Personality and intelligence as predictors of statistics examination grades

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Abstract

This paper looks at the relationship between psychometrically measured individual differences, namely the Big Five personality traits and several cognitive ability tests, and two statistics examination grades (SEG) at the university level. A total of 91 (74 females and 17 males) British students participated in the study. A series of bivariate and partial correlations showed that there were significant and positive associations between SEG and psychometric intelligence (notably spatial ability), as well as Conscientiousness. There were negative and significant correlations between SEG and Extraversion. This pattern of results was confirmed by a series of hierarchical regressions, in which personality traits were found to account for additional and unique variance in SEG (over and above psychometric intelligence). Cognitive ability accounted for about 3% of the variance in overall SEG, whilst personality traits accounted for an additional 12%. When lecturer rated seminar performance was also included in the regression equation, individual differences still showed some incremental validity in the prediction of SEG. Extraversion, Openness, Conscientiousness and, to a lesser extent, general intelligence, showed incremental validity in the prediction of SEG. Whilst tutor-related seminar performance accounted for 37% of the variance in overall SEG, psychometric intelligence accounted for an additional 1% and personality for a unique 10% of the variance.

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1. Introduction

Since the beginnings of the development of psychometric instruments, psychologists and educators have been interested in predicting academic achievement (e.g., Binet, 1903; Busato, Prins, Elshout, & Hamaker, 2000; Ebbinghaus, 1897; Goh & Moore, 1987; Harris, 1940; Savage, 1962; Terman, 1916; Willingham, 1974). As a result, individual differences such as personality traits and intelligence have become constructs of both theoretical and practical importance. From a theoretical point of view, personality and intelligence are important because they provide an established and comprehensive frame of reference for the description of an individual, as well as specific similarities and differences between individuals. From an applied perspective, these individual differences are important in so far as they may be effectively used to predict future behaviour, for instance academic and work performance (see Cattell, 1987; Hofstee, 2001). However, after more than one hundred years of systematic research in the area, there is still more uncertainty than certainty about the extent to which cognitive and non-cognitive individual differences may relate to an individual’s academic and work-related performance. Further, the effectiveness of psychometric instruments in the prediction of academic performance has yet to be consistently replicated, across settings, subjects and assessment methods.

Although it is commonly acknowledged that psychometric intelligence is a robust predictor of academic performance (higher intelligence leads to academic success, while lower intelligence is related to academic failure), several studies have suggested that, at higher levels of education, the predictive power of cognitive ability is only modest, and often not significant (Ackerman, 1994; Sanders, Osborne, & Greene, 1955; Seth & Pratap, 1971; Singh & Varma, 1995; Thompson, 1934; Wolf, 1972). At the same time, there has been increasing interest in the past 10 years in identifying consistent non-cognitive correlates of academic performance, notably personality traits. Whereas cognitive ability is usually measured by testing a person’s performance on a number of objectively solvable problems (power tests or tests of maximal performance), non-cognitive traits are referred to subjective tendencies to behave in a specific manner (typical performance) (see Cronbach, 1949).

Although research examining the psychometric links between personality and intelligence is far from conclusive, the literature (see Eysenck, 1994; Hofstee, 2001; Zeidner & Matthews, 2000) seems to indicate that personality and intelligence should be considered orthogonal constructs and thus separate predictors of academic performance. Intellectual ability refers to what a person can do, whereas personality traits may provide information on what a person will do. Consequently, both personality and intelligence should be considered when attempting to predict academic success or failure. However only a handful of psychometrically sound studies have tested the predictability of academic performance by established personality and intelligence measures simultaneously. Furthermore, the comparative predictive power between individual differences and other indicators of academic performance, such as previous academic behaviour remains to be replicated.

Following the traditional research approach of predicting future academic achievement from the results of cognitive ability measures, notably IQ tests (Binet, 1903; Busato et al., 2000; Harris, 1940; Terman, 1916; Willingham, 1974), researchers have tested the predictive power of self-report inventories such as the Big Five (Costa & McCrae, 1992) and the Eysenckian three (Eysenck & Eysenck, 1985) superfactors. A series of recent studies have suggested that personality traits may
play a significant role in an individual's academic performance. Although the processes by which personality traits may affect academic performance have not been subjected to rigorous empirical research (mainly because of the lack of integration between psychometric and experimental research lines), a few researchers (notably Matthews, Davies, Westerman, & Stammers, 2000) have outlined and identified the mechanisms underlying the relationship between personality traits and several indicators of performance. Further, there have been attempts to develop a theoretical framework for the integration of non-cognitive and cognitive individual differences underlying academic performance (e.g., Chamorro-Premuzic & Furnham, in press). Correlations between cognitive ability and academic or occupational performance measures are usually explained in terms of the ability to learn more efficiently and effectively, which leads to successful problem-solving across a variety of scenarios. On the other hand, correlations between personality and performance measures are usually interpreted in terms of the likelihood of certain personality traits (for instance Neuroticism or trait anxiety) to lead to certain states (e.g., anxiety, anger, fear) that are counterproductive for several types of performance, mainly because they would interfere with the cognitive processes, such as working memory, underlying successful task-problem-solving (see Matthews et al., 2000, for a detailed review on this topic). At the same time there are other personality variables, notably Conscientiousness or achievement striving, which seem to be beneficial for most types of performance because of their association with a number of behavioural tendencies (e.g., organization, persistence, drive, determination, responsibility) that enhance, as opposed to impair, academic or work performance. To the extent that an individual is aware of these behavioural patterns and thus able to rate him/herself on a number of sample items referring to these situations—and to the extent that he/she chooses to respond honestly to the questions—personality inventories will significantly predict academic performance.

Chamorro-Premuzic and Furnham (2003a) examined the relationship between established personality traits (Big Five and Gigantic Three) and academic performance in two samples of British university students. It was found that personality scores (assessed at the beginning of the first academic year) were significant predictors of final examination results and course work (assessed three years later). Even when previous academic record (seminar-based continuous assessment) was taken into account, personality traits—notably Conscientiousness and Psychoticism, but also Neuroticism and Extraversion—accounted for approximately 15% of unique variance in grades. The authors concluded that well-established personality traits such as those assessing the “Big Five” and the “Gigantic Three” would improve the prediction of academic success and failure in university programs.

These results were replicated in a second, similar, study, in which the relationship between academic performance and personality traits was also examined at the primary trait level (Chamorro-Premuzic & Furnham, 2003b). Conscientiousness (positively), Extraversion (negatively), and Neuroticism (negatively) were again found to be significant predictors of academic exam grades, accounting for approximately 15% of the variance. Interestingly, at the primary trait level (e.g., dutifulness, achievement striving, activity) personality accounted for almost 30% of the variance in examination grades. Thus the authors concluded that personality inventories may represent an important contribution to the prediction of academic success and failure in university (particularly in highly selective and competitive settings). Specifically Neuroticism, Extraversion, and Conscientiousness seem to play a relevant role in the processes underlying academic performance, but how exactly are these traits related to academic achievement?
The relationship between academic performance and Neuroticism is usually understood in terms of anxiety, particularly under stressful conditions such as university examinations (Hembree, 1988; Siepp, 1991). Furthermore, researchers have noted that Neuroticism may also impair performance on psychometric intelligence tests (Boyle, 1983; Zeidner & Matthews, 2000). Studies have also shown that neurotic students have a greater tendency to be absent in examinations due to medical illness or to request, and require, “special treatment” (Chamorro-Premuzic & Furnham, 2002). Further, Neuroticism is also associated with negative physical consequences such as racing heart, perspiration, gastric disturbances and muscle tension (Matthews et al., 2000), all of which may negatively contribute to academic achievement (impairing study habits and attendance). From a psychological point of view, it has been shown that Neuroticism is related to poor self-concept (Wells & Matthews, 1994) and low self-estimated intelligence (Furnham, Chamorro-Premuzic, & Moutafi, under review). Since experiencing stressful situations is, to a great extent, dependent on an individual’s perception and appraisal of his/her capabilities to cope with that situation (Lazarus & Folkman, 1984; Seyle, 1976), it is likely that low self-concept and self-estimated intelligence may partly determine the increase of anxiety in neurotic individuals.

The relationship between academic performance and Extraversion has also been widely explored. Research seems to indicate that several variables such as age, level of education and type of assessment may play a crucial role and even determine the nature and sign of this correlation. Specifically, the correlation between academic performance and Extraversion has been found to change from positive in primary school to negative in secondary school and university (see Entwistle, 1972; Eysenck & Cookson, 1969; Petrides, Chamorro-Premuzic, Frederickson, & Furnham, in press). This change has been attributed to the move from the sociable, less competitive, atmosphere of primary school to the rather formal atmosphere of secondary school, although others have argued that this change is due to the fact that the less able individuals become extraverted and vice-versa (Anthony, 1973). It is likely that introverts have an advantage in written assessments, whereas extraverts would benefit from oral examinations (Chamorro-Premuzic & Furnham, 2003a; Furnham & Medhurst, 1995; Robinson, Gabriel, & Katchan, 1993). Further, a recent study has shown that extraverts express preference for viva exams, whilst introverts overtly dislike this type of assessment (Furnham & Chamorro-Premuzic, under review). It is however generally accepted that introverts have an advantage over extraverts with respect to the ability to consolidate learning, as well as lower distractibility and better study habits (Entwistle & Entwistle, 1970; Eysenck & Cookson, 1969; Sanchez-Marín, Rejano-Infante, & Rodríguez-Troyano, 2001). Accordingly, it can be expected that, in university samples (particularly when students are assessed by long, written, examinations) introverts will tend to outperform extraverts.

The relationship between Conscientiousness and academic performance has been the focus of several recent studies. Researchers have shown that there are significant associations between Conscientiousness and academic performance in school (Wolfe & Johnson, 1995), undergraduate (Busato, Prins, Elshout, & Hamaker, 1999; Goff & Ackerman, 1992), and post-graduate (Hirschberg & Itkin, 1978; Rothstein, Paunonen, Rush, & King, 1994) levels of education. These associations are generally explained in terms of the higher “strength of character” (Smith, 1969), motivation (Andersson & Keith, 1997; Boekaerts, 1996; Pelechano, 1972), achievement striving, dutifulness, order and responsibility that characterises conscientious individuals (Chamorro-Premuzic & Furnham, 2003a; De Raad & Schouwenburg, 1996). Thus, careful, organised, hard
working, persevering and achievement-oriented students may expected to succeed in academic settings.

The present study will examine the relationship between examination grades (on two statistics examinations held 4 months apart) and individual differences at the university level. It will aim to compare the predictive power of cognitive ability measures with that of personality inventories. Furthermore, it is also aimed to compare the predictive power of both non-cognitive and cognitive traits with that of previous academic record (namely continuous assessment). Several hypotheses will be tested.

H1: There will be significant associations between statistics examination grades (SEG) and cognitive ability measures. Specifically, it is expected that psychometric intelligence will be positively related to SEG. This would be shown in a series of correlations and regressions.

H2: There will be significant relationships between individual differences in personality and SEG. Specifically, it is expected that (H2a) Neuroticism will be negatively correlated with SEG, (H2b) Extraversion will be negatively associated with SEG, whilst (H2c) Conscientiousness will be positively related to SEG.

H3: Individual differences will show some incremental validity in the prediction of SEG with respect to previous academic record (specifically continuous assessment). This will be tested through a series of hierarchical regressions.

2. Method

2.1. Participants

The sample was composed of 91 (74 females and 17 males) undergraduate students from University College London. Admission to this programme is based primarily on school grades, as well as evidence of motivation, maturity and stability (as assessed in a series of interviews). All students were fluent English speakers. Age ranged from 18 to 25, with an arithmetic mean of 19.7 (SD = 1.25) years.

2.2. Measures

SEG: SEG data for each participant were recorded throughout the first academic year in students’ files. It was measured by two exam marks based on two three-hour statistics exams (on a 1–100% scale where 32% is a pass and 70% is a first or distinction). The content is based on an introductory statistic examination course designed for first year university students and the following sample items are included:

An individual scores 81 on a test of verbal ability, and 6.4 on a test of visuo-spatial ability. For the verbal ability test, the population mean is 50 and the standard deviation 20. For the visuo-spatial test, the mean is 0 and the SD 5. Both tests have scores that are normally distributed in the general population. (A) In which domain is this individual stronger—verbal ability or visuo-spatial ability? (B) What percentage of the population
would be expected to score higher than this person on (i) verbal ability and (ii) visuospatial ability?

*Which of the following increase the power of the test?*

(a) increasing \( n \) (the sample size),
(b) increase the sample variance,
(c) increasing the effect size,
(d) (a) and (c).

Although the data was analysed separately for the two examination grades, the discussion of the results will be predominantly based on the overall SEG, that is, the arithmetic mean of the two marks for each student. SEG ranged from 30.44 to 91.03, with an average of 70.14 (SD = 16.04).

**Personality:** *The NEO-FFI* (Costa & McCrae, 1992). This 60 item, non-timed questionnaire, measures the Big Five personality factors, i.e., Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness. Items involve questions about typical behaviours or reactions, which are answered on a five-point Likert scale, ranging from “strongly disagree” to “strongly agree”. The manual shows adequate indices of reliability and validity (see Costa & McCrae, 1992). Together with NEO PI-R, this inventory is currently the most frequently used personality measure.

**Intelligence:** Three measures of cognitive ability were employed in this study.

(a) *The Wonderlic Personnel Test* (Wonderlic, 1992). This 50-item test can be administered in 12 min and measures general intelligence. Scores can range from 0 to 50. Items include word and number comparisons, disarranged sentences, serial analysis of geometric figures and story problems that require mathematical and logical solutions. The test has impressive norms and correlates very highly \( (r = 0.92) \) with the WAIS-R.

(b) *S&M Test of Mental Rotation Ability* (Philips & Rawles, 1979). This is a quick measure of mental rotation based upon Shepard and Metzler’s (1971) visual spatial ability test. The S&M test is a timed version of Vanderberg and Kuse’s (1978) mental rotation test and can be administered in 2 min.

(c) *AH5 (Part 1)* (Heim, Watts, & Simmonds, 1970). This is a well-established measure of verbal and spatial ability. It was designed to be used with selected, highly intelligent students. There are alternative tests (Part 1 and Part 2). The test is 20 min long and has good British norms.

**Seminar performance:** Every week (throughout two academic terms) participants attended a compulsory one-hour tutorial or seminar as part of their degree. They also wrote 3–6 essays for the seminar leader which were marked and determined feedback given. Two different seminar leaders (i.e., staff members) evaluated each student’s presentation and discussion of diverse subjects and wrote a final report upon conclusion of each seminar on a standard form. Seminar performance was given by three variables, namely seminar behaviour (behaviour in class), absenteeism (level of attendance), and overall essay marks (for a total of 10 essays), all of which were aggregated scores across all semesters. Seminar behaviour was a measure on the six 7-point
scales in which students were rated by their tutors. Absenteeism was calculated in percentages for each participant [total number of seminar meetings/seminar meetings missed \times 100]. Overall essay marks were obtained by calculating the arithmetic mean for each participant (number of essays submitted was held constant, i.e., four). Previous studies have found these seminar leader ratings both reliable and valid (Chamorro-Premuzic & Furnham, 2003a, 2003b; Furnham & Medhurst, 1995).

2.3. Procedure

Personality and intelligence measures were administered at the beginning of the first academic year, during a series of inaugural lectures. Each student completed the short version of the Big Five personality inventory (Costa & McCrae, 1992), as well as three different ability tests, namely the Wonderlic Personnel tests (Wonderlic, 1992), part 1 of the Alice Heim 5 (Heim et al., 1970), and the S&M Test of Mental Rotation Ability (Philips & Rawles, 1979). Five examiners were present during completion of the tests to ensure proper administration. Seven months later, students completed the two statistics examinations (from which grades were derived). These exams are described below. During this seven-month period, students’ performance on a number of weekly seminars was also assessed via continuous assessment. This data was used to test the predictability of individual differences with regard to SEG in comparison with previous academic performance (continuous assessment).

3. Results

In the first part of the analyses, a series of bivariate and partial correlations were computed on the data in order to test the relationship between individual differences and SEG. Correlation coefficients are presented in Table 1.

The correlations between SEG and cognitive ability showed several significant and positive associations between these measures. SEG_1 was significantly and positively correlated with the three psychometric intelligence tests, whilst SEG_2 was significantly and positively correlated with

<table>
<thead>
<tr>
<th></th>
<th>SEG_1</th>
<th></th>
<th>SEG_2</th>
<th></th>
<th>SEG overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuroticism</td>
<td>0.07</td>
<td>(0.10)</td>
<td>−0.01</td>
<td>(0.00)</td>
<td>0.04 (0.05)</td>
</tr>
<tr>
<td>Extraversion</td>
<td>−0.22*</td>
<td>(−0.27*)</td>
<td>−0.21*</td>
<td>(−0.21)</td>
<td>−0.24* (−0.26*)</td>
</tr>
<tr>
<td>Openness</td>
<td>0.00</td>
<td>(−0.00)</td>
<td>−0.12</td>
<td>(−0.13)</td>
<td>−0.06 (−0.07)</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>−0.02</td>
<td>(−0.02)</td>
<td>−0.06</td>
<td>(−0.06)</td>
<td>−0.04 (−0.04)</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>0.14</td>
<td>(0.19)</td>
<td>0.32**</td>
<td>(0.31**)</td>
<td>0.25* (0.27*)</td>
</tr>
<tr>
<td>Wonderlic</td>
<td>0.29**</td>
<td>[0.38**]</td>
<td>0.02</td>
<td>[0.18]</td>
<td>0.17 [0.32**]</td>
</tr>
<tr>
<td>Alice Heim</td>
<td>0.23*</td>
<td>[0.31**]</td>
<td>0.10</td>
<td>[0.29*]</td>
<td>0.18 [0.33**]</td>
</tr>
<tr>
<td>Spatial ability</td>
<td>0.25*</td>
<td>[0.19]</td>
<td>0.21*</td>
<td>[0.18]</td>
<td>0.25* [0.21*]</td>
</tr>
<tr>
<td>Gender</td>
<td>−0.08</td>
<td>–</td>
<td>−0.01</td>
<td>–</td>
<td>−0.05 –</td>
</tr>
</tbody>
</table>

*Note. N = 91. *p < 0.05, **p < 0.01 (partiallying out psychometric intelligence) [partiallying out personality traits].
spatial ability. When the overall SEG was examined, it was found to be significantly and positively correlated with spatial ability, but not with Wonderlic or Alice Heim scores. H1 was therefore partly confirmed. When personality traits were partialled out, the correlations showed significant associations between overall SEG and all cognitive ability measures. This indicates that cognitive ability is particularly related to SEG when individual differences in personality are being controlled for.

As can be observed, there were significant correlations between Extraversion and all SEG. These correlations were negative, indicating that grades tended to decrease as Extraversion scores increased. This confirmed H2b. On the other hand, Conscientiousness was positively and significantly correlated with SEG_2 and overall SEG. Thus conscientious students tended to obtain higher grades than their low conscientious counterparts. This supported H2c. However, contrary to what was predicted in H2a, there were no significant associations between Neuroticism and SEG. When cognitive ability measures were partialled out, the correlational pattern between personality traits and SEG remained very similar. There were no significant gender correlates of SEG.

The second part of the analyses consisted of a series of hierarchical regressions in which the predictability of SEG by individual differences and previous academic performance (continuous assessment) was tested. In a first series of regressions, the predictability of psychometric intelligence (block 1) and personality traits (block 2) were tested. Results are summarised in Table 2.

As can be seen, cognitive ability accounted for 11% of the variance in SEG_1, and Wonderlic scores were the only significant predictor in this model. When personality traits were added as predictors, the model accounted for an additional 6% of the variance in SEG_1, and Extraversion was a negative and significant predictor. When SEG_2 was entered as criterion variable, cognitive ability measures failed to be significant predictors (although spatial ability was a significant

| Table 2 |
|----------------------------------|-----------------|-----------------|-----------------|
| St. $\beta$ coefficients and $t$-values for the predictors of SEG after hierarchical regressions |
| SEG_1 (St. $\beta$) | $t$ | SEG_2 (St. $\beta$) | $t$ | SEG overall (St. $\beta$) | $t$ |
| Wonderlic | 0.41 | 2.53* | 0.03 | 0.38 | 0.23 | 1.40 |
| Alice Heim | -0.12 | 0.72 | 0.04 | 0.34 | -0.06 | 0.36 |
| Spatial ability | 0.18 | 1.58 | 0.15 | 1.34 | 0.16 | 1.36 |
| F(3, 70) | 4.17** | 0.44 | 1.75 |
| Adj. $R^2$ | 0.11 | -0.01 | 0.03 |
| Neuroticism | -0.08 | 0.67 | -0.06 | 0.51 | -0.08 | 0.66 |
| Extraversion | -0.31 | 2.46** | -0.19 | 1.48 | -0.27 | 2.18** |
| Openness | -0.07 | 0.65 | -0.22 | 1.83 | -0.17 | 1.42 |
| Agreeableness | -0.04 | 0.32 | -0.09 | 0.74 | -0.07 | 0.60 |
| Conscientiousness | 0.13 | 1.04 | 0.41 | 3.16* | 0.30 | 2.41** |
| F(8, 65) | 2.93* | 2.23** | 2.65** |
| Adj. $R^2$ | 0.17 | 0.11 | 0.15 |

* $p < 0.05$.
** $p < 0.01$. 
predictor in the model). When the Big Five personality traits were added as predictors, the model significantly accounted for 11% of the variance in SEG_2, and Conscientiousness was a significant predictor in the model. The hierarchical regression in which overall SEG was regressed onto cognitive ability and personality measures showed that personality traits, but not psychometric intelligence, were significant predictors of overall SEG. Particularly Extraversion (negatively) and Conscientiousness (positively) were significant predictors of overall SEG. Thus the first series of hierarchical regressions provided additional support for H2 (particularly H2b and H2c), but only modest support for H1.

Table 3 shows quite clearly that seminar leader reports accounted for most of the variance: around a third for the overall score. Intelligence contributed only 1–6% additional variance but personality added around 10%. Interestingly it was essay marks that was the best predicted of statistical results.

The results thus show that students who score high in their term essay results and seminar behaviour, who are rarely absent from their seminars and who tend to be introverts, conscientious and not very open to experience do best on their statistics exam results.

To further investigate these results various further regressions were performed. First the three significantly intercorrelating intelligence tests that loaded on one factor were combined to obtain an overall 'g' score. Next seminar behaviour and essay grades were combined to a measure of seminar performance. Then a series of hierarchical regressions were run with seven predictor

<table>
<thead>
<tr>
<th>Table 3</th>
<th>St. $\beta$ coefficients and t-values for the predictors of SEG after hierarchical regressions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SEG_1</td>
</tr>
<tr>
<td>Seminar behaviour</td>
<td>0.34</td>
</tr>
<tr>
<td>Essays</td>
<td>0.51</td>
</tr>
<tr>
<td>Attendance</td>
<td>-0.08</td>
</tr>
<tr>
<td>$F(3,77)$</td>
<td>18.43*</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.39</td>
</tr>
<tr>
<td>Wonderlic</td>
<td>0.30</td>
</tr>
<tr>
<td>Alice Heim</td>
<td>-0.08</td>
</tr>
<tr>
<td>Spatial ability</td>
<td>0.12</td>
</tr>
<tr>
<td>$F(6,74)$</td>
<td>12.14*</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.45</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>-0.04</td>
</tr>
<tr>
<td>Extraversion</td>
<td>-0.21</td>
</tr>
<tr>
<td>Openness</td>
<td>-0.06</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>0.15</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>0.15</td>
</tr>
<tr>
<td>$F(11,69)$</td>
<td>7.92*</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.49</td>
</tr>
</tbody>
</table>

* $p < 0.01$.
** $p < 0.05$.
*a High scores indicate high absenteeism.
variables: intelligence (g), seminar performance, seminar absenteeism and four of the five personality trait scores (Agreeableness was omitted because it neither theoretically nor empirically related to the dependent variable). This point of this analysis was to see if substantially more of the variance in the exam marks would be accounted for. The results however were very similar to those reported in Table 3.

4. Discussion

The results of this study confirmed most of the hypotheses. They showed that three sets of factors were logically and systematically related to university statistics exam test scores. They were seminar leader ratings of progress (observational data); intelligence test scores (test data) and personality traits (self-report data). Each of these factors contributed unique variance to combine test score and account for nearly half of the variance (for the two exams combined).

The results shown in Table 3 indicate that seminar leader (lecturer) ratings account for around a third of the variance, intelligence tests barely 3% and the remainder of around 10% attributable to personality traits. Each will be considered in turn.

Various longitudinal studies have demonstrated that seminar reports are both reliable and have predictive validity. Furnham and Medhurst (1995) showed when six different university teachers rated a students’ term-long (2–3 month) seminar performance (based on about 12 seminars) their alphas were between 0.62 and 0.78 for each item (e.g., written expression, participation in class, etc.) and that overall the alpha reliability between different raters of the same student over 3 years exceeded 0.80. Further, these seminar ratings were consistently and systematically related to various self-report measures of personality and learning style.

More importantly, Chamorro-Premuzic and Furnham (2003a) showed in two studies that seminar-leader ratings predicted both final exam and course work marks of students accounting for between a fifth and a tenth of the variance. In that study, using two different well-established personality variables (measuring both the Big Five and the Gigantic Three) seminar ratings accounted for more of the variance than the personality traits. The same results occurred here although based on two different tutor ratings and using specific (statistic) exams as the predicted criteria. This suggests that tutors are accurate assessors of student performance as well as their potential. This is no doubt based on various forms of data: essays, presentations and general seminar performance. Indeed essay marks were the best predictor of statistical examination grades. Interestingly poor attendance at seminars was also a predictor of grades.

The second most powerful predictor of grades was personality. The results showed that conscientious introverts did best. In previous studies Neuroticism has been a significant predictor of examination grades (Chamorro-Premuzic & Furnham, 2003a, 2003b). Statistics often frighten psychology students and it was therefore surprising that Neuroticism had no predictive power. There was however an indication that low Openness scores were significant predictors of examination grades. This may, at first, seem surprising given that Openness has often been found to be significantly correlated with intelligence (Ackerman & Heggestad, 1997; Zeidner & Matthews, 2000). However the nature of statistics is that it requires hypothetical-deductive thinking while Openness is more associated with inductive, creative, thinking.
Certainly the fact that personality traits seem logically and statistically related to examination grades suggests that they may serve a useful selection function. It appears to be the case that whatever the nature of the examination: essay, statistics, course work, Conscientiousness is a consistent predictor of academic performance. This is unsurprising given that Conscientiousness is associated with the work ethic, dutifulness, need for achievement. However there is also some consistent evidence that in university students Conscientiousness is negatively associated with intelligence. Moutafi, Furnham, and Paltiel (in press) argue that in highly competitive work and educational environments comparatively less intelligent (fluid intelligent) people learn to become more conscientious to compensate for their ability. This thesis remains to be tested.

This study goes further than others in this area by relating psychometric intelligence to statistics exam performance (Chamorro-Premuzic & Furnham, 2003a, 2003b). Whilst there was evidence that these tests were predictive, the amount of variance accounted for over and above the seminar leader ratings and the personality traits was modest. It is interesting that spatial ability was the best predictor. This maybe due to gender operating as a mediator variable (although limitations of the present sample, which was rather small and predominantly composed of female students, do not allow us to test this hypothesis). However the fact that males are better at both statistics and spatial ability tests may have been reflected in the present results.

Psychometric intelligence maybe a less powerful predictor of exam success because of the problem of restriction of range. Indeed examining the results of the Wonderlic it seems the students' mean score was in the 77% percentile (mean 27 vs. norm of 21) though the standard deviation of 6.89 was not unlike norms (SD = 7.12). However the fact that the mean score for the present sample was considerably higher than the population norm may be indicative of the highly selective sample examined in the present study. It is not uncommon that the validity of psychometric intelligence is more limited in more homogeneous samples, particularly at higher levels of cognitive ability. Conversely, personality inventories tend to play an increasing role in the prediction of performance in samples with high g distribution of scores. This is consistent with the previous literature (Ackerman, 1994; Sanders et al., 1955; Seth & Pratap, 1971; Singh & Varma, 1995; Thompson, 1934; Wolf, 1972).

Finally it should be pointed out that students were marked anonymously. They were taught and examined by one member of staff who did not take tutorials with the students. In this sense there could have been no effect of marker bias or self-fulfilling prophecies.

References


