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Predicting political beliefs with polygenic scores for cognitive performance and educational attainment

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ABSTRACT

Intelligence is correlated with a range of left-wing and liberal political beliefs. This may suggest intelligence directly alters our political views. Alternatively, the association may be confounded or mediated by socioeconomic and environmental factors. We studied the effect of intelligence within a sample of over 300 biological and adoptive families, using both measured IQ and polygenic scores for cognitive performance and educational attainment. We found both IQ and polygenic scores significantly predicted all six of our political scales. Polygenic scores predicted social liberalism and lower authoritarianism, within-families. Intelligence was able to significantly predict social liberalism and lower authoritarianism, within families, even after controlling for socioeconomic variables. Our findings may provide the strongest causal inference to date of intelligence directly affecting political beliefs.

Intelligence has been found to be associated with a range of political beliefs including liberalism (Carl, 2014), anti-racism (Deary, Batty, & Gale, 2008), support for the EU and NATO (Oskarsson et al., 2014), free speech (De Keersmaecker, Bostyn, Van Hiel, & Roets, 2021), tolerance (Lasker & McNaughton, 2022) and anti-authoritarianism (Choma & Hanoch, 2017).

Two meta-analyses of this literature have been performed. Onraet et al. (2015) meta-analysis found intelligence to be negatively correlated with right-wing ideological attitudes ($r = -.20$). However, the correlation depended on the type of right-wing attitude measured, with higher correlations with authoritarianism ($r = -.30$) and ethnocentrism ($r = -.28$) compared to conservatism ($r = -.13$). Jedinger and Burger (2022) found a very small but significant correlation between intelligence and fiscally conservative beliefs ($r = .07$). Overall, intelligence has been found to be associated with beliefs that can be described as socially liberal and possibly also fiscally conservative.

To put these effect sizes into context, in the American National Election Study (Gaziano, 2014), it has been estimated that education has an effect of $\beta = -0.139$ and income has an effect of $\beta = 0.124$ on right-wing ideology, after controlling for age, race, and gender. Intelligence has a correlation with political belief that is comparable if not greater than the correlations between belief and measures of SES commonly studied by political scientists.

Although IQ is known to be associated with political belief, it is not known why this is the case. The relationship between intelligence and political belief could be confounded or mediated by socioeconomic factors and environmental factors more broadly. In this study, we employ polygenic scores, within-family designs and controls to causally identify the direct effect of cognitive ability on political beliefs.

We might believe intelligence directly changes political beliefs. Political beliefs likely reflect our ethical values and our empirical beliefs, both of which might be altered by intelligence. Intelligence is related to greater general knowledge (Furnham & Chamorro-Premuzic, 2006), knowledge of economics (Caplan & Miller, 2010) and financial literacy (Lin & Bates, 2022). Moreover, intelligence may be related to subjective values, as it shows correlations with patience (Shamosh & Gray, 2008), openness (Anglim et al., 2022), "emotional intelligence" (MacCann, Joseph, Newman, & Roberts, 2014) and moral judgement in the Defining Issues Test (Derryberry, Jones, Grieve, & Barger, 2007). Onraet et al. (2015) suggested that the use of stereotypes and socially conservative beliefs function as heuristics, utilizing fewer cognitive resources than thinking about social issues on a case-by-case base. This could cause lower cognitive ability to be associated with right-wing views.

The relationship between intelligence and political belief could alternatively be accounted for by socioeconomic mediation. In the political science literature two plausible mediators of IQ's effect are income and education.

Education, which may be in a reciprocal causal relationship with IQ

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scores, has been found to be associated with liberal values and support for capitalism (Weakliem, 2002). Dunn (2011) has summarised theories of education's relationship with political beliefs into three categories: self-interest theories, whereby education, in changing socioeconomic outcomes, also alters political self-interest; developmental theses, whereby the increased knowledge and cognitive ability, caused by education, directly affects political opinion; and socialization theses, where values are inculcated by peer effects or through the education of values themselves.

Another plausible mediator of IQ's relationship with political beliefs is income. Popular economic models characterise voter preference as a function of income, in turn derived from exogenous differences in human capital (Meltzer & Richard, 1983). Human capital in turn is partly composed of intelligence. Longitudinal designs (Jæger, 2006) and random lotteries (Powdthavee & Oswald, 2014) support the notion that income causes right-wing views. Thus the mediators of income and education may help explain intelligence's correlations with political beliefs.

The relationship between intelligence and political belief may also be confounded by environmental factors. Twin studies of political belief have established a genetic component to political beliefs, but they have also established the role of environment. Meta-analysis of results from 12,000 twin pairs (Hatemi et al., 2014) indicates a significant shared environmental effect of 0.18, compared to 0.40 for the genetic variance and 0.42 for the non-shared environment. Adoption studies have also been able to identify an effect of the shared environment. In particular, these studies have identified that a portion of the shared environmental effect comes from the cultural transmission of political values from parent to offspring (Willoughby et al., 2021).

Various approaches have been used to disentangle the effect of intelligence from confounds and its direct effect from its total effect, mediated by socioeconomic variables. The simplest approach has been to control for possible mediators and confounds in linear regression. Robust relationships between cognitive ability and liberal views have been found after controlling for measures of education and socioeconomic status (e.g., Carl, 2014; Deary et al., 2008).

A further improvement is to use a within-family design, studying whether the sibling with higher cognitive ability also has more liberal views. This removes any confounding arising from the shared environment, including the common effect of transmission of political values from parents. Ahlskog and Oskarsson (2022) studied the relationship between IQ and political values in a sample of around 700 Swedish siblings, finding the effect sizes to be similar before and after using family fixed effects. This indicates that confounding through the shared environment is insufficient to account for intelligence's relationship with political views.

Studies using family fixed effects can exclude confounding from the shared environment, but not the non-shared environment—that is, environmental factors unique to each sibling. We study the relationship between cognitive ability and political beliefs with a novel approach using polygenic scores. A polygenic score is a DNA-based predictor of someone's trait, calculated as a linear combination of the estimated effect of alleles. When controlling for parental polygenic scores, the scores of the offspring are not confounded by environmental variation, since genes are randomly and independently inherited from parents via the process of Mendelian segregation. This allows polygenic scores to act as instruments for mental abilities. This exclusion of environmental confounds provides an advantage in causal identification compared to regressing political beliefs on cognitive abilities. This approach of controlling for parental polygenic scores has been used in various other papers (e.g. Willoughby, McGue, Iacono, Rustichini, & Lee, 2021). We supplement this approach by including adoptees who are randomly assigned to families, ensuring their shared environment is uncorrelated with their polygenic score.

As of writing, one published paper has found that polygenic scores can predict political beliefs. Ahlskog (2023) found a polygenic score for educational attainment had a positive effect on social liberalism and a negative effect on economic conservatism, using family fixed effects. This was interpreted as evidence for education affecting political beliefs. We focus specifically on the psychological trait of intelligence, measured more precisely, with the cognitive performance polygenic score from Becker et al. (2021). Cognitive performance is simply a euphemism for intelligence.

1. Method

1.1. Sample

The Sibling Interaction and Behavior Study (SIBS) recruited families between 1998 and 2003 (McGue et al., 2007). State birth records and records from adoption agencies allowed for a representative sample of adoptive and biological families to be recruited. Statistics used in this study were taken at intake or follow-up 3 lasting from 2017 to 2023. The sample and political-attitude scales have previously been used and described in Willoughby, Giannelis, Ludeke, Klemmensen, et al. (2021), so our description is substantially similar.

All biological offspring were of European ancestry, whilst adopted offspring were either European or East Asian—born in South Korea, to be specific. Table 1 shows the number of individuals from each group for which we have data on political beliefs, IQ and reported age at follow-up three. Of complete offspring pairs, where we have variables for both siblings, 82 pairs are biological, 96 pairs are adopted and an additional 35 pairs include an adopted and biological offspring. We also include parents in the table, since we employ them as observation in models not using family fixed effects.

Comparison of current participants with nonparticipants on intake measures related to socioeconomic status and cognitive ability revealed no substantial attrition effects (see supplementary materials of Willoughby, Giannelis, Ludeke, Klemmensen, et al., 2021). However, 63% of the included sample is female compared to 54% at intake, suggesting males were more likely to drop out.

The adoptees were placed in their families before their second birthdays, implying there can be negligible selective placement. In the international adoptions, parents had little information about the children that could be used to prefer some over others (McGue et al., 2007). Sacerdote (2007) has argued that there is strong reason to suppose random assignment in international adoptees. Furthermore, the polygenic scores of MCTFR adoptees do not significantly correlate with those of their adoptive parents (Willoughby, McGue, Iacono, & Lee, 2021). However, Beauchamp, Schmitz, McGue, and Lee (2023) have regressed polygenic scores for educational attainment and cognitive performance on large range of family characteristics in the adoptive sample. In the Asian adoptees, family characteristics did not significantly predict polygenic scores, but they did in the European adoptees.

1.2. Political attitudes

We employ five scales about political attitudes that were given to parents and offspring during their third follow-up assessment. These were measures of political orientation, authoritarianism, egalitarianism, social liberalism and fiscal conservatism. We also include one social-attitude scale—religiousness. Scales, reliabilities and numbers of items

Table 1
Description of sample.

Group	Ancestry	*N*	Age at intake	Age at follow-up 3
Biological offspring	European	293	14.8 (1.9)	31.4 (2.5)
Adopted offspring	European	78	15.0 (2.1)	31.9 (2.7)
Adopted offspring	East Asian	248	15.1 (2.0)	32.4 (2.7)
Parent	European	262	47.1 (4.4)	64.3 (4.8)

Note: The mean (SD) of age are given at the two waves.

are presented in Table 2.

Political orientation was assessed with the single item "What is your political orientation?" on a 1–5 scale ranging from "extremely conservative" to "extremely liberal." Authoritarianism was measured using 12 items capturing three facets of authoritarianism (subordination, aggression, and conventionalism) from Duckitt, Bizumic, Krauss, and Heled (2010)'s tripartite authoritarianism-conservatism-traditionalism model. Egalitarianism was measured with eight items from Feldman and Steenbergen (2001) and Feldman (1988). Religiousness was assessed with the 9-item religiousness scale created by Koenig, McGue, Krueger, and Bouchard (2005). The scale asks about participation in and frequency of religious activities. 11 items were used to measure socialism liberalism and six measuring fiscal conservatism. These items were adapted from similar questions in the General Social Survey items (Smith, Davern, Freese, & Morgan, 2018). A list of all items for each scale can be found in the supplementary materials of Willoughby, Giannelis, Ludeke, Klemmensen, et al. (2021).

Correlations among our political scales are presented in Table 3. Due to the high correlations among the variables, we create a composite measure to summarise the relationship between intelligence and political opinion. Authoritarianism, egalitarianism, social liberalism and fiscal conservatism scales are combined to create a sum score called the political composite. Before summing, we change the signs of our scales so higher scores indicate left-wing views, ensuring that high composite scores indicate left-wing views too. A scale was coded as being left-wing or right-wing by its correlation with authoritarianism, which is assumed to be right-wing. Example items are shown in Table 2.

1.3. Cognitive and control variables

Participants were assessed for their cognitive ability at intake with IQ tests. The Wechsler Adult Intelligence Scale–Revised (WAIS-R; Wechsler, 1981) was used for participants age 16 years and older and the Wechsler Intelligence Scale for Children–Revised (WISC-R; Wechsler, 1974) for participants 15 years and younger. Following intake assessment, one individual with an IQ below 70 was dropped from subsequent assessments (McGue et al., 2007).

Educational attainment was assessed using self-reported years of education. Income was assessed as self-reported gross labor income, in thousands of US dollars. Both measures were taken at follow-up three. A value of 1 was added to income before it was then log transformed. Some 7 individuals do not have reported educational attainment and 14 individuals do not have a reported value of income. Summary statistics for education and income are given in Supplementary Table S1and histograms in Supplementary Fig. S2.

Table 2
Political scales.

Scale	ω_h	ω_t	N items	Example item
Political orientation	–	–	1	What is your political orientation?
Authoritarianism	0.74	0.88	12	Obedience and respect for authority are the most important virtues children should learn.
Egalitarianism	0.79	0.90	8	If wealth were more equal in this country, we would have many fewer problems.
Social liberalism	0.72	0.89	11	The use of marijuana should be legal.
Fiscal conservatism	0.77	0.90	6	The government is spending too little money on Social Security.

Note: ω_h represents McDonald's hierarchical omega and ω_t represents McDonald's total omega. Estimates of reliability are reproduced here from Willoughby, McGue, Iacono, and Lee (2021). Items for fiscal conservatism were reverse coded to ensure higher scores represented right-wing views.

Table 3
Correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Composite						
(2) Political orientation	0.78					
(3) Authoritarianism	−0.85	−0.63				
(4) Egalitarianism	0.88	0.73	−0.62			
(5) Social liberalism	0.88	0.67	−0.77	0.66		
(6) Fiscal conservatism	−0.86	−0.67	0.57	−0.78	−0.64	
(7) Religiousness	−0.42	−0.40	0.39	−0.28	−0.50	0.29

1.4. Polygenic scores

Genome-wide association studies (GWAS) use regression to estimate effect sizes of genes on human traits. These genes are single nucleotide polymorphisms (SNPs). At each loci of the genome there are either 0, 1 or 2 copies of the SNP. Multiplying a person's number of SNPs by their effect sizes and then summing over all the loci gives us an estimate of a person's genetic value for a trait. This genetic index of someone's trait is known as a polygenic score.

The Sibling Interaction and Behavior Study (SIBS) has been genotyped along with other cohorts from the Minnesota Center for Twin and Family Research (MCTFR; Miller et al., 2012), meaning we know how many copies of a SNP each participant has at half a million loci. Our polygenic scores were derived from genome-wide association study (GWAS) summary statistics for two behavioral phenotypes; cognitive performance (CP; Lee et al., 2018) and educational attainment (EA; Lee, Wedow, et al., 2018). Cognitive performance refers to a score on an IQ test and is a euphemism for intelligence. Educational attainment refers to the number of years an individual has spent in education. The EA polygenic score is employed because it is trained on a large sample ($N \approx 770,000$) compared to the CP polygenic score ($N \approx 250,000$), potentially allowing for greater power. However, it also will proxy mental abilities and traits relevant to educational success in addition to the *g* factor of intelligence.

For the European subjects we use scores that were pre-calculated as part of the Polygenic Index Repository (Becker et al., 2021). Non-European subjects were not included in the repository, so we made polygenic scores for the Asian subjects ourselves. Furhter details regarding the genotyping of the sample and creation of the polygenic scores can be found in Supplementary Section 2.

Of the 668 biological and adopted siblings with the necessary variables recorded, 139 were not genotyped. Of the 252 genotyped biological offspring, 91 did not have polygenic scores for both of their parents available.

1.5. Modelling strategy

We run a series of regressions on our scales of political beliefs, using a range of controls and IQ or polygenic scores as explanatory variables or instruments. We adjust *p*-values given in the text for multiple testing across our seven traits using the Benjamini-Hochberg correction. In tables, focusing on our political composite of all traits, we do not adjust *p*-values for multiple correction. We standardize all continuous variables to have a mean of zero and a standard deviation of one. To remove confounding by the shared environment, we can employ family fixed effects, which is the standard "within-family" design. We use this method when using an observed phenotype as an explanatory variable. However, it is not necessary when using the polygenic score as the explanatory variable. This is because an offspring's polygenic score can be decomposed into the sum of the average parental polygenic score and a random deviation ascribable to Mendelian segregation. The second term is uncorrelated with all potential confounders and therefore equivalent to random treatment assignment. Therefore, it is sufficient to control for the average polygenic scores of the parents to remove not only confounding by the shared environment but any conceivable confounding whatsoever. This approach also provides more degrees of freedom for estimation. For models that don't examine within-family variation, we also incorporate the parents in the sample to attain greater power.

Notice that the offspring polygenic score, even without controlling for the parental polygenic scores, is already uncorrelated with the non-shared environment. This is because if heritable traits of the parents can affect the offspring phenotype at all, then the midparent component of the polygenic score exerting such effects is part of the shared environment rather than the non-shared environment.

In some models we control for variables related to socioeconomic status, education and income. We refer to these variable as potential mediators since they could plausibly mediate the effect of intelligence. If intelligence still has an effect on political beliefs after using the controls, then that suggests its total effect is not entirely mediated by education or income. However, these variables might proxy confounders, affecting both politics and intelligence simultaneously. Intelligence is measured in childhood, so income and education cannot alter the measure but only correlate with other variables which do act as confounds. In this case, using the controls will simply remove a potential bias. In models using a polygenic score instead of phenotypic intelligence, income and education should not act as confounds since environmental factors cannot alter a person's genes. The variables could function as colliders being affected by intelligence and political beliefs simultaneously. This would be unusual since it is unlikely that political beliefs have a non-negligible effect on income or education. In this case, controlling for the variables would induce a bias.

We have evidence that adopted Asians are effectively placed at random with their families. If this is correct, then the control for parental polygenic scores is unnecessary in this group. As discussed above, there is some evidence that adoptees of European ancestry were placed selectively, meaning that controlling for the parental polygenic scores is insufficient to remove environmental confounding for this group.

Our approach with the adoptees was to set their midparent polygenic score to zero, thus only controlling for the midparent score when the respondent was a biological offspring. To deal with the possible selective placement of European adoptees we reran our main analysis in Supplementary Fig. S3 finding the results change negligibly, with the significance of no results changing. Further details of our modelling approach can be found in Supplementary Section S3.

1.6. Mendelian randomization

A polygenic score can be used as an instrumental variable to estimate the extent to which two other variables, X and Y, stand in a causal relation to each other. This approach is known as Mendelian randomization (MR). The idea of this approach is to find an instrument, I, that satisfies the following two properties:

1. I is only correlated with X because of its causal effect on X, the magnitude of this effect being γ; and
2. I only affects Y, if at all, through its effect on X.

Pearl (2009) provided a more general treatment and definition of instrumental variables, but this formulation suffices for our purposes. Let β denote the causal effect of X on Y—the chief quantity of interest. Then we can represent this situation as $I \xrightarrow{\gamma} X \xrightarrow{\beta} Y$, where possibly confounding variables also contribute to the correlation between X and Y. But since any such confounders do not contribute to the correlation between I and Y, we can obtain an unbiased estimate of β by performing a "two-stage" regression in which we first obtain the effect of I on X (γ) and then use this to divide the effect of I on Y ($\gamma\beta$). Our own situation is a particularly propitious one for applying MR because of the possibilities in the study design (random segregation of offspring polygenic scores or random placement of adoptees) for ensuring that our polygenic score is indeed a valid instrument by at least the first criterion above.

The second criterion is called the exclusion restriction. It is particularly unlikely that the exclusion restriction would hold for the EA polygenic score, since it captures a range of mental characteristics which predispose one to education, in addition to intelligence. Thus we choose to use the CP polygenic score as an instrument, but to use the EA polygenic score only as an explanatory variable.

There may still be cases where the genetic variants used in the polygenic CP score violate the exclusion restriction, in which case the regression beta will be biased from the true effect. Still, we believe there are two reasons to prefer the MR approach, even if there is bias.

Firstly, MR has an intuitive interpretation. With environmental confounding avoided, its estimate tells us that for every standard deviation increase in IQ caused by variation in the polygenic score, political beliefs change by the regression beta. In other words, MR merely scales the covariation to be in units of IQ rather than those of the polygenic score. This allows us to compare its effect size with IQ's association with political beliefs. By contrast, a naive regression of political beliefs on the polygenic score has no natural unit since it is dependent upon how predictive the polygenic score is of intelligence. This also helps explain why we do not use MR with the EA polygenic score. Given genetic variation in educational attainment proxies a range of psychological traits, it is not obviously useful to scale its effect to be comparable with either education or IQ. The same reasoning about appropriate scale underlies more complex methods to correct estimated effects of polygenic scores for the error in them (Becker et al., 2021; DiPrete, Burik, & Koellinger, 2018), yet these methods still rely on very similar assumptions.

A second reason for our approach, is that any violation of the exclusion restriction will similarly bias the result regardless of whether the polygenic score is used in MR or simply as a control variable. In Supplementary Section S3 we give further justification and description of our modelling approach.

We estimate the power of our MR estimates using the IVpower function in the ivmodel package for R. The function is based on the estimate of power described in Freeman, Cowling, and Mary Schooling (2013). This function may somewhat overestimate power since it does not take into account the clustered structure of the data and the calculation relies on the asymptotic distribution of the estimator. We also apply this power calculation to ordinary linear regression estimates of the effect of IQ on political beliefs. This is because the power for a linear regression is the same as that of an instrumental variable regression when the instrument correlates perfectly with the endogenous variable (Freeman et al., 2013).

We calculate the power to reject the null at $p < 0.05$, before any adjustment for multiple correction. The calculation assumes the true effect size is 0.3 on left-wing attitudes. This is larger than Onraet et al. (2015) estimate of the effect of IQ on right-wing attitudes $r = -.20$, but it is consistent with the attitudes most correlated with IQ, such as lower authoritarianism ($r = -.30$) and and ethnocentrism ($r = -.28$). Our study uses measures of intelligence and political attitudes that are much more reliable than those typically used in the literature, meaning we should expect somewhat higher estimates. For example, estimates using the General Social Survey (e.g. Carl, 2014) employ a ten-item vocabulary test as a measure of intelligence whereas we use a Wechsler IQ test.

In this paper, we refer to the MR estimate of the effect of intelligence on political views as the effect of "genotypic IQ," as opposed to the effect of "phenotypic IQ" obtained without using an instrument.

1.7. Multi-ancestry interacted Mendelian randomization

The SIBS sample contains individuals of European and East Asian ancestry. The prediction accuracy of polygenic scores decays with genetic distance from the ancestry group the GWAS was trained on. This can be explained by differing allele frequencies and different patterns of linkage disequilibrium (Martin et al., 2017).

Naively including the East Asians in our MR model would increase power through a larger sample size, but it would also reduce power through reducing the effect size of the polygenic score. We use this approach with the EA polygenic score, standardizing it within each ancestry group. In MR models, to account for the heterogeneous effect size of the polygenic score across the ancestry groups, we include an interaction between an East Asian dummy variable and the polygenic score only in the first-stage regression. We refer to this method as multi-ancestry interacted Mendelian randomization (MAI-MR).

The same modelling approach has been used in the economics literature. Including an interaction in the first-stage model exploits the heterogeneity in the instrument's strength to increase the efficiency of the model. It has been used before when the effect of experimental treatments differs across groups (Abadie, Gu, & Shen, 2023).

MAI-MR will estimate a weighted average of the genotypic effect over ancestries (Abadie et al., 2023). The genotypic effect may differ between ancestries if either the causal effect of the phenotype differs or if the CP polygenic score has an effect on political belief, not mediated by intelligence, which differs between ancestries (see Supplementary Section S3 for further details). As a robustness test, we rerun our analyses for each ancestry group alone in the supplement. To account for the fact that the key dimensions of population structure are different between the ancestry groups we run interactions between each genetic principal component and East Asian ancestry.

2. Results

2.1. Regressions of political beliefs on IQ

Fig. 1 is a forest plot showing the effects of phenotypic and genotypic IQ on our scales of political beliefs, using different control variables. All estimates, standard errors and relevant diagnostic test statistics for the plot are presented in the supplementary spreadsheets. IQ and political beliefs are standardized. Table 4 shows the full regression models for the composite political scale.

Across all political beliefs, phenotypic IQ significantly predicts views in a left-wing direction. The effect of IQ on our political composite is 0.35. Upon controlling for family fixed effects, IQ has a significant effect on the political composite $(\beta = 0.26, p = 0.040)$, authoritarianism $(\beta = -0.35, p = 0.011)$, and social liberalism $(\beta = 0.28, p = 0.011)$. The point estimates remain similar after controlling for income and education, but the effect on the composite is no longer statistically significant. *P*-values given in the text are adjusted for the false discovery rate.

Genotypic IQ significantly predicts left-wing political views across the political scales. After controlling for the midparent PGS, genotypic IQ significantly predicted three of the seven political variables; the political compostie $(\beta = 0.54, p = 0.009)$ authoritarianism $(\beta = -0.67, p = 0.002)$. When controlling for education and income, genotypic IQ no longer significantly predicted any of the political beliefs, after adjusting for multiple testing.

First-stage regressions examining the effect of the polygenic score on intelligence are presented in Supplementary Table S3. *F*-statistics for the instruments in the models of the political composite went from 28.5 to

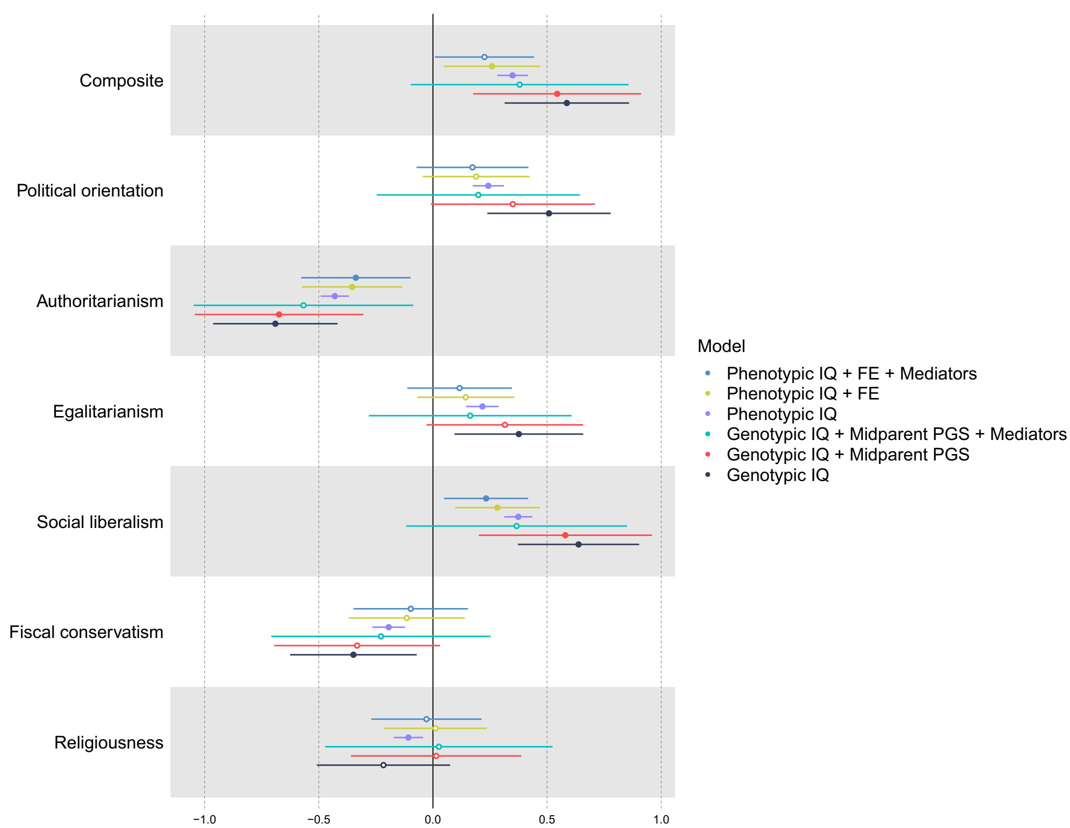

Fig. 1. Intelligence and political belief. The data points represent the regression betas of IQ. The 95% confidence intervals are clustered at the family level. Estimates are colored in if they are significant after a Benjamini-Hochberg correction for multiple testing at $p < 0.05$. Models are labeled by their most important right-hand-side variables. In the phenotypic models the estimates are obtained from ordinary least squares; in the genotypic models, two-stage least squares (2SLS) with the CP polygenic score as the instrument. FE stands for family fixed effects. Models using midparent PGS control for the mean polygenic score of the parents. Putative mediators include years of education and the logarithm of income. All models include controls for sex, age, an East Asian dummy variable and the first five genetic principal components, interacted with the East Asian variable.

Table 4
Regressions of the political composite on IQ.

	Dependent variable: political composite					
	Phenotypic			Genotypic		
	(1)	(2)	(3)	(4)	(5)	(6)
IQ	0.349***	0.258*	0.226*	0.587***	0.544**	0.380
	(0.034)	(0.108)	(0.111)	(0.139)	(0.188)	(0.243)
Midparent PGS					0.011	0.007
					(0.047)	(0.047)
Ancestry (East Asian = 1)	0.159	−0.418	− 0.431	− 0.049	0.047	0.172
	(0.083)	(0.311)	(0.327)	(0.199)	(0.263)	(0.274)
Age	− 0.168***	0.004	0.025	− 0.224	− 0.038	− 0.051
	(0.036)	(0.147)	(0.149)	(0.051)	(0.058)	(0.063)
Sex (female = 1)	0.236**	0.191	0.073	0.313**	0.287*	0.071
	(0.078)	(0.225)	(0.234)	(0.099)	(0.116)	(0.150)
Years of education			0.226			0.220*
			(0.136)			(0.096)
Log income			− 0.122			− 0.081
			(0.119)			(0.048)
Family fixed effects	No	Yes	Yes	No	No	No
Observations	881	619	604	767	438	426
Degrees of freedom	876	192	183	752	422	408
R^2	0.127	0.817	0.831	0.097	0.057	0.137
F-statistic on instruments	NA	NA	NA	28.519	18.260	11.586
Wu-Hausman statistic	NA	NA	NA	2.92	2.169	0.812
Wu-Hausman *p*-value	NA	NA	NA	0.088	0.142	0.368
Hansen statistic	NA	NA	NA	0.228	0.080	0.121
Hansen *p*-value	NA	NA	NA	0.633	0.777	0.727

Note: $*p < 0.05$; $**p < 0.01$; $***p < 0.001$. *P*-values in this table are not adjusted for multiple testing. Models 1–3 are ordinary least-squares (OLS) regressions of the political composite on IQ. Models 4–6 are two-stage least-squares (2SLS) regressions employing the CP polygenic score and an interaction with an East Asian dummy as instrumental variables. 2SLS regressions include the first five genetic principal components and their interaction with the East Asian Ancestry dummy, which are omitted from the table. Constants are not shown in the regression table. Cluster robust standard errors are shown in parentheses. Continuous variables are standardized, whilst dummy variables are not.

18.3 to 11.50. This means the polygenic score effectively predicts intelligence and had good strength for the first two sets of models, but had mediocre strength in the last set of models. The power to reject the null at $p < 0.05$, assuming the true effect was 0.30, was around 99% for the phenotypic models. When modelling the political composite in the genotypic model, the power was 56% with minimal controls, 40% after

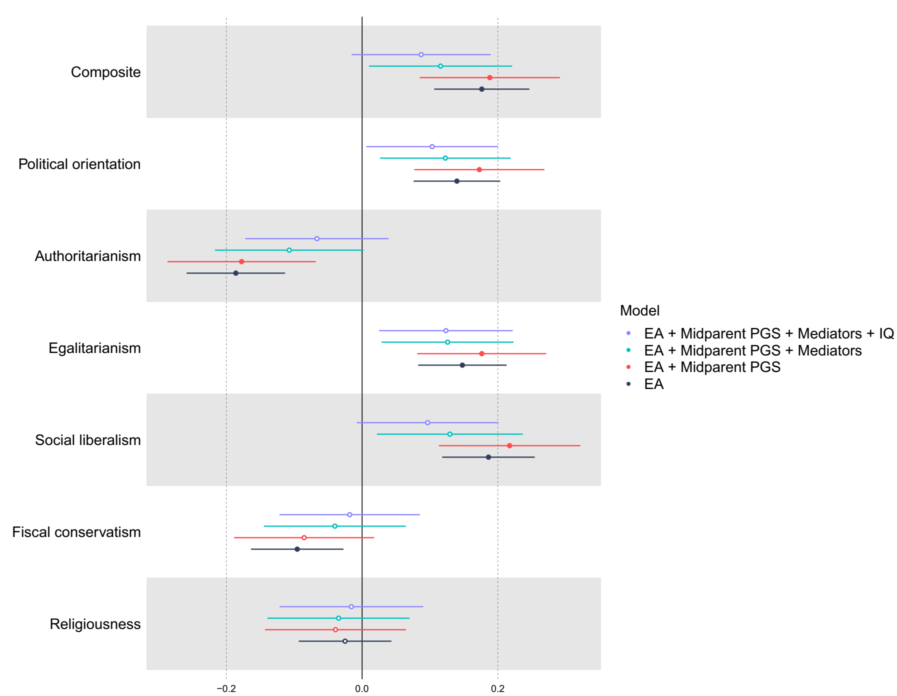

Fig. 2. EA polygenic score and political belief. The data points represent the regression betas of the EA polygenic score, standardized to have a standard deviation of one. The 95% confidence intervals are clustered at the family level. Estimates are colored in if they are significant after a Benjamini-Hochberg correction for multiple testing at $p < 0.05$. Models are labeled by their most important right-hand-side variables; EA is the EA polygenic score, and midparent PGS is the mean EA polygenic score of the parents. Putative mediators include years of education and log income. All models include controls for sex, age, an East Asian dummy variable and the first five genetic principal components, interacted with the East Asian variable.

controlling for the midparent polygenic score and 27% when controlling for putative mediators. This suggests that significant results for the genotypic models are somewhat affected by the Winner's curse and are likely larger than the true effect. Moreover, when controlling for potential mediators the genotypic models do not have enough power to be very informative regarding the true effect size.

There appears to be a difference between the estimated effects of phenotypic and genotypic IQ (Fig. 1), suggesting that one or both estimates may be biased by confounding or some assumption violation (Wu-Hausman test with minimal controls, $p = 0.088$; with the midparent polygenic score as a control, $p = 0.142$; with putative mediators, $p = 0.368$). For example, the effect of genotypic IQ may be biased by a failure of the exclusion restriction, in that the CP polygenic score has an additional direct effect on political views unmediated by IQ itself. However, the statistical power of the genotypic models is not sufficient for us to confidently state that it produces larger estimates.

2.2. Regressions of political beliefs on the EA polygenic score

Fig. 2 is a forest plot showing the effect size of the EA polygenic score in models with increasing numbers of control variables. Table 5 presents the full regression models. With minimal controls the EA polygenic score predicts left-wing beliefs across all the political scales, but it does not significantly predict religiousness. After controlling for the midparent PGS, the effect of the EA polygenic score on fiscal conservatism becomes statistically non-significant, but remains significant for the five other political traits. When potential mediators are controlled for, the EA polygenic score no longer significantly predicts any of the political traits after correcting for multiple testing. To compare the effect of these controls we may focus on the models of the political composite. The PGS has an effect size of 0.18 ($p < 0.001$) before using additional controls and an effect size of 0.19 ($p = 0.002$) after controlling for the midparent PGS an effect size of 0.12 ($p = 0.113$) after controlling for socioeconomic mediators.

Because the EA polygenic score is an indicator of intelligence and other mental traits, it is unclear through which psychological traits the score affects political beliefs. We perform an additional set of models controlling for IQ. In these models, the EA polygenic score's point estimate remains similar to earlier estimates, but confidence intervals are too large to be informative regarding whether part of the polygenic score's explanatory power comes from non-cognitive traits.

Table 5
Regressions of the political composite on the EA polygenic score.

	Dependent variable: political composite			
	(1)	(2)	(3)	(4)
EA polygenic score	0.176***	0.188***	0.116*	0.087
	(0.036)	(0.053)	(0.054)	(0.052)
Midparent polygenic score		0.002	0.003	0.001
		(0.053)	(0.053)	(0.051)
Ancestry (East Asian = 1)	− 0.018	0.130	0.242	0.215
	(0.169)	(0.301)	(0.292)	(0.278)
Age	− 0.089*	− 0.074	− 0.086	− 0.070
	(0.037)	(0.050)	(0.051)	(0.053)
Sex (female = 1)	0.080	0.088	− 0.103	− 0.030
	(0.062)	(0.099)	(0.099)	(0.099)
Log income			− 0.059	− 0.067
			(0.042)	(0.043)
Years of education			0.304***	0.263***
			(0.045)	(0.047)
IQ				0.150**
				(0.053)
Observations	950	438	426	426
Degrees of Freedom	935	422	408	407
R^2	0.059	0.075	0.156	0.173

Note: $^*p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$. Omitted from the table are the constants, the first five genetic principal components and their interaction with the East Asian Ancestry dummy. Cluster robust standard errors are shown in parentheses. Continuous variables are standardized, whilst dummy variables are not.

3. Discussion

Although a large literature has found associations between cognitive ability and political beliefs, the extent to which the relationship was confounded or mediated by environmental and socioeconomic factors has been unclear. We used a within-family design, finding phenotypic cognitive ability is still associated with a wide range of political beliefs, avoiding confounding from environmental factors common to siblings. We also used a novel method, associating polygenic scores with political beliefs. This approach removed confounding from the non-shared environment and confounding from all environmental variation when we controlled for parental polygenic scores and had adoptees that were randomly assigned to families.

Genotypic IQ had a significant effect on all our measures of political beliefs: political orientation, authoritarianism, egalitarianism, social liberalism, fiscal conservatism and a composite of these scales. Across all these traits, genotypic IQ was associated with left-wing beliefs. After we controlled for the average parental polygenic score, we found genotypic IQ still significantly predicted social liberalism, the political composite, and lower levels of authoritarianism. Consistent with Onraet et al. (2015) meta-analysis, we find the largest effect sizes for authoritarianism rather than other measures of ideology.

The results were consistent with intelligence having a causal effect on political beliefs, suggesting the relationship between intelligence and political belief cannot be explained away by environmental confounding. Moreover, the weak effects of controlling for possible socioeconomic mediators imply that intelligence may directly change how we think about politics, rather than merely being an upstream cause of other theories of belief formation, such as self-interest or values inculcated by education.

We also studied the effects of genotypic variation in educational attainment (EA). The EA PGS had the advantage of being trained on a larger sample size, but the potential disadvantage of capturing psychological traits relevant to education, other than intelligence. Across all six of our political measures we found genotypic variation in EA to have a significant effect in the left-wing direction. With the exception of the effect of fiscal conservatism, these results were robust to controlling for parental polygenic scores.

A few limitations should be noted with regards to our methodology. One issue is that of genetic confounding. If our polygenic score for cognitive performance alters political belief through direct pleiotropy, that is, a pathway other than intelligence, then our estimate of the effects of intelligence on political beliefs will be biased. The GWAS used to produce the CP polygenic score was not within families, meaning that genetic variants would have been included because they happen to correlate with intelligence, not necessarily because they caused it. For example, cross-trait assortative mating between intelligent people and liberal people would bias the polygenic scores and our results. Due to the independent assortment of genes in Mendelian segregation within families, this would not have been a problem for the phenotypic models using family fixed effects.

Other forms of genetic confounding may be relevant for both phenotypic and genotypic models. It is theoretically possible that whatever developmental processes lead to intelligence also lead to left-wing political views. For example, intelligence is genetically correlated with personality traits, such as openness. Within siblings, intelligence predicts differences in personality (Bartels et al., 2012). We also know that personality traits are correlated with political beliefs (Lee, Ashton, Griep, & Edmonds, 2018):personality. If intelligence is causing variation in personality, then this could be a mediator of its effect; if not, then the correlation will induce a slight bias on our estimated effect of intelligence.

Another possible problem could arise from intelligence tests being biased by motivation. IQ scores have been found to correlate with self-reported effort at $r = .50$ (Cole, Bergin, & Whittaker, 2008), although the magnitude of the causal effect of effort is unclear (Bates & Gignac, 2022). Burger, Pfattheicher, and Jauch (2020) have speculated that supporters of right-wing ideologies may be less motivated to do well in intelligence tests. If they were correct then the correlation between intelligence and left-wing beliefs would be upwards biased, though the authors find mixed evidence for effort correlating with either ideology or intelligence in their sample. If effort is not correlated with ideology, then the effect of variation in motivation will have acted as measurement error, altering the effect sizes.

Estimated effects of intelligence seemed to be larger in our genotypic models, using the polygenic score as an instrument, than in our phenotypic models. One worry could be that given the large confidence intervals for the genotypic model, the results could reflect a winner's curse with the estimates only being published because they happened to be significant. However, in reduced form, the polygenic scores have regression betas similar to those that were published by Ahlskog (2023). Ahlskog found the educational attainment polygenic score had a beta of 0.140 on social ideology in a large within family sample. By contrast we find an effect of 0.15 of the CP polygenic score and effect of 0.19 of the EA polygenic score on the political composite. Thus the regression betas we have found using polygenic scores are only slightly higher, indicating that all polygenic score estimates may be upwards biased.

A key question for our results is their generalizability to other samples and contexts. Meta-analyses of the relationship between intelligence and political opinion (Jedinger & Burger, 2022; Onraet et al., 2015) find over 90% of the variation in estimated effect sizes comes from between-study heterogeneity rather than sampling error. This could imply that the effect of cognitive ability is substantially dependent on the society and culture. However, our sample is limited to European and Asian Minnesotans. Under Onraet et al. (2015) hypothesis, that the less intelligent are attracted to conservatism because rules and stereotypes reduce the need for cognitive resources, we should expect the effect of intelligence to be similar across societies. Likewise, any hypothesis that intelligence systematically changes moral tastes would also not predict variation in its effect across societies. Differing relationships between intelligence and economic interest could cause such heterogeneity, but in our study and others, the effect of intelligence seems robust to controlling for income. Alternatively, the differing effect sizes might simply be explained by other external factors becoming more or less salient.

Surprisingly, we found cognitive ability to significantly and negatively predict fiscal conservatism. Compared against the studies in Jedinger and Burger (2022) meta-analysis, this appears to the first time cognitive ability has been significantly associated with left-wing economic beliefs. One possibility could be that the relationship between intelligence and fiscal conservatism has changed over time; political beliefs were measured 2017—2023. This is unlikely to be a generational effect. In Supplementary Table S6, we compare the association of intelligence with political beliefs in parents versus to the offspring, finding no significant effects but again with large standard errors.

We have a speculation for why the relationship between intelligence and fiscal conservatism might have changed. Over the 2010s there has been a political realignment, with left-wing parties obtaining a more educated and wealthier set of voters, whilst the right-wing parties have received the opposite (Pew Research Centre, 2016). One explanation for this has been the increased salience of identity, cultural and social issues relative to economic issues (Davies, 2018; Gallup, 2024), at least prior to the pandemic. It is possible that intelligent individuals who have moved left for social reasons may have also begun to subscribe to the economic views of their comrades, whilst the same could have occurred to the less intelligent individuals who have moved to right-wing parties. After all, individuals' beliefs over a range of markedly different policy issues, from gay marriage to gun control, tend co-occur in a left or right-wing direction, suggesting tribalism may encourage people into particular sets of views regardless of their logical coherence. Cohen (2003) found partisans were much more likely to support a policy if they were told that their party supported it. To exemplify this tribalism, before Richard Nixon introduced price controls, only 37% of Republican activists supported the policy (Barton, 1975). Afterwards, 82% supported the idea. Regardless of the cause of our finding, it is only the estimate of one study. It will be interesting to see whether our finding replicates.

Future research should build theories of why intelligence affects political views and test them. In particular, this requires more testing for interactions. Ahlskog (2022) has suggested and tested the idea that cognitive ability's effect on political beliefs may be moderated by socioeconomic status. The theory being that intelligent people are more attuned to their class's economic interest. Furthermore, the relationship between intelligence and political beliefs should be studied across time to see how societal change impacts the relationship between intelligence and ideology. Future research should involve pooling many samples to obtain both greater power and more heterogeneous cultures, enabling interaction effects to be tested.

Although we have found evidence for intelligence causing political beliefs, we have not commented on its implications. This is intentional. In a world where politics is increasingly polarizing and divisive, it is all the more important for scientists to perform their work neutrally, with a disinterest for everything but the truth (Merton, 1973, Chapter 3). Without this norm, both the objectivity and the authority of research are undermined, as trust in scientists becomes partisan (Kennedy & Tyson, 2023). After all, an "is" does not imply an "ought" (Hume, 1739, Book 3, Part 1, Section 1); scientific facts have no bearing on right or wrong. However, in any practical field of ethical decision-making, the facts are relevant. In this regard scientists may be obliged to comment, even if in only a measured manner.

It is tempting to make inferences to the veracity or the quality of an ideology based on the intelligence of its supporters. As discussed, intelligence might affect political beliefs through increased knowledge of the facts. Nevertheless, there are many other possible causal pathways with no such implication or even the opposite. Such pathways could include, intelligence altering one's self-interest, or intelligence enabling individuals to identify and support prestigious beliefs. All we can say from the current study is that there are likely to be causal pathways not mediated by education or income. We cannot say that the beliefs of high IQ people tell us what is right to believe, but rather only what smart people choose to believe.

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CRediT authorship contribution statement

Tobias Edwards: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing. **Alexandros Giannelis:** Writing – original draft, Writing – review & editing, Formal analysis. **Emily A. Willoughby:** Data curation, Visualization, Writing – original draft, Writing – review & editing. **James J. Lee:** Writing – review & editing, Conceptualization.

Declaration of competing interest

The authors declare no conflicts of interest.

Data availability

The authors do not have permission to share data.

Appendix A. Supplementary data

The supplement is available to download at *Intelligence*. Supplementary spreadsheets and additional materials are publicly accessible at https://osf.io/3g6ca/.

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