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Brief Report

The association between personality and cognitive ability: Going beyond simple effects

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ABSTRACT

To examine the relationship between the Big Five and cognitive ability, we investigated whether we could replicate in a heterogeneous population sample the positive association between cognitive ability and Openness and Emotional Stability and its negative association with Conscientiousness. Besides analyzing the pure associations, we shed further light on sources of these associations by investigating potential moderating effects of education and labor force participation. Our results clearly replicate the previously found positive association between cognitive ability and Emotional Stability and Openness and the negative relationship between Conscientiousness and cognitive ability. The correlation between cognitive ability and Openness was found to be moderated by educational attainment, the negative association between Conscientiousness and cognitive ability was moderated by labor force participation.

1. Introduction

The degree to which personality and cognitive ability are related is a question that has generated intensive research and intense debate. Some authors have concluded that intelligence test performance may be influenced by some non-ability traits but that intelligence and personality are two independent constructs (Zeidner & Matthews, 2000). Others (e.g., Ackerman, 1996) have argued that personality traits play a significant role in the development of intellectual skills. With regard to the most well-established model of personality, the Big Five, numerous studies and meta-analyses have indicated a substantial but comparatively modest association between personality and intelligence. The proportion of variance in cognitive ability explained by personality typically ranges between five and ten percent (Furnham, Dissou, Sloan, & Chamorro-Premuzic, 2007). Studies have consistently found a positive link between cognitive ability and Openness (see, for example, meta-analytical results by Ackerman & Heggestad, 1997 and Von Stumm & Ackerman, 2013) and Emotional Stability (e.g., Ackerman & Heggestad, 1997; Moutafi, Furnham, & Crump, 2003; Zeidner & Matthews, 2000), and a negative association between cognitive ability and Conscientiousness (e.g., DeYoung, 2011; Furnham et al., 2007; Moutafi et al., 2003; Soubelet & Salthouse, 2011).

In particular, the negative association between Conscientiousness and cognitive ability appears contradictory at first sight, given that both intelligence and Conscientiousness are positively associated with work-related outcomes (e.g., Barrick & Mount, 1991; Gottfredson, 1997; Schmidt & Hunter, 1998). As one possible explanation for this "mysterious" effect (see Furnham et al., 2007), it has been suggested that the consistently found negative association between Conscientiousness and intelligence might be a methodological artifact caused by a sampling bias (e.g., Murray, Johnson, McGue, & Iacono, 2014; Soubelet & Salthouse, 2011). Almost all of these studies investigated only college student populations (see Furnham et al., 2007), and thus samples that are comparatively homogeneous with regard to education, age, labor market experience, and intelligence itself. Hence, the negative association might have been artificially created because individuals with low cognitive ability and low Conscientiousness were missing from the samples (see Major, Johnson, & Deary, 2014). Whether the negative association between Conscientiousness and cognitive ability can be replicated in a more heterogeneous adult population and can therefore be regarded as a general effect is a hitherto unanswered question.

Besides offering methodological explanations, some researchers have also tried to explain the negative association between cognitive competencies and Conscientiousness substantively. Based on their finding that the Conscientiousness facet Orderliness, in

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particular, is negatively correlated with intelligence, Moutafi et al. (2003) argued that people with lower intelligence use planning and organization to compensate for their disadvantage on intellectual tasks (for a rebuttal, see Murray et al., 2014).

1.1. Measuring cognitive ability

Competence tests, such as those used in the Organisation for Economic Co-operation and Development's (OECD) Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS), are highly correlated with intelligence. For TIMSS, Lynn and Mikk (2007), for example, report correlations with a general intelligence factor ranging between 0.92 and 1. Similar results can be found for PISA (e.g., Rindermann, 2006) and for the National Adult Literacy Survey (NALS; Gottfredson, 1997). It has even been debated whether the literacy, mathematics (or numeracy), and science competence tests measure general intelligence from a conceptual and empirical perspective (Rindermann, 2006). Other researchers have shown, however, that – in addition to general intelligence – such competence tests assess domain-specific competencies (e.g., Baumert, Brunner, Lüdtke, & Trautwein, 2007; Gottfredson, 1997). This debate notwithstanding, it has been clearly shown that – to a large extent – these competence tests measure general intelligence. Thus, these competence measures can be regarded as appropriate indicators of cognitive ability. For example, Hunt and Wittmann (2008) used the PISA 2003 competence measures as a proxy for intelligence to replicate results on country differences in IQ initially reported by Lynn and Vanhanen (2002). And Gottfredson (1997) used NALS data to show that general intelligence (*g*) is associated with cumulative life outcomes such as labor force participation or living in poverty.

Besides being good indicators of cognitive ability, competence measures used in studies such as PISA, TIMSS, and the OECD-initiated Programme for the International Assessment of Adult Competencies (PIAAC; aka "PISA for adults") have a further advantage compared to the commonly used IQ data – namely, that they are based on probability samples that are representative of the respective target populations (PISA: 15-year-olds; PIAAC: adults between 16 and 65 years of age) in the participating countries.

1.2. Aim of the present study

The present study examines the relationship between personality – in particular, the Big Five personality domains – and cognitive ability. As indicators of cognitive ability, we used the competence measures of the literacy and numeracy domains assessed in PIAAC. We investigated whether it was possible to replicate the previously found positive association between cognitive ability and Openness and Emotional Stability and its negative association with Conscientiousness. As it has been suggested that this negative correlation between Conscientiousness and cognitive ability might be caused by biased – primarily college student – samples, we investigated whether this effect was in fact less pronounced in a more heterogeneous adult population. Besides analyzing the pure associations, we aimed to shed further – or new – light on causes of these links by examining potential moderating effects of education and labor force participation.

2. Method

2.1. Sampling method and participants

Data for the present study were collected in part within PIAAC. This programme compares cognitive skills such as literacy and numeracy across a large number of (mainly OECD) countries. For the present research, we analyzed the German PIAAC data.[1] The target population were adults (aged between 16 and 65 years) randomly selected from local population registers in randomly selected municipalities throughout Germany. Participation in PIAAC was voluntary; an incentive of 50 euros was offered upon participation in the survey, which comprised a personal interview (average duration: 45 min) and a cognitive assessment lasting approximately 60 min. No time limit was imposed on the cognitive test. A detailed description of the sampling procedure and the technical implementation is given in Zabal et al. (2014).

In addition to the PIAAC study conducted in 2012, 3758 of the original 5465 participants in Germany were re-interviewed in 2014 as part of the PIAAC Longitudinal Study (PIAAC-L).[2] Data from the 2012 German PIAAC wave and the 2014 follow-up survey were combined and used for the present analyses.

2.2. Measures and procedure

The following variables from PIAAC 2012 were investigated:

Verbal and numerical cognitive ability: Literacy and numeracy skills assessed in PIAAC were used as measures of verbal and numerical cognitive ability. Both competencies were assessed using a multistage adaptive testing design comprising a total of 58 items for literacy and 56 items for numeracy. Using a largely randomized procedure, respondents were allocated to the competence domains. Detailed information on the nature of the test and a selection of sample items are provided in the reader's companion for the survey (OECD, 2013a, pp. 17).[3] For each participant, 10 plausible values were estimated for each competency domain. (For details of the design and the IRT scaling process in PIAAC, see OECD, 2013b). Analyses of the cognitive data were run separately for each of the ten plausible values per domain. Results were then averaged within each domain.

Education: Each respondent's highest level of educational attainment was assessed with two separate questions (highest general education and highest vocational education qualification in the categories of the German education system), which were then mapped to the 1997 International Standard Classification of Education (ISCED 1997; [PIAAC 2012 variable: B_Q01a]).[4] Forty-one respondents who reported that they had a foreign educational qualification for which they were unable to state the German equivalent were excluded from the analyses.

In addition variables from the 2014 PIAAC-L follow-up were used for the present analyses:

Labor force participation: All respondents were asked to report whether they were currently employed and, if not, what their current status was (PIAAC-L 2014 variable: perw_14). Based on this, a dichotomous variable was generated and used in the analyses (1 = *in full-time employment*, 0 = *not in full-time employment*).[5]

[1] Rammstedt, B. et al. (2015). Programme for the International Assessment of Adult Competencies (PIAAC). Germany – Reduced Version. GESIS Data Archive, Cologne. ZA5845 Datenfile Version 2.0.0, http://dx.doi.org/10.4232/1.12182.

[2] GESIS – Leibniz Institute for the Social Sciences, German Socio-Economic Panel (SOEP) at DIW Berlin & LIfBi – Leibniz Institute for Educational Trajectories (2016): PIAAC-Longitudinal (PIAAC-L), Germany. GESIS Data Archive, Cologne. ZA5989 Data File Version 1.0.0, http://dx.doi.org/10.4232/1.12487.

[3] See also: www.oecd.org/site/piaac/mainelementsofthesurveyofadultskills.htm.

[4] Eighteen respondents reported that they had no formal qualification or a qualification below ISCED level 1; 185 respondents reported that they had attained ISCED level 1; 373 reported ISCED level 2; 1606 reported ISCED level 3A-B; 18 reported ISCED level 4A-B; 261 reported ISCED level 4 (without distinction A–B–C); 476 reported ISCED level 5B; 134 reported ISCED level 5A (bachelor's degree); 602 reported ISCED level 5A (master's degree); and 44 reported ISCED level 6. Foreigners who obtained their qualifications in another country were asked to report the German equivalent. If they were unable to do so, they were excluded from the analyses ($n = 41$).

[5] Besides part-time employed respondents, this category includes those who were unemployed or not in the labor force.

Table 1
Means and standard deviations of the Big Five scales, and correlations with verbal and numerical ability (correlations corrected for attenuation in brackets).

	M	*SD*	Extraversion	Agreeableness	Emotional Stability	Conscientiousness	Openness	Verbal ability[a]
Extraversion	5.03	1.15						
Agreeableness	5.44	0.95	0.04*** (0.08)					
Emotional Stability	4.17	1.26	0.14*** (0.21)	0.11*** (0.22)				
Conscientiousness	5.78	0.94	0.17*** (0.27)	0.22*** (0.45)	0.04** (0.07)			
Openness	4.83	1.17	0.31*** (0.50)	0.09*** (0.19)	−0.03 (−0.05)	0.12*** (0.21)		
Verbal ability[a]	277.33	0.44	−0.05** (−0.06)	−0.02 (−0.03)	0.11*** (0.14)	−0.09*** (−0.12)	0.05** (0.07)	
Numerical ability[a]	280.02	0.36	−0.06** (−0.07)	−0.03 (−0.05)	0.14*** (0.18)	−0.08*** (−0.10)	0.05** (0.07)	0.87***

[a] Means and standard deviations were averaged across the ten plausible values, correlations were Fisher's Z-transformed, averaged, and then back-transformed, Die BFI-S item were measured on a scale from 1 to 7.
** $p < 0.01$.
*** $p < 0.001$.

Respondents who indicated that they were still undergoing education were excluded from the analyses. The rationale behind dividing respondents into two groups – full-time employed and not full-time employed – was (1) to separate respondents for whom working is the most substantial part of their everyday lives from other respondents, (2) to create categories of similar size, and (3) to simplify the interpretation of the interaction term by creating a binary variable.

In addition, a short version of the Big Five Inventory (BFI; John, Donahue, & Kentle, 1991) comprising three items per dimension was administered to respondents in the 2014 follow-up survey to assess their personality. This 15-item questionnaire – originally developed for use in the German Socio-Economic Panel (SOEP; Schupp & Gerlitz, 2014) – contains short statements, which are rated on a seven-point Likert scale ranging from 1 = "does not apply at all" to 7 = "applies completely." Studies investigating the reliability and validity of this BFI-S have concluded that its psychometric properties were acceptable (e.g., Hahn, Gottschling, & Spinath, 2012). In the present sample, Cronbach's alpha for the BFI-S scales ranged between 0.41 for Agreeableness and 0.69 for Extraversion.[6]

As our study design – though longitudinal – includes only one assessment of cognitive abilities and personality, respectively, we subjected the data to cross-sectional analysis.

3. Results

To what degree is personality related to a person's cognitive ability? To investigate this question, we correlated the scale scores for the Big Five dimensions with the estimates for verbal and numerical ability. Besides means and standard deviations for the five personality domains, Table 1 shows the resulting correlations between the Big Five and verbal and numerical ability. For both competency domains, the strongest correlation found was with Emotional Stability (0.11 and 0.14, respectively), indicating that emotionally stable persons have, on average, higher verbal and numerical abilities. In addition, both abilities were found to be significantly negatively related to Conscientiousness (−0.09 and −0.08, respectively). Smaller, but still significant, correlations were found between both cognitive abilities and Openness and Extraversion, indicating that introverts (−0.05 and −0.06, respectively) and open persons (0.05 for both domains) have, on average, higher cognitive abilities.

In a second step, we analyzed the degree to which the Big Five personality domains incrementally predict cognitive ability. Studies have shown that intelligence is highly related to education and to work outcomes (e.g., Gottfredson, 1997; Schmidt & Hunter, 1998). We therefore investigated the extent to which the Big Five contribute to predicting intelligence over and above education and labor force participation.

In a first step, we conducted regression analyses including only the Big Five personality domains. As a recent study (Major et al., 2014) demonstrated that there are also quadratic associations between personality and cognitive ability, we included both linear and quadratic relations in our analyses. In a second and third step, we then included in the regression analyses (a) the highest level of educational attainment and (b) labor force participation. As the highest level of educational attainment is a valid predictor only for those participants who have completed their initial formal education, we excluded all participants from further analyses who reported that they were still undergoing education ($N = 544$). We conducted the regression analyses separately for each of the ten plausible values and then averaged the regression coefficients across the ten analyses.

The regression results for all three analyses – (1) Big Five only, (2) Big Five and highest educational qualification, and (3) Big Five, highest educational qualification, and labor force participation – are displayed in Table 2. When only the Big Five domains were included in the model, Emotional Stability was the strongest predictor of intelligence, followed by Extraversion, Openness, and Conscientiousness; both Extraversion and Conscientiousness were negatively correlated with cognitive ability. In addition to these linear effects, a small quadratic association of Conscientiousness with both cognitive abilities was also detected, which indicates that very high Conscientiousness scores, in particular, are associated with lower cognitive ability. Overall, the model explained four and six percent of the variance in the two domains, respectively.

In a second step, we investigated the degree to which the Big Five explained additional variance over and above the highest educational qualification, as the primary predictor of cognitive ability. In addition, we analyzed whether the personality domains interacted with the educational qualification in predicting cognitive ability – in other words, whether the ability of persons with higher or lower education was more sensitive to personality effects. We

[6] These coefficients appear low at first sight. However, in evaluating these it has to be kept in mind, that (a) Cronbach's alpha is only a lower bound estimate of reliability for heterogeneous scales, (b) the BFI-S items were selected to be heterogeneous and to represent a maximum bandwidth of the corresponding construct, and (c) the coefficients are in line with earlier studies investigating the psychometric properties of the BFI-S (Hahn et al., 2012).

Table 2
Verbal and numerical ability regressed on the Big Five, education, and labor force participation.

Predictor	Verbal ability			Numerical ability		
	Standardized regression coefficient	*p*	R^2	Standardized regression coefficient	*p*	R^2
Model 1			0.04 (0.00)			0.06 (0.00)
Extraversion (linear)	−0.07 (0.01)	0.001 (0.001)		−0.09 (0.01)	<0.001 (0.000)	
Agreeableness (linear)	−0.02 (0.01)	0.231 (0.147)		−0.05 (0.01)	0.021 (0.016)	
Emotional Stability (linear)	0.13 (0.01)	<0.001 (0.000)		0.17 (0.01)	<0.001 (0.000)	
Conscientiousness (linear)	−0.11 (0.01)	<0.001 (0.000)		−0.10 (0.01)	<0.001 (0.000)	
Openness (linear)	0.07 (0.01)	0.001 (0.002)		0.08 (0.01)	<0.001 (0.000)	
Extraversion (quadratic)	0.01 (0.01)	0.572 (0.210)		0.01 (0.00)	0.778 (0.164)	
Agreeableness (quadratic)	−0.03 (0.01)	0.104 (0.069)		−0.04 (0.01)	0.062 (0.041)	
Emotional Stability (quadratic)	−0.03 (0.01)	0.097 (0.060)		−0.03 (0.01)	0.107 (0.110)	
Conscientiousness (quadratic)	−0.10 (0.01)	<0.001 (0.000)		−0.10 (0.01)	<0.001 (0.000)	
Openness (quadratic)	−0.03 (0.00)	0.103 (0.046)		−0.04 (0.00)	0.034 (0.012)	
Model 2			0.25 (0.01)			0.28 (0.01)
Extraversion (linear)	−0.02 (0.01)	0.352 (0.163)		−0.04 (0.01)	0.031 (0.026)	
Agreeableness (linear)	0.00 (0.01)	0.733 (0.177)		−0.02 (0.01)	0.251 (0.147)	
Emotional Stability (linear)	0.06 (0.01)	<0.001 (0.001)		0.10 (0.01)	<0.001 (0.000)	
Conscientiousness (linear)	−0.11 (0.01)	<0.001 (0.000)		−0.09 (0.01)	<0.001 (0.000)	
Openness (linear)	0.01 (0.01)	0.622 (0.224)		0.01 (0.01)	0.472 (0.217)	
Extraversion (quadratic)	0.01 (0.01)	0.584 (0.244)		0.00 (0.00)	0.780 (0.157)	
Agreeableness (quadratic)	−0.01 (0.01)	0.570 (0.259)		−0.01 (0.01)	0.449 (0.215)	
Emotional Stability (quadratic)	−0.01 (0.01)	0.410 (0.199)		−0.01 (0.01)	0.405 (0.290)	
Conscientiousness (quadratic)	−0.07 (0.01)	<0.001 (0.000)		−0.07 (0.01)	<0.001 (0.001)	
Openness (quadratic)	−0.02 (0.00)	0.250 (0.117)		−0.03 (0.00)	0.076 (0.031)	
Education	0.45 (0.01)	<0.001 (0.000)		0.47 (0.01)	<0.001 (0.000)	
Education ∗ E	−0.02 (0.01)	0.296 (0.138)		−0.03 (0.01)	0.063 (0.081)	
Education ∗ A	−0.01 (0.01)	0.681 (0.208)		0.00 (0.01)	0.655 (0.148)	
Education ∗ ES	−0.02 (0.01)	0.275 (0.177)		−0.01 (0.01)	0.617 (0.304)	
Education ∗ C	0.01 (0.01)	0.647 (0.275)		0.01 (0.01)	0.624 (0.270)	
Education ∗ O	−0.09 (0.01)	<0.001 (0.000)		−0.08 (0.01)	<0.001 (0.000)	
Model 3			0.26 (0.01)			0.31 (0.01)
Extraversion (linear)	−0.03 (0.01)	0.267 (0.150)		−0.06 (0.01)	0.021 (0.025)	
Agreeableness (linear)	0.05 (0.01)	0.068 (0.037)		0.03 (0.01)	0.170 (0.072)	
Emotional Stability (linear)	0.03 (0.01)	0.247 (0.190)		0.06 (0.01)	0.017 (0.019)	
Conscientiousness (linear)	−0.05 (0.01)	0.101 (0.121)		−0.03 (0.02)	0.240 (0.233)	
Openness (linear)	0.04 (0.01)	0.152 (0.075)		0.04 (0.01)	0.118 (0.072)	
Extraversion (quadratic)	0.01 (0.01)	0.635 (0.257)		0.00 (0.00)	0.846 (0.102)	
Agreeableness (quadratic)	−0.01 (0.01)	0.480 (0.250)		−0.02 (0.01)	0.363 (0.196)	
Emotional Stability (quadratic)	−0.01 (0.01)	0.451 (0.231)		−0.01 (0.01)	0.453 (0.295)	
Conscientiousness (quadratic)	−0.06 (0.01)	<0.001 (0.001)		−0.06 (0.01)	0.001 (0.003)	
Openness (quadratic)	−0.01 (0.00)	0.378 (0.156)		−0.02 (0.00)	0.155 (0.058)	
Education	0.43 (0.01)	<0.001 (0.000)		0.44 (0.01)	<0.001 (0.000)	
Education ∗ E	−0.02 (0.00)	0.340 (0.142)		−0.03 (0.01)	0.060 (0.072)	
Education ∗ A	0.00 (0.01)	0.775 (0.159)		0.00 (0.01)	0.713 (0.240)	
Education ∗ ES	−0.02 (0.01)	0.171 (0.117)		−0.01 (0.01)	0.445 (0.260)	
Education ∗ C	0.02 (0.01)	0.185 (0.134)		0.03 (0.01)	0.137 (0.089)	
Education ∗ O	−0.08 (0.01)	<0.001 (0.000)		−0.07 (0.01)	<0.001 (0.000)	
Full-time	0.12 (0.01)	<0.001 (0.000)		0.17 (0.01)	<0.001 (0.000)	
Full-time ∗ E	0.01 (0.01)	0.551 (0.195)		0.03 (0.01)	0.312 (0.224)	
Full-time ∗ A	−0.04 (0.01)	0.085 (0.040)		−0.05 (0.01)	0.052 (0.039)	
Full-time ∗ ES	0.02 (0.01)	0.429 (0.179)		0.02 (0.01)	0.415 (0.205)	
Full-time ∗ C	−0.09 (0.01)	<0.001 (0.000)		−0.09 (0.01)	<0.001 (0.001)	
Full-time ∗ O	−0.03 (0.01)	0.217 (0.103)		−0.03 (0.01)	0.299 (0.199)	

Note. Parameters are averaged across the ten plausible values (*SD* in brackets), E = Extraversion, A = Agreeableness, C = Conscientiousness, ES = Emotional Stability, O = Openness, $N = 3174$.

therefore included the highest educational qualification in the regression. Results reveal that – for both domains – the effects of personality on cognitive ability decreased after controlling for education. Only Emotional Stability (0.06 and 0.10, respectively) and (low) Conscientiousness (−0.11/−0.07 and −0.09/−0.07, respectively) were found to have substantial associations with verbal and numerical ability over and above the educational qualification. In addition to these main effects for both skill domains, Openness significantly interacted with education level in predicting cognitive ability (−0.09 and −0.08, respectively), indicating that persons with a lower level of educational attainment benefit from high Openness with regard to their cognitive abilities.

In a third step, we analyzed (a) whether the Big Five were still predictive of cognitive ability when both educational attainment and labor force participation (in full-time employment vs. not in full-time employment) were taken into account, and (b) whether this predictiveness varied across full-time employed and not full-time employed respondents. Results regarding the remaining main effects for personality after controlling for both educational attainment and labor force participation[7] are slightly different for the two cognitive abilities: In the case of verbal ability, none of the Big Five domains proved to have a significant direct relationship with the ability level, whereas in the case of numerical ability, Emotional Stability (0.06) followed by Extraversion (−0.06) predicted a significant

[7] Including labor-force participation first and then educational attainment did not change the patterns of the associations.

share of ability after controlling for education and labor force participation. However, the interactions of personality and labor force participation in predicting cognitive ability were absolutely parallel across both domains. Conscientiousness significantly interacted with labor force participation in predicting intelligence (−0.09 for both domains), which indicates that among persons in full-time employment, Conscientiousness is negatively associated with cognitive ability; no such relationship was found among non-employed persons or persons in part-time employment.[8]

4. Discussion

The present study investigated the relationship between personality and cognitive ability. As previous studies have been criticized for investigating student populations only, we examined whether the previously found associations between cognitive ability and Openness and Emotional Stability and its negative association with Conscientiousness could be generalized to a heterogeneous adult population. By analyzing data from the German PIAAC and PIAAC-L surveys – using the competence estimates for literacy and numeracy as indicators of verbal and numerical cognitive ability – we also investigated the degree to which these associations replicated in a linguistic and cultural setting other than those featured in earlier studies that focused on US or British samples.

Based on this heterogeneous sample, the magnitude of the variance explained by the Big Five personality domains is, overall, highly comparable with that reported by earlier studies in this field that were based on selective samples (see Furnham et al., 2007). In addition, our results clearly replicated the positive association typically found between cognitive ability and Emotional Stability; this replication was completely consistent across verbal and numerical ability. In addition, we were also able to confirm the positive relationship between cognitive ability and Openness. However, the latter effect was found to interact with the person's level of educational attainment: High Openness was a predictor of cognitive ability only for persons with low educational qualifications. For highly educated persons, by contrast, no such relationship could be identified. Our results thus suggest that being open-minded and intellectually interested can be beneficial to the intellectual development of persons socialized in intellectually less stimulating surroundings – that is, persons who leave the education system early. Alternatively, it could be that persons with comparatively higher cognitive ability leaving the educational system early become more open-minded and curious, e.g. to retain intellectual stimulating surroundings.

Theorists have debated possible explanations for the regularly found negative association between Conscientiousness and cognitive ability. One hypothesis that has been proposed is that this correlation is a methodological artifact caused by the sampling bias of previous studies. If this hypothesis that the negative correlation between intelligence and Conscientiousness applies only to highly educated college student populations were correct, an interaction between education and Conscientiousness should be found in predicting ability in a heterogeneous sample. We therefore investigated (a) the extent to which this correlation was replicated in data representing the full adult population and (b) whether we could identify this hypothesized interaction of education and Conscientiousness in this comprehensive data set. On the basis of these data, we were able to negate this hypothesis and to show that this negative association is not in fact caused by a sampling bias. Rather, in a heterogeneous population sample, too, there is a negative association between verbal and numerical ability and Conscientiousness. As suggested by Major et al. (2014), we also investigated quadratic effects and found a negative quadratic association between Conscientiousness and ability, which indicates that very highly conscientious respondents, in particular, show lower cognitive ability. In addition, our analyses revealed no interaction between Conscientiousness and education in predicting cognitive ability. Our results therefore support the assumption that there is a negative relationship between Conscientiousness and cognitive ability and contribute to further understanding this association. We could show that the relationship between Conscientiousness and cognitive ability is moderated by labor force participation and that the negative association between Conscientiousness and intelligence applies only to persons in full-time employment. Conscientiousness and intelligence are both highly relevant criteria for job success (e.g., Barrick & Mount, 1991; Gottfredson, 1997; Schmidt & Hunter, 1998). Our results can thus be interpreted as supporting the intelligence compensation hypothesis (Moutafi et al., 2003), which assumes that, on the labor market, people can compensate comparatively low cognitive ability with high Conscientiousness. By contrast, more cognitively talented persons fulfill their job requirements more easily and do not therefore need to be as conscientious. Alternatively, however, the interaction effect of labor force participation and Conscientiousness on cognitive ability found here might reflect personality differences among occupations. It could be the case, for example, that lower-skilled workers are more conscientious than high-skilled persons.

Our study thus showed that the negative association between Conscientiousness and intelligence is not restricted to college student populations. Rather, our findings provide preliminary evidence that this association can indeed be found in the total population, albeit not in a uniform way: It is more pronounced among persons in full-time employment. Hence, our results support the assumption that low cognitive abilities can be compensated with high Conscientiousness.

However, as the present study investigated the Big Five personality domains using a very brief instrument, further studies are needed that replicate the effects found here using longer Big Five instruments that also allow differential effects of the domain's facets to be examined.

Another limitation of the present study – or at least one difference between it and earlier studies – might be the fact that ability was assessed in a low-stakes setting, which may have affected the individual's test motivation. As shown in a recent study (Duckworth, Quinn, Lynam, Loeber, & Stouthamer-Loeber, 2011), test motivation can have an impact not only on the test scores themselves but also on associations of ability with life outcomes, for example, with personality characteristics.

In sum, our findings clearly replicate the simple positive association between cognitive ability and Emotional Stability and Openness and its negative association with Conscientiousness. In addition, we were able to show that the association with Openness is moderated by education insofar as only persons with a low level of education benefit intellectually from high Openness. Labor force participation moderates the negative association between cognitive ability and Conscientiousness, indicating that Conscientiousness is negatively linked to cognitive ability only among persons in full-time employment. Hence, our results contribute to understanding the associations between personality and cognitive ability.

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[8] There were no range restrictions of the cognitive ability variables or the Conscientiousness variable that may have biased the results (|skewness| < 0.72, |kurtosis| < 0.44).

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