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## When IQ is not everything: Intelligence, personality and academic performance at school

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### ABSTRACT

Surprisingly little research has examined the interaction between cognitive ability and personality amongst adolescents. We hypothesized that high cognitive ability would be of most benefit to school performance amongst those adolescents who were also high in “openness/intellect”. Respondents were 786 high school students (418 males, 359 females; 9 did not report) who completed standardized cognitive ability tests in the 7th Grade and provided personality and school performance scores in the 10th Grade. The mean age of participants in Grade 10 was 15.41 yrs. ( $SD = 0.53$ ). As expected, intellect was associated with higher academic performance amongst those high in ability, but not amongst those low in ability, and this effect was consistent across different subjects, and across parametric and nonparametric analyses. The effect was not eliminated when other personality traits were controlled. We discuss the implications of these findings for understanding and increasing academic performance.

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### 1. Introduction

The adolescent years are a critical period of the lifespan and understanding the role that individual difference factors play in predicting the academic performance of youth is of paramount importance. It is well documented, for instance, that those who complete high school have improved financial outcomes over those who do not (Ceci & Williams, 1997). Countries are now ranked with respect to the achievement of their students in reading, mathematics, and science (Organisation for Economic Co-operation and Development, 2011). Maximizing the academic success of young people may be of critical national importance in the globalised economy.

Perhaps not surprisingly, a rather large psychological literature now exists on the relationships between individual difference factors (such as personality and mental ability) and scholastic achievement, a literature that can be traced back for at least a century, if not longer (e.g., Webb, 1915). In our report we present longitudinal data in which we assess the significant predictors of academic success at school. Our paper extends previous research by focusing on the interaction of personality and intelligence amongst adolescents.

#### 1.1. The role of the major personality dimensions

Two meta-analyses have examined the relationships with academic performance and the Big Five (Poropat, 2009) and Eysenck's Big Three personality factors (Poropat, 2011). Poropat's (2009) meta-analysis found that conscientiousness (C) had the highest corrected correlation with academic performance (.22), only slightly lower than that for intelligence (.25). The next highest corrected correlation was .12 for openness to experience (O). Thus, he concluded that “Conscientiousness has the strongest association with academic performance of all the FFM (Five-Factor model) dimensions” (p. 328). This echoes the views of others who have claimed that “Conscientiousness can perhaps be conceived of as the non-cognitive counterpart of the cognitive g factor. . .” (De Fruyt & Mervielde, 1996, p. 420). In fact, the importance of C has been known for several years, with Barton, Dielman, and Cattell (1972) noting its significance in a study of the scholastic achievement of high school students.

#### 1.2. Personality and intelligence

There is a rich history of research that has examined the links between personality and intelligence (e.g. Ackerman & Heggstad, 1997; Brebner & Stough, 1995; Chamorro-Premuzic & Furnham, 2005; Zeidner, 1995). For example, a meta-analysis by Ackerman and Heggstad (1997) found that the strongest links between

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intelligence and personality were with the openness–intellect (O/I) dimension ( $r = .33$ ). Weaker correlations were observed with neuroticism (N;  $r = -.15$ ) and with extraversion (E;  $r = .08$ ). Correlations with C ( $r = .02$ ) and agreeableness (A;  $r = .01$ ) were much weaker. Thus, intelligence appears to be significantly related to a personality dimension most closely associated with “intellectually oriented traits” (Zeidner & Matthews, 2000, p. 585) or typical intellectual engagement (Rolfhus & Ackerman, 1996), as indicated by intellectual motives and interests.

The existence and interpretation of the personality dimension sometimes referred to as openness (O), and other times referred to as Intellect, has given rise to considerable discussion (e.g., Brand, 1994; Chamorro-Premuzic & Furnham, 2005; Goldberg, 1994; McCrae, 1994), but seems largely a function of how the lexical method has been employed in defining personality (McCrae, 1994). Brand (1994) suggested that 40% of the variance of O is shared with intelligence, whilst McCrae (1994) and Chamorro-Premuzic and Furnham (2005) noted some overlap between O, Intellect, and intelligence. According to McCrae (1994), Intellect, which comprises intelligence imagination, and introspection (Goldberg, 1994), best describes the dimension based overwhelmingly on trait adjectives, whereas O describes the dimension derived largely from psychological constructs.

### 1.3. Aims and rationale of this study

The aim of this study was to assess the interactive effects of intelligence and personality on school performance. Surprisingly, very few studies include both personality and intelligence measures (but see Furnham & Monsen, 2009). Our main a priori prediction was that intelligence will be of most benefit to school grades amongst those who enjoy using their intelligence, that is, amongst those adolescents higher on O/I. To put this differently, we expected intelligence to moderate the link between O/I and grades, with O/I being more strongly associated with performance amongst adolescents higher in intelligence compared to those lower in intelligence.

We also set out to examine the predictors of performance in various subjects. Indeed, Barton et al. (1972) found different personality factors to predict different subject areas across the 6th and 7th Grades. For instance, “being socially bold” was found to predict Math and Science performance. Our study extends that of Barton et al. (1972) by also including intelligence as a possible moderator variable in assessing the effects of personality on academic performance.

## 2. Method

### 2.1. Participants

Participants were 786 high school students (418 males, 359 females; 9 did not report) who completed standardized cognitive ability tests in the 7th Grade and then had personality and academic performance (school Grades) assessed in the 10th Grade. The mean age of the group in 10th Grade was 15.41 yrs. ( $SD = 0.53$ ). Participants were located in five high schools in the Wollongong Catholic Diocese in New South Wales (NSW), Australia. The schools in question are not totally private and receive some of their funding from the government. Indeed, not all students in our schools are Catholic and, over the last decade, the number of students attending Catholic, other religious, and fully private schools in Australia has increased at a significantly faster rate than students in public schools that are fully funded by the government (ABS, 2011).

The Diocese is located on the city of Wollongong, but also reaches in the south-western Sydney area thereby ensuring a student population that is ethnically and socio-economically quite diverse. For example, the spread of some occupations of the fathers of our participants closely resembled national distributions at the time (ABS, 2004): for example, professionals, 20.4% (16.5% nationally); associated professionals, 15.1% (12.7%); intermediate production and transport, 11.2% (13.4%); tradespersons, 34.3% (21%); managers, 4.8% (9.7%); labourers, 3.3% (10.8%); advanced clerical, 1.2% (0.9%); intermediate clerical, 5.5% (8.8%); elementary clerical, 4.3% (6.1%). Additionally, 22% lived in non-intact families, whereas the national divorce rate at the time was 29% (ABS, 2005), and 19.77% were exposed to a language other than English in the home, whereas the national figure was 15.8% (ABS, 2006).

We tested for differences on our measures between those who provided data at both time points and those who did not. There were no significant differences in personality, but completers had higher mean standardized cognitive ability ( $M = .12$ ,  $SD = .94$ ) than non-completers ( $M = -.24$ ,  $SD = .93$ ).

### 2.2. Materials

Students completed a number of personality and attitudinal measures annually for the duration of the Wollongong Youth Study. The following are relevant for this report:

#### 2.2.1. Intelligence

Intelligence was assessed in Grade 7, the 1st yr of high school in NSW. Students completed standardised measures of verbal and numerical ability. These tests are curriculum-based, criterion-referenced tests and are administered by the NSW Department of Education and Training to all students in the State during their first year of high school. There are five numerical (number, measurement, space, data, numeracy problem solving) and three verbal (writing achievement, reading achievement, and language achievement) subtests. Alpha coefficient for the numerical tests was .95 and .87 for the verbal ability tests. We averaged the scores on these measures to compute a measure of intelligence. Our previous research has shown this measure to be highly related to academic performance as assessed in subsequent years (Heaven & Ciarrochi, 2008).

#### 2.2.2. Five factor personality dimensions (Goldberg, 1999)

We used the 50-item version of the International Personality Item Pool (IPIP) to assess extraversion (E), openness/intellect (O/I), agreeableness (A), conscientiousness (C), and neuroticism (N) in Grade 10 (Goldberg, 1999). Following Goldberg, the O dimension was assessed with items focusing on ideas, such as “I do not have a good imagination”, “I am full of ideas”, “I have difficulty understanding abstract ideas”, “I use difficult words”, etc. Thus, this dimension can be referred to O/Intellect. The IPIP has been found to correlate quite highly with the equivalent markers of another measure of the Big Five dimensions, the NEO–FFI inventory (Gow, Whiteman, Pattie, & Deary, 2005). On this occasion, we obtained the following Cronbach coefficient alphas:  $\alpha = .76$  (A),  $\alpha = .74$  (C),  $\alpha = .79$  (N),  $\alpha = .76$  (O/Intellect), and  $\alpha = .82$  (E).

#### 2.2.3. Grade 10 end-of-year school results

We obtained the final marks for students in Religious Studies, English, Mathematics, Science, History, and Geography. As different marking schedules were used in the different subjects, final marks were converted to z-scores within subjects to facilitate comparisons. In line with most previous studies, we also calculated a total overall grade for each student to indicate overall academic performance. This was calculated by averaging the z scores across the subjects.

3. Results

The means and standard deviations of the main study variables were as follows: Agreeableness ( $M = 37.31, SD = 5.86$ ), conscientiousness ( $M = 31.18, SD = 6.2$ ), neuroticism ( $M = 24.08, SD = 7.10$ ), O/Intellect ( $M = 34.34, SD = 6.12$ ), extraversion ( $M = 34.52, SD = 7.14$ ), intelligence ( $M = 88.41, SD = 6.2$ ), and total grade which was based on the average standardized grade across all subjects ( $M = -.006, SD = .85$ ).

In order to assess the extent to which our anticipated key effects might be contaminated by gender, we used *t*-tests and a Bonferroni correction ( $.05/8 = .0063$ ) to examine the possibility of sex differences in personality, intelligence, total grades, and the interactions between intelligence and the various personality dimensions. Girls scored slightly higher than boys on intelligence ( $M_m = 87.5, SD = 6.52; M_f = 89.51, SD = 5.57$ ), agreeableness ( $M_m = 35.37, SD = 5.75; M_f = 39.52, SD = 5.18$ ), neuroticism ( $M_m = 22.84, SD = 6.80; M_f = 25.51, SD = 7.20$ ), and extraversion ( $M_m = 33.49, SD = 7.04; M_f = 35.77, SD = 7.07$ ). There was no significant sex difference involving O/Intellect, or the interaction between O/Intellect and intelligence,  $ps > .3$ . In addition, controlling for sex in the remaining analyses made no difference to our conclusions; consequently sex is not discussed further in this results section.

Table 1 presents the correlations between the study variables. Intelligence shared about 9% to 14% of the variance with A and O/Intellect, respectively, and between 4% (Religious Studies) and 19% (Science) of the variance with grades. Grades tended to be highly correlated, having between 36% (Geography and Math) and 55% (Geography and History) of their variance in common. The personality dimensions correlating the strongest with O/Intellect were A (16% variance shared) and C (12% variance shared).

3.1. Hierarchical regression analyses

We examined the significant predictors of academic performance using hierarchical regression analysis. We focused on total grade first and then expanded our analyses to individual subjects. Although our focus was on intelligence and openness/intellect, we included the four other personality dimensions as covariates in the analyses in order to rule out the possibility that the O/Intellect effects were explicable through association with other personality dimensions. We entered intelligence in step 1, the five personality dimensions in step 2, and the personality  $\times$  intelligence interactions in step 3. All of the personality  $\times$  intelligence interactions were tested. We followed the advice of Aiken and West (1991) and centred all variables and formed the interactions by multiplying these centred variables, a procedure that reduces problems of collinearity between interaction terms and main effects. Except

Table 2

Hierarchical regression analysis summary for intelligence (Grade 7) and personality (Grade 10) predicting academic performance in Grade 10.

	$\beta$	SE $\beta$	R <sup>2</sup>	$\Delta R^2$
Step 1			.22***	.217***
IQ	.50***	.045		
Step 2			.23***	.017
Agreeable	-.06	.051		
Conscientiousness	.10*	.047		
Neuroticism	.03	.045		
Intellect/open	.08	.053		
Extraversion	.04	.046		
Step 3			.25***	.016**
IQ $\times$ Intellect	.13**	.043		

\*  $p < .05$ .  
 \*\*  $p < .01$ .  
 \*\*\*  $p < .001$ .

for the interactions between O/Intellect and performance, none of the other personality by intelligence interactions approached significance,  $p > .1$ , and so were excluded from further analysis.

Table 2 shows the result of this analysis for total grade. Intelligence in Grade 7 was the strongest predictor of academic performance in Grade 10. The main effects of the five personality factors (step 2) were not significant as a whole, although the individual personality factor C did reach significance. As expected, the interaction between intelligence and O/Intellect was significant. Following a procedure outlined by Aiken and West (1991), we utilized the regression equation to estimate two lines, one at above average intelligence ( $+5 SD$ ) and one at below average intelligence ( $-5 SD$ ). The interaction is plotted in Fig. 1 and illustrates that higher O/Intellect was associated with higher grades, but only amongst those with higher intelligence.

IQ was not skewed and O/Intellect was mildly skewed (Skew statistic = .22, SE = .10, Ratio = 2.2), but the interaction involving O/Intellect and intelligence was significantly skewed (Skew statistic = 1.76, SE = .12, Ratio = 14.67). We thus replicated the analyses in Table 2, but tested the key interaction effect using nonparametric bootstrapping analysis (Mooney & Duval, 1993). Missing values were replaced using expectation maximization imputation (Howell, 2008), and 5000 samples were drawn to estimate the 95% confidence intervals around the interaction term. We found that the estimated beta for the interaction between intelligence and O/Intellect was .19, and the confidence intervals ( $\beta_{lower} = .075$  to  $\beta_{upper} = .297$ ) did not overlap with 0; we therefore reject the null hypothesis that  $\beta = 0$ .

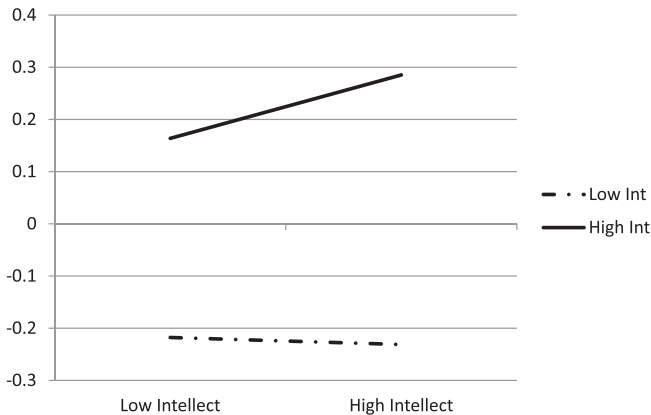
Given the reliability of the interaction across parametric and nonparametric analysis, we sought to examine its reliability across

Table 1

Correlations between cognitive ability (Grade 7), personality (Grade 10), and school performance in Grade 10.

	1	2	3	4	5	6	7	8	9	10	11	13	
1. Cognitive ability	1.00												
2. A	.30**	1.00											
3. C	.05	.23**	1.00										
4. N	.06	-.05	-.30**	1.00									
5. Intellect/O	.37**	.43**	.35**	-.09*	1.00								
6. E	.07	.27**	.07	-.25**	.24**	1.00							
7. Total grade	.46**	.11**	.11**	.06	.24**	-.03	1.00						
8. Religious studies	.20**	.06	.12*	.09	.12*	.00	.69**	1.00					
9. English	.41**	.17**	.09*	.07	.27**	.00	.87**	.62**	1.00				
10. Mathematics	.42**	.04	.09*	.04	.16**	-.06	.85**	.54**	.62**	1.00			
11. Science	.44**	.06	.08*	.04	.17**	-.02	.90**	.63**	.70**	.75**	1.00		
12. History	.38**	.10*	.12**	.06	.23**	-.03	.87**	.65**	.71**	.62**	.70**	1.00	
13. Geography	.38**	.09*	.11**	.06	.17**	.00	.82**	.67**	.70**	.63**	.72**	.74**	1.00

\*  $p < .05$ .  
 \*\*  $p < .01$ .



**Fig. 1.** The relationship between individual differences in O/Intellect and standardized academic grades amongst those low ( $-5$  SD) and high ( $+5$  SD) in Intelligence (Int).

each of the school subjects. We tested the full regression model presented in Table 2, except that instead of total grade we predicted grades in the individual school subjects. We will focus on the results of the interaction testing which are of primary interest. There was a significant interaction between O/Intellect and intelligence for Religious Studies ( $\beta = .15$ ,  $SE = .051$ ), English ( $\beta = .11$ ,  $SE = .045$ ), Math ( $\beta = .10$ ,  $SE = .043$ ), Science ( $\beta = .15$ ,  $SE = .043$ ), History ( $\beta = .09$ ,  $SE = .044$ ), and Geography ( $\beta = .09$ ,  $SE = .045$ ). Thus, the effects were consistent across all subjects.

Intelligence was also a strong and consistent predictor across all subjects, varying in prediction between  $\beta = .36$  ( $SE = .052$ ) for History to  $\beta = .47$  ( $SE = .05$ ) for Math. There was one notable exception to these effects: Intelligence was a weaker predictor of Religious Studies ( $\beta = .16$ ,  $SE = .06$ ) than it was of all the other subjects,  $t_s > 5$ ,  $p_s < .001$ . Given that C was a significant predictor of total grade (Table 2), we examined the consistency of this effect across the individual subjects and found that, when controlling for all other variables in Table 2, C was a significant predictor of Religious Studies ( $\beta = .14$ ,  $SE = .057$ ), Math ( $\beta = .10$ ,  $SE = .047$ ), Science ( $\beta = .094$ ,  $SE = .046$ ), History ( $\beta = .101$ ,  $SE = .048$ ), and Geography ( $\beta = .10$ ,  $SE = .049$ ). It was not a significant predictor of English ( $\beta = .047$ ,  $SE = .048$ ).

#### 4. Discussion

The aim of this study was to assess the unique explanatory power of personality, intelligence, and their interaction in predicting academic performance in high school. We used standardised verbal and numerical measures assessed in the seventh grade to construct a general measure of intelligence. As expected, this was a powerful predictor of school performance 3 yrs hence, with the effects of personality being much more limited. In line with previous research (e.g. Poropat, 2009), C was also found to be a significant predictor of academic performance for total grade and most of the individual subjects. Perhaps of most interest, the interaction between O/Intellect and intelligence was a significant predictor of outcome across all subjects. Thus, high levels of O/Intellect predicted good academic outcomes, but only amongst those with higher levels of intelligence. This finding contradicts that of Furnham and Mosen (2009) who included a measure of O in their study rather than O/Intellect.

Contrary to the views of Ackerman and Heggstad (1997) who suggested that Math ability does not overlap with personality traits, we found C to be important in predicting Math and Science outcomes. Thus, besides intelligence, higher performance in these

subject areas (and in several others in our study) is likely to be boosted by specific individual characteristics such as higher levels of persistence and industriousness (corresponding with conscientiousness).

The possibility that intelligence interacts with personality (in the present case with O/Intellect) in predicting academic performance has not been well explored in the literature. However, our findings are generally consistent with past research into the nature of the O dimension. Following a study into creativity, intelligence, and personality, McCrae (1987) found that most of the facets of the O dimension were significantly related to the subscales of the creative personality scale including, for example, remote consequences, word fluency, expressional fluency, and associational fluency. He therefore concluded that those higher on O "... may be intrigued by the task of imagining consequences or generating words...", are more likely to be accepting of unconventional perspectives, and "... may develop an interest in varied experience..." (p. 1264). Although our study did not set out to investigate creativity, our data suggest that O/Intellect is associated with important skills to master study in a range of different subject areas, each with their own demands and unique perspectives. Certainly, this seems to be the case amongst those with higher levels of intelligence.

That C and O/Intellect (amongst those with higher intelligence) were found to be significant predictors of academic performance is also in line with the conclusions of Blickle (1996). He argued that, whereas C is more closely related to learning discipline including such traits as effort, strategy, and time management, O is more closely aligned with what he referred to as "elaboration". This comprises skills in the areas of critical evaluation, relationships, and literature. Our data suggest that these skills are of most use amongst those with higher levels of intelligence. It appears that being interested in ideas and thinking is not enough to get better grades; one also needs higher intelligence.

#### 5. Conclusion and future directions

Clearly, personality has an important role to play in facilitating learning and performance in the school context, once general intelligence has been taken into consideration. In particular, the major personality domains of C and O/Intellect appear to be important in predicting outcomes in specific subjects, at least amongst high school students. Even small increments in these dimensions over time are likely to have far-reaching cumulative effects in performance over the high school career of a young person over and above that of intelligence. Future longitudinal research is required to assess the strength of this suggestion. Future research is also needed to examine how high O/Intellect people differ from their low O/Intellect counterparts: Perhaps they study more than others? Or, perhaps they study or engage with material differently, with their learning being driven more by curiosity than by rote learning? These intriguing questions require further study.

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