sample of MZ twins from the United States to show that the association between education and knowledge is confounded by factors rooted in the family. Here, we used a new dataset to provide an additional look at the relationship between education and political knowledge within MZ twin pairs. Using data from a sample of Danish twins, we found that after accounting for common familial factors, the estimated association between education and political knowledge was close to zero and far from reaching statistical significance.

Our results are important for a number of different reasons. First, some scholars have found that although the magnitude of the relationship between education and political knowledge decreases after accounting for a number of possible confounders, a significant effect still remains. Rasmussen (2016), for example, found that the relationship is at least partially confounded by psychological traits, like the Big five personality traits and intelligence, but noted that education was still a statistically significant predictor even in the presence of controls. The discordant twin design used here showed that there are additional factors that confound the relationship. Indeed, after we accounted for all observed and unobservable shared familial factors, we found that education was not significantly related to political knowledge. It appears that the relationship between the two variables is influenced by factors that are correlated with both education and knowledge. This fits well with Rodenburger (2020) who found that the relationship between political interest and voter turnout is driven by self-selection. Second, replication is a critical part of the scientific enterprise, and we have shown that the findings reported by Weinschenk and Dawes (2019) hold

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naïve model to the fixed-effects model. In addition, as another robustness check, we estimated models where the knowledge measure is coded so that 1=correct, 0=incorrect, and don't know responses are omitted (as opposed to being included as zeros). We find a similar pattern of results. In the OLS model, education has a statistically significant effect on knowledge. However, the effect is not statistically significant in the fixed-effects context.

up when examined in a different sample. Importantly, the dataset used in this study was collected in a different context. Thus, this study helps show that the initial results from a U.S. sample are externally valid to at least some extent.

In the end, we believe that there are a number of future research ideas that stem from our analysis. First, additional replications of this study would be valuable. Although there were many useful features of our dataset, we note that the sample size was relatively small. Thus, we encourage other researchers to examine the relationship between education and knowledge using the discordant twin design in the context of other (hopefully large) samples. Although it was comforting to find that our results were very similar to Weinschenk and Dawes (2019) and that our naïve and fixed-effects estimates were significantly different from one another, additional studies would further enhance our confidence in the finding that the relationship between education and knowledge is small and not statistically significant after accounting for confounding factors. Second, although the approach used here allowed us to account for familial factors, it did not enable us to say how much each of the family factors we discussed (e.g. genes, socialization, personality) influenced the relationship between education and knowledge (i.e. we can only say that family factors influence the correlation). Thus, scholars may wish to employ a Cholesky decomposition (using MZ and DZ twins) model as a way of examining the extent to which genes and environmental factors explain the observed relationship between education and knowledge. Another possibility would be to try to directly measure some of the confounders we discussed in this paper. For example, recent advances have made it possible to directly control for genetic predispositions to have certain traits, such as educational attainment, cognitive ability, and personality, by using polygenic risk indices (see, e.g. Dudbridge 2013; Lee et al. 2018). The application of such measures to the study of political knowledge could greatly enhance our understanding of this important concept and its relationship to other variables.

Disclosure statement

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