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Childhood personality and academic performance: A sibling fixed-effects study

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Abstract

Objective: This study investigated the associations between personality traits at age 8 and academic performance between ages 10 and 14, controlling for family confounds.

Background: Many studies have shown links between children's personality traits and their school performance. However, we lack evidence on whether these associations remain after genetic and environmental confounders are accounted for.

Method: Sibling data from the Norwegian Mother and Child Cohort Study (MoBa) were used ($n = 9701$). First, we estimated the overall associations between Big Five personality traits and academic performance, including literacy, numeracy, and foreign language. Second, we added sibling fixed effects to remove unmeasured confounders shared by siblings as well as rating bias.

Results: Openness to Experience (between-person $\beta = 0.22$ [95% CI: 0.21–0.24]) and Conscientiousness (between-person $\beta = 0.18$ [95% CI 0.16–0.20]) were most strongly related to educational performance. Agreeableness (between-person $\beta = 0.06$ [95% CI −0.08–0.04]) and Extraversion (between-person $\beta = 0.02$ [95% CI 0.00–0.04]) showed small associations with educational performance. Neuroticism had a moderate negative association (between-person $\beta = -0.14$ [95% CI −0.15–0.11]). All associations between personality and performance were robust to confounding: the within-family estimates from sibling fixed-effects models overlapped with the between-person effects. Finally, childhood personality was equally predictive of educational performance across ages and genders.

Conclusions: Although family background is influential for academic achievement, it does not confound associations with personality. Childhood personality traits reflect unbiased and consistent individual differences in educational potential.

KEYWORDS

academic performance, Big Five, childhood personality, sibling fixed-effects design

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1 | INTRODUCTION

Academic performance in childhood and adolescence strongly predicts success and well-being (Andersen et al., 2019). As such, it is important to understand why individual differences in achievement arise. A large body of research has identified factors contributing to academic performance. Evidence shows that cognitive resources such as general cognitive ability are among the best predictors of academic performance (Laidra et al., 2007). However, there is also a strong and growing interest in a range of individual characteristics that are often summarized as "noncognitive" skills, such as personality traits, motivation, academic mind-sets, social skills, academic perseverance, and learning strategies, that also play an essential role in shaping students' everyday learning behavior and their academic performance (Brandt et al., 2020; Gatzka & Hell, 2018; Mammadov et al., 2018; Spengler et al., 2016).

Even though personality is systematically related to academic performance (Cunha & Heckman, 2008; Richardson et al., 2012), to date, a limited number of studies have evaluated the importance of primary school-age personality on later academic performance. The Big Five personality traits is the predominant theoretical framework for describing personality (McCrae & Costa, 1999). In the most comprehensive assessment of the relationship between academic outcomes and the Big Five, Mammadov (2021) synthesized independent samples ($n = 29{,}080$ to 166,436) in 23 (Extraversion) to 31 (Conscientiousness) unique studies of personality and primary school educational performance over the last 30 years. The previous studies covered in the meta-analysis mainly used correlational or cross-sectional research designs. In such designs, results may be confounded by factors that are systematically related to personality and academic performance. Such factors include household environment such as socioeconomic status, shared school influences, shared genetic effects, and systematic rating bias (i.e., shared rating bias due to having the same parent) (Damian & Roberts, 2015; Paulhus et al., 1999; Serna, 2004). Importantly, even after extensive controls for these known confounds, observational studies provide limited causal knowledge if unmeasured confounds and reverse causality are at play. To date, we are unaware of any studies estimating the associations between the Big Five and academic performance in primary/lower secondary school level (students aged from 10 to 14) while controlling for unmeasured confounds. Thus, the main contribution of this study is the application of a sibling fixed-effects design, which solves the limitations of previous studies by removing unmeasured confounding factors shared by siblings as well as rating bias.

1.1 | The Big Five model of personality

According to Allport (1961), personality influences a person's characteristic patterns of behavior, thoughts, and feelings. Although personality traits show changes in mean levels across the lifespan, there seems to be substantial stability even from childhood (Caspi et al., 2005; Hampson & Goldberg, 2006). Decades of research in this field have uncovered five basic personality factors that have repeatedly and consistently emerged upon analyses of the traits most used in psychological instruments to describe people. The Big Five model, as proposed by Costa and McCrae (1992), includes the following major personality dimensions: Openness to Experience (O), Conscientiousness (C), Extraversion (E), Agreeableness (A), and Neuroticism (N).

The Big Five is considered a robust theoretical framework for describing personality (McCrae & Costa, 1999) and is one of the most popular and empirically supported models (Allik et al., 2018; Feher & Vernon, 2021; Miller et al., 2003; Saucier, 2009), including in children (Zell & Lesick, 2021).

1.2 | The associations between the Big Five and childhood academic performance

From a theoretical perspective, several Big Five personality traits may be related to school performance because they describe individual characteristics that may facilitate learning and test performance. Conscientiousness may be of particular importance because students who score high on Conscientiousness tend to be self-disciplined, effective at carrying out tasks and organized (McCrae & John, 1992). These characteristics are expected to help students' performance in examinations, tests, and other evaluation measures. Moreover, Openness to Experience has been shown to be associated with performance-related outcomes such as a positive approach to learning (Vermetten et al., 2001), autonomous motivation, and critical thinking (Bidjerano & Dai, 2007), which, in turn, may have positive effects on students' school performance. Furthermore, given that Extraversion and Agreeableness are both interpersonal traits, their relationships with performance might be related to how student performance is measured. For example, students who cooperate, share, and listen in the classroom may get high-performance evaluations in group course projects, while a human evaluator can be biased by students' personalities (Mammadov, 2021). Finally, high levels of Neuroticism may have aversive effects on academic performance because students with high scores on this personality dimension tend to

exhibit higher stress and anxiety levels. As a result, they tend to perform poorer on tests, exams, or other evaluation assessments (Ackerman et al., 2011; O'Connor & Paunonen, 2007).

The associations between the Big Five personality traits and academic performance at school are well-documented empirically, largely through cross-sectional observational studies (Borghans et al., 2016; Mammadov, 2021; Poropat, 2009). Several systematic reviews and meta-analyses have demonstrated that personality has reliable and substantial associations with academic performance (Andersen et al., 2019; Demetriou et al., 2019; Mammadov, 2021; Poropat, 2009, 2014a; Richardson et al., 2012). Conscientiousness was the strongest personality predictor of academic performance ($r = 0.27$) in a recent meta-analysis (Mammadov, 2021), while Openness to Experience demonstrated a weak and positive overall association ($r = 0.16$). In the same meta-analysis, Extraversion was found to be related to academic performance in primary and lower secondary education ($r = 0.15$) but not at subsequent levels. In contrast, Neuroticism was not significantly related to school performance outcomes ($r = -0.02$). Finally, Agreeableness emerged as a significant but weak predictor of academic performance ($r = 0.09$).

Finally, previous research suggests that the strength of association between the Big Five and academic performance may change depending on the level of education (Poropat, 2009). In his meta-analysis, Mammadov (2021) found that although Conscientiousness and Neuroticism were equally important across all educational levels, Openness to Experience, Extraversion, and Agreeableness were stronger predictors of academic performance in primary compared to secondary and postsecondary education. One possible explanation for these findings is the different assessment practices in postsecondary education or the fact that students' performance at primary school is assessed based on a standard curriculum, which tends to vary widely at subsequent levels of education (Tatar, 1998). Previous studies indicate that the effect of early personality on education attenuates with time; however, these studies have not measured educational performance consistently over time. In all, it is unclear to what extent childhood personality is equally relevant for concurrent as to future educational performance.

1.3 | Rater bias and shared familial confounding: The limitations of previous studies

In sum, previous research provides consistent evidence that students' personality is related to academic performance. Nonetheless, somewhat neglected issues are rating bias and shared familial confounding. First, most research in the field is based on parental reports of children's personality. When parents rate their children's personality, they typically provide biased ratings since they rate them more favorably than others (Laidra et al., 2006). Yet rater bias has not been taken into account in these studies, which has implications for estimating causal relationships between personality and academic performance.

Second, potential confounders affecting personality and academic performance need to be considered. For example, personality traits and academic performance are genetically influenced characteristics, with heritability estimates for personality in young people and adults of ~40% (Spengler et al., 2012; Vukasovic & Bratko, 2015). Some of the genes influencing achievement may also influence personality, making it likely that the associations between these variables are not only due to causal phenotypic effects but also due to genetic confounding (Bueno, 2019). Indeed, multivariate twin studies suggest that the prediction of academic outcomes from personality arises largely for genetic reasons. In the U.K. Twins Early Development study, the highest genetic correlations (i.e., a measure of the extent to which the same genes influence two traits regardless of their heritabilities) between personality and age-16 exam grades emerged for Conscientiousness (0.36) (Rimfeld et al., 2016). In the Texas Twin Project, Openness had the strongest genetic overlap with achievement (Tucker-Drob et al., 2016). This evidence makes it essential to control for genetic influences when estimating effects of personality on academic performance.

Based on the above, there is a need for studies on personality and performance that adjust for rating bias and confounding factors shared by members of the same family. For this reason, in this study, we use a sibling fixed-effects design, which adjusts for all stable factors that have equal effects on siblings in the same family. This design essentially estimates to what extent the differences between sibling pairs in their personality can explain differences in their school performance. There are two types of familial confounding: by environments shared by siblings or by shared genetic variants. In the case of familial environmental confounds explaining the entire effect of personality on educational performance, we would expect the within-family effect to go null. Since siblings, on average only share 50% of their genes, in a scenario with only genetic confounds explaining the between-individual effect, we would expect the association to be halved under genetic confounding (see Figure 1). With any mixture of these two types of familial confounds, we would expect the effect to go to a place between halved and null. In the scenario of an unbiased effect, we would expect the effect

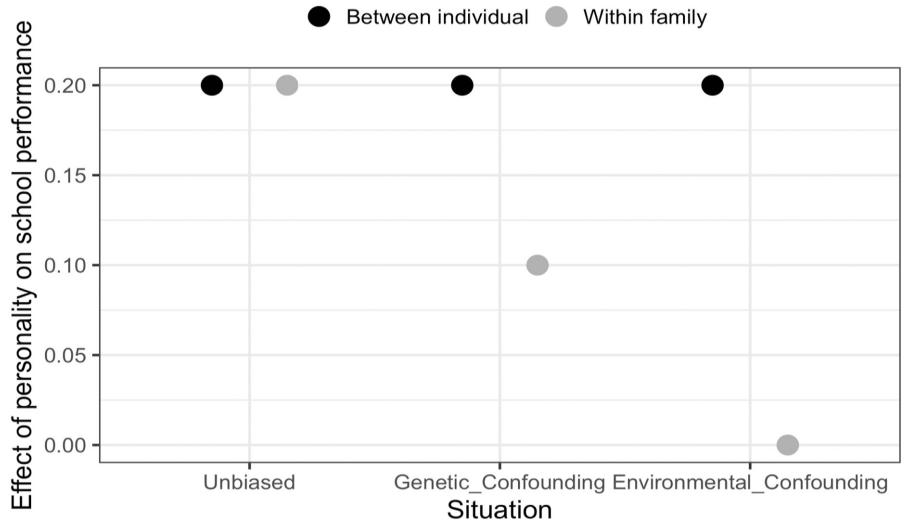

FIGURE 1 Expected between- and within-family associations under the assumptions of no confounding, genetic confounding, and environmental confounding using the sibling control design.

to be close to what is found when not adjusting for unmeasured familial confounds (i.e., "unbiased"; see Figure 1). Because childhood personality in this study was rated by the same mother, within-pair differences cannot be due to systematic rating bias (to the extent that it is the same for both siblings). Moreover, the use of fixed-effects models means that all unobserved confounds shared between siblings, such as the home environment, schools, neighborhoods, and genetics, are controlled for (again, at least to the extent that these are experienced similarly by members of the pair). As a result, the sibling fixed-effects design provides better information about causal associations than correlational research designs or cross-sectional observational studies.

1.4 | Hypotheses

Using a population-based sample of siblings to adjust for factors shared by members of the same family, we aimed to estimate the association between Big Five personality at age 8 and academic performance from ages 10 to 14. Previous evidence suggests that confounding factors, including household environment, socioeconomic status, shared school influences, systematic parental rating bias, and genetic effects, are likely to be at play. However, due to the strong associations between personality and achievement in the literature, we hypothesize that mid-childhood five-factor personality still has a nonzero within-family effect on academic performance over and beyond confounds. Given the importance of Conscientiousness in previous studies and personality being strongly influenced by factors not shared by siblings, we hypothesize that Conscientiousness will also be the strongest predictor of academic performance within families.

2 | METHODS

2.1 | Data and participants

Data were used from the Norwegian Mother and Child Cohort Study (MoBa) conducted by the Norwegian Institute of Public Health (NIPH). MoBa is a prospective population-based pregnancy cohort study following over 100,000 pregnancies. Recruitment started in 1999, and both mothers and fathers were invited (Magnus et al., 2016). In MoBa, there were 106,658 children born after August 2002, with questionnaire data linked to register data from Statistics Norway. We present the sample selection in Figure 2. We excluded the second and third child of multiple births (i.e., twin #2 and triplet #2 and #3), children with lacking paternal id in the registry (to ascertain that they are full siblings), children who died before the age of 8, children without a record in the Medical Birth Registry of Norway, children without siblings in MoBa, and missing or invalid questionnaire data at 8 years. This resulted in an analysis sample of 9701 children. Among these, 4770 children were part of sibling pairs, 157 were part of sibling trios, and four children were part of sibling quadruples. The average sibling age difference was 2.58 years with $SD = 0.99$. Five hundred and sixty-six children had missing data on national test scores, but valid data on personality to be applied in the sibling fixed-effects model. The analysis sample consisted of children attending Grade 5 (corresponding to primary education), Grade 8, and Grade 9 (corresponding to lower secondary education).

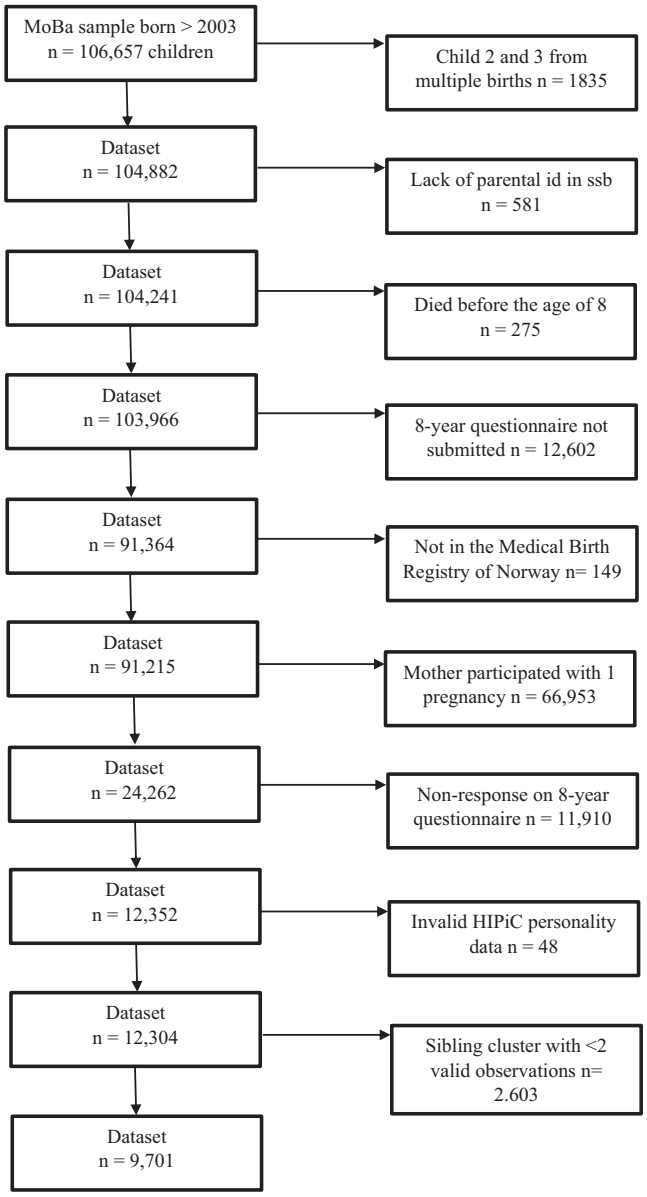

FIGURE 2 Flow chart of participants.

2.2 | Measures

At age 8, mothers rated their children's personality using a validated Norwegian short form of the Hierarchical Personality Inventory for Children (HiPIC; Mervielde & De Fruyt, 1999; Vollrath et al., 2016). The HiPIC short form assesses each of the Big Five Factors using six items. We calculated standardized scores for each scale using a Graded Response Item Response Theory model in Stata 17.0.

Academic performance was measured using standardized national test results in Grades 5, 8, and 9 for literacy, numeracy, and foreign language (i.e., English). The test in English was not given in 9th grade. Test data were obtained through linkage to Norway's National Education Database. The tests were introduced in 2007 to monitor school development. The tests are compulsory, with 96% of all students in Norway taking them. Students with special needs and those following introductory language courses may be exempt. At each age, we calculated a mean score of numeracy and literacy but kept foreign language separate due to no measurement in 9th grade. We standardized by the complete registry population means and standard deviations for each test in each year. Hence, observed means and variances in the MoBa sample indicate differences from the general population.

2.3 | Analyses

We estimated linear mixed models by means of the *mixed* function in Stata 17.0. Each child had up to three lines of data representing tests in 5th, 8th, and 9th grade with an age variable centered to 5th grade. The siblings were nested within a family cluster variable. We estimated correlated random intercepts and random slopes for age at the child (2nd) level and family (3rd) level. The analyses were adjusted for maternal parity (i.e., sibling birth order effects). We allowed effects of personality on school performance to interact with age, gender, and age*gender. Given the centering of age and gender (centered to gender grand mean), any additional contributions to the model from these interactions respectively indicate that: the effect of personality on academic performance increases from mid-childhood to adolescence (i.e., age*personality), the effect of personality on academic performance differs across gender (i.e., gender*personality), or the effect of personality over age differs by gender (i.e., age*gender*personality). For the sibling fixed-effects model, we included mean personality for the child clusters and centered the personality variables on the cluster mean.

3 | RESULTS

The average maternal age at recruitment (18th week of gestation) was 30.47 years ($SD = 3.93$) (min = 18; max = 45). The sibling intraclass correlation coefficients (ICCs) for five-factor personality were: Conscientiousness (0.22), Openness to Experience (0.29), Extraversion (0.23), Neuroticism (0.23), and Agreeableness (0.25). The siblings were moderately correlated with each other on national academic performance tests, ranging from ICCs of 0.27 (i.e., literacy 9th grade) to 0.45 (i.e., foreign language 8th grade) (see Table 1). Compared to the entire population, the participants in MoBa had lower standard deviations and higher averages, 0.14 SD (i.e., foreign language 5th

TABLE 1 Descriptives of national academic performance tests.

Test	Grade	*n*	Mean	*SD*	ICC ± SE[a]
Total (literacy + numeracy)	5th	9167	0.43	0.94	0.39 ± 0.013
	8th	4613	0.48	0.93	0.42 ± 0.028
	9th	2917	0.48	0.88	0.34 ± 0.071
Literacy	5th	8993	0.36	0.94	0.34 ± 0.014
	8th	4577	0.44	0.94	0.34 ± 0.030
	9th	2884	0.42	0.88	0.27 ± 0.079
Numeracy	5th	9108	0.40	0.95	0.37 ± 0.013
	8th	4479	0.44	0.88	0.42 ± 0.029
	9th	2884	0.19	0.88	0.36 ± 0.067
Foreign language	5th	9033	0.14	0.96	0.36 ± 0.013
	8th	4557	0.19	0.96	0.45 ± 0.027

[a]Adjusted for birth order and gender.

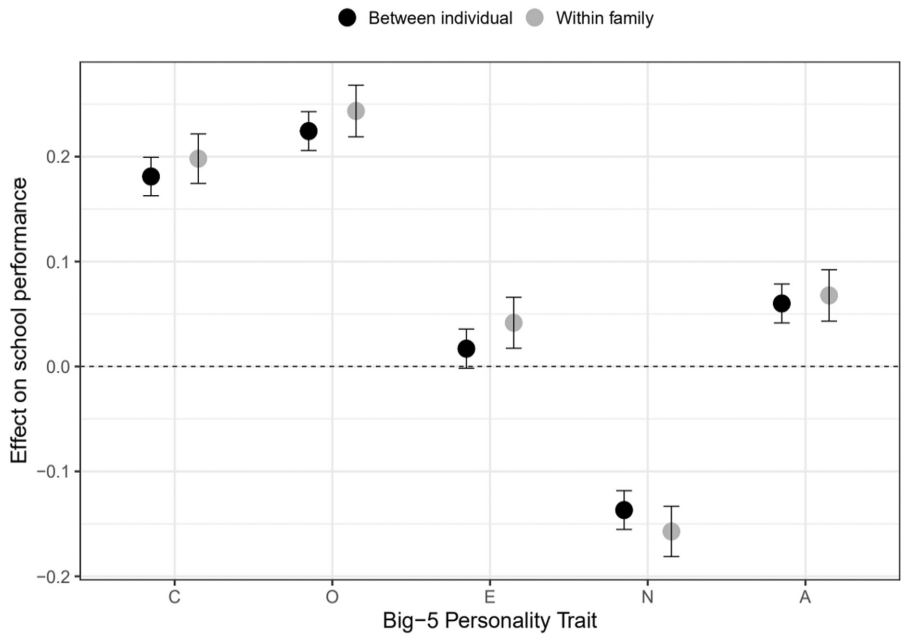

FIGURE 3 The associations between the Big Five and overall academic performance between individuals and within families. C = Conscientiousness, O = Openness, E = Extraversion, N = Neuroticism, A = Agreeableness.

grade) to 0.48 SD (i.e., total academic performance) above the population mean.

We tested the associations between personality traits and academic performance (a composite of literacy and numeracy) using linear mixed models. In a first series of models, we estimated the associations between the Big Five personality traits and overall academic performance between individuals (black in Figure 3). In a second series of results, within-family effects were estimated by using sibling fixed-effects analyses (gray in Figure 3).

As displayed in Figure 4, analyses were repeated to show the associations between Big Five personality traits and all three school subjects (symbols) separately, both between individuals (black) and within families (gray).

3.1 | Conscientiousness

Figure 3 shows that the association between Conscientiousness and overall academic performance was positive (between-person $\beta = 0.18$ [95% CI 0.16–0.20]). When controlling for confounding of the association between Conscientiousness and academic performance, we found no evidence for confounding: the within-family effect (within-family $\beta = 0.20$ [95% CI 0.17–0.22] was overlapping with the between-person effect. We then explored

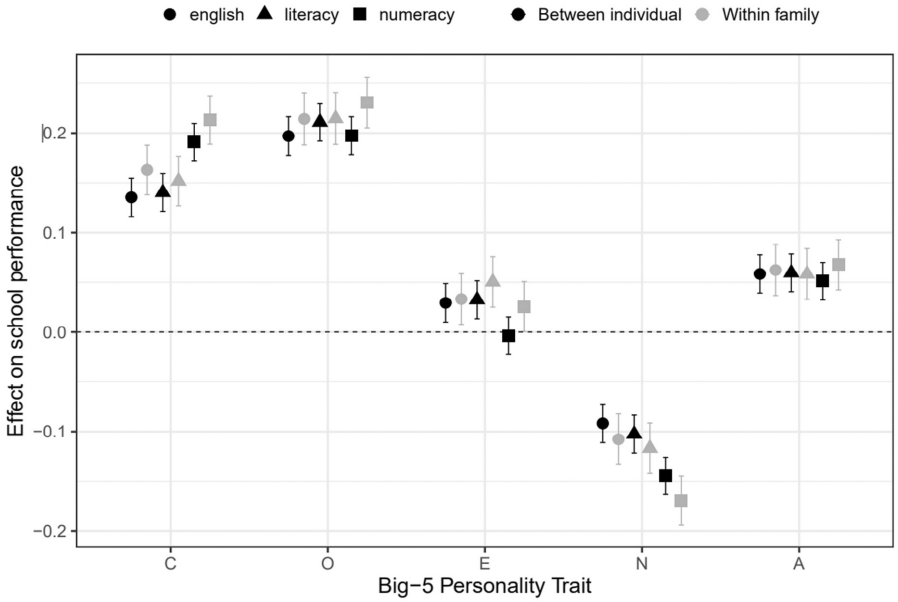

FIGURE 4 The associations between the Big Five and the three school subjects. C = Conscientiousness, O = Openness, E = Extraversion, N = Neuroticism, A = Agreeableness.

associations between Conscientiousness and school subjects (i.e., literacy, numeracy, and foreign language) and found them to be 0.14, 0.19, and 0.14 (all $p < 0.001$). Associations were unattenuated within families, estimated at 0.15, 0.21, and 0.16 for literacy, numeracy, and foreign language, respectively (all $p < 0.001$; see Figure 4).

Additionally, we examined whether the associations between Conscientiousness and academic performance were moderated by gender or age. Analyses showed no significant gender differences in the association and no evidence of a change in the association over time ($p > 0.05$).

3.2 | Openness to Experience

Figure 3 shows that the association between Openness to Experience and overall academic performance was positive (between-person $\beta = 0.22$ [95% CI 0.21–0.24]). We found no evidence for confounding of the association between Openness to Experience and academic performance: the within-family effect (within-family $\beta = 0.24$ [95% CI 0.22–0.27] was overlapping with the between-person effect. We then explored associations between Openness to Experience and school subjects (i.e., literacy, numeracy, and foreign language) and found them to be 0.21, 0.20, and 0.20 (all $p < 0.001$). Associations were unattenuated within families, estimated at 0.22 ($p < 0.001$), 0.23 ($p < 0.01$), and 0.21 ($p < 0.001$) for literacy, numeracy, and foreign language, respectively (see Figure 4).

Additionally, we examined whether the associations between Openness to Experience and academic performance were moderated by gender or age. Analyses showed no significant gender differences in the association and no evidence of a change in the association over time.

3.3 | Extraversion

Figure 1 shows a slightly positive, but non-significant association between Extraversion and overall academic performance (between-person $\beta = 0.02$ [95% CI −0.002–0.04]). When controlling for confounding of the association between Extraversion and academic performance, we found no evidence for confounding: the within-family effect (within-family $\beta = 0.04$ [95% CI 0.02–0.07]) overlapped with the between-person effect. We then explored associations between Extraversion and school subjects (i.e., literacy, numeracy, and foreign language) and found them to be 0.03 ($p < 0.001$), 0.00 ($p > 0.05$), and 0.03 ($p < 0.01$). Associations were unattenuated within families, estimated at 0.05 ($p < 0.001$), 0.03 ($p < 0.05$), and 0.03 ($p < 0.05$) for literacy, numeracy, and foreign language, respectively (see Figure 4).

Additionally, we examined whether the associations between Extraversion and academic performance were moderated by gender or age. Analyses showed no significant gender differences in the association and no evidence of a change in the association over time.

3.4 | Neuroticism

Figure 3 shows that the association between Neuroticism and overall academic performance was negative

(between-person $\beta = -0.14$ [95% CI −0.15–0.11]). When controlling for confounding of the association between Neuroticism and academic performance, we found no evidence for confounding: the within-family effect (within-family $\beta = -0.16$ [95% CI −0.18–0.13] was overlapping with the between-person effect. We then explored associations between Neuroticism and school subjects (i.e., literacy, numeracy, and foreign language) and found them to be −0.10, −0.14, and −0.09. Associations were unattenuated within families, estimated at −0.12, −0.17, and −0.11 for literacy, numeracy, and foreign language, respectively (see Figure 4).

Additionally, we examined whether the associations between Neuroticism and academic performance were moderated by gender or age. Analyses showed no significant gender differences in the association and no evidence of a change in the association over time.

3.5 | Agreeableness

Figure 3 shows that the association between Agreeableness and overall academic performance was positive (between-person $\beta = 0.06$ [95% CI 0.04-0.08). When controlling for confounding of the association between Agreeableness and academic performance, we found no evidence for confounding: the within-family effect (within-family $\beta = 0.05$ [95% CI 0.04-0.09] was overlapping with the between-person effect. We then explored associations between Agreeableness and school subjects (i.e., literacy, numeracy, and foreign language) and found them to be 0.06, 0.05, and 0.06. Associations were unattenuated within families, estimated at 0.07, 0.06, and 0.06 for literacy, numeracy, and foreign language, respectively (see Figure 4).

Additionally, we investigated whether the associations between Agreeableness and academic performance were moderated by gender or age. Analyses showed no significant gender differences in the association and no evidence of a change in the association over time.

4 | DISCUSSION

We found Big Five personality at age 8 to be associated with academic performance from ages 10 to 14. Moreover, all relationships were unattenuated when controls for familial confounding and rater bias were introduced. Further, our findings indicate that childhood personality is equally predictive for educational performance in girls and boys and across ages 10– 14. The strength of the associations between personality and educational performance varied across traits: Openness to Experience and Conscientiousness were the strongest correlates of educational performance. Neuroticism was moderately negatively related to educational performance, while Agreeableness and Extraversion had a modest positive association with educational performance.

Our results suggest that Conscientiousness is an important noncognitive predictor of academic performance in the mid-childhood. Our results are in line with previous studies, showing that Conscientiousness emerges as a strong and consistent predictor (Mammadov, 2021). This personality dimension is associated with goal setting, concentration, effort regulation (Poropat, 2009), and self-control (MacCann et al., 2009). Conscientiousness may as such be the expression of a greater ability to self-regulate, leading to higher levels of time on task and consequently greater learning (Poropat, 2014b). These characteristics and skills are important for students to be successful across all academic domains and educational stages.

We also found Openness to Experience to be a noncognitive predictor for academic performance in mid-childhood. This is in line with previous studies of primary/lower secondary school levels (Mammadov, 2021). As stated by De Raad and Schouwenburg (1996), Openness to Experience seems to reflect "the ideal student" (p. 327), who is foresighted, smart, and resourceful. In addition, other studies have reported Openness to Experience to be positively correlated with an active approach to learning (Vermetten et al., 2001), motivation to learn (Tempelaar et al., 2007), critical thinking (Bidjerano & Dai, 2007), and it has the strongest negative correlation with absenteeism (Lounsbury et al., 2004).

Moreover, we found Extraversion to be modestly related to educational performance. Previous studies on the Big Five and educational performance have provided mixed results regarding this personality dimension. According to De Raad and Schouwenburg (1996), more extraverted students are expected to perform better academically due to their higher energy levels and positive attitude that leads to a desire to learn and understand. In contrast, Eysenck (1992) suggested that more extraverted students would be more likely to socialize and pursue activities than other studying, leading to lower levels of performance. Consequently, it is unclear how Extraversion affects educational performance. Empirically there is weak evidence for its practical significance, while one widely acknowledged argument is that its influence occurs indirectly through some mediating variables (Mammadov, 2021; Richardson et al., 2012; Woodfield et al., 2006).

Additionally, we found Neuroticism to have a moderate negative association with educational performance. This is in line with previous studies which found negative associations between Neuroticism and academic performance (Biderman & Reddock, 2012; Chamorro-Premuzic & Furnham, 2003; Gerbino et al., 2018). Moreover,

Mammadov (2021) et al. found that Neuroticism does not seem to be an important determinant of academic performance since the correlations were not statistically significant. One possible explanation is that neurotic students tend to be more distracted from their tasks due to their emotional state, which leads to poorer performance and less learning. On the other hand, other studies reported significant positive correlations (Culjak & Mlacic, 2014; Lounsbury et al., 2004; Steele-Johnson & Leas, 2013). However, the negative effect of Neuroticism seems theoretically more plausible as neurotic students tend to demonstrate higher levels of anxiety and stress that, in turn, can result in poor academic performance in tests or in other assessments (Ackerman et al., 2011; O'Connor & Paunonen, 2007).

Finally, we found that Agreeableness has a modest association with educational performance. This result is also in line with the meta-analysis of Mammadov (2021), which demonstrated that Agreeableness is a significant but weak predictor of academic performance ($r = 0.09$). Agreeableness may positively impact on academic performance by facilitating cooperation with learning processes (De Raad & Schouwenburg, 1996). This idea is consistent with another study that found Agreeableness to be linked to compliance with teacher instructions, effort, and staying focused on learning tasks (Vermetten et al., 2001). Prior studies have to a great extent used educational outcomes evaluated by the teacher. In such scenarios, the interpersonal skills reflected by Agreeableness could influence the outcome. The application of objectively measured standardized tests is in this respect a strength of the current study.

4.1 | Between-person versus within-family effects

In previous studies, there has been considerable concern regarding systematic rating bias (Brandt et al., 2021; Laidra et al., 2006). In our study, siblings always had their personality evaluated by the same rater, their mother. Although siblings were correlated approximately 0.25 in their measured personality, which could partly reflect maternal rating bias, we did not find the within-family effects of personality on educational performance to be considerably attenuated. This does not prevent maternal rating bias from confounding other associations with personality. However, it appears that it does not confound associations with standardized performance tests in this study.

By design, the sibling fixed-effects approach adjusts for all stable factors that have equal effects on siblings in the same family. This includes the socioeconomic position and stable aspects of the parents but only captures half of the common genetic component of both personality and educational performance. If the personality–educational performance association was entirely due to genetic confounding, we would expect a 50% reduction in the effect, something we did not observe. This could imply that the association is not confounded by genetic variants having an effect on both personality and academic performance, even though both traits are heritable. Full siblings are, on average, 50% genetically different, and the within-family effects of personality on educational performance could therefore represent children seeking different environments to improve their learning, such as friends, libraries, engagement in homework, and interactions with adults. This type of child-driven genetic effect mediated through the environment is termed "active gene-environment correlation" (Plomin et al., 1977; Scarr & McCartney, 1983). Future studies using measured genotypes such as polygenic scores representing endogenous variation (Pingault et al., 2018) in personality and noncognitive skills (Demange et al., 2022) could potentially reveal the active role of personality in educational performance.

4.2 | Associations across gender, age, and school subjects

This study showed that the associations between personality traits and academic performance were consistent across gender, age, and school subjects. The equal effects of personality academic performance in girls and boys may be expected as we measured personality at age 8, and gender differences in both personality and school performance are small before the onset of puberty. Gender differences in school performance increase in adolescence, which is possibly related to a drop in Conscientiousness during the teenage years that boys recover from later than girls (Soto et al., 2011). As demonstrated by Spinath et al. (2014), there is some evidence to support gender differences in performance-related student characteristics. However, up to now, the findings that have been reported to show that the Big Five predicts academic performance differently for boys and girls are not consistent, while only a few studies examined gender differences in the associations between academic performance and personality traits (Freudenthaler et al., 2008; Hicks et al., 2008; Nguyen et al., 2005; Spinath et al., 2010). Furthermore, the meta-analysis conducted by Mammadov (2021) did not find evidence for gender as a moderator. Future studies should address differences between skill-based assessments like the ones presented here and achievement-based assessments like grade point averages.

Regarding age effects, previous studies suggested that the strength of the associations between personality traits and academic performance change as students advance through the education system (Poropat, 2009); therefore, the moderating effect of age is expected to be parallel to the changes associated with education level (Poropat, 2014b). Based on this argument, the meta-analysis of Mammadov (2021) reported that the effect of age was significant for Openness to Experience and Extraversion, while the relationships between academic performance with Openness to Experience became weaker as age increased. Also, the results of the same meta-analysis showed that the associations with other personality traits and academic performance were not affected by age. In our study, we found 8-year personality to be equally predictive of educational performance between 10 and 14 years, and this was expected since our sample consisted only of students attending the primary level of education and the first year of lower secondary school level. As a result, we were not able to identify any dynamic developmental processes.

4.3 | Limitations and future directions

This study is not without limitations. First, our sibling design cannot control for confounding factors not shared by sibling pairs (e.g., perinatal factors). Sibling comparison studies often tend to amplify the bias due to confounding factors not shared by family members, but these issues also apply when comparing unrelated individuals (Sjölander et al., 2022). The design also cannot control for bias arising from cross-sibling interactions (Frisell et al., 2021). However, the evidence base on sibling effects (contrast and imitation) for personality and achievement in childhood remains unclear (Demange et al., 2022). Second, our study focused on three core subjects (i.e., literacy, numeracy, and foreign language). However, it would be interesting for future studies to consider a broader range of academic subjects and ages including upper secondary (students aged 15 to 17) and postsecondary (students after 18) school levels. Additionally, our study used a nationwide sample of Norwegian children. Future research could test whether the results are replicable in other countries. Finally, since academic performance seems to be particularly related to Conscientiousness and Openness to Experience, further research is warranted on school programs that nurture noncognitive skills related to these personality traits, including creative thinking, perseverance, and not just cognitive skills. For this reason, school-based practices and policies that aim to promote academic performance should include activities that stimulate healthy personality development.

4.4 | Conclusion

The present study reaffirms the critical role of personality traits in explaining academic performance. First, our results suggest that high Openness to Experience and Conscientiousness were the personality traits most predictive of educational performance. Agreeableness and Extraversion had a modest positive association with educational performance, while Neuroticism showed to be moderately negatively related to educational performance. Second, we controlled for confounding of the associations between personality traits and academic performance using a sibling fixed-effects design and found no evidence for confounding. Third, we found childhood personality to be equally predictive of academic performance in girls and boys. Finally, we found the effect of eight-year personality to be equally predictive of educational performance at any age between 10 and 14 years.

AUTHOR CONTRIBUTIONS

Study conception and design: EY; analysis and interpretation of results: EY, RC, AC; initial draft manuscript preparation: AC; manuscript revision: AC, RC, EY. All authors reviewed the results and approved the final version of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The data are available for researchers with study questions that fall within the general aims of MoBa. Approval from

a Norwegian regional committee for medical and health research ethics [https://helseforskning.etikkom.no] is a prerequirement. The MoBa protocol and guidelines for access to data are available at http://www.fhi.no/moba-en. Enquiries can be sent to datatilgang@fhi.no. Data from the Norwegian Educational Database can be accessed via Statistics Norway (see here: https://www.ssb.no/en/data-til-forskning).

ETHICS STATEMENT

The establishment of MoBa and initial data collection was based on a license from the Norwegian Data Protection Agency and approval from The Regional Committees for Medical and Health Research Ethics. The MoBa cohort is now based on regulations related to the Norwegian Health Registry Act. The current study was approved by The Regional Committees for Medical and Health Research Ethics (project # 2017/2205).

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