Educational Research, 2014
Vol. 56, No. 2, 230–243, http://dx.doi.org/10.1080/00131881.2014.898917

Routledge
Taylor & Francis Group

Gender differences in school success: what are the roles of students' intelligence, personality and motivation?

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(*Received 24 June 2013; final version received 10 January 2014*)

Background: Education is a key variable for reaching individually and socially desired outcomes. Specifically, school grades are important admission criteria for higher education and job positions. Nowadays, in countries committed to equal opportunities, girls obtain better school grades than boys, but the reasons why girls outperform boys are not well understood. In the following, individual student characteristics (i.e. intelligence, personality, motivation) were investigated as promising candidates that may account for gender differences in school performance.
Purpose: This is a review of research findings on gender differences in performance-related individual students' characteristics. These findings may help to explain differences in boys' and girls' school achievement. It was hypothesised that girls are better adapted to today's school environment because of their intelligence (general, specific), personality (Big Five) and motivation (ability self-concept, interest or intrinsic values, goal orientations). To investigate this hypothesis, we reviewed literature with respect to five questions: (1) How strongly are intelligence, personality and motivation associated with school achievement? (2) Are there mean level differences between boys and girls in these characteristics? (3) Do these characteristics show gender differences in predicting school achievement? (4) Can gender differences in these characteristics explain the association between gender and school achievement? (5) Are gender differences in these characteristics causally related to differences in boys' and girls' school achievement?
Sources of evidence: We mainly based our review on meta-analyses and literature reviews. If no meta-analyses or reviews were available, we reported results of representative single studies, including results from our own studies. To illustrate the magnitude of gender differences, we also reported statistical parameters (correlation coefficients, effect sizes and regression coefficients).
Main argument: Concerning the five research questions, we found that, first, among the characteristics investigated here, general intelligence, ability self-concepts and self-discipline were the most important predictors of school performance. Second, gender differences in students' individual characteristics varied from non-existent (e.g. general intelligence) to strong (e.g. self-discipline). Third, there was no indication that these characteristics were differently important for boys' and girls' school performance. Fourth, gender differences in intelligence, personality and motivation partially mediated the association between gender and school achievement but cannot fully explain it. Fifth, whether differences in intelligence, personality and motivation cause performance differences between boys and girls remains unknown because there were no studies that have investigated this question with designs that could test for causal inferences.

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Conclusion: Gender differences in students' individual characteristics contribute to a significant extent to gender differences in school performance. Taken together, the effects of gender differences in students' individual characteristics can partially but not fully account for gender differences in school performance. Girls are somewhat better adapted to today's school environments, especially because of their better verbal intelligence, higher Agreeableness, stronger self-discipline, as well as certain aspects of their motivation. In light of these specific differences, it is argued that changing certain aspects of school environments might help boys to better succeed in school and, thus, reduce educational inequality.

Keywords: gender differences; school achievement; individual differences; intelligence; personality; motivation

Introduction

Since the 1990s, there has been increasing evidence that, in countries committed to equal opportunities, girls outperform boys on different academic achievement criteria (e.g. USA: Epstein et al. 1998; Hong Kong: Wong, Lam, and Ho 2002; Scotland: Scottish Office 1998; Germany: Steinmayr and Spinath 2008; Austria: Freudenthaler, Spinath, and Neubauer 2008). The reasons for these gender differences are not well understood. Individual student characteristics have been shown to explain the largest portion of variance in school performance among all possible classes of variables (e.g. Baumert, Trautwein, and Artelt 2003). Therefore, from a psychological perspective, individual student characteristics such as intelligence, personality and motivation seem to be promising candidates for accounting for gender differences in school performance. We hypothesised that, in countries that are dedicated to equal opportunities, girls are better adapted to the demands of school environments because of their intelligence, personality and motivation. To investigate this hypothesis, we reviewed the literature with respect to five questions:

(1) How strongly are intelligence, personality and motivation associated with school achievement?
(2) Are there mean level differences between boys and girls in these characteristics? How large are these differences?
(3) Does the importance of these characteristics as predictors of school achievement differ for boys and girls?
(4) Can gender differences in these characteristics explain the association between gender and school achievement?
(5) Are gender differences in these characteristics causally related to differences in boys' and girls' school achievement?

To our knowledge, no previous review has summarised research findings on intelligence, personality, motivation and school success at the same time. Moreover, no previous work has simultaneously targeted the five research questions to provide a systematic review of the research findings.

When possible, we drew on meta-analyses or literature reviews. We included meta-analyses reporting gender differences in school achievement that were included in the data bases PsycINFO and ERIC in 2013. If no such comprehensive analyses were available, representative results of single studies are reported. For these single studies, we often draw on research from our own group because in many cases these are the only studies available. To highlight which results came from meta-analyses or literature reviews, we marked the corresponding references with *MA/LR*. If references are not

marked, reported results stem from single studies. Our review is not fully comprehensive concerning questions for which no meta-analyses or reviews were available, because it was not possible to provide a complete overview of all single studies. Moreover, we drew on school-aged samples when they were available. If no such samples were available, results relied on adult samples. Finally, because gender differences vary according to the operationalisation of school achievement, it is important to note that we preferred studies that operationalised school achievement in terms of grades over studies that used standardised achievement test data. This choice was made because grades are the most ecologically valid measure of school success.

How strongly are intelligence, personality and motivation associated with school achievement?

In this section, first, we will briefly define the constructs that we focussed on. Second, we will answer the question of how strongly intelligence, personality and motivation are associated with school achievement by reporting the corresponding correlations. Correlations of $r < 0.30$ are considered small, correlations of $r = 0.30$–0.49 to be moderate, and correlations of $r \geq 0.50$ to be strong (based on Cohen 1988).

Intelligence

Although the word intelligence means many different things to different people (Cianciolo and Sternberg 2004; Neisser et al. 1996), a central feature of most definitions of intelligence is the ability to learn. Correlations between measures of general intelligence and measures of educational achievement are strong ($r = 0.50$; *MA/LR*: Gustafsson and Undheim 1996). This relation is even stronger when it is modelled on a latent basis (*MA/LR*: Neisser et al. 1996; e.g. Deary et al. 2007). Specific types of intelligence (e.g. verbal, numerical) typically have weaker ($r < 0.40$) associations with corresponding school achievement than general intelligence (e.g. Calvin et al. 2010; Freudenthaler, Spinath, and Neubauer 2008; Steinmayr and Spinath 2008). The results are summarised in Table 1.

Personality traits

The personality model most commonly used in recent years is the Five-Factor Model or the Big Five (Digman 1990; Goldberg 1990; McCrae and Costa 1987). In this model, personality is described by five broad factors, namely Conscientiousness, Openness, Agreeableness, Neuroticism and Extraversion. Findings on the relation between the Big Five and school achievement have been rather inconsistent. The most consistent results have been found for Conscientiousness, which has a positive association with school achievement ($r = 0.19$; *MA/LR*: Poropat 2009). The facets of Conscientiousness, such as competence, order, dutifulness, achievement striving, self-discipline and deliberation (cf. Costa, Terracciano, and McCrae 2001), represent behaviours that contribute to better school achievement (e.g. doing assigned homework; Trautwein et al. 2006). Among the facets of Conscientiousness, self-discipline is considered especially important when investigating gender differences in school (e.g. Duckworth and Seligman 2005, 2006; *MA/LR*: Silverman 2003). Self-discipline is defined as the ability to suppress prepotent responses in the service of a higher goal (Duckworth and Seligman 2006). In single studies, associations between self-discipline and grades (GPA) have been found to be strong ($r = 0.57/0.67$; Duckworth and Seligman 2005, 2006).

Table 1. Gender differences and school achievement: Overview of results for the five research questions.

	Question 1 Association (r) with grades	Question 2 Effect size (d) of gender differences in means	Question 3 Evidence of differential prediction of school achievement between genders	Question 4 Mediation effects between gender and school achievement	Question 5 Evidence of causal effects of gender differences on school achievement
Cognitive abilities					
General intelligence	0.50	0.00	–	0.00	–
Verbal intelligence	<0.40	−0.45 to −0.02	–	1/3 of variance	–
Numerical intelligence	<0.40	−0.14 to 0.16	–	1/2 of variance	–
Personality traits					
Openness	0.10	0.00	–	0.00	–
Extraversion	−0.01	0.00	–	0.00	–
Neuroticism	−0.01	−0.30	–	0.00	–
Agreeableness	0.07	−0.28	–	1/4 of variance	–
Conscientiousness	0.19	0.00	–	0.00	–
Self-discipline	0.57–0.67	−0.09 to −0.71	–	1/2 of variance	–
Motivation					
Ability self-concept					
School in general	0.40–0.61	0.11	–	0.00	–
Mathematics	0.40–0.61	0.28	–	Suppressor effect	–
Languages	0.40–0.61	−0.23	–	1/4 of variance	–
Intrinsic motivation/ interest					
School in general	0.20–0.30	−0.29 to −0.33	For boys more important?	0.00	–
Mathematics	0.20–0.30	0.15–0.69	For boys more important?	Suppressor effect	–
Languages	0.20–0.30	−0.30 to −0.62	For boys more important?	1/2 of variance	–
Learning goals	0.10–0.11	−0.24 to 0.04	–	–	–
Performance-approach goals	0.06–0.13	−0.04 to 0.19	–	–	–
Performance-avoidance goals	−0.13	0.00–0.12	–	–	–
Work-avoidance goals	−0.20 to −0.30	0.16–0.54	–	1/3 of variance	–

Negative d indicates larger means for girls.

Openness involves active imagination, aesthetic sensitivity, attentiveness to inner feelings, preference for variety and intellectual curiosity. The positive relation between Openness and achievement ($r = 0.10$; *MA/LR*: Poropat 2009) is partly due to the medium correlation between Openness and intelligence (*MA/LR*: Chamorro-Premuzic and Furnham 2005). Nevertheless, after controlling for intelligence, Openness is still associated with school achievement (*MA/LR*: Poropat 2009). Agreeableness, Neuroticism and Extraversion are not related or are only weakly related to school performance. Agreeableness is characterised by adjectives such as kind, sympathetic, cooperative, warm and considerate. Agreeableness has been found to be weakly associated with school achievement when it is measured as grades ($r = 0.07$; *MA/LR*: Poropat 2009) compared with standardised achievement tests (*MA/LR*: Chamorro-Premuzic and Furnham 2005). Agreeableness can facilitate learning through cooperation and compliance with teachers' instructions. Even though the meta-analysis by Poropat (2009) did not find an association between the broad trait Neuroticism and school performance ($r = -0.01$), facets of Neuroticism were negatively associated with school performance, that is, primarily test anxiety and fear of failure (*MA/LR*: Zeidner 1995). Moreover, monitoring one's emotional state tends to distract from achievement-related behaviour (*MA/LR*: Eysenck et al. 2007). Poropat (2009) also found that Extraversion was, on average, not related to grades ($r = -0.01$). However, as was the case for all other associations between the Big Five and grades, substantial heterogeneity was found among correlations. Negative associations between Extraversion and school performance, for example, have been argued to be due to students pursuing social activities instead of studying (*MA/LR*: De Raad and Schouwenburg 1996).

Motivation

Motivation is the force that energises and directs experience and behaviour. In contrast with the construction of intelligence and personality, there is no single leading model and many different motivational constructs have been used in this research. For this review, from the vast array of achievement motivation theories (cf. Murphy and Alexander 2000), we chose two theoretical frameworks that have been extensively investigated in school settings: expectancy-value and goal theory.

In the expectancy-value model (Eccles et al. 1983; Wigfield and Eccles 2000), ability self-concepts (i.e. beliefs about one's own ability) and the values ascribed to tasks are the most proximal determinants of achievement-related behaviour. Among different values, intrinsic or interest values (i.e. engaging in a task for reasons that lie within the task itself rather than in its consequences) are the best-investigated task values. Both ability self-concepts and intrinsic or interest values can be investigated domain-specifically or for school in general. Associations with grades do not differ according to the investigated domain. For ability self-concepts, the relations with school achievement are moderate to strong ($r = 0.40$–0.61; *MA/LR*: Hansford and Hattie 1982; *MA/LR*: Möller et al. 2009). For intrinsic or interest values, the relation to school achievement is weak to moderate ($r = 0.20$–0.30; *MA/LR*: Schiefele, Krapp, and Winteler 1992; e.g. Gottfried 1985, 1990; Steinmayr and Spinath 2007, 2009).

Goal theories (Dweck 1986; Elliot 1999; Nicholls 1984) hold that achievement behaviour can be explained by the pursued goals. Best investigated is the trichotomous goal framework (Elliot 1999), in which three goals are distinguished: learning goals (wanting to increase one's competence), performance-approach goals (wanting to demonstrate high competence) and performance-avoidance goals (trying not to demonstrate

low competence). Moreover, work-avoidance goals (wanting to invest little effort) can be described as the opposite of achievement motivation (e.g. Nicholls 1984). Overall, the associations between goal orientations and school achievement have been weak. Recent meta-analyses (*MA/LR*: Huang 2012; *MA/LR*: Hulleman et al. 2010) have reported the following average correlations between academic achievement and goal orientations: learning goals ($r = 0.10/0.11$), performance-approach goals ($r = 0.06/0.13$) and performance-avoidance goals ($r = -0.13$). Work-avoidance goals were not included in these analyses. Single studies have reported that an orientation towards work-avoidance goals is consistently negatively associated with achievement ($r = -0.20$ to -0.30; e.g. Dupeyrat and Mariné 2005; Steinmayr and Spinath 2008).

Summary RQ 1

The first research question focussed on how strongly intelligence, personality and motivation are related to school achievement. In sum, the strongest relations have been found for intelligence, self-discipline and ability self-concepts, whereas the relations between school achievement and the other constructs have been moderate (intrinsic or interest values, work-avoidance goals) or weak (Openness, Agreeableness, Conscientiousness, Neuroticism, Extraversion, learning goals, performance-approach and performance-avoidance goals).

Are there mean level differences in these characteristics between boys and girls?

To answer this question, we will report mean level differences between boys and girls in terms of the effect size Cohen's *d* (Cohen 1988). Cohen's *d* can be interpreted as the difference between boys' and girls' mean levels in a certain characteristic in standard deviation units. Effects of $d \leq 0.35$ are considered small, *d* between 0.36 and 0.79 to be medium and $d > 0.80$ to be strong (based on Cohen 1988). In the following, a positive *d* stands for larger means in boys, whereas a negative *d* denotes larger means in girls.

Intelligence

Most studies have found no or only negligible gender differences in general intelligence (*MA/LR*: Halpern 2012; *MA/LR*: Hyde 2005; e.g. Johnson, Carothers, and Deary 2008; Strand, Deary, and Smith 2006). Boys show greater variability in general intelligence, that is, they are overrepresented in the extremes of the intelligence distribution (e.g. Johnson, Carothers, and Deary 2008). Similarly, there are, by and large, no or only small gender differences in most specific kinds of intelligence (*MA/LR*: Else-Quest, Hyde, and Linn 2010; *MA/LR*: Halpern 2012; *MA/LR*: Hyde 2005). Hyde's (2005) overview of meta-analyses on gender differences reported that girls have a small to moderate advantage over boys on most verbal intelligence subtests ($-0.45 \leq d \leq -0.02$), whereas boys have a small advantage over girls on some numerical ability tests but not on others ($-0.14 \leq d \leq 0.16$).

Personality traits

Gender differences in mean expressions of personality traits are small compared with the individual variation within genders (Costa, Terracciano, and McCrae 2001; Feingold 1994). On the level of the broad Big Five factors, gender differences have been found for Neuroticism and Agreeableness with women being less emotionally stable

($d = -0.30$) and more agreeable ($d = -0.28$; *MA/LR*: Costa, Terracciano, and McCrae 2001; *MA/LR*: Feingold 1994). For all other Big Five factors, gender differences should not be interpreted on the factor level but rather on the facet level because gender differences vary depending on the facet being considered (*MA/LR*: Costa, Terracciano, and McCrae 2001, for facet level). For Extraversion, adult females score higher on warmth, gregariousness, activity and positive emotions, whereas adult males score higher on assertiveness and excitement seeking. Concerning Openness, adult women score higher on four facets (aesthetics, feelings, actions, values), whereas males show higher scores on one facet (ideas). Regarding Conscientiousness, females show more dutifulness and self-discipline, whereas males show higher scores on competence. Whereas the magnitude of gender differences in self-discipline is small according to meta-analyses ($d = -0.09$; *MA/LR*: Costa, Terracciano, and McCrae 2001; $d = -0.12$; *MA/LR*: Silverman 2003), in single studies, moderate gender differences have appeared in self-discipline in favour of girls ($d = -0.71/-0.41$; Duckworth and Seligman 2005, 2006).

Motivation

With regard to gender differences in mean levels, the ability self-concept and intrinsic or interest values need to be examined domain-specifically. Boys have a more positive ability self-concept in mathematics ($d = 0.28$) and girls in languages ($d = -0.23$; *MA/LR*: Wilgenbusch and Merrell 1999). If school-related ability self-concepts are assessed in general, boys score slightly higher than girls ($d = 0.11$; *MA/LR*: Wilgenbusch and Merrell 1999). In a similar vein, intrinsic or interest values are higher for boys in mathematics ($d = 0.15$–0.69) and higher for girls in languages ($d = -0.30$ to -0.62; e.g. Spinath, Freudenthaler, and Neubauer 2010; Steinmayr and Spinath 2008, 2010; Wigfield et al. 1997). For school in general, girls show higher intrinsic motivation ($d = -0.29$ to -0.33; e.g. Freudenthaler, Spinath, and Neubauer 2008; Steinmayr and Spinath 2010).

Regarding goals, girls achieve slightly higher scores in learning goals ($d = -0.24$ to 0.04; e.g. Freudenthaler, Spinath, and Neubauer 2008; Nie and Liem 2013; Steinmayr and Spinath 2008), whereas boys have weakly to moderately higher work-avoidance scores ($d = 0.16$–0.54; e.g. Freudenthaler, Spinath, and Neubauer 2008; Steinmayr and Spinath 2008). No consistent gender differences have been found for performance-approach ($d = -0.04$ to 0.19) and performance-avoidance goals ($d = 0.00$–0.12; e.g. Freudenthaler, Spinath, and Neubauer 2008; Steinmayr and Spinath 2008).

Summary RQ 2

The second research question focussed on whether girls and boys differ in their intelligence, personality traits and motivation. In sum, there are no gender differences in general intelligence and small to moderate differences in verbal and numerical intelligence. Concerning personality traits, small to moderate gender differences have been found for Agreeableness, Neuroticism and self-discipline. With regard to motivation, there are weak gender differences for learning goals and weak to moderate gender differences for work-avoidance goals, domain-specific intrinsic motivation and ability self-concepts.

Does the importance of these characteristics as predictors of school achievement differ between boys and girls?

Next, we looked at whether intelligence, personality or motivation showed gender differences in predicting school performance. Such differences might be observed in

significantly different correlations or regression weights for boys and girls when predicting school achievement with these characteristics.

Intelligence

Neither general intelligence (e.g. Calvin et al. 2010; Fischer, Schult, and Hell 2013; Freudenthaler, Spinath, and Neubauer 2008; Steinmayr and Spinath 2008) nor domain-specific intelligence (e.g. Calvin et al. 2010; Freudenthaler, Spinath, and Neubauer 2008; Steinmayr and Spinath 2008) have been found to be differently related to school success when comparing relations for boys versus relations for girls.

Personality traits

Similarly, there have been no consistent findings that the Big Five personality traits predict school success differently for boys and girls (e.g. Freudenthaler, Spinath, and Neubauer 2008; Mellon, Schmitt, and Bylenga 1980; Steinmayr and Spinath 2008).

Motivation

By and large, motivation is, like intelligence and personality traits, not differently related to school success when comparing relations for boys with relations for girls. Meta-analyses have shown no differential prediction of boys' and girls' school achievement from the ability self-concept (*MA/LR*: Hansford and Hattie 1982; *MA/LR*: Möller et al. 2009) or from goals (*MA/LR*: Huang 2012; *MA/LR*: Hulleman et al. 2010). Some studies have found that intrinsic motivation is more important for predicting boys' compared with girls' school achievement (e.g. Freudenthaler, Spinath, and Neubauer 2008), but other studies have not been able to replicate this finding (e.g. Steinmayr and Spinath 2008).

Summary RQ 3

The third research question focussed on whether students' individual characteristics differently predict gender differences in school performance. In sum, no gender differences were found in the prediction of school achievement for intelligence, personality traits or motivation.

Can gender differences in these characteristics explain differences in boys' and girls' school achievement?

Mediation analyses were needed to answer this question. Mediation analysis can show whether the association between gender and school achievement diminishes or even vanishes completely when a certain student characteristic is controlled for. An important prerequisite for mediation is a substantial correlation between the student characteristic and school achievement. Therefore, in the following, we will report only results for characteristics that have been shown to be associated with school achievement. Although mediation is an important prerequisite for causal relations, causality cannot be established by the kind of mediation analysis used in most of the extant studies.

Intelligence

The finding that girls outperform boys on most verbal intelligence subtests and that boys outperform girls on some numerical intelligence subtests (*MA/LR*: Else-Quest, Hyde, and Linn 2010; *MA/LR*: Halpern 2012; *MA/LR*: Hyde 2005) raises the question of whether these differences account for the association between gender and school achievement. Mediation analyses have shown that girls' better verbal abilities cannot (e.g. Deary et al. 2007; Freudenthaler, Spinath, and Neubauer 2008; Steinmayr and Spinath 2008) or can only partly (about 30%; Calvin et al. 2010) explain their better school performance in languages and in general. In the same vein, boys' better numerical abilities cannot (e.g. Steinmayr and Spinath 2008; Freudenthaler, Spinath, and Neubauer 2008) or can only partly (about 50%; Calvin et al. 2010) explain their better performance in mathematics.

Personality traits

Duckworth and Seligman (2006) found that gender significantly predicted grades (GPA; Study 1: $\beta = 0.31$; Study 2: $\beta = 0.26$). When self-discipline was introduced as a mediator, the association between gender and grades was reduced to non-significance (Study 1: $\beta = 0.13$; Study 2: $\beta = 0.12$). Thus, self-discipline explained almost 50% of the magnitude of the association between gender and grades. These results held after controlling for intelligence. In a similar vein, Steinmayr and Spinath (2008) showed that Agreeableness partially mediated the association between gender and general school achievement (explaining 25% of the total effect of gender on general school achievement) as well as performance in German (as a first language) (explaining 17% of the total effect of gender on achievement in German) after controlling for intelligence.

Motivation

A study by Steinmayr and Spinath (2008) investigated different motivational constructs as mediators after controlling for intelligence. These mediating effects have to be reported on a domain-specific level, separately for performance in German and mathematics. In both ability domains, intrinsic values and ability self-concept influenced the association between gender and grades but in different ways. For performance in German, intrinsic values in German explained 48% and ability self-concept in German explained 25% of the total effect of gender on performance in German (the indirect effect of gender via motivation on school performance in relation to the total gender effect on school performance). Therefore, girls' higher performance in German could be partly explained by their higher ability self-concept and task values in German. For performance in mathematics, intrinsic values and ability self-concept in mathematics (with boys having higher scores) functioned as suppressors. In contrast with a mediator effect, a suppression effect is shown when the association between gender and school achievement is enhanced when a certain student characteristic is controlled for (cf. Tabachnick and Fidell 2007). In this regard, intrinsic values and ability self-concept enhanced the direct effect of gender on performance in mathematics (after controlling for intelligence) by 12% (intrinsic values) and 19% (ability self-concept). This means that boys' higher ability self-concept and intrinsic values in mathematics prevent them from attaining even worse grades in mathematics than girls. Furthermore, work avoidance mediated the association between gender and grades in German (explaining 19% of the total effect of

gender on performance in German). On the domain-general level, work-avoidance goals were shown to partially mediate the association between gender and GPA (explaining 35% of the total effect of gender on GPA) so that girls' higher grades in German and school performance in general could be attributed in part to their lower tendency to avoid work.

Summary RQ 4

The fourth research question focussed on whether gender differences in intelligence, personality and motivation can explain differences in boys' and girls' school achievement. In sum, gender differences in students' characteristics contribute to gender differences in school performance but cannot fully explain them.

Are gender differences in these characteristics causally related to differences in boys' and girls' school achievement?

Finally, the last research question refers to whether gender differences in the aforementioned variables cause performance differences between boys and girls in school. The answer to this question remains open for all characteristics considered here. To establish causality, experimental approaches must ideally be employed. For obvious reasons, this is not possible with regard to intelligence, personality and motivation. Thus, although mediation analyses can point out some promising candidates for explaining gender differences in school achievement, it remains unknown whether these effects are actually causal or whether they might be explained by other mechanisms.

Conclusion

With this article, we aimed to provide a systematic answer to the question: To what extent can gender differences in intelligence, personality and motivation account for gender differences in school performance? It was shown that intelligence, personality and motivation are important predictors of school achievement, but they can only partially explain gender differences in school success. It can be concluded that girls are somewhat better adapted to today's school environment than boys, and this can partially explain why they often outperform boys in academic contexts. In the following, we will briefly summarise our main findings and finish with a suggestion for how to change the school environment might be altered to help boys better adapt to academic demands.

First, we looked at the roles of intelligence, personality and motivation in school achievement (Question 1). To succeed in school, students benefit most from general intelligence, followed by self-discipline, the ability self-concept, intrinsic values and low work-avoidance goals. Because these variables are important predictors of school performance, we were interested in whether boys and girls differ in these characteristics (Question 2) and whether these characteristics predict the school performance of boys and girls differently (Question 3). Taken together, girls have small (higher verbal intelligence) to medium (higher self-discipline, domain-specific ability self-concept, intrinsic motivation, lower work-avoidance goals) advantages over boys in their achievement-related characteristics. None of these characteristics predicts girls' school achievement better than it predicts boys' school achievement.

The last two questions focussed on whether gender differences in these variables can explain (Question 4) and have been found to cause gender differences in school

performance (Question 5). Although boys and girls differ in their verbal and numerical abilities, these differences only partly contribute to girls' higher performance in languages and in general and boys' higher performance in mathematics, respectively. Concerning personality traits, girls outperforming boys in school in general can be partly attributed to girls' higher self-discipline and higher Agreeableness. Similarly, on a domain-specific level, the ability self-concept and intrinsic motivation seem to partly explain girls' higher performance in languages and boys' higher performance in mathematics, respectively. On a domain-general level, girls' higher grades can partly be attributed to their lower work-avoidance goals. Although gender differences in intelligence, personality and motivation contribute to gender differences in school performance, these differences cannot fully explain performance differences between boys and girls in school.

Finally, regarding research question 5, it remains unresolved whether girls outperform boys both in languages and in general because they have a higher verbal intelligence, self-discipline, ability self-concept and intrinsic values. Such causal inferences cannot be drawn on the basis of correlational studies. Thus, the present review identified a research gap with respect to the question of potentially causal mechanisms behind the mediation effects. The best way to establish causality is by means of experimental approaches. However, given the specific research topic of gender differences in individual student characteristics, experimental approaches are difficult or even impossible to employ. Future research should look for alternative methodological approaches to address the question of causality. For example, cross-lagged panel longitudinal designs provide an approach that comes close to establishing causality. Promising candidates for causal influences on gender differences in school achievement are the characteristics that were shown to mediate gender effects on school achievement in this review.

Moreover, future research should take into account the finding that intelligence, personality and motivation are not independent from one another. Investigating several constructs at a time and looking at combined effects will probably result in even larger shares of explained variance in boys' and girls' school achievement.

As a limitation concerning the presented findings, it needs to be noted that our review was not fully comprehensive. For some research questions, there were no meta-analyses because only a few studies exist. Of these single studies, we included only some representative examples. Thus, our review was not fully comprehensive concerning questions for which no meta-analyses were available. Moreover, the research summarised here stems from societies in which gender equality is largely realised.

If individual differences are a means for adapting to the environment, then a better adaptation can be achieved either by changing individual characteristics or by changing the environment. Although individual characteristics are malleable to some extent, changing the environment might be easier to realise. In the school environment as it is today, boys might 'get away with' behaviour that hampers learning, such as not doing homework, showing externalising behaviour, etc. A school environment that does not tolerate noncompliance with rules could decrease differences in boys' and girls' school achievement. Arguably, the challenge for schools is to generate an environment that grants students the freedom to grow up as responsible self-determined individuals, but at the same time helps individuals to reach desired outcomes such as good grades. Thus, by changing certain aspects of the school environment, it may be possible to reduce gender differences in school success and increase educational equality.

References

Baumert, J., U. Trautwein, and C. Artelt. 2003. "Schulumwelten – institutionelle Bedingungen des Lehrens und Lernens [School Environments – Institutional Conditions of Teaching and Learning]." In *PISA 2000: Ein differenzierter Blick auf die Länder der Bundesrepublik Deutschland* [PISA 2000: A Differentiated View on the Federal States of the German Federal Republic], edited by J. Baumert, C. Artelt, E. Klieme, M. Neubrand, M. Prenzel, U. Schiefele, W. Schneider, et al., 261–331. Opladen: Leske + Budrich.

Calvin, C. M., C. Fernandes, P. Smith, P. M. Visscher, and I. J. Deary. 2010. "Sex, Intelligence and Educational Achievement in a National Cohort of Over 175,000 11-year-old School Children in England." *Intelligence* 38: 424–432.

Chamorro-Premuzic, T., and A. Furnham. 2005. *Personality and Intellectual Competence*. Mahwah, NJ: Erlbaum.

Cianciolo, A. T., and R. J. Sternberg. 2004. *Intelligence: A Brief History*. Oxford: Blackwell Publishing.

Cohen, J. 1988. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Mahwah, NJ: Lawrence Erlbaum Associates.

Costa, P., A. Terracciano, and R. R. McCrae. 2001. "Gender Differences in Personality Traits Across Cultures: Robust and Surprising Findings." *Journal of Personality and Social Psychology* 81: 322–331.

Deary, I. J., S. Strand, P. Smith, and C. Fernandes. 2007. "Intelligence and Educational Achievement." *Intelligence* 35: 13–21.

De Raad, B., and H. C. Schouwenburg. 1996. "Personality in Learning and Education: A Review." *European Journal of Personality* 10: 303–336.

Digman, J. M. 1990. "Personality Structure: Emergence of the Five-factor Model." *Annual Review of Psychology* 41: 417–440.

Duckworth, A. L., and M. E. P. Seligman. 2005. "Self-discipline Outdoes IQ in Predicting Academic Performance of Adolescents." *Psychological Science* 16: 939–944.

Duckworth, A. L., and M. E. P. Seligman. 2006. "Self-discipline Gives Girls the Edge: Gender in Self-discipline, Grades, and Achievement Test Scores." *Journal of Educational Psychology* 98: 198–208.

Dupeyrat, C., and C. Mariné. 2005. "Implicit Theories of Intelligence, Goal Orientations, Cognitive Engagement, and Achievement: A Test of Dwecks' Model with Returning to School Adults." *Contemporary Educational Psychology* 30: 43–59.

Dweck, C. S. 1986. "Motivational Processes Affecting Learning." *American Psychologist* 41: 1040–1048.

Eccles, J., T. F. Adler, R. Futterman, S. B. Goff, C. M. Kaczala, J. L. Meece, and C. Midgley. 1983. "Expectancies, Values, and Academic Behaviors." In *Achievement and Achievement Motives*, edited by J. T. Spence, 75–146. San Francisco, CA: Freeman.

Elliot, A. J. 1999. "Approach and Avoidance Motivation and Achievement Goals." *Educational Psychologist* 34: 169–189.

Else-Quest, N. M., J. S. Hyde, and M. C. Linn. 2010. "Cross-national Patterns of Gender Differences in Mathematics: A Meta-analysis." *Psychological Bulletin* 136: 103–127.

Epstein, D., J. Elwood, V. Jey, and J. Maw. 1998. *Failing Boys? Issues in Gender and Achievement*. Buckingham: Open University Press.

Eysenck, M. W., N. Derakshan, R. Santos, and M. G. Calvo. 2007. "Anxiety and Cognitive Performance: Attentional Control Theory." *Emotion* 7: 336–353.

Feingold, A. 1994. "Gender Differences in Personality: A Meta-analysis." *Psychological Bulletin* 116: 429–456.

Fischer, F., J. Schult, and B. Hell. 2013. "Sex Differences in Secondary School Success: Why Female Students Perform Better." *European Journal of Psychology of Education* 28: 529–543.

Freudenthaler, H., B. Spinath, and A. Neubauer. 2008. "Predicting School Achievement in Boys and Girls." *European Journal of Personality* 22: 231–245.

Goldberg, L. R. 1990. "An Alternative 'description of personality': The Big-five Factor Structure." *Journal of Personality and Social Psychology* 59: 1216–1229.

Gottfried, A. E. 1985. "Academic Intrinsic Motivation in Elementary and Junior High School Students." *Journal of Educational Psychology* 77: 631–645.

Gottfried, A. E. 1990. "Academic Intrinsic Motivation in Young Elementary School Children." *Journal of Educational Psychology* 82: 525–538.

Gustafsson, J.-E., and J. O. Undheim. 1996. "Individual Differences in Cognitive Functions." In *Handbook of Educational Psychology*, edited by D. C. Berliner and R. C. Calfee, 186–242. New York: Prentice Hall International.

Halpern, D. F. 2012. *Sex Differences in Cognitive Abilities*. 4th ed. New York: Psychology Press.

Hansford, B. C., and J. A. Hattie. 1982. "The Relationship Between Self and Achievement/Performance Measures." *Review of Educational Research* 52: 123–142.

Huang, C. 2012. "Discriminant and Criterion-related Validity of Achievement Goals in Predicting Academic Achievement: A Meta-analysis." *Journal of Educational Psychology* 104: 48–73.

Hulleman, C. S., S. M. Schrager, S. M. Bodmann, and J. M. Harackiewicz. 2010. "A Meta-analytic Review of Achievement Goal Measures: Different Labels for the Same Constructs or Different Constructs with Similar Labels?" *Psychological Bulletin* 136: 422–449.

Hyde, J. S. 2005. "The Gender Similarity Hypothesis." *American Psychologist* 60: 581–592.

Johnson, W., A. Carothers, and I. J. Deary. 2008. "Sex Differences in Variability in General Intelligence: A New Look at the Old Question." *Perspectives on Psychological Science* 3: 518–531.

McCrae, R. R., and P. T. Costa. 1987. "Validation of the Five-factor Model of Personality Across Instruments and Observers." *Journal of Personality and Social Psychology* 52: 81–90.

Mellon, P. M., N. Schmitt, and C. Bylenga. 1980. "Differential Predictability of Females and Males." *Sex Roles* 6: 173–177.

Möller, J., B. Pohlmann, O. Köller, and H. W. Marsh. 2009. "A Meta-analytic Path Analysis of the Internal/External Frame of Reference Model of Academic Achievement and Academic Self-concept." *Review of Educational Research* 79: 1129–1167.

Murphy, P. K., and P. A. Alexander. 2000. "A Motivated Exploration of Motivation Terminology." *Contemporary Educational Psychology* 25: 3–53.

Neisser, U., G. Boodoo, T. J. Bouchard, A. W. Boykin, N. Brody, S. J. Ceci, D. F. Halpern, et al. 1996. "Intelligence: Knowns and Unknowns." *American Psychologist* 51: 77–101.

Nicholls, J. G. 1984. "Achievement Motivation: Conceptions of Ability, Subjective Experience, Task Choice, and Performance." *Psychological Review* 91: 328–346.

Nie, Y., and G. A. D. Liem. 2013. "Extending Antecedents of Achievement Goals: The Double-edged Sword Effect of Social-oriented Achievement Motive and Gender Differences." *Learning and Individual Differences* 23: 249–255.

Poropat, A. E. 2009. "A Meta-analysis of the Five-factor Model of Personality and Academic Performance." *Psychological Bulletin* 135: 322–338.

Scottish Office. 1998. *Raising Standards – Setting Targets: Gender Issues in Raising Attainment*. Edinburgh: HMSO.

Schiefele, U., A. Krapp, and A. Winteler. 1992. "Interest as a Predictor of Academic Achievement: A Meta-analysis of Research." In *The Role of Interest in Learning and Development*, edited by K. A. Renninger, S. Hidi, and A. Krapp, 183–212. Hillsdale, NJ: Lawrence Erlbaum Associates.

Silverman, I. W. 2003. "Gender Differences in Delay of Gratification: A Meta-analysis." *Sex Roles* 49: 451–463.

Spinath, B., H. Freudenthaler, and A. Neubauer. 2010. "Predicting Domain-specific School Achievement in Boys and Girls by Intelligence, Personality and Motivation." *Personality and Individual Differences* 48: 481–486.

Steinmayr, R., and B. Spinath. 2007. "Predicting School Achievement from Motivation and Personality." *Zeitschrift für Pädagogische Psychologie* [German Journal of Educational Psychology] 21: 207–216.

Steinmayr, R., and B. Spinath. 2008. Sex Differences in School Achievement: What are the Roles of Personality and Achievement Motivation? *European Journal of Personality* 22: 185–209.

Steinmayr, R., and B. Spinath. 2009. "The Importance of Motivation as a Predictor of School Achievement." *Learning and Individual Differences* 19: 80–90.

Steinmayr, R., and B. Spinath. 2010. "Konstruktion und erste Validierung einer Skala zur Erfassung subjektiver schulischer Werte (SESSW) [Construction and First Validation of a Scale for Assessing Subjective School-related Values]." *Diagnostica* 56: 195–211.

Strand, S., I. J. Deary, and P. Smith. 2006. "Sex Differences in Cognitive Ability Test Scores: A UK National Picture." *British Journal of Educational Psychology* 76: 463–480.

Tabachnick, B. G., and L. S. Fidell. 2007. *Using Multivariate Statistics*. 5th ed. Boston, MA: Pearson.

Trautwein, U., O. Lüdtke, H. W. Marsh, O. Köller, and J. Baumert. 2006. "Tracking, Grading, and Student Motivation: Using Group Composition and Status to Predict Self-concept and Interest in Ninth-grade Mathematics." *Journal of Educational Psychology* 98: 788–806.

Wigfield, A., and J. S. Eccles. 2000. "Expectancy-value Theory of Achievement Motivation." *Contemporary Educational Psychology* 25: 68–81.

Wigfield, A., J. S. Eccles, K. S. Yoon, R. D. Harold, A. J. A. Arbreton, C. Freedman-Doan, and P. Blumenfeld. 1997. "Change in Children's Competence Beliefs and Subjective Task Values Across the Elementary School Years: A 3-year Study." *Journal of Educational Psychology* 89: 451–469.

Wilgenbusch, T., and K. W. Merrell. 1999. "Gender Differences in Self-concept Among Children and Adolescents: A Meta-analysis of Multidimensional Studies." *School Psychology Quarterly* 14: 1001–1120.

Wong, K.-C., Y. R. Lam, and L.-M. Ho. 2002. "The Effects of Schooling on Gender Differences." *British Educational Research Journal* 28: 827–843.

Zeidner, M., ed. 1995. *Personality Trait Correlates of Intelligence*. New York: Plenum Press.