Available online at www.sciencedirect.com
ScienceDirect
Personality and Individual Differences 44 (2008) 1596–1603
PERSONALITY AND INDIVIDUAL DIFFERENCES
www.elsevier.com/locate/paid

Short Communication

Personality, intelligence and approaches to learning as predictors of academic performance

Tomas Chamorro-Premuzic [a,*], Adrian Furnham [b]

[a] *Department of Psychology, Goldsmiths, University of London, New Cross, London SE14 6NW, UK*
[b] *Department of Psychology, University College London, UK*

Received 1 September 2007; received in revised form 19 December 2007; accepted 7 January 2008
Available online 20 February 2008

Abstract

Students completed four psychometric tests soon after arriving at university: the NEO–PI-R measure of the Big Five personality traits (Costa & McCrae, 1992); the Study Process Questionnaire, which measures approaches to learning (Biggs, 1978); and two measures of cognitive ability: the Wonderlic IQ Test (Wonderlic, 1992) and the Baddeley Reasoning Test (Baddeley, 1968) of fluid intelligence (*gf*). A year later they completed comprehensive essay-based exams and received a mean score based on six examinations. Academic performance (AP) correlated with ability, achieving and deep learning approaches, Openness and Conscientiousness. Together, these variables explained 40% of the variance in AP. Path analyses indicated that the effects of ability on AP were mediated by personality and learning approaches.

Keywords: Personality; Intelligence; Learning; Academic performance

1. Introduction

This paper explores the degree to which personality, ability and learning approaches predict academic performance (AP). In doing so, it attempts to assess the incremental validity of learning

* Corresponding author. Tel.: +44 (0) 207 919 7885; fax: +44 (0) 207 919 7873; mobile: +44 (0) 794 138 6220.
E-mail address: t.chamorro-premuzic@gold.ac.uk (T. Chamorro-Premuzic).

0191-8869/$ - see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.paid.2008.01.003

approaches over and above measures of personality and cognitive ability, which are not only the two most well-established predictors of AP, but also the most general and widely explored constructs of differential psychology. Moreover, given the recent interest in understanding how different predictors of AP are related – which may reflect developmental links among ability and non-ability determinants of learning and educational attainment – the current study used a path analytic approach, based on recent theoretical developments, to account for the empirical relationship among these constructs.

1.1. Ability and AP

The fact that cognitive ability tests predict AP is well-documented (Chamorro-Premuzic, 2007). Indeed, AP has been the criterion for validating IQ tests for over a century, and one would hardly refer to these tests as "intelligence" measures if they did not correlate with AP. However, IQ tests rarely account for more than 50% of the variance in AP (Chamorro-Premuzic & Furnham, 2004; O'Connor & Paunonen, 2007), suggesting that factors other than ability contribute to individual differences in AP.

1.2. Personality and AP

The past ten years have seen a growing number of studies on the personality correlates of AP (see reviews by Chamorro-Premuzic & Furnham, 2004; O'Connor & Paunonen, 2007). These studies indicate that Conscientiousness is the most significant correlate of AP, an association that has been explained in terms of the persisting, self-disciplined, and achievement-oriented nature of conscientious students (Chamorro-Premuzic & Furnham, 2004). Evidence also suggests that Openness to Experience, a trait that assesses individual differences in aesthetic interests, creativity, and intellectual curiosity, is positively linked to AP (O'Connor & Paunonen, 2007).

Although the effects of Conscientiousness on AP appear to be independent from IQ, negative correlations between *gf* and Conscientiousness (Moutafi, Furnham, & Patiel, 2004) have led to suggestions that Conscientiousness may act as a "compensatory force" for lower cognitive ability (Chamorro-Premuzic & Furnham, 2004, 2006). On the other hand, the overlap between Openness and AP has often been interpreted in terms of cognitive ability. Thus, correlations in the region of $r = .2$–$.4$ have been reported between Openness and ability measures, particularly tests of crystallized ability (Ackerman & Heggestad, 1997). In fact, a causal association between Openness and the knowledge-based components of intelligence has been proposed whereby open individuals are more likely to "invest" in activities that stimulate the acquisition of knowledge (Chamorro-Premuzic & Furnham, 2004, 2006).

1.3. Learning approaches and AP

Another determinant of AP is students' approaches to learning (Biggs, 1978; Biggs & Kirby, 1984). Biggs (1987) distinguished between three major approaches, namely *deep*, *achieving*, and *surface*. Deep learners are intrinsically motivated and enjoy exploring the subject matter as much as they can. On the other hand, achieving students are extrinsically motivated and want to do well because of the rewards attached to high performance. Finally, surface learners are interested in

learning the indispensable facts only and expend minimum effort to achieve this (Chamorro-Premuzic, Furnham, & Lewis, 2007).

Previous evidence relating learning approaches to AP is inconsistent. Wilding and Valentine (1972) found that achieving learning predicted exam success. Snelgrove and Slater (2003) found that deep learning was positively related to GPA (in Sociology), whereas surface motive was negatively related to exam results (in Nursing programs). Duff (2004) on the other hand, found that deep and surface learning correlated negatively with coursework grades on an MBA, whereas strategic approach was a positive correlate.

Furthermore, recent studies have highlighted the conceptual and empirical overlap between learning approaches and personality traits (Chamorro-Premuzic et al., 2007; Zhang, 2003), suggesting that between 20% and 45% of the variance in learning approaches can be accounted for by the Big Five personality traits. Specifically, Openness has been linked to deep learning, whereas achieving learning has been linked to Conscientiousness. Given this overlap, it is important to show that any effects of learning approaches on AP are independent of personality and vice-versa.

Thus the present study set out to explore the personality, ability, and learning approaches correlates of AP. In line with the above-reviewed literature, it was predicted that Openness, Conscientiousness, *gf*, IQ, deep and achieving learning would all correlate positively and significantly with AP. Furthermore, it was also hypothesized that the link between Openness and AP would be mediated by deep learning and IQ, whilst *gf* would be negatively related with Conscientiousness, which would, in turn, positively affect AP.

2. Method

2.1. Participants

A total of 158 undergraduate students from University College London participated in this study. Age ranged from 18 to 21 ($M = 19.21$, $SD = 2.32$) years. Approximately 70% of the participants were female, though participants' gender was not available. Students took part in this study as part of their coursework. Data were merged by an external researcher.

2.2. Measures

2.2.1. Study process questionnaire (Biggs, 1987)

This 42-item questionnaire was used to assess three main approaches to learning, namely *surface* (a reproduction of what is taught to meet the minimum requirement), *deep* (a real understanding of what is learned), and *achieving* (designed specifically to maximize grade). The scale is frequently used in applied, educational and differential psychology and has good psychometric properties (e.g., Chamorro-Premuzic et al., 2007; Snelgrove & Slater, 2003; Zhang, 2003).

2.2.2. The revised NEO personality inventory (NEO–PI-R) (Costa & McCrae, 1992)

This widely used inventory (see Chamorro-Premuzic, 2007) assesses the "Big Five" personality traits, namely Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness. It includes 240 items (48 per factor) that are answered on a 5-point Likert-type scale (ranging from

"strongly disagree" to "strongly agree"). There is wide consensus (see Chamorro-Premuzic, 2007) on the idea that the NEO–PI-R represents a state-of-the-art instrument for assessing the five major personality traits and their underlying facets.

2.2.3. The Wonderlic Personnel Test (Wonderlic, 1992)

This 50-item test is administered in 12 min and measures IQ. Scores can range from 0 to 50. Items include word and number comparisons, disarranged sentences, serial analysis of geometric figures and mathematical/logical problems. The test correlates very highly ($r = .92$) with the WAIS-R (Wechsler, 1981; see Wonderlic, 1992), making it an ideal option for collecting IQ data under time-constraints.

2.2.4. The Baddeley Reasoning Test (Baddeley, 1968)

This 64-item test is administered in 3 min and measures *gf* through logical reasoning. Scores can range from 0 to 64. Each item is presented in the form of a grammatical transformation and is answered with 'true'/'false', e.g. 'A precedes B–AB' (true) 'A does not follow B–BA' (false). The test has been employed extensively in the past (see Chamorro-Premuzic & Furnham, 2006) to obtain a quick and reliable indicator of people's intellectual ability. To our knowledge, it represents the quickest reliable measure of *gf*.

AP was operationalized in terms of second year exam results, that is, the average mark from six yearly, essay-type, written examinations. Data were available for 137 students. Grades ranged from 44 to 73.33 ($M = 62.75$, SD = 7.14).

2.3. Procedure

Within a month of arriving at university students completed the four tests in a classroom exercise. A month later, they received feedback on their scores and a full description of the tests. A year later, students completed their second year exams (first year exams are taken only as preparation for later years and have no incidence on GPA). Individual difference data were matched with exam results. Drop outs and missing data inevitably reduced the size of the sample.

3. Results

Bivariate Pearson correlation coefficients are presented in Table 1. As shown, exam marks were significantly correlated with deep and achieving learning, Conscientiousness, Openness, IQ and *gf*. Deep learning was significantly correlated with Openness, IQ, and *gf*. On the other hand, IQ was significantly correlated with Openness to Experience, whilst *gf* was significantly related to Conscientiousness. Both ability measures were significantly inter-correlated, and so were achievement and surface learning approaches.

Hierarchical regression was performed to test the degree to which personality predicts AP over and above intelligence, as well as the incremental validity of learning approaches over personality and intelligence. In block 1, both ability tests were entered as predictors of AP, and *gf* was the only significant predictor (stepwise method was used for each block). In blocks 2 and 3, Conscientiousness and Openness were found to predict AP over and above *gf*. In block 4, deep learning

Table 1
Correlations among target variables

		2	3	4	5	6	7	8	9	10	Exams
1.	Surface, α .66	−.00	.26**	−.15	−.13	−.13	.03	−.06	−.07	00	−.15
2.	Deep, α .68		.17*	−.05	.18*	.21*	.04	.13	.32**	.27**	.33**
3.	Achieving, α .70			−.04	−.14	−.12	−.16	.02	−.05	.06	.18*
4.	Neuroticism, α .81				−.13	.13	.1	−.14	−.08	.11	−.05
5.	Extraversion, α .80					.15	.31**	.33**	.02	.14	.16
6.	Openness, α .79						.13	.15	.22*	.01	.21**
7.	Agreeableness, α .84							.19*	.05	.01	.02
8.	Conscientiousness, α .82								−.13	−.19*	.37**
9.	IQ									.44**	.24*
10.	*gf*										.27*

Note. $N = 158$.
α's not available for ability tests.
* $p < .05$.
** $p < .01$.

approach showed incremental validity over *gf*, Conscientiousness and Openness in the prediction of AP. Results are summarized in Table 2. As shown, ability explained 6% of the variance in AP, Conscientiousness explained an additional 27%, Openness an extra 4%, and deep learning an additional 3%.

Table 2
Learning approaches, personality and intelligence as predictors of exam marks

		Unstandardized coefficients		Standardized coefficients	
		Beta	SE	Beta	*t*
1	*gf*	.17	.07	.27	2.49*
	$F(1, 80) = 6.23$*	Adj $R^2 = .06$			
2	*gf*	.22	.06	.36	3.85**
	Conscientiousness	.44	.08	.53	5.71**
	$F(2, 79) = 20.7$**	Adj $R^2 = .33$			
3	*gf*	.21	.06	.34	3.76**
	Conscientiousness	.44	.07	.54	5.97**
	Openness	.24	.10	.22	2.43*
	$F(3, 78) = 16.6$**	Adj $R^2 = .37$			
4	*gf*	.19	.06	.29	3.28**
	Conscientiousness	.41	.07	.49	5.45**
	Openness	.19	.10	.17	1.91
	Deep learning	.35	.16	.21	2.25*
	$F(4, 77) = 14.38$**	Adj $R^2 = .40$			

Note. $N = 158$.
* $p < .05$.
** $p < .01$.

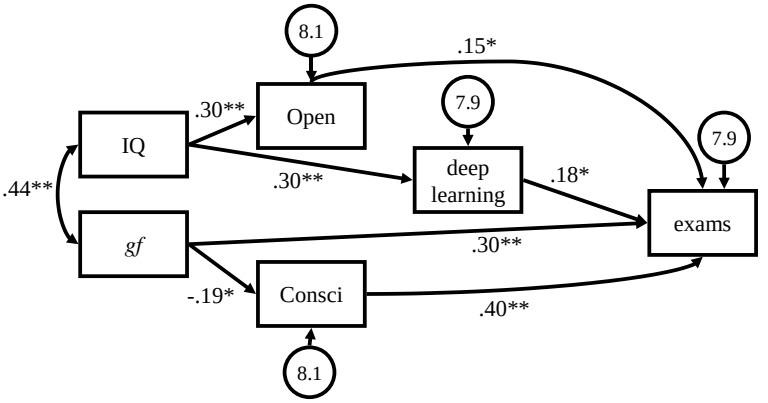

Fig. 1. Personality and deep learning mediating the effects of ability on exams. CFI = .96, NFI = .90, RMSEA = .06, PGFI = .32, chi-square (7, $N = 158$) = 10.67, $p = n/s$ Notes: IQ = Wonderlic (1992); *gf* = Baddeley (1968); Open = Openness to Experience; Consci = Conscientiousness (Costa & McCrae, 1992); deep learning (Biggs, 1978). Residual values represent CR coefficients; double arrows = Pearson's *r*; other values are standardized Beta coefficients; $^{*}p < .05$, $^{**}p < .01$.

Finally, two path analyses were tested to examine the mediational effects of personality and learning approaches in the relationship between ability and AP, as well as whether learning approaches mediated the effects of personality on AP. Fig. 1 shows the path model where Openness and deep learning fully mediate the effects of IQ on AP, whilst Conscientiousness partly mediates the link between *gf* and AP. This model fitted the data well. Fig. 2 depicts the second model, where IQ was tested as mediator rather than exogenous variable (thus Openness and IQ swapped places in the model). As seen, *gf* and Openness affected IQ, which in turn affected deep learning, which in turn affected AP. Again, Conscientiousness partly mediated the effects of *gf* on AP. The model fitted the data well.

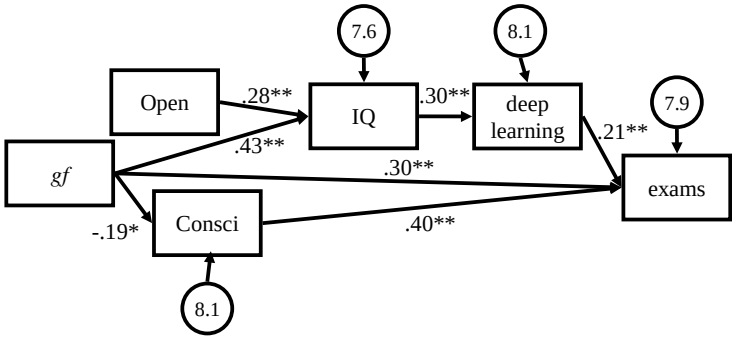

Fig. 2. Personality, IQ, and deep learning mediating the effects of *gf* on exams. CFI = .93, NFI = .87, RMSEA = .07, PGFI = .35, chi-square (8, $N = 158$) = 14.36, $p = n/s$ Notes: IQ = Wonderlic (1992); *gf* = Baddeley (1968); Open = Openness to Experience; Consci = Conscientiousness (Costa & McCrae, 1992); deep learning (Biggs, 1978). Residual values represent CR coefficients; double arrows = Pearson's *r*; other values are standardized Beta coefficients; $^{*}p < .05$, $^{**}p < .01$.

4. Discussion

As predicted, both ability measures, Openness, Conscientiousness, deep and achieving approaches to learning were all positively related to AP. Importantly, the two personality traits showed incremental validity (over *gf*) in the prediction of AP. Particularly Conscientiousness accounted for a substantial amount of additional variance in AP, which is in line with O'Connor and Paunonen (2007) paper. On the other hand, deep learning approach contributed to the prediction of AP beyond personality and intelligence.

Results were supportive of initial hypotheses and highlight the importance of including different ability and non-ability factors when predicting AP. Although Conscientiousness was the strongest predictor of exam grades, a combination of *gf*, Conscientiousness, Openness, and deep learning approach explained the highest percentage of variance. This pattern of results indicates that different individual difference factors operate quite independently to affect individual differences in academic achievement a year later.

However, the more sophisticated path analyses revealed some mediational effects among the association between the predictors and AP. In line with Chamorro-Premuzic and Furnham (2004), Chamorro-Premuzic and Furnham (2006), Conscientiousness was negatively linked to *gf* but positively linked to exam grades, adding support to the idea of a "compensational function" of this personality trait. Thus in both models lower *gf* led to higher Conscientiousness, which, in turn, led to higher AP (it is noteworthy that the opposite pattern, higher *gf* leading to lower Conscientiousness, which in turn leads to lower AP, is also congruent with the data). Whereas the effects of Conscientiousness on AP were largely independent of other factors, the association between Openness and AP revealed a more complex pattern.

In the first model, Openness was found to mediate the links between IQ and AP, suggesting that individuals with higher IQ obtain higher grades only because they are more open to new experiences. Likewise, deep learning mediated the effects of IQ on AP, suggesting that IQ led to higher AP because individuals with a higher IQ employed a deep learning approach. Whereas this model fitted the data well, it is informative mainly in regards to the validity of the measures: for instance, practitioners and researchers may benefit from knowing that two short self-report scales (Openness and deep learning) accounted for the shared variance between IQ and exam grades.

However, the second model appears to be theoretically more interesting as it highlighted the "investment" role of Openness to Experience as a determinant of higher IQ. Thus IQ was separately affected by *gf* and Openness (which were not inter-correlated) and affected deep learning, which in turn led to higher exam grades. Although the single wave nature of our data makes these causational interpretations speculative at best, this model is consistent with Chamorro-Premuzic and Furnham (2006) conceptualization of different ability and non-ability determinants of AP, and expands it by including a learning approach factor to explain the paths from Openness to IQ and IQ to AP. Another limitation of this study is the fact that the sample comprised what may safely be regarded as generally highly-achieving students, pre-selected on the basis of previous AP. Clearly, this may have reduced the number of self-handicapping and surface learners (see Thomas & Gadbois, 2007), as those with lower cognitive ability and lower Conscientiousness.

Despite these limitations, our results are of interest to practitioners and applied researchers interested in the prediction of academic success, in that they highlight the incremental validity of personality and learning approaches over IQ. It is hoped that the present findings will

encourage differential and educational psychologists interested in understanding the developmental paths underlying academic achievement, in particular effects *among* different determinants of AP, to conduct longitudinal tests of the models explored in this paper. Future studies are also encouraged to explore alternative constructs relating to individual differences in learning or cognitive styles, notably Riding (1997) and Sternberg and Grigorenko (1995).

Acknowledgement

The study was supported by a British Academy grant to the first author.

References

Ackerman, P. L., & Heggestad, E. D. (1997). Intelligence, personality and interests: Evidence for overlapping traits. *Psychological Bulletin, 121*, 219–245.

Baddeley, A. (1968). A 3 min reasoning test based on grammatical transformation. *Psychonomic Science, 10*, 341–342.

Biggs, J. (1978). Individual and group differences in study processes. *British Journal of Educational Psychology, 48*, 266–279.

Biggs, J. (1987). *Study process questionnaire manual*. Hawthorne: Australian Council for Educational Research.

Biggs, J., & Kirby, J. (1984). Differentiation of learning processes within ability groups. *Educational Psychology, 4*, 21–38.

Chamorro-Premuzic, T. (2007). *Personality and individual differences*. Oxford: Blackwell.

Chamorro-Premuzic, T., & Furnham, A. (2004). A possible model for explaining the personality-intelligence interface. *British Journal of Psychology, 95*, 249–264.

Chamorro-Premuzic, T., & Furnham, A. (2006). Intellectual competence and the intelligent personality: A third way in differential psychology. *Review of General Psychology, 10*, 251–267.

Chamorro-Premuzic, T., Furnham, A., & Lewis, M. (2007). Personality and approaches to learning predict preference for different teaching methods. *Learning and Individual Differences, 17*, 241–250.

Costa, P. T., Jr., & McCrae, R. (1992). *Revised NEO Personality Inventory (NEO–PI-R) and NEO Five-factor Inventory (NEO–FFI): Professional manual*. Odessa, FL: Psychological Assessment Resources Inc..

Duff, A. (2004). The role of cognitive learning styles in accounting education. *Journal of Accounting Education, 22*, 29–52.

Moutafi, J., Furnham, A., & Patiel, L. (2004). Why is conscientiousness negatively correlated with intelligence? *Personality and Individual Differences, 37*, 1013–1022.

O'Connor, M., & Paunonen, S. (2007). Big Five personality predictors of post-secondary academic performance. *Personality and Individual Differences, 43*, 971–990.

Riding, R. J. (1997). On the nature of cognitive style. *Educational Psychology, 17*, 29–49.

Snelgrove, S., & Slater, J. (2003). Approaches to learning: Psychometric testing of a study process questionnaire. *Journal of Advanced Nursing, 43*, 496–505.

Sternberg, R. J., & Grigorenko, E. (1995). Styles of thinking in the school. *European Journal for High Ability, 6*, 201–219.

Thomas, C. R., & Gadbois, S. A. (2007). Academic self-handicapping: The role of self-concept clarity and students' learning strategies. *British Journal of Educational Psychology, 77*, 101–119.

Wechsler, D. (1981). *Manual for the Wechsler ability intelligence scale – revised*. New York: Psychological Corporation.

Wilding, J., & Valentine, E. (1972). Factors predicting success and failure in the first year examinations of medical and dental courses. *Applied Cognitive Psychology, 6*, 247–261.

Wonderlic, E. (1992). *Wonderlic personnel test*. Libertyville, IL: Wonderlic.

Zhang, L. (2003). Does the big five predict learning approaches? *Personality and Individual Differences, 34*, 1431–1445.