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Parents' Education and Children's Achievement: The Role of Personality

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Abstract

The reasons for the positive association between families' background variables, such as parents' education, and children's academic achievement have not fully been clarified yet. The present study investigates children's intelligence and personality as potential mediators. A sample of 580 German high school students (mean age: $M = 17.0$; $SD = 0.7$) indicated the highest education of their parents and completed measures assessing their own personality and intelligence. Children's academic achievement was operationalized by grade point average. Children's intelligence, openness to experience and, marginally, conscientiousness partially mediated the association between parents' education and children's academic achievement. Even after controlling for children's intelligence, the mediating effects of those personality traits held. Results are discussed with regard to potential underlying processes. Copyright © 2010 John Wiley & Sons, Ltd.

Key words: parents' education; academic achievement; intelligence; personality; mediation analysis

PARENTS' EDUCATION AND CHILDREN'S ACADEMIC ACHIEVEMENT: THE ROLE OF PERSONALITY

International large scale scholastic achievement assessments, such as PISA or TIMSS, show that in many countries children's academic attainment is strongly associated with their families' social background. This is the case in many OECD-countries but especially pronounced in Germany (Organisation of Economic Co-Operation and Development OECD, 2007). In the PISA 2006 study the relationship between student's performance in science/math/reading competencies and the PISA index of their families' socioeconomic status (SES) was $r = .38/.38/.35$ for the OECD average and $r = .44/.44/.40$ for Germany (OECD, 2007, pp. 127/129/131). So far little is known about the processes leading to the association between children's social background and their scholastic achievement. It is plausible to hypothesize that the association between family background and children's

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school achievement is mediated by children's characteristics that both are related to social background variables and lead to higher academic attainment. This assumption has been investigated with regard to children's intelligence (e.g. Johnson, McGue, & Iacono, 2007) but not for personality.

Personality has been identified as another important student characteristic associated with academic achievement (*cf.* Poropat, 2009). Furthermore, children's personality is also associated with family background characteristics (e.g. Roskam, Vandenplas-Holper, & De Maere-Gaudissart, 2001). Therefore, personality might be another variable that mediates the relationship between family background variables and children's scholastic achievement. The present study is the first one testing whether students' personalities contribute to the explanation of the association between families' background characteristics and school attainment beyond intelligence.

Relationship between parents' education and children's academic achievement

There is a wide variety of family background variables that have been studied with regard to their association with children's academic achievement. Children's social background has often been referred to as SES. Most frequently SES has been indicated by parents' occupation, education or income (Bradley & Corwyn, 2002). The relationship between these variables and children's academic achievement is about $r = .30$. Sirin (2005) found no differences between the association of parents' occupation, education or income with children's academic performance.

Consequently, the three main indicators of social background seem to be equivalent concerning their association with academic achievement. However, according to Bourdieu (1986) parents' education is suggested to be of special importance for the academic success of their children. This is explained by a long-lasting transformation process of parents' cultural capital into their children's academic attainment. This thought is adapted in the model proposed by Laosa (1982). He put forward that schooling has a long lasting effect on a person's behavioural dispositions, e.g. how a person acts as a parent. Thus, parental education is of special importance for parent–child interaction and, thus, in turn for the development of children's personality. This view is supported by studies that show that parents' education and not their occupation is associated with children's personality or learning strategies (e.g. Laosa, 1978). However, beyond the mechanisms proposed by Bourdieu (1986) and Laosa (1978) the reasons for the relationship between parents' education and children's scholastic attainment might be more straightforward and independent from children's and parents' characteristics: For example, better-educated parents could have higher demands of academic effort from their children, and these children, in turn, put more effort in their school-work.

In the present study we investigate children's personality as a mediator variable between children's social background and their scholastic attainment. According to the model of Laosa (1978), the chances are especially high to find an association between parents' education, as an indicator of social background and children's personality. Thus, in the present study we concentrate on parents' education (the highest academic track they have completed) as an indicator of social background. However, it has to be noted that other parental characteristics and attitudes are also important for children's academic success (*cf.* Eccles et al., 1983). For example, Sirin (2005) demonstrated that children's ethnic background functions as a moderator variable concerning the relationship between SES and children's academic attainment.

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Intelligence as a mediator of the relationship between parents' education and academic achievement

According to Baron and Kenny (1986) a mediator must be causally related to the predictor and to the criterion. Different variables have been discussed as possible mediators of the association between families' social background and children's academic achievement (e.g. Marks, Cresswell, & Ainley, 2006). The variable most frequently investigated is intelligence.

Intelligence fulfils the prerequisites of being a mediator. Children's intelligence is positively associated with both parents' education (Strenze, 2007) and children's school achievement (*cf.* Gustafsson & Undheim, 1996; Kuncel, Hezlett & Ones, 2004; Schmidt & Hunter, 1998).

Parents' education might be interpreted as a proxy of parents' intelligence. The causal mechanisms explaining the association between parent's education and children's intelligence might be found in genes (more intelligent parents reach higher education and transmit their higher intelligence to their offspring genetically), the environment (more intelligent parents might provide a more intellectually stimulating environment to their children) or an interaction of both (more intelligent children better respond to the environment their more intelligent parents provide) (Bouchard & McGue, 1981; Plomin, 1997; Plomin, DeFries, & Loehlin, 1977). Parents' education might additionally influence their children's intelligence by mechanisms independent from parents' intelligence. Bourdieu (1986) claims that more educated parents provide their children with more social and cultural capital. These social and cultural experiences might foster children's intelligence even more.

A study by Watkins, Lei and Canivez (2007) supported the view that intelligence causes academic achievement. The authors demonstrated in a cross-lagged panel analysis that intelligence influenced academic achievement but not *vice versa*.

Studies investigating the mediating role of intelligence in the association between children's social background and academic achievement usually report a reduction in correlation coefficients but not up to a trivial level (e.g. Baumert, Watermann, & Schümer, 2003; Hecht, Burgess, Torgesen, Wagner, & Rashotte, 2000; Johnson et al., 2007; Kemp, 1955; Lloyd & Barenblatt, 1984). An exception is the study of Colom and Flores-Mendoza (2007). The authors reported very small correlations between social background variables and academic achievement in samples of seven to eleven year old children after controlling for intelligence. However, these results should be interpreted cautiously as the initial associations between families' background variables and scholastic achievement had been unusually weak in two groups ($r = .11$ and $r = .25$) and even close to zero in the third group ($r = .01$ for parental education and $r = .02$ for parents' income).

Taken together, these findings support the notion of intelligence being a mediator of the relationship between families' background variables and academic achievement. However, they also indicate that a complete mediation cannot be expected (see also Johnson et al., 2007; White, 1982) and that other variables must be considered.

Personality as a mediator of the association between parents' education and children's academic achievement

Another candidate variable that might function as a mediator between parents' education and children's academic achievement is children's personality. Though it has not been

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investigated in this context, personality fulfils the prerequisites for being a potential mediator of the association between parents' education and children's academic achievement.

Parental education and some personality traits of children are positively related (e.g. Gürsoy & Bicakci, 2007; Roskam et al., 2001; Scott, Scott, Boehnke, & Cheng, 1991). At the same time, certain personality traits of children and children's academic achievement are positively related (Poropat, 2009). In his meta-analysis on the Big Five personality traits, Poropat (2009) found agreeableness and openness to experience to have an average small positive relationship and conscientiousness a medium positive one with academic achievement.

As education and certain personality traits are correlated (Poropat, 2009), parents' education might not only serve as a proxy of their intelligence but also of their personality. If parents' education is considered as a proxy of their personality, different mechanisms are possible that might explain a causal relationship between parents' education and children's personality traits. Personality like intelligence might be genetically transmitted from parents to their offspring, influenced by the environment and caused by an interaction of both genes and the environment. Behaviour genetic studies provide evidence that genes and non-shared environment have a strong impact on individual differences in children's and adolescent's personality whereas shared family environment seems to have the weakest influence (e.g. Heiman, Stallings, Young, & Hewitt, 2004; Plomin, 1997). However, recent twin studies underpin the importance of gene-environment interaction and correlation for individual differences in personality traits and suggest that both genetic and environmental effects on personality are moderated by certain differences in the shared family environment (e.g. Krueger, South, Johnson, & Iacono, 2008).

Furthermore, effects of parents' education that are independent from parents' personality might shape children's personality. Here again, the mechanisms described by Bourdieu (1986) might apply. Additionally, Laosa (1982) claims, that parents' education influences how they interact with their children. In his model, he postulated direct effects of parents' schooling as well as indirect effects via family interaction patterns on their children's development of personality characteristics.

Concerning a causal relationship between certain personality traits and academic achievement, Caspi, Roberts and Shiner (2005, p. 474) argued that personality traits and achievement might be causally related when achievement criteria and personality constructs overlap, i.e. when a certain behaviour indexing a certain personality trait is also part of successful achievement. Some behaviours relevant to conscientiousness, such as exerting effort, are likely to be important for achieving high grades in school (Rothstein, Paunonen, Rush, & King, 1994), which suggests that the relationship could be causal.

Taken together, the above described findings provide evidence that children's personality might help to explain the association between parents' education and children's academic achievement. When investigating this relationship, it is important to control for children's intelligence. Johnson et al. (2007) found the variable 'parental expectations for educational attainment' to function as a mediator of the relationship between SES and children's academic achievement. This effect completely vanished when children's intelligence was introduced in the analysis. We do not expect a comparable effect in the present study, as several studies demonstrated that personality predicts scholastic achievement independently from intelligence (e.g. Steinmayr & Spinath, 2008).

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However, as personality and intelligence are slightly related the association between personality and academic achievement might be altered by intelligence (*cf*. Poropat, 2009).

Hypotheses

The present study aims at investigating the following hypotheses:

(1) Children's intelligence partially mediates the association between parents' education and children's academic achievement.
(2) Children's agreeableness, openness to experience and conscientiousness partially mediate the association between parents' education and children's academic achievement.
(3) The mediating effects of children's personality will still be present when controlling for children's intelligence.

METHOD

Sample

The sample consisted of 580 11th to 12th graders (355 female; mean age $M = 16.98$, $SD = .74$). All students attended a 'Gymnasium', the highest educational level in the German school system. Students were recruited from three different schools located in two mid-sized towns in two federal states of Germany. Six complete grades were tested at three schools. Participation was voluntary and we received signed consent forms from parents of underage students. About 98% of all students were willing to participate. At the day of testing some students were ill, which resulted in an overall participation rate of about 93%. Our sample can be considered typical of the population from this type of school (i.e. the majority is Caucasian from medium to high socio-economic status homes; more girls than boys attend this kind of school).

Measures

Parents' education
Students indicated on two items the highest educational degree their mothers and fathers attained. Alternatives reached from 'no school leaving certificate at all' (0) up to 'university degree' (5) (comparable to master degree). There was also a category 'other' (6) to allow participants to indicate graduations that had not been stated. If category 6 was marked answers were not included in the analyses which resulted in 18 missing cases concerning fathers' education and 20 cases not indicating mothers' education. Correlation between mothers' and fathers' educational level was $r = .44$.

Academic achievement
Academic achievement was measured by grade point average (GPA) as indicated by participants' last report cards. Report cards were provided by the schools or by the students themselves, who were asked to bring the report cards on the day of the testing. In Germany, grades range from 1 to 6 with 1 indicating the best and 6 the poorest achievement. To facilitate interpretation, all grades were reversed. The subjects German and Math were mandatory for all students and thus all students had grades in these subjects. Concerning foreign language, science and social science, students were allowed to choose courses

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within each category. Grades of the different courses within each category were summed up as indicators of academic achievement in these domains. This procedure resulted in five indicators of academic achievement. Cronbach's α coefficient of these 5 indicators of GPA was $\alpha = .78$.

Intelligence
Participants' intelligence was measured by the German Intelligence Structure Test 2000 R (I-S-T 2000 R; Amthauer, Brocke, Liepmann, & Beauducel, 2001). The test consists of a verbal, numeric and figural subtest. The composite score of all subtests measures general reasoning and was used as a proxy of general intelligence. Internal consistencies (Cronbach's α) were $\alpha = .81$ (verbal), $\alpha = .89$ (numeric), $\alpha = .82$ (figural) and $\alpha = .90$ (general reasoning), respectively.

Personality
Personality was assessed with the German version of the NEO–FFI (Borkenau & Ostendorf, 1993). The instrument comprises 60 items and measures the Big Five factors of personality (neuroticism [*N*], extraversion [*E*], openness to experience [*O*], agreeableness [*A*] and conscientiousness [*C*]) with 12 items indicating each scale. Answers were indicated on a five point rating scale ranging from total disagreement (1) to absolute agreement (5). Cronbach's α coefficients were $\alpha = .78$ (*N*), $\alpha = .84$ (*E*), $\alpha = .85$ (*O*), $\alpha = .73$ (*A*) and $\alpha = .76$ (*C*), respectively.

Procedure
Testing took place during a regular school day and was conducted by trained research assistants in classrooms with groups of about 20. First, students completed the information on their parents' education and some demographic data, then they completed the NEO–FFI and last the intelligence test was administered.

Analyses

Mediation analyses
As recommended by Baron and Kenny (1986), mediation analyses were conducted using structural equation modelling (SEM). In a first set of analyses, only one mediator at a time (general intelligence, *N*, *E*, *O*, *A* and *C*, respectively) was specified. In a second set of analyses, we checked whether mediational effects of personality still held after controlling for intelligence.

Model specification
Figure 1 shows the model specified to test general intelligence as a mediator of the relation between parents' education and academic achievement as an example of all models tested.

In all models, parents' education was indicated by fathers' and mothers' educational attainment. Academic achievement was indicated by participants' grades in German, Math, Foreign Language, Science and Social Science. Performance in both German and Foreign Language require verbal abilities, performance in both German and Social Science greatly depend on writing essays and both Math and Science require numerical and figural abilities. Because of the similar demands in these subjects, the models allowed for co-varying error terms between German and Social Science, German and Foreign Language, as well as between Math and Science. General intelligence was indicated by subscales in

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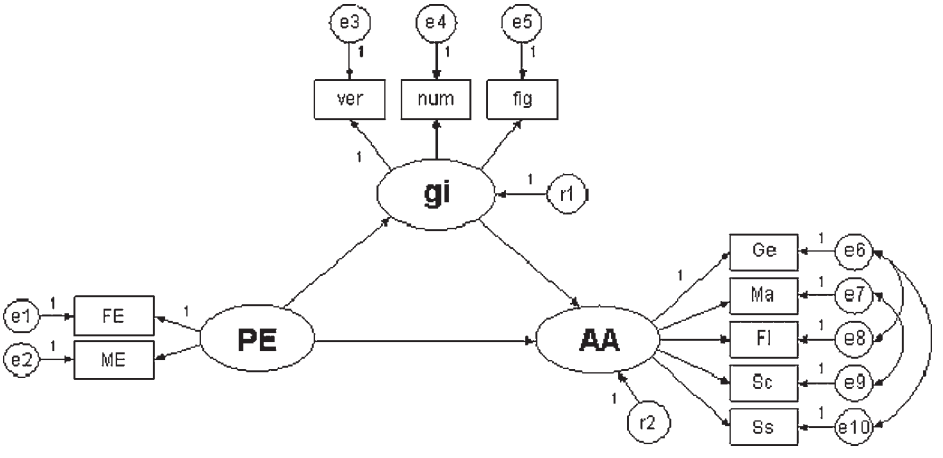

Figure 1. One example of the structural equation models specified to test general intelligence as a mediator of the relation between parents' education and academic achievement. Academic achievement (AA), indicated by grades in German (Ge), Math (Ma), Foreign Language (Fl), Science (Sc) and Social Science (Ss), is explained by parents' education (PE), indicated by fathers' and mothers' education (FE and ME, respectively) and general intelligence (gi) as the investigated mediator-variable, indicated by subscales in verbal (ver), numerical (num) and figural (fig) intelligence.

verbal, numeric and figural intelligence. The Big Five traits were indicated by three item-parcels of the respective scale. Item parcels were formed by summing up items 1–4, 5–8 and 9–12 of each scale.

Figure 2 shows, as an example of all other models, the openness to experience model specified to test this trait as a mediator of the relationship between parents' education and children's academic achievement controlling for children's general intelligence. The residuals of general intelligence and the respective trait were allowed to co-vary freely.

Estimation procedure and missing values

Analyses were conducted using the statistical software package Mplus (Muthén & Muthén, 1998–2007). Coefficients were estimated applying the full information maximum-likelihood estimator (FIML) with robust standard errors. This procedure allows accounting for cases with incomplete data.

Testing for significance of the mediation effects

Mediation effects were tested for significance ($\alpha = .05$) according to the procedure proposed by MacKinnon and colleagues (MacKinnon, Fairchild, & Fritz, 2007). The confidence interval for each mediation effect was calculated via the computer program *PRODCLIN* to check whether the mediation effect is different from 0 (MacKinnon, Fritz, Williams, & Lockwood, 2007).

RESULTS

Table 1 shows the means, standard deviations, internal consistencies and intercorrelations among all variables.

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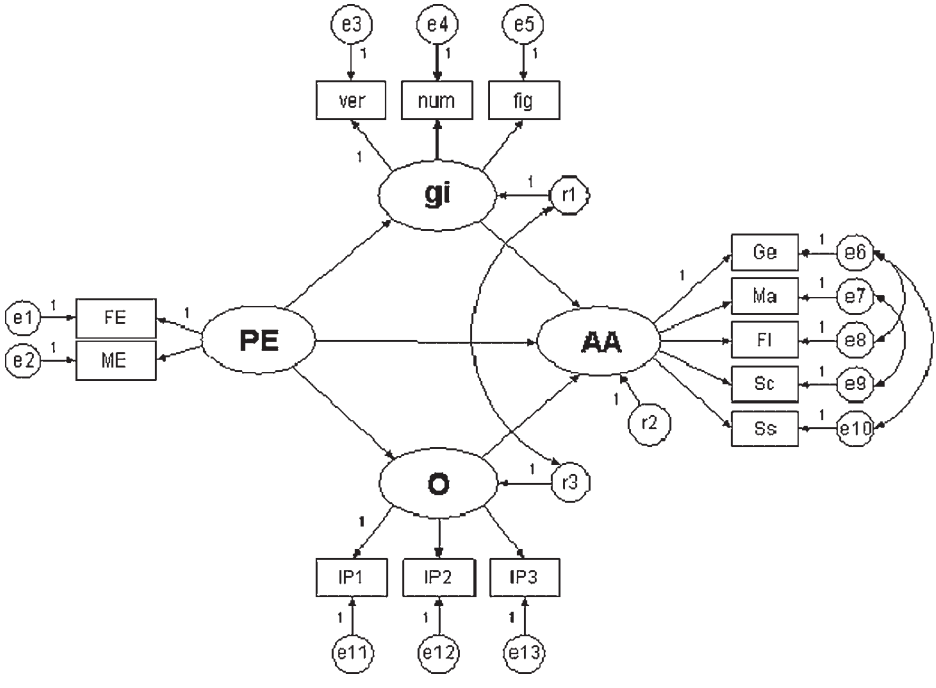

Figure 2. One example of the structural equation models specified to test openness to experience as a mediator of the relation between parents' education and academic achievement controlling for general intelligence. Academic achievement (AA), indicated by grades in German (Ge), Math (Ma), Foreign Language (Fl), Science (Sc) and Social Science (Ss), is explained by parents' education (PE), indicated by fathers' and mothers' education (FE and ME, respectively), openness to experience (*O*), indicated by three item-parcels (IP1, IP2 and IP3, respectively) and general intelligence (gi), indicated by subscales in verbal (ver), numerical (num) and figural (fig) intelligence.

Internal consistencies of all measures were at least satisfactory. Parents' education and children's general intelligence were positively associated with children's academic achievement and with each other. Children's *N* (negatively), *O*, *A* and *C* (all positively) were also substantially related to children's academic achievement, with *C* having the strongest relationship. Only children's *O* (positively) and, marginally ($p < .10$), *N* (negatively) as well as *C* (positively) were significantly correlated with parents' education.

Mediation analyses

Table 2 shows the fit indices of the mediator analyses, the standardized path coefficients and the 95%-confidence intervals of the mediated effects.

The fit indices of the model testing children's general intelligence as a mediator indicated an acceptable fit (CFI = .92, RMSEA = .07 and SRMR = .05). The overall model fit of the models, investigating children's different personality traits as potential mediators, was excellent (all CFI $\geq$ .98, RMSEA $\leq$ .04 and SRMR $\leq$ .04 for models *N*, *E*, *O*, *A* and *C*).

In Hypothesis 1, we predicted a significant mediation effect of children's general intelligence, which was supported by the mediation analysis (*cf.* last column in Table 2). We further hypothesized that children's *A*, *C* and *O* would mediate the association between

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Table 1. Means (*M*), standard deviations (*SD*), internal consistencies (α) and intercorrelations[a] among parents' education, academic achievement, general as well as verbal, numeric and figural intelligence and the Big Five of personality

	Descriptives			Intercorrelations																
	M	*SD*	α	FE	ME	AA	Ge	Ma	Fl	Sc	Ss	gi	ver	num	fig	*N*	*E*	*O*	*A*	*C*
Parents' education (PE)	3.02	1.57		**0.87**	**0.83**	**0.25**	**0.14**	**.020**	**0.18**	**0.19**	**0.20**	**0.25**	**0.25**	**0.14**	**0.11**	−0.08	0.00	**0.20**	0.03	0.08
Fathers' education (FE)	3.40	1.94			**0.44**	**0.21**	**0.21**	**0.18**	**0.16**	**0.14**	**0.16**	**0.19**	**0.20**	**0.15**	**0.09**	−0.06	0.02	**0.15**	0.06	0.08
Mothers' education (ME)	2.63	1.73				**0.23**	**0.10**	**0.17**	**0.15**	**0.20**	**0.20**	**0.17**	**0.22**	**0.09**	**0.10**	−0.07	−0.03	**0.20**	−0.00	0.06
Academic achievement (AA)	**4.08**	**0.62**	**.78**				**0.67**	**0.68**	**0.75**	**0.76**	**0.79**	**0.27**	**0.26**	**0.23**	**0.12**	**−0.09**	**0.02**	**0.24**	**0.10**	**0.33**
German (Ge)	**4.10**	**0.83**						**0.33**	**0.53**	**0.37**	**0.49**	**0.11**	**0.17**	**0.06**	**0.03**	**−0.01**	**0.03**	**0.20**	**0.03**	**0.22**
Math (Ma)	**3.93**	**1.11**							**0.35**	**0.59**	**0.37**	**0.35**	**0.18**	**0.36**	**0.21**	−0.07	**−0.05**	**0.01**	**0.03**	**0.23**
Foreign Language (Fl)	**3.97**	**0.79**								**0.40**	**0.47**	**0.12**	**0.21**	**0.09**	**0.00**	−0.01	**−0.04**	**0.23**	**0.12**	**0.26**
Science (Sc)	**3.96**	**0.86**									**0.47**	**0.31**	**0.23**	**0.26**	**0.21**	−0.14	**−0.05**	**0.13**	**0.09**	**0.24**
Social Science (Ss)	**4.20**	**0.71**										**0.12**	**0.17**	**0.09**	**0.03**	**−0.08**	**0.09**	**0.24**	**0.05**	**0.29**
General intelligence (gi)	109.72	17.93	.90										**0.64**	**0.82**	**0.76**	**−0.19**	**−0.12**	**0.11**	**−.10**	0.02
Verbal (ver)	35.97	6.30	.81											**0.30**	**0.30**	−0.07	**−0.17**	**0.27**	**−0.10**	0.03
Numeric (num)	39.96	9.67	.89												**0.40**	**−0.19**	−0.06	−0.02	−0.07	0.07
Figural (fig)	33.80	7.83	.82													**−0.14**	−0.07	0.06	−0.07	−0.02
Neuroticism (*N*)	2.84	0.63	.78														**−0.31**	−0.03	−0.05	**−0.18**
Extraversion (*E*)	3.51	0.51	.84															0.01	**0.16**	**0.13**
Openness (*O*)	3.27	0.54	.85																0.04	0.03
Agreeableness (*A*)	**3.47**	**0.49**	**.73**																	**0.15**
Conscientiousness (*C*)	**3.40**	**0.58**	**.76**																	

Notes. $N = 548–580$. All means and standard deviations are unstandardized. The parents' education score ranges from 0 to 5, with 5 indicating the highest education. Academic achievement and subject grades range from 1 to 6, with 6 indicating the best grade. Scales of the Big Five traits range from 1 to 5, with 5 indicating higher values in the direction of the scales. PE is a composite of FE and ME; AA of Ge, Ma, Fl, Sc and *Ss*; gi of ver, num and fig. Significant correlations are printed in bold, with $r \geq |.09|$, $p < .05$, $r \geq |.11|$, $p < .01$ and $r \geq |.15|$, $p < .001$.

[a]Here and in the following we report product-moment correlations. We also computed rank correlations but only observed marginal differences to the corresponding product-moment correlations. Thus, we limit our depiction of results to the last-mentioned.

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Table 2. Results of SEM (Full information maximum likelihood-estimations with robust standard errors) testing children's general intelligence and Big Five-traits as mediators of the relationship between parents' education (PE) and children's academic achievement (*AA*) as well as confidence intervals for the mediated effects

	Academic achievement						
	Fit indices			Standardized coefficients			
Model (df)	CFI	RMSEA	SRMR	PE → AA	PE → Med	Med → AA	CI of the mediated effect
gi (29)	.092	0.07	0.05	0.28^{***}	0.35^{***}	0.31^{***}	0.014 to 0.078
N (29)	0.99	0.03	0.03	0.37^{***}	$-0.10^{\#}$	−0.06	−0.002 to 0.009
E (29)	0.98	0.04	0.03	0.38^{***}	−0.00	0.03	−0.002 to 0.002
O (29)	0.98	0.04	0.04	0.29^{***}	0.31^{***}	$.026^{***}$	0.015 to 0.059
A (29)	1.00	0.01	0.02	0.38^{***}	0.04	0.11^{*}	−0.004 to 0.010
C (29)	1.00	0.00	0.02	0.34^{***}	$0.11^{\#}$	0.39^{***}	−0.001 to 0.038

Notes. df = model degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; *gi* = general intelligence; *N* = neuroticism; *E* = extraversion; *O* = openness to experience; *A* = agreeableness; *C* = conscientiousness; PE = parents' education; AA = academic achievement; Med = mediator; CI = 95%-confidence interval (based upon the unstandardized coefficients), CIs *not* including zero indicate a significant mediation effect.
$^{\#}p \leq .10$; $^{*}p \leq .05$; $^{***}p \leq .001$.

parents' education and children's academic achievement (Hypothesis 2). *O* significantly reduced the association between parents' educational background and children's scholastic achievement. The mediation effect of *C* was only marginally significant ($p < .07$). The remaining variables *N*, *E* and *A* were not substantially related to parents' education and/or children's academic achievement, i.e. did not meet the basic requirements of a mediating variable. Thus Hypothesis 2 was only partly supported.

Mediation analyses controlling for intelligence

We assumed that the mediation effects of children's personality traits would still hold after controlling for children's intelligence (Hypothesis 3). To investigate this hypothesis, we tested the mediation effects of all Big Five traits controlling for children's general intelligence (see Table 3).

Fit indices indicated that all models fitted the data as least sufficiently well. *O* showed a significant mediation effect even after controlling for children's general intelligence. The marginally significant mediation effect of *C* did not change after controlling for children's general intelligence ($p < .06$). As in the first set of analyses neither *N*, *E*, nor *A* significantly mediated the association between parents' education and children's academic achievement after controlling for children's general intelligence.

Finally, we conducted an additional analysis testing children's *O*, *C* and intelligence simultaneously as mediators. In this model, *O* and *C* were controlled for general intelligence and for each other, i.e. the residuals of the latent variables were allowed to covary freely. The model (CFI = .93, RMSEA = .06, SRMR = .06) confirmed the results reported before: The mediation effects for children's *O* and intelligence were significant ($p < .01$), whereas *C* only marginally ($p < .06$) mediated the relation between parental education and children's academic achievement.

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Table 3. Results of SEM (Full information maximum likelihood-estimations with robust standard errors) testing Big Five traits as mediators of the relationship between parents' education (PE) and academic achievement (AA) controlling for general intelligence as well as confidence intervals for the mediated effects

	Academic achievement										
	Fit indices			Standardized coefficients						CI of the mediated effects	
Model (df)	CFI	RMSEA	SRMR	PE → AA	PE → gi	gi → AA	PE → Trait	Trait → AA	gi ←→ Trait	gi	Trait
gi + *N* (56)	0.95	0.06	0.05	0.28^{***}	0.34^{***}	0.31^{***}	$-0.10^{\#}$	−0.00	-0.24^{***}	0.013 to 0.077	−0.005 to 0.005
gi + *E* (56)	0.93	0.06	0.05	0.26^{***}	0.37^{***}	0.33^{***}	0.00	0.08	-0.21^{**}	0.016 to 0.087	−0.017 to 0.017
gi + *O* (56)	0.91	0.07	0.06	0.23^{**}	0.36^{***}	0.26^{**}	0.30^{***}	0.21^{***}	0.13	0.009 to 0.076	0.008 to 0.049
gi + *A* (56)	0.94	0.05	0.04	0.25^{**}	0.35^{***}	0.35^{***}	0.05	0.17^{**}	-0.18^{**}	0.016 to 0.084	−0.005 to 0.012
gi + *C* (56)	0.95	0.05	0.04	0.23^{**}	0.36^{***}	0.31^{***}	$0.11^{\#}$	0.39^{***}	−0.02	0.015 to 0.078	−0.001 to 0.036

Notes. df = model degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; gi = general intelligence; *N* = neuroticism; *E* = extraversion; *O* = openness to experience; *A* = agreeableness; *C* = conscientiousness; PE = parents' education; AA = academic achievement; trait = respective Big Five-factor of the model; CI = 95%-confidence interval (based upon the unstandardized coefficients), CIs *not* including zero indicate a significant mediation effect.

$^{\#}p \leq .10$; $^{**}p \leq .01$; $^{***}p \leq .001$.

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DISCUSSION

The present study aimed at investigating whether children's intelligence and personality explain the relationship between parents' education and children's academic achievement. As reported in numerous studies before, in the present study the association between parents' education and children's academic achievement was positive (e.g. Sirin, 2005; White, 1982). The strength of the found correlation ($r = .25$) was comparable to the one found in the meta-analysis of Sirin (2005) ($r = .30$). Children's general intelligence, *O*, and, marginally, *C* were identified as significant mediators of the relationship between parents' education and children's academic achievement. These effects of children's personality were not altered after controlling for their intelligence. However, even after controlling for children's personality and intelligence, parents' education was still a significant predictor of children's academic achievement.

The presented results contribute to the discussion of the association between SES and academic achievement. An issue often raised here is the question which processes underlie this phenomenon and how it can be altered. It has not previously been clarified whether social background fully relates to characteristics (such as children's intelligence) that actually are manifested in higher academic capabilities or whether the correlation still remains significant when controlling for those variables.

First, we demonstrated that the association between parents' education (as one indicator of SES) and children's academic attainment was significantly reduced when controlling for children's personality and intelligence. Thus, the association between parents' education and children's academic success was partly explained by children's characteristics that were both related to academic success and social background. The underlying mechanisms might be found in genetic transmission of those characteristics from parents to their children or in factors completely independent from parents' personality.

However, based on our data we cannot specify why the variables investigated as mediators and parental education were associated. On the one hand, we interpreted parents' education as a proxy of their personality and intelligence. Thus, it is possible that parental intelligence and personality influenced children's intelligence and personality and, in turn, children's academic achievement. On the other hand, it might be that parents' education itself influenced children's intelligence and personality independent from parents' characteristics. Higher education is associated with higher cultural capital (Bourdieu, 1986). For example, better-educated parents might attend more cultural events with their children, which might in turn foster certain personality traits like the two facets openness to actions and openness to aesthetics of the broad personality trait openness to experience.

On the basis of the present data it cannot be answered which one of these possible reasons caused the shared variance with children's characteristics nor whether all of them account for it. Without a genetically informative design and/or any measures of parents' intelligence and personality, there is no way to determine whether parents' education itself and/or parents' personality and intelligence were associated with children's intelligence and personality. Further studies should assess both parents' and children's educational success, personality and intelligence and should perhaps realize a genetically informative design by conducting a twin study with children.

Second, we demonstrated that, even after controlling for children's intelligence and personality, an association between parents' education and children's academic success remained. Thus, the investigated students' characteristics just partially mediated the relationship between parents' education and children's academic achievement. This is a

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hint to the existence of further mediating factors that operate with regard to this relationship.

Concerning students' and parents' characteristics, motivation might further function as a mediator of the relationship between social background and children's academic achievement. Motivation is associated with academic and professional success. Thus, parents' education or their general SES might also serve as a proxy of motivation. Motivational traits such as intrinsic motivation or ability self-concepts are both genetically and environmentally determined (Spinath, Spinath, & Plomin, 2008), related to school achievement (e.g. Steinmayr & Spinath, 2008) and to students' background variables (OECD, 2007). Consequently, children's motivation also fulfils the prerequisites for being a candidate mediator of the relationship between parents' education and children's academic achievement.

Additional mediating variables might be assigned to factors acting independently from parents' and children's dispositional traits. For example, it is possible that well-educated parents tend to encourage and support their children's academic effort further than the extent that would be predicted based on the parents' own characteristics. This encouragement might foster children's academic success beyond what would be predicted from children's personality and intelligence.

This thought is supported by different studies. A positive association between parental expectation for educational attainment (e.g. Kaplan, Liu, & Kaplan, 2001) or parenting practices (e.g. Steinberg, Lamborn, Darling, Mounts, & Dornbusch, 1994) and children's academic achievement have already been demonstrated. Moreover, higher educated parents have higher educational expectations for their children (Suizzo, 2007) and more academically supporting parent–child interaction (Sandefur, Meier, & Campbell, 2006). For example, parental education and parent–child communication about school have been found to be associated with each other and to be positively related to children's positive academic outcomes (*cf.* Grolnick & Slowiaczek, 1994).

The question remains if and how the relationship between parents' education and children's academic achievement might be altered. On the one hand, our study demonstrated that the association between children's social background and children's academic achievement might partly be attributed to factors that are associated with both parents' education and children's academic achievement. It is difficult for any school system to eliminate the advantages that would follow from differences like this. Another example would be if highly-educated parents encourage academic achievement in their children to a greater extent than less-educated parents do. Again, any actions a school might take would not completely invalidate the consequences that result from differences like these in children's background. This view is support by the results of PISA 2006 (OECD, 2007). Although the participating countries have different school systems, there was a substantial though varying association between children's social background and their academic achievement in all of them.

On the other hand, our study showed that even after controlling for variables that are associated with both parents' education and children's academic achievement a significant association between parents' education and children's academic attainment remained. Association like this might be a hint to social inequalities in academic achievement that schools might compensate for. For example, the association might be weakened by providing children from lower educated households with experiences or encouragement not provided by their homes. Possible actions to be realized by schools could set at providing children from lower-educated household with experiences fostering their

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cultural and social experiences. Again, the results from the PISA studies (OECD, 2007) provide evidence that some school systems are more successful than others at granting equal opportunities to children independent from their social background. It is up to further studies to examine which specific aspects of the different school systems amplify or abate the always existing correlation between social background and children's academic achievement.

Limitations and future directions

First, one limitation of the present study is the investigated sample. The investigated students were enrolled in school type called 'Gymnasium'. These schools represent the highest school track in Germany. Consequently, the investigated sample was pre-selected by ability, personality and school performance, which resulted in a more narrow distribution of children's characteristics. Furthermore, children from low SES households are under-represented at these kinds of school, which also resulted in a more narrow distribution of this predictor in the present sample. These restrictions in range might explain the fact that some correlations found in the present study were lower than those found in other publications (e.g. OECD, 2007). However, the results presented occurred despite this range restriction. This might also be interpreted as a hint that the mediating effects of children's intelligence and personality would be even stronger in a sample with a wider range in the investigated variables. Further studies should focus on samples with a wider ability and social background range.

Second, by indicating family's social background via mothers' and fathers' highest education we only focussed on one important indicator of SES. Many studies investigated the impact of SES by building a composite index of at least two of the following variables: Education, occupation and income (e.g. Colom & Flores-Mendoza, 2007; Johnson et al., 2007). Using a composite of all three is in line with the recommendations by Bradley and Corwyn (2002, p. 373). However, it has already been reported in one study that only parental education and not other indicators of SES such as occupation were related to children's behaviour relevant for academic success (Laosa, 1978). Further studies should investigate whether there are differential association between SES indicators and potential mediating variables.

Third, although the presented results support the view that intelligence and some personality traits function as partial mediators of the relationship between parents' education and their offspring's school achievement, the effects should be interpreted cautiously. According to Baron and Kenny (1986) a true mediator (here intelligence or personality) must be causally influenced by the independent variable (parents' education) and, in turn, must causally influence the dependent variable (academic achievement). Due to the cross-sectional nature of our data, they do not allow for such a causal conclusion.

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