An inquiry into the relationship between intelligence and prosocial behavior: Evidence from Swedish population registers

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Abstract

We characterize the relationship between intelligence and prosocial behavior by using administrative data on cognitive ability, charitable giving, voting, and possession of eco-friendly cars for 1.2 million individuals. We find strong positive associations with all three behaviors, and they remain strong when using within-twin pair variation in cognitive ability to account for plausible confounders. Moreover, we find that among several dimensions of cognitive ability, general intelligence is the strongest predictor of prosocial behavior. Mediators, such as income, education, and family situation, play only a minor role, and the positive relationships are mirrored in altruistic preferences.

I. Introduction

A unique feature of us humans is our inclination to cooperate with non-kins to produce public goods and redistribute resources (Fehr and Fischbacher 2003, Silk and House 2011). This type of prosocial behavior has important implications for nearly all aspects of economic decision making and the functioning of our societies (Ostrom et al. 2002, Gintis et al. 2005, Henrich 2018). However, finding a rational explanation for why humans have evolved into a prosocial animal has been a key challenge for evolutionary biologists for a long time (Hamilton 1964, Alexander 1987, Batson 1987, Bowles and Gintis 2011, Henrich 2018).

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In this paper, we investigate if prosocial behaviors, such as donating money to charities, vote in democratic elections or voluntarily reducing one's carbon footprint, can be explained by another unique human feature – our highly developed intelligence. For this purpose, we analyze high quality administrative data from Sweden containing information on cognitive ability, charitable giving, voting, and possession of environmentally friendly cars for 1.2 million individuals.

An interesting link between prosocial behavior and intelligence is proposed by Singer (1981); who suggests that ethical reasoning and prosocial behavior may be evolutionary side effects of highly developed intelligence. If intelligence increases fitness more than altruism decreases fitness, both may coevolve. A related argument, put forward by Herrnstein and Murray (1994), is that individuals that are more intelligent better understand the needs and perspectives of others. In this sense, intelligence may be related to both empathy and theory of mind.[1] Bryan, Jeon-Slaughter, and Kang (2003) further argue that giving up resources to benefit others is less costly for more intelligent individuals as they can more easily regain spent resources. Prosocial behavior can therefore also serve as a costly signal of fitness (Millet and Dewitte 2007) and more intelligent individuals may also have a better understanding of how prosocial behavior benefit themselves through reciprocal favors from other members of society (Grueneisen and Warneken 2022). These theoretical arguments all suggest that intelligence is positively and causally linked to prosocial behavior.[2]

Several previous attempts have been made to empirically characterize the relationship between intelligence and prosocial behavior. One strand of literature has used lab experiments, such as the dictator game and public goods game, to investigate whether intelligence predicts giving. Some of these studies have documented a negative association (Ben-Ner, Kong and Putterman 2004, Ponti and Rodriguez-Lara 2015, Cueva et al 2016, and Kanazawa and Fontaine 2013), a few find no association (Brandsäter and Güth 2002, Benjamin, Brown, and Shapiro 2013), and others document a positive association between

[1] This link has some support from neuroimaging and electroencephalographic (EEG) studies, which have found that specific centers in the brain are involved in both emotional and cognitive tasks. For instance, the anterior cingulate cortex regulates both cognitive and emotional processing (Bush et al. 2000), suggesting that higher cognitive ability and sensitivity to the well-being (or suffering) of others may result from high functionality in the same brain centers.

[2] That intelligence is negatively related to antisocial behaviors, such as crime, has been discussed by e.g. Herrnstein and Murray (1994), Heckman, Stixrud, and Urzua (2006) and Frisell, Pawitan, and Långström (2012).

intelligence and generosity towards others in these types of games (Millet and Dewitte 2007, Chen et al 2013, and Gou et al 2019).

Another strand of the literature has relied on surveys containing self-reported measures of prosocial behaviors, such as charitable giving (Bekkers 2006, James 2011, Wiepking and Maas 2009), voting (Deary, Batty, and Gale 2008, Denny and Doyle 2008), and altruistic preferences (Falk et al. 2018), or various proxies for intelligence, such as cognitive reflection tests, memory tests, verbal proficiency, or self-reported math skills (Bekkers 2006, James 2011, Falk et al. 2018, Wiepking and Maas 2009). These studies generally find a positive relationship and that the relationship is evident in a large number of countries (Falk et al. 2018).

We add to this literature by conducting the first large-scale study on the relationship between reliable and objectively reported measures of both intelligence and prosocial behavior.[3] Moreover, while the literature has, hitherto, focused on whether there is an association between intelligence and prosocial behavior or not, surprisingly few attempts have been made to assess whether the association is a consequence of confounding factors correlated with both intelligence and the behavior in question.[4] A positive association could arise without any of the theoretical arguments mentioned above being valid. For instance, more intelligent individuals may be more likely to grow up with parents and peers who promote prosocial values, which in turn renders prosocial behavior. We take this issue seriously and use within twin-pair variation in cognitive ability to estimate the relationship. By doing so, we effectively account for many potentially confounding environmental and genetic factors. We also control for a well-established measure of personality (sometimes referred to as non-cognitive ability in the economics literature) to account for intelligence being positively correlated with closely related cognitive functions, which may influence prosocial behavior, such as for instance empathy. Moreover, we investigate how the relationship is mediated by education, income and family situation. Finally, to understand if our results are likely to generalize to other prosocial behaviors, we investigate if the relationship between cognitive ability and prosocial behavior is mirrored in altruistic preferences.

[3] Our paper also relates to the broader empirical literature trying to explain why some individuals are more inclined to behave prosocially than others (see e.g. Heckman, Stixrud, and Urzua 2006, Cesarini et al. 2008, 2009, Kosse et al 2020).

[4] An exception is James (2011) who study the relationship between cognitive decline and charitable giving in survey data covering elderly Americans with an individual fixed effects approach.

We measure intelligence using cognitive ability test scores from the mandatory military enlistment and we study three different third-party-reported prosocial behaviors in the administrative registers: charitable giving, voting, and ownership of eco-friendly cars. These behaviors are prosocial in the sense that they are generally encouraged, primarily benefit others (typically strangers), and are thus akin to behaviors observed in classical applications of, for example, the dictator game or the public goods game.[5]

The perhaps most prominent example of real-life prosocial behavior is charitable giving. Individuals with more human capital are generally more generous toward charities (see e.g. Bryant et al. 2003, Wiepking and Maas 2009, Bekkers and Wiepking 2011). However, less is known as to why human capital is such a strong predictor of charitable giving (Bekkers and Wiepking 2011). Some argue that education fosters an attitude of giving to organizations working for good causes (Wiepking and Maas 2009), while others have noted that specific abilities, such as verbal proficiency (Bekkers 2006, Wipeking and Maas 2009), represent important predictors of charitable giving over and beyond education. These findings point to the potential role of cognitive ability as an independent explanatory determinant of charitable giving. In line with this conjecture, James (2011) has analyzed data from the Health and Retirement Study and found that cognitive decline predicts lower charitable giving among elderly Americans.

Voting complements charitable giving as a prosocial behavior in that it incurs a time cost rather than a monetary cost for the donor. In this respect, voting is similar to volunteering.[6] Voting in elections is also often modelled and viewed as a prosocial act (see e.g. Jankowski 2002, Edlin, Gelman, and Kaplan 2007) as voting is irrational from a narrowly self-interested perspective (Downs 1957) but benefits others with similar interests and may contribute to a better quality in political outcomes through “the miracle of aggregation” (Converse 1990). A number of studies have been conducted on the link between cognitive ability and political participation (see e.g. Dal Bó et al. 2017). This literature has been motivated by the conjecture that the strong positive association between education and voting could be explained by intelligence predicting both educational attainment and political participation (Herrnstein and

[5] We are not claiming that charitable giving, voting or buying an eco-friendly car are solely, or even mainly, prosocial behaviors, only that those behaviors contain generally accepted prosocial elements.

[6] Using survey data, Denny (2003) found that literacy is positively correlated with volunteering after controlling for education.

Murray 1994).[7] In line with this argument, a few studies have also found a positive link between proxies for intelligence and survey data on voting (see e.g. Denny and Doyle 2008, Deary, Batty, and Gale, 2008).[8] To the best of our knowledge, we are the first to study the link between cognitive ability and register-based voting data. An advantage of using validated turnout data is that this avoids the common problem of over-reporting of political participation in surveys (for a recent discussion on this issue, see DeBell et al. 2018).

The choice to analyze the possession of an environmentally friendly car (hereafter eco-friendly car) as a prosocial behavior is motivated by the general observation that many behaviors cause negative environmental externalities. Minimizing these negative externalities contributes to preserving and managing our common environment (Hardin 1968, Ostrom 1990). Since an eco-friendly car typically costs more than a similar conventional car but emits less pollutants, buying an eco-friendly car is similar in kind to making a contribution in a public goods game. Studies using variation in average intelligence quotient (IQ) between countries have found that a higher national IQ is associated with higher environmental awareness (Salahodjaev 2018), less deforestation (Obydenkova et al. 2016), and that it has an inverted U-shape relation with CO_2 emissions (Salahodjaev et al. 2016).[9] As far as we know, we are the first to study the link between intelligence and environmental behaviors at the individual level.

We find a strong positive relationship between cognitive ability and all three prosocial behaviors. A one standard deviation increase in cognitive ability is associated with a 41 percent increase in the probability of giving to charity, a 30 percent increase in the probability of voting, and a 14 percent increase in the probability of having an eco-friendly car.

We find similar positive associations between cognitive ability test scores and all three prosocial behaviors in a sample of women who has enlisted (~3000), suggesting that our findings are not specific to men only.

Cognitive ability is assessed through four subtests concerning logical ability, verbal ability, spatial ability, and technical comprehension. We find strong positive associations between test

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[7] See Lindgren, Oskarsson, and Persson (2018) for a recent example of how education affect voting.

[8] Hillygus (2005) found a positive correlation between SAT scores and political engagement in survey data covering American college graduates.

[9] Several studies have studied the link between other individual characteristics and environmental attitudes, see, for instance, Torgler and Garcia-Valiñas (2007).

scores on all four subtests and all three prosocial behaviors. Interestingly, the strongest associations are found for the subtests measuring logical ability and verbal ability. These subtests are also considered best measures of general intelligence (or fluid intelligence).

Using within twin-pair variation in cognitive ability to account for confounders, we find that the estimates are generally lower than the unconditional correlations. However, the estimates still reveal strong associations with all three behaviors. A one standard deviation increase in cognitive ability is associated with a 26 percent increase in probability of giving to charity, 11 percent increase in the probability of voting, and 13 percent increase in the probability of having an eco-friendly car. We interpret these estimates as evidence that the unconditional correlations are substantially biased, but they also strengthen the case for a real and profound relationship between intelligence and prosocial behaviors. The twin estimates are only marginally affected by several potentially mediating variables (income, education, and family situation), suggesting that there is a direct link between intelligence and prosocial behavior.

Finally, as our prosocial behaviors represent only few of many possible prosocial behaviors, we have matched survey responses on self-reported altruism to the cognitive ability test scores for a subsample of individuals (~600). We find that more intelligent individuals are more altruistic compared to less intelligent individuals. This result is consistent with the interpretation that intelligence is broadly associated with altruistic preferences and prosocial behavior in general.

II. Data

We use administrative data from the Swedish Military Archive covering all men (and women) alive on January 1, 2016, who enlisted for military service in Sweden between 1969 and 1997. Enlistment was mandatory for men and voluntary for women. More than 90 percent of all men in each birth cohort participated in the enlistment procedure the year they turned 18 or 19. Exemption was granted only to individuals with severe disabilities. More than 1.2 million men and 3,000 women enlisted during this period. The data thus cover almost the entire population of Swedish men born between 1951 and 1979, who are on average in their late 40s and early 50s when we measure the outcomes. See Appendix A, Table S1 (Appendix A-C are available online) for additional descriptive statistics for the analyses samples. In addressing the role of confounders, we exploit variation within twin-pairs, in total 5,890 pairs.[10] In

[10] We identify twin-pairs as two individuals who share biological mother and biological father, according to the Multi-Generation Register, and quarter of birth year from the Income and Tax register.

Sweden, all individuals have a personal identity number (PIN). We use the PIN to connect information from the enlistment records with data from other registers containing data on prosocial behaviors, which we describe below.

We measure intelligence using scores from a cognitive ability test taken during the military enlistment. This test has been evaluated by psychologists and is considered good at capturing intelligence (Carlstedt 2000, Mårdberg and Carlstedt 1998), as defined by a hierarchical g-factor model (Carroll 1993). The test consists of four subtests which measure general intelligence (sometimes also referred to as fluid intelligence), but also to some extent crystallized, verbal, and spatial intelligence (Mårdberg and Carlstedt 1998). The test was incentivized, as higher scores led to more attractive positions during the military service, which was also mandatory. Consequently, the cognitive ability measure is likely to be a reliable measure of intelligence. Moreover, the test score is highly correlated with a test score on a similar cognitive ability test taken at the age of 50–65 (Rönnlund et al. 2015), suggesting that it is a good predictor of intelligence during the entire adulthood. The enlistment test scores were summarized into a so-called stanine scale, where 1 corresponds to IQ<76, 5 to 96<IQ<104, and 9 to IQ>126 (Öhman 2015). These test scores have been used and discussed extensively in the literature concerning how intelligence is related to labor market and educational outcomes (Lindqvist and Vestman 2011, Lundborg, Nystedt, and Roth 2014, Carlsson et al. 2015, Grönqvist, Öckert, and Vlachos 2017, Grönqvist, Nilsson, and Robbling 2020, Edin et al. 2021), health (Hemmingsson et al. 2007, Öhman 2015), and crime (Frisell, Pawitan, and Långström (2012). For the regression analyses, we follow the earlier literature, for example Edin et al. (2021), and standardize the cognitive scores, to have mean zero and unit variance, to account for the slight drift in scores over cohorts.

Data on charitable giving is retrieved from the Swedish Tax Agency's Income and Tax Register. We use information on individual-level donations to major charities in Sweden during the period 2012–2015. These data exist since donations to charities allowed for tax reductions during these years.[11] To get the tax reduction, the donor had to make one or more

[11] The recipient organization had to be a tax-exempted foundation or other non-profit organization active in charity work for the economically needy or in the promotion of scientific research as well as approved by the Tax Agency. The approved organizations received 80 percent of all funds collected by all 405 organizations accredited by the Swedish Fundraising Control (a non-profit organization with the purpose of monitoring and collecting statistics on the fundraising activities by the accredited organizations), and the gifts observed in the tax register accounts for 47 percent of all charitable gifts to the organizations approved by the Tax Agency. The

gifts, each of at least SEK 200 (≈USD 20) to a given organization per year and a total annual gift amount of at least SEK 2,000.[12] The tax register covers information on all gifts amounting to at least SEK 200, thus also gifts that did not lead to a tax reduction and gifts that exceeded the maximum amount resulting in a tax reduction (which was SEK 6,000). Besides donating, all the donor had to do to be eligible for the tax reduction was to provide his/her personal identity number (cf. social security number in the US) to the charity, which, in turn, reported the donation to the Tax Agency. This procedure involves important advantages compared to the system of tax deductions for charitable donations used in, for instance, the US (Clotfelter 1997), which requires the donor to understand the tax law and actively file forms to receive the tax return. In contrast, the Swedish system minimizes the risk that a relationship between cognitive ability and charitable giving arises due to more intelligent individuals being more financially literate (Lussardi and Mitchell 2014) and more familiar with the tax code and potential deductions (Chetty and Saez 2013).[13] Charitable giving is defined as a binary variable taking the value one if the individual has made at least one gift amounting to SEK 200, or more during the years 2012–2015 and otherwise zero. In Appendix C and Appendix D, we provide results for several alternative definitions of charitable giving, such as donated amount and giving to specific organizations.

Data on voting is obtained from electoral rolls for the Swedish election to the European Parliament in 2009, with an overall turnout of 45.5 percent. The election rolls have been digitized and made available to us by political scientists at Uppsala University. Extensive quality checks show that the resulting data on voter turnout are of very high quality and they have been used in, for example Lindgren, Oskarsson, and Persson (2018), who study the

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remaining 53 percent come from bequests, donations from organizations, as well as small and anonymous gifts from individuals.

[12] The tax reduction was 25 percent of the gift amount and could amount to a maximum of SEK 1,500 per year, corresponding to a total annual gift amount of SEK 6,000.

[13] One potential concern with the data on charitable giving is that people's decision to donate could be driven by extrinsic (monetary) incentives associated with the tax reduction rather than by prosocial motives. There are two reasons why this appears to be of little importance. First, statistics from the umbrella organization for charities in Sweden reveal no clear surge in donations following the introduction of the tax reduction in 2012 (Swedish Fundraising Association 2021). Second, if monetary incentives serve as key drivers for the charitable gifts, we would expect to see bunching at the threshold for the tax reduction of SEK 2,000. Comfortingly, however, there is no clear excess mass at the threshold value, as can be seen in Figure S1 in Appendix C. The clear spikes are at SEK 200, which indicates one eligible gift, at SEK 1,000, indicating bunching at even amounts, and at SEK 2,400, which is likely to capture repeated monthly donations of SEK 200.

impact of education on voter turnout. We define voting as a binary variable taking the value one if the individual voted in the election and otherwise zero. Voting data are available for a slightly smaller sample than the data on charitable giving and having an eco-friendly car.[14] In Appendix C and Appendix D, we also provide results for voting in several other elections.

Data on eco-friendly cars are retrieved from the Swedish Vehicle Register, a population-wide register containing detailed information on all cars registered in Sweden, which enables us to link cars to their owners. A car is considered eco-friendly if its primary or secondary fuel is ethanol, natural gas, biodiesel, or electricity. We define possession of an eco-friendly car as a binary variable taking the value one if anyone in the individual's household owned an eco-friendly car in any year during the period 2007–2015, and zero otherwise. In Appendix C and Appendix D, we provide results for several alternative definitions of possession and ownership of eco-friendly cars.

From the Military Archive, we also collect a measure for personal aptitude for military service, henceforth denoted *personality*, measured at enlistment through a psychological assessment of the enlistee's emotional stability, sociality, persistence, and willingness to assume responsibility and take initiative.[15]

Moreover, we have collected data on mediators (education, income, marriage, presence of children) from the Income and Tax Register, the Education Register and the Multi-Generation Register, described in more detail in Section IV.B.

Finally, we complement the analyses with survey data on prosocial preferences, described in more detail in section III.C.

Further details on the data and how to access the data are provided in Appendix A and Appendix B.

[14] The voting population is restricted to individuals born 1960 or later, in total 856,795 individuals.

[15] The measure is commonly referred to as non-cognitive ability in the economics literature and it has been used previously in research relating it to labor market and educational outcomes, see, for instance, Lindqvist and Vestman (2011), Lundborg, Nystedt, and Roth (2014), Carlsson et al. (2015), Grönqvist, Öckert, and Vlachos (2017), Grönqvist, Nilsson, and Robbling (2020), Edin et al. (2021), and health, see, for instance, Öhman (2015).

III. Evidence from population registers

A. *The relationship between cognitive ability and prosocial behaviors*

In Figure 1, we characterize the relationship between cognitive ability and prosocial behaviors by displaying the categorical averages of the outcomes per stanine score. We also report estimates of the gradients obtained from a bivariate regression model: $y_i = \alpha + \beta C_i + \varepsilon_i$, where y_i is the outcome (charitable giving, voting, or having eco-friendly car) of individual i. C_i refers to cognitive ability (mean=0 and variance=1), and ε_i is an error term. Statistical significance and p-values are calculated using robust standard errors.

Panel A shows that the incidence of giving increases monotonically over the full range of cognitive ability scores. Men with a top score of 9 are more than five times as likely to make a charitable donation as men with the lowest score of 1 and more than twice as likely as men with the average score of 5. An estimate of the gradient (β), implies that a one standard deviation increase in cognitive ability is associated with a 7.1 percentage point or a 41 percent relative increase in the probability of giving to charity ($p<0.001$).

Panel B shows that men with higher cognitive ability scores are on average more likely to have voted and that the share of men who voted increases monotonically over the full range of cognitive ability scores. Men with a top score were more than three times as likely to vote as men with the lowest scores and 70 percent more likely to vote as men with an average score. The gradient estimate (β) implies that a one standard deviation increase in cognitive ability is associated with a 12.8 percentage point or a 30 percent relative increase in the probability of voting ($p<0.001$).

Panel C shows that the share having an eco-friendly car increases monotonically over the full range of cognitive ability scores. The share with an eco-friendly car among men with the lowest cognitive ability score is 8 percent. Men with a top score were almost twice as likely to have an eco-friendly car as men with the lowest scores and 30 percent more likely than men with an average score. The gradient estimate (β) implies that a one standard deviation increase in cognitive ability is associated with a 1.7 percentage point or a 14 percent relative increase in the probability of having an eco-friendly car ($p<0.001$).

We find similar positive associations also with regard to several alternative ways of defining charitable giving, voting, and having an eco-friendly car, see Appendix C (figures S2–S16), and Appendix D (tables S2–S4).

We also analyze the relationship between intelligence and the prosocial behaviors among women who have enlisted. It should be noted that the sample of women is considerably smaller than that of men, resulting in lower statistical power. It should also be noted that enlistment was voluntary for women, resulting in a selected sample of women. With these caveats in mind, we find positive relationships for women as well, see Figure 2. The incidence of giving increases monotonically over the full range of cognitive ability scores. Women with a top score are five times as likely to make a charitable donation as women with the lowest score and nearly twice as likely as women with the average score. The gradient estimate (β) implies that a one standard deviation increase in cognitive ability is associated with a 6.8 percentage point or a 22 percent relative increase in the probability of donating to charity ($p<0.001$). Women with higher cognitive ability scores are on average also more likely to have voted, and the share of women who voted increases monotonically over the full range of cognitive ability scores. Women with a top score were more than twice as likely to vote as women with the lowest scores and 50 percent more likely to vote than women with an average score. The gradient estimate (β) implies that a one standard deviation increase in cognitive ability is associated with an 8.9 percentage point or a 16 percent relative increase in the probability of voting ($p<0.001$). However, we find no clear indications of a positive relationship between cognitive ability and having an eco-friendly car for women. Taken at face value, the gradient estimate implies that a one standard deviation increase in cognitive ability is associated with a 0.9 percentage point or a 6 percent relative increase in the probability of having an eco-friendly car. However, this estimate is not statistically different from zero ($p=0.126$). Taken together, the results are largely consistent with the results for men, suggesting that the relationship between intelligence and prosocial behavior is similar for both men and women.

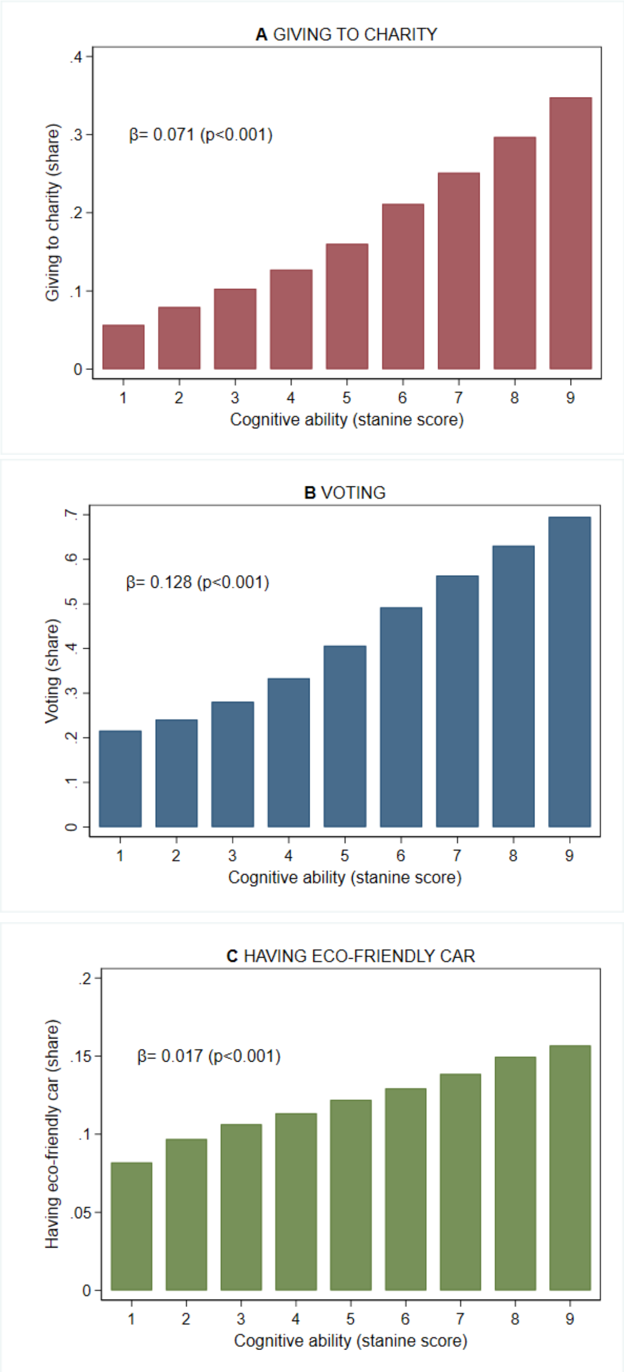

Fig. 1. The relationship between cognitive ability and prosocial behaviors for men (A–C). Panels A and C are based on data on 1,265,135 men and B on 856,795 men. The bars display the categorical averages of the outcome per cognitive ability score. The β-coefficients, displayed in top left corners, are estimates from a linear bivariate regression model: $y_i = \alpha + \beta C_i + \varepsilon_i$, where y_i is the outcome (charitable giving, voting, or having eco-friendly car) of individual i. C_i refers to cognitive ability, standardized by enlistment year to have a mean of zero and unit variance, ε_i is an error term, and p-values are calculated using robust standard errors. See Appendix A for detailed descriptions of the samples and variables. Column 1 in tables S2–S4 in Appendix D provides detailed regression results.

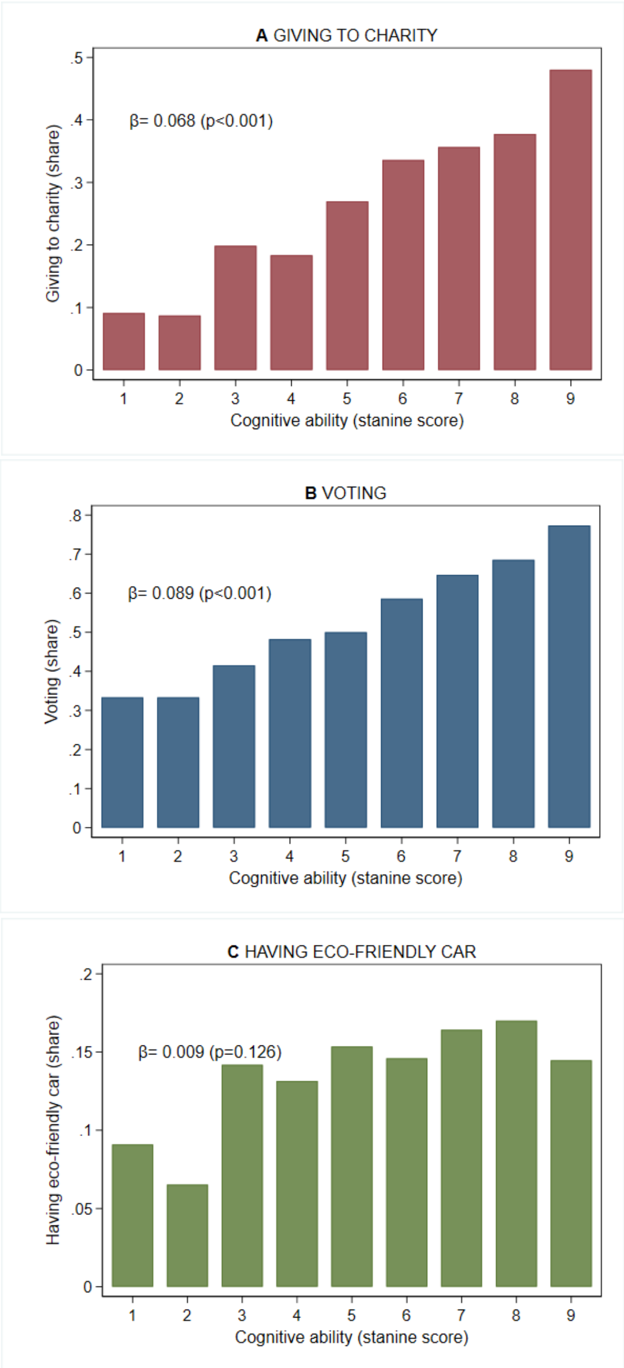

Fig. 2. The relationship between cognitive ability and prosocial behaviors for women (A–C). Panels A and C are based on data on 3,223 women and B on 3,135 women. The bars display the categorical averages of the outcome per cognitive ability score. The β-coefficients, displayed in top left corners, are estimates from a linear bivariate regression model: $y_i = \alpha + \beta C_i + \varepsilon_i$, where y_i is the outcome (charitable giving, voting, or having eco-friendly car) of individual *i*. C_i refers to cognitive ability, standardized by enlistment year to have a mean of zero and unit variance, ε_i is an error term, and p-values are calculated using robust standard errors. See Appendix A for detailed descriptions of the samples and variables. Table S5 in Appendix D provides detailed regression results.

B. *Dimensions of intelligence*

Cognitive ability is assessed through four subtests concerning logical ability, verbal ability, spatial ability, and technical comprehension.[16] Inspired by a hierarchical g-factor model (Carroll 1993), each subtest measures a specific dimension of intelligence more reliably than the other subtests (Mårdberg and Carlstedt 1998). The logical ability test has the highest g-loading and is considered the best measure of general intelligence. The verbal test has a high loading on crystallized intelligence (Gc), the spatial ability has a high loading on spatial intelligence (Gv), and the technical comprehension test has modest loadings on both crystallized and spatial intelligence. All four tests have significant g-loading (Gustafsson 1984) but decrease in the order mentioned (Mårdberg and Carlstedt 1998). The result of each subtest is summarized on a stanine scale. Figure 3, panels A–C, shows that test scores on all subtests are positively related to all three prosocial behaviors. It also shows that all three prosocial behaviors are more strongly associated with scores on the logical and verbal tests than scores on the other two tests.

[16] Details on the subtests are provided in Appendix A.

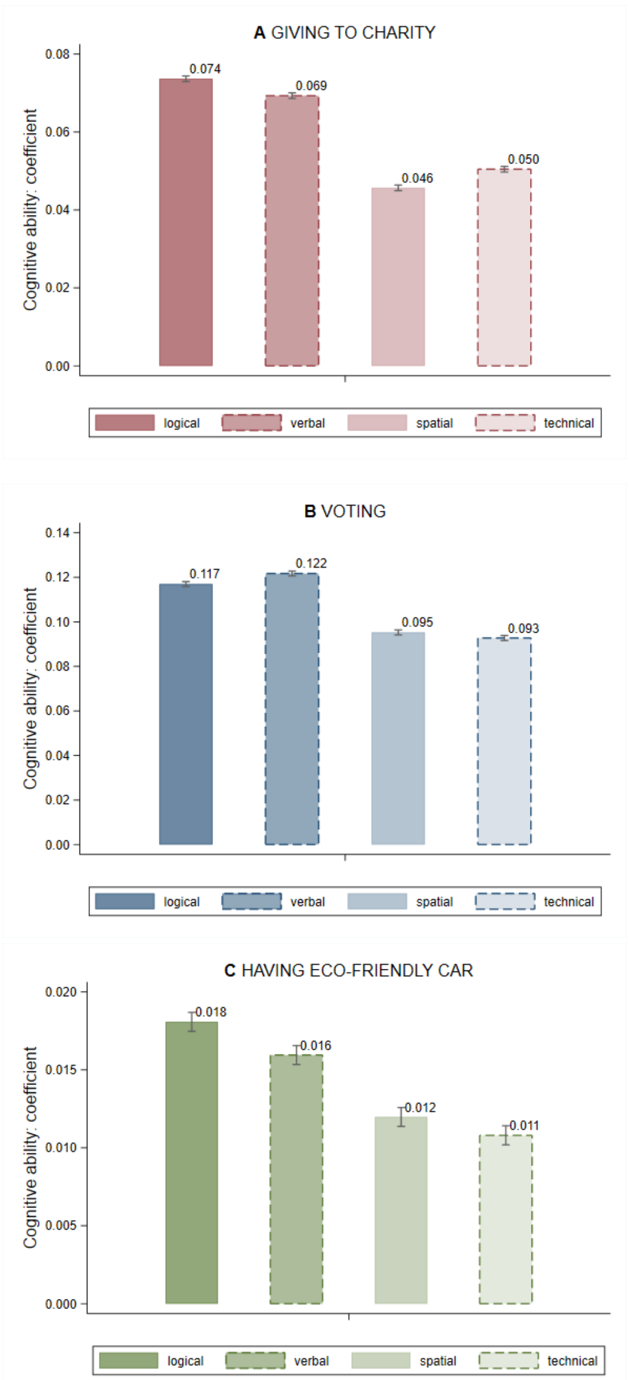

Fig. 3. The relationship between different dimensions of cognitive ability and prosocial behaviors (A–C). Panels A and C are based on data on 1,096,691 men and B on 689,697 men, for whom there is data available on all four separate subtests of cognitive ability. The coefficient estimates and the accompanying 95 percent confidence intervals are obtained from a linear bivariate regression model: $y_i = \alpha + \beta C_i + \varepsilon_i$, where y_i is the outcome (charitable giving, voting, or having eco-friendly car) of individual i. C_i refers to cognitive ability, standardized by enlistment year to have a mean of zero and unit variance, ε_i is an error term, and confidence intervals are calculated using robust standard errors. See Appendix A for detailed descriptions of the samples and variables. Tables S6–S8 in Appendix D provide detailed regression results.

C. *Altruistic preferences*

Despite having analyzed three different prosocial behaviors, these behaviors are limited in scope and do not tell us whether more intelligent individuals generally behave more prosocial. We have therefore matched survey responses on self-reported altruism (scale 0–10), as in (Falk et al. 2018), for a subsample of men (n=581) who participated in the military enlistment. See Elinder et al. (2020) and Appendix A for details about the survey.[17]

Figure 4 shows that the degree of altruism increases over the range of cognitive ability scores. A regression estimate of the relationship indicate that a one standard deviation increase in cognitive ability is associated with a 0.15 standard deviation increase in altruism (p<0.001). We interpret this result as consistent with the interpretation that more intelligent individuals are more altruistic and therefore likely to generally behave more prosocial.

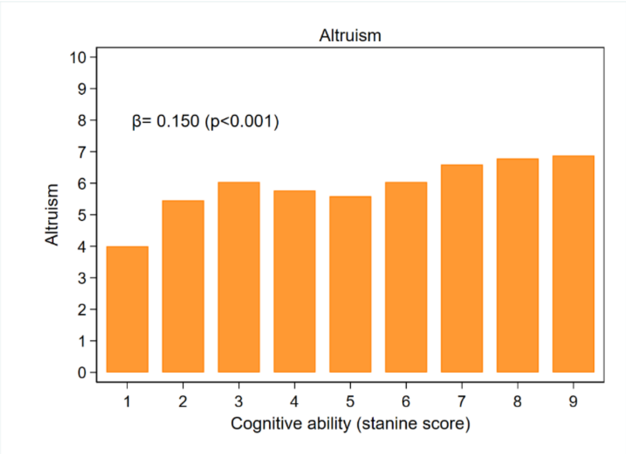

Fig 4. The relationship between cognitive ability and altruistic preferences. The figure is based on data on 581 men. The bars display the categorical averages of the outcome per cognitive ability score. The β-coefficients, displayed in top left corner, are estimates from a linear bivariate regression model: $y_i = \alpha + \beta C_i + \gamma \boldsymbol{Z}_i + \varepsilon_i$, where y_i is altruism (mean=0 and variance=1) of individual i. C_i refers to cognitive ability (mean=0 and variance=1), $\boldsymbol{Z}_i$ is vector of control variables (age, age^2), as in Falk et al. (2018), ε_i is an error term. p-values are calculated using robust standard errors. See main text and Appendix A for details about variables and sample.

[17] Unfortunately, according to the agreement with the survey respondents, we are not allowed to link the survey data to the administrative data on prosocial behaviors and investigate any associations between preferences and behaviors.

D. *Conclusion*

The results above show that cognitive ability, and especially general intelligence, is positively associated with three prosocial behaviors: charitable giving, voting and possession of eco-friendly car. This is consistent with the theoretical arguments pointing to a direct link between general intelligence and prosocial behavior (Singer 1981, Herrnstein and Murray 1994, Bryan, Jeon-Slaughter, and Kang 2003, Millet and Dewitte 2007, Grueneisen and Warneken 2022) as well as with several previous empirical studies using survey data. The magnitudes of the associations in our study are also on par with those in many of the previous studies. For example, our finding that one standard deviation increase in intelligence is associated with a 30 percent increase in voting is very similar to the 38 percent increase found by Deary, Batty, and Gale (2008). Moreover, Wiepking and Maas (2009) find that one standard deviation increase in verbal proficiency is associated with 18 percent higher donated amount. We find that a standard deviation increase is associated with 41 percent increased likelihood of giving to charity. Our finding that intelligence is positively associated with altruism is also in line with the finding in Falk et al (2018). The discrepancy in magnitude of the estimates (0.15 vs. 0.04) may partly be due to the fact that measure of self-reported math ability used in Falk et al. (2018) is a proxy for intelligence.[18]

IV. Evidence from twins

The results in the previous section show that there are strong positive associations between cognitive ability and several prosocial behaviors. However, there are many reasons why these relationships may not be causal. A key concern is that intelligence is correlated with other factors, which, in turn, are correlated with prosocial behavior.

For example, more intelligent individuals are likely to be raised in families with more intelligent parents (Björklund et al. 2010, Grönqvist et al. 2017) who may transmit prosocial values, both genetically (Cesarini et al. 2009) and through their behaviors and expectations

[18] The survey we use includes the math question in Falk et al. (2018), which asks the respondent to rate his/her math skills on an 11-point Likert scale. The correlation between cognitive ability and math ability is 0.40. This may explain why we find that the positive association between self-reported math ability and altruism is somewhat weaker ($\beta=0.11$, $p<0.01$) than the association between cognitive ability and altruism.

(Wilhelm et al. 2008, Bekkers 2006). This argument is not only valid at the family level, but partly also at peer, school and the neighborhood levels.[19]

More intelligent individuals are also more likely to have grown up in privileged families and neighborhoods (Chetty et al. 2014), and may therefore have been less exposed to environmental risks (Banzhaf et al. 2019) which are detrimental to cognitive development, such as lead (Grönqvist, Nilsson, and Robling 2020), air pollution (Simeonova et al. 2019), or in utero alcohol exposure (Nilsson 2017). If any of these or other environmental factors affect both cognitive development and prosocial behavior, then the estimated positive association between cognitive ability and prosocial behavior may be spurious.

Our strategy to control for confounding factors due to unobserved genetic, family and environmental background endowments is to exploit variation in cognitive ability within twin pairs. Twin-based approaches have been used extensively in economics and other fields for similar purposes (Behrman 2016). Since twins experience a similar in utero environment and are typically raised by the same parents, go to the same school, and are influenced by the same peer groups when growing up, the approach effectively accounts for family and environmental confounders. It also partially accounts for confounders due to genetics. Any variation that remains thus stem from variation in non-shared environment and non-shared genetics.

Yet, it remains possible that the association may be confounded by personality traits other than cognitive ability, which are correlated with both cognitive ability and prosocial behavior. While the Big Five personality traits have been found to be uncorrelated, or only exhibit a weak correlation, with intelligence (Matthews, Deary, and Whiteman 2009), empathy has been shown to be related to both intelligence and prosocial behavior (Guo et al. 2019).[20] Likewise the cognitive ability measure in our data is positively correlated with the scores on the personality test (described in Section II), which in turn is correlated with three prosocial behaviors. We therefore control for the personality measure in the regression models.

There are in total 5,890 pairs of male twins in the enlistment data and Table S1 in Appendix D shows that the twins are very similar to the population at large in terms of observable characteristics and, importantly, in cognitive ability and prosocial behaviors. In Figure 5, we

[19] See, for example, Bobonis and Finan (2009) and Bayer et al. (2009) for studies on the importance of neighborhood and peer effects for educational outcomes and crime.

[20] The Pearson correlation coefficient between cognitive ability and personality is 0.38.

display the variation in cognitive ability that is used in the analysis, calculated as the difference between the maximum and minimum stanine score within the twin-pair. It can be seen that, for 70 percent of the twin-pairs there is difference of one or more stanine points and for 30 percent the difference exceeds one standard deviation (two stanine points).

The regression model takes the following form:

$$y_{i,j} = \alpha + \beta C_{i,j} + \gamma P_{i,j} + \delta_j + \varepsilon_{i,j} \quad (1)$$

Where y_i is the outcome (charitable giving, voting, or having eco-friendly car) of individual i of twin-pair j and $C_{i,j}$ refers to cognitive ability (standardized by enlistment year to have a mean of zero and unit variance) and $P_{i,j}$ refers to personality (also standardized by enlistment year to have a mean of zero and unit variance). The δ_j is a twin-pair fixed effect which captures characteristics common to twins of the same pair, and identification of the cognitive ability coefficient, β, relies upon twin variation in cognitive ability and it will not be biased due to any confounding influence from unobserved family level factors that are also associated with prosocial behaviors.[21] We cluster the standard errors at twin-pair level to correct for interdependence within the twin-pair.

[21] One concern with the measures of cognitive ability and personality is that they are measured with some form of error. The individual may for example have had a “bad day” at the enlistment day. The test scores may therefore not capture the individual’s true ability. This would then lead the estimates of the relationship between cognitive ability and prosocial behaviors to be biased (Wooldridge 2006), and more so in the models relying on within-family variation (Griliches 1979). A similar concern applies to the personality measure. The fact that we standardize the variables partly mitigates this issue. Another approach is to correct for measurement errors using reliability ratios. In Appendix D, tables S12-S14, we reproduce the main results using reliability ratios for the cognitive ability and personality measures. The reliability ratios are obtained from Lindqvist and Vestman (2011). It can be seen that the measurement error corrected results are nearly identical to the main results in terms of magnitude and statistical significance.

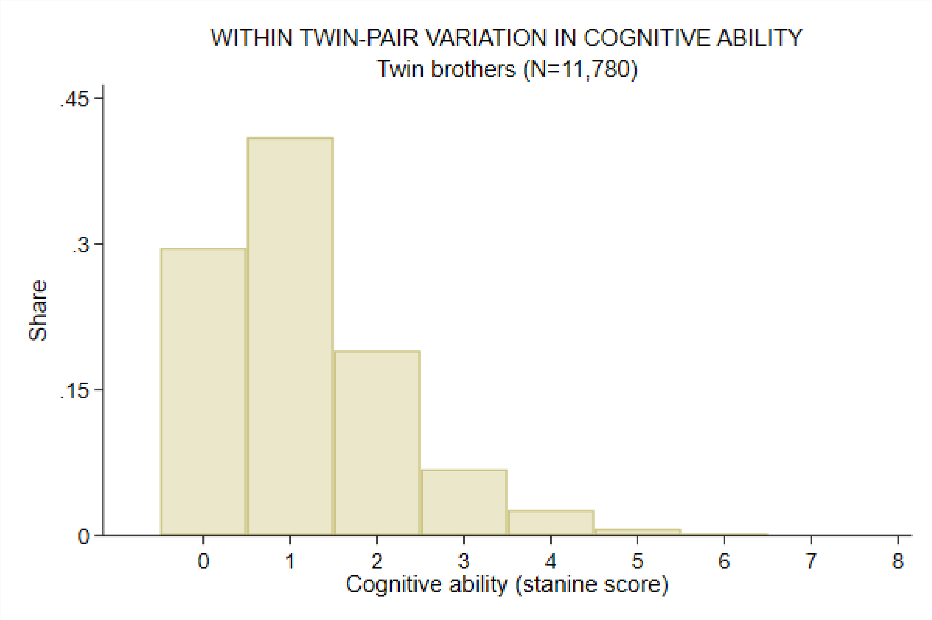

Fig. 5. The distribution of within twin-pair differences in cognitive ability

The figure is based on data on 5,890 twin-pairs (11,780 twins). The within twin-pair difference is calculated as the difference between the maximum and minimum value of cognitive ability within the twin-pair. See main text and Appendix A for details about variables and sample.

A. *Twin estimates*

The left-hand bars of panels A–C in Figure 6 show that the gradients for twins are nearly identical to the gradients in the population (0.076 vs. 0.071; 0.129 vs 0.128; 0.022 vs 0.017). The middle bars show the β estimates from regressions with twin-pair fixed effects and the control for personality (see model 1 above). The strength of the relationship between cognitive ability and charitable giving, as well as that between cognitive ability and voting, decreases substantially but remains positive and statistically significant ($p<0.01$ and $p<0.01$) when accounting for confounding factors. A one standard deviation increase in cognitive ability is associated with a 4.7 percentage point increase in charitable giving and a 4.8 percentage point increase in voting. The strength of the association between cognitive ability and having an eco-friendly car is not significantly altered, but the confidence intervals reveal a positive association which is only barely statistically significant ($p=0.036$). Taken together, the twin estimates show that the positive associations between intelligence and all three prosocial behaviors remain after controlling for a wide range of potentially confounding factors. We interpret these estimates as evidence that the unconditional correlations are substantially biased, but they also strengthen the case for a real and profound relationship between intelligence and prosocial behaviors.

It is worth commenting on role played by personality. Tables S9-S11, in Appendix D, show that the personality measure is uncorrelated with the all three prosocial outcomes, conditional on cognitive ability and twin-pair fixed effects. This is noteworthy given that several studies investigating other types of outcomes such as schooling, earnings, and health have found that this personality measure is a stronger predictor than cognitive ability.[22]

However, it should be noted that our findings do not rule out that other personality traits are important determinants for prosocial behavior. In particular, it would be interesting to assess to what degree specific personality traits such as emotional intelligence, empathy, and theory of mind are linked to prosocial behavior (Wiepking and Maas 2009, Klimecki et al. 2016). Unfortunately, such data are not readily available in Swedish registers or surveys.

[22] Previous studies also indicate that specific personality traits such as agreeableness, emotional stability, self-esteem, etc. play an important role in relation to prosocial acts in general (e.g., Ben-Ner et al. 2004, Klimecki et al. 2016) as well as for deciding to donate to charity (e.g., Wiepking and Maas 2009).

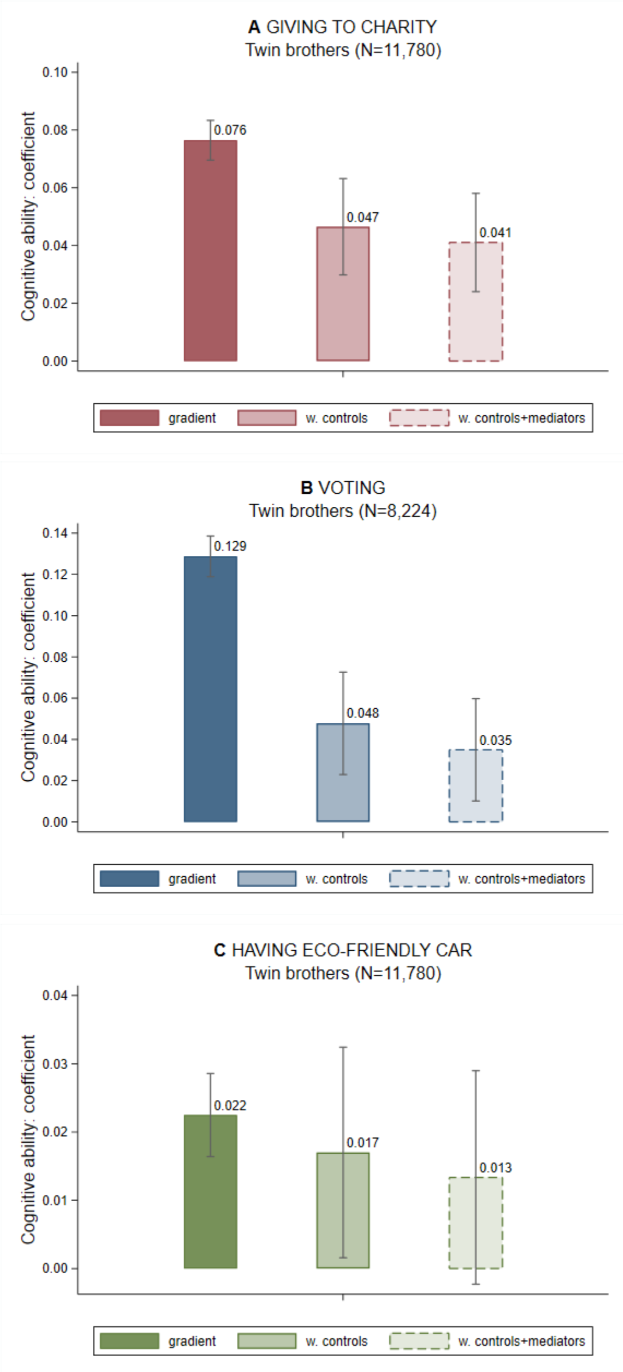

Fig. 6. The role of confounders and mediators for the relationship between cognitive ability and prosocial behavior (A–C). Panels A and C are based on data on 11,870 male twins and B on 8,224 male twins. The left-hand bars display regression estimates of cognitive ability and accompanying 95 percent confidence intervals from the model: $y_i = \alpha + \beta C_i + \varepsilon_i$, the middle bar from the model: $y_{i,j} = \alpha + \beta C_{i,j} + \gamma P_{i,j} + \delta_j + \varepsilon_{i,j}$ 2, and the right-hand bars from the model $y_{i,j} = \alpha + \beta C_{i,j} + \gamma P_{i,j} + \theta \boldsymbol{X}_{i,j} + \delta_j + \varepsilon_{i,j}$, where y is the outcome (charitable giving, voting, or having eco-friendly car), C is cognitive ability (mean=0 and variance=0), P is personality (mean=0 and variance=0), δ is a twin-pair fixed effect, $\boldsymbol{X}$ a vector of mediators (education, income, married, parent) and ε is an error term. i and j refer to individual and twin-pair respectively. Confidence intervals are calculated using standard errors clustered at the twin-pair level. See Appendix A for detailed description of the samples and variables. Tables S9–S11 in Appendix D provide detailed regression results.

B. *Mechanisms – mediators and mitigators*

An effect of higher intelligence on prosocial behaviors may be explained by various mediating or mitigating mechanisms. For instance, more intelligent young individuals are more likely to proceed with university studies, earn more (Lindqvist and Vestman 2011), find a partner (Aspara, Wittkowski, and Luo 2018), and have fewer children (Meisenberg 2010). Each of these factors may also promote prosocial behavior (Bekkers and Wiepking 2012). For instance, individuals with higher cognitive ability are more likely to both succeed in and gain from education (Edin et al. 2021). Education may, in turn, transmit social norms and foster moral reasoning as well as increase awareness of the needs and well-being of others (Wiepking and Bekkers 2012). Cognitive ability is also rewarded in the labor market and positively associated with income (Lindqvist and Westman 2011). Higher income, in turn, reduces the opportunity cost of giving to charity (Meer and Priday 2020). Income has also been shown to be positively related to voting (Wolfinger and Rosenstone 1980). Moreover, individuals with lower cognitive ability have been shown to be less successful in the marriage market (Heckman, Stixrud, and Urzua 2006), and there is a tendency to mate with partners with similar cognitive ability (Eika, Mogstad, and Zafar 2019). Similarly, men with higher cognitive ability are more likely to be parents (Heckman, Stixrud and Urzua 2006), and being a parent might turn focus more toward the family rather than toward others, thus mitigating prosocial behavior (Elinder, Engström, and Erixson 2021).

The right-hand bars in panels A–C in Figure 6 show coefficient estimates of the association between cognitive ability and the three prosocial behaviors, after controlling for years of education, annual disposable income, being married, and having children (as well as twin-pair fixed effects and personality).[23] In all cases, the coefficient estimates are only marginally affected but the coefficient estimate with respect to possession of an eco-friendly car is now

[23] *Education* is measured as the number of years of completed education in 2015, as reported in the Education Register. *Income* is measured as the average of the sum of annual pre-tax labor and capital incomes, reported in the Income and Tax Register, over the same period as the prosocial behavior is measured. In the estimation of charitable giving, income is averaged over the years 2012–2015, for voting in 2009, and for eco-friendly cars 2007–2015. *Married* is an indicator variable for being married, as reported in the Income and Tax Register, in any of the years for which the prosocial behavior is measured. *Parent* is an indicator variable for being a parent to (a living) child, as reported in the Multi-Generation Register, in any of the years for which the prosocial behavior is measured.

statistically significant at the ten percent level. These results thus indicate that there is an important and strong direct link between intelligence and prosocial behavior.

C. *Conclusion*

The twin-estimates suggest that the positive association between cognitive ability and prosocial behavior is unlikely to be a direct consequence of unobserved confounding factors only. Yet, such factors appear to explain almost half of the cross-sectional relationship. This should be kept in mind when interpreting the results from studies that do not properly account for such confounders. It should, however, be noted that some unobserved factors correlated with both intelligence and prosocial behavior may remain unaccounted for in our empirical strategy. Estimating an unbiased causal effect of intelligence on any outcome provides challenges, which, to our knowledge, no one has yet provided a feasible solution. We are, nevertheless confident, that our twin estimates provide a substantial advancement in this direction. Moreover, we find little evidence of the economic and family variables have a substantial impact on the estimated relationships, suggesting that there may indeed be a strong, direct link between intelligence and prosocial behaviors.

V. Discussion

Our results offer several new insights on the relationship between intelligence and prosocial behavior. First, strong links between cognitive ability and all three measures of prosocial behavior are found in a sample covering essentially the entire population of Swedish men born between 1951 and 1979. Similar links are also found for the smaller sample of women. The three different measures of prosocial behavior complement each other, such that charitable giving concerns monetary donations and is similar in kind to giving in dictator games, whereas voting and choosing an eco-friendly car are akin to cooperation in social dilemmas such as public goods games. While buying an eco-friendly car requires the sacrifice of monetary resources, voting incurs a time cost. Moreover, we also find that the positive associations between cognitive ability and prosocial behaviors are mirrored in altruistic preferences. Despite our aim to capture a variety of prosocial behavior, prosociality can take many different forms. It is possible that less intelligent individuals may be equally or more prosocial in other ways (e.g., volunteering). However, several studies have found that less intelligent individuals are more likely to engage in anti-social behavior, such as committing crimes (see for example Heckman, Stixrud, and Urzua 2006, Frisell, Pawitan, and Långström 2012).

The positive relationship between cognitive ability and prosocial behavior prevails even after controlling for common family and environmental background and shared genes, thus suggesting a deeper link between intelligence and prosocial behavior. While our results indicate that general intelligence is the cognitive function that best explains prosocial behavior, a key challenge for future research is to improve the understanding of the relative importance of other closely related cognitive functions, such as empathy and theory of mind for prosocial behavior (Singer and Fehr 2005), as well as their potential interactions with intelligence.

The results presented herein also provide input to theories on the development of human cooperation and the success of our species (Henrich 2018). The cultural brain hypothesis (CBH) states that human cooperation and cognitive ability are transmitted and selected for, from generation to generation, through cultural selection (Henrich 2018). The CBH can explain the increase in human brain size over time (Mutukrishna and Henrich 2016) and is also consistent with the increased levels of IQ observed in many countries over the last century (Flynn 1984, 1987). If intelligent individuals contribute more to solving social dilemmas, as our results suggest, then an important self-reinforcing mechanism should be added to theories on the coevolution of human cooperation and cognitive ability.

If the results presented here generalize to other domains of prosocial behavior, we will be in a better position to understand several important challenges facing humanity, such as why individuals differ in terms of their attitudes toward vaccination during a pandemic (Batty et al. 2021) or why individuals differ in their attitudes toward taking costly actions to reduce greenhouse gas emissions. Early adopters of such prosocial behaviors would then have better cognitive abilities, and to increase the number of followers, extrinsic rewards or nudges may be more effective than moral arguments (Campos-Mercade et al. 2021).

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