Conscientiousness, Extroversion and Academic Perfomance. Evidence from Chilean Undergraduates

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Abstract

This study aims at exploring the relationship between academic performance and the personality traits of the students. We considered a number of control variables as well. Our data come from the institutional records of the School of Economics and Business at the University of Chile, and from the records of the Ministry of Education. There are few or no examples of this type study with data from less developed countries. Our results, when we consider the effects of the personality traits, are much in line with the literature. On the other hand, we found considerable empirical support for the idea that the type and number of tests and evaluations matter for the academic performance. This is an important result because it has interesting implication for the improvement of the academic performance. Gender seems also to play a role for the determination of the academic performance and, in consequence, we explored this issue.

Keywords: Big Five, student performance, quantitative literacy education

JEL Classifications: I21, I23 y A22

1 Introduction

This study is, to a large extent, a result of our discussions about the problems of teaching quantitative methods to undergraduate students at the School of Economics and Business of the University of Chile. We were interested in discussing which quantitative methods should be taught and how, as well as how to measure the academic performance of the students. Quite soon an important issue emerged: could the academic results be related to student's characteristics and, nonetheless, to their personality traits? Another interesting issue emerged: Can the different types of tests and evaluations influence the academic performance? We were aware of an extensive literature on the subject presenting evidence on these problems. However, few or none of these studies were based on data from less developed countries (LDC).

Thus, the main aim of this study is relating the student's personality traits with their academic performance using the empirical evidence collected at the School of Economics and Business of the University of Chile. We studied this relationship under different types of tests and evaluations. A few personality traits, also known in the literature as the ***Big Five***, led to the ***Five Factor Model (BF)*** presented in (Borghans et al. 2008). This BF model became quite popular and has been used in several different contexts, beginning with the work of (Goff and P. L. Ackerman 1992) and (Rolfhus and Phillip L Ackerman 1999) who related the Big Five to intelligence and knowledge. This model has also been used for explaining the choice of career, as in (Jin, Watkins, and Yuen 2009), the learning styles (Komarraju et al. 2011), assistance and out-of-classroom study time (Delaney, Harmon, and Ryan 2013). The academic performance has been studied at different levels; for secondary school students in (Noftle and Robins 2011), undergraduate students in (T. Chamorro-Premuzic and A. Furnham 2003), and graduate students in (Rothstein et al. 1994).

We collected data about the performance of undergraduate students following the first course on Statistics at the School of Economics and Business (FEN). This is a mandatory course with several evaluations of different types and characteristics. The performance data was completed with data from the student's records at the University and the Ministry of Education. These data was complemented with an open and voluntary survey aimed at capturing the BF personality traits. This survey includes the measurement errors inherent in self-reporting, often commented in the literature

The results of this study show, clearly, that conscientiousness and extro-

version are the most relevant out of the Big Five in order to explain academic performance. Our evidence suggests that the effects of conscientiousness and extroversion on academic performance vary according to the type and characteristics of the evaluation used to measure these academic results. This conclusion is important because it allows the design and implementation of improved evaluations contributing to reach the targets of the learning process. On the other hand, it is worth nothing that we could not find this kind of conclusions in the relevant literature, and we hope that the evidence presented by this paper will will contribute to the debate.

Thus, we analyzed these data considering different types of evaluations; namely, group and individual evaluations, multiple choice questions and open answer question, evaluation with longer and evaluations with shorter time available for study. We found that a higher level of conscientiousness has a positive effect on the academic performance in the case of evaluations with less available study time, in evaluations after the regular schedule and on the final grade of the course, but not so in the case of the grade of multiple choice tests, which were used for first time just in this year. On the other hand, extroversion showed a negative effect in the case of first-time evaluations and the final grade of the course. We also found that a higher level of conscientiousness and a lower degree of extroversion positively affects the academic performance, possibly due to out-of-schedule study, limiting time allocated to social activities. However, related control variables proved to be important for explaining the student's academic performance.

We also observed gender differences in the academic performance, with reasonable significance for certain types of tests. We explored these gender differences using a Oaxaca-Blinder approach. A classical reference for this approach is (Oaxaca and Ransom 1994).

This paper is organized as follows. The next section discuss some theoretical underpinnings, mostly the role of conscientiousness and extroversion in the learning process. We organized this discussion along a revision of the results presented in the literature. Section Three presents and discuss the data, as well as our statistical and econometric approach. A section presenting the results of our estimations follows. A section with our conclusions and implications for educational policy ends the paper.

2 Theoretical Underpinnings

This study focuses on the five main personality traits considered in the literature, also known as the Big Five. There is an extensive literature considering these traits. The available empirical evidence suggests that Conscientiousness and Extroversion are the two most relevant of these five personality traits. Thus, we organize our discussion around these two personality traits that are the focus of our study. A review of the literature follows.

Conscientiousness

Most researchers report a small but positive effect of Conscientiousness on the academic performance of the students. See, for example, (Goff and P. L. Ackerman 1992), (Busato et al. 1998) and (Busato et al. 2000). Some researchers suggest that the positive effect of Conscientiousness on academic performance is due to the relationship between this personality trait and other traits, as character strength in the case of (Smith 1970), motivation in the case of (Anderson and Keith 1997) and (Adrian Furnham 1995), and auto-discipline, in the case of (Duckworth and Seligman 2005). Additionally, (Delaney, Harmon, and Ryan 2013) found that a higher degree of Conscientiousness is positively related with the off-classroom study time and the assistance to the courses for undergraduate students. Thus, we can expect that a student with a higher degree of Conscientiousness would also be more constant and disciplined, which would lead to a better academic performance than those students with a lower degree of Conscientiousness.

Several studies, as in the case of (T. Chamorro-Premuzic and A. Furnham 2003), (De Raad and Schouwenburg 1996), and (Duckworth and Seligman 2005), suggest that students with a higher degree of Conscientiousness would be more constant and disciplined. Thus, when these students, with a higher degree of Conscientiousness, know that they will sooner face a test with a short time for studying and preparation would choose a strategy including studying earlier and working more off-classroom time. (Delaney, Harmon, and Ryan 2013) also suggest this. However, (Moutafi, Adrian Furnham, and Paltiel 2004) found that the students with greater cognitive ability show a lower level of Conscientiousness. These students could compensate the earlier study time of students with a higher degree of Conscientiousness.

In the case of evaluations that demand off-classroom working time, students with a higher degree of Conscientiousness should show better academic

performance as suggested by (Duckworth and Seligman 2005). In the case of our study, these evaluations are taken by groups with three students. The groups are formed by the students themselves, thus raising the issue of self-election and free-riders. This will be discussed later on.

We expect to find a positive effect between the end grade of the course and the level of Conscientiousness, as suggested by (Goff and P. L. Ackerman 1992), (Wolfe and Johnson 1995), (Bauer and Liang 2003) and (Adrian Furnham, Tomas Chamorro-Premuzic, and McDougall 2003). It should be noted that most of these studies used the academic performance as declared by the students. This contrasts with our study where we use data form administrative records on academic performance.

Finally, we should state that all the hypotheses discussed above are in line with those proposed in (Almlund et al. 2011), who defined personality as ***"a response function of agents that depends on situations (including incentives), endowments of traits, information, and resources within a conventional economic model"***. Thus, we can expect that the effect of the personality traits on the academic performance would not be homogeneous given different types of evaluations, taken under different conditions.

Extroversion

Introverted students would have better academic results in written evaluations than extroverted students, as suggested by (Busato et al. 2000), (Adrian Furnham and Tomas Chamorro-Premuzic 2004) and (Hair and Hampson 2006). However, the evidence suggests that extroverted students get better academic results when the evaluations is related to an active participation at the classroom, as in (Rothstein et al. 1994). Most often we assume that more introverted students use less time socializing and more time studying as suggested in (Sánchez, Rejano, and Rodríguez 2001). On the other hand, (N. J. Entwistle and D. Entwistle 1970) and (Eysenck and Cookson 1969) suggest that introverted students are more able to consolidate what has been learned, are less prone to distractions, and have better study habits. Thus, when the available study time is scarce, extroverted students should have a worse academic performance than introverted students. However, this academic performance should be reduced when the available study time is abundant, possibly because extroverted students can reach a better balance between socialization and studying.

Following (Goff and P. L. Ackerman 1992), (Bauer and Liang 2003), and (Adrian Furnham, Tomas Chamorro-Premuzic, and McDougall 2003) more extroverted students should get lower end grades for the course and worse results in individual evaluations. this could be explained by a more active social life for the extroverted students, which leads to a reduction of the time devoted to studying, as suggested in (N. J. Entwistle and D. Entwistle 1970) and (Sánchez, Rejano, and Rodríguez 2001). On the other hand, less extroverted students are often capable of keeping concentration during longer periods of time, which is useful for consolidating knowledge, as suggested in (Eysenck and Cookson 1969).

When working in off-classroom assignments and evaluations, extroverted students should have worse academic results, due to the tendency to use more off-classroom time socializing rather than studying, as suggested in (N. J. Entwistle and D. Entwistle 1970) and (Sánchez, Rejano, and Rodríguez 2001). However, in the case of our study the self-selection of the groups could modify this hypothesis.

The Model

Summing up the discussion above, we can see that the literature suggests that there should be a relationship between the personality traits and the academic performance of the students. That is, the personality traits could contribute to explaining the academic performance of the students. Thus, we specify a linear model explaining an indicator of academic performance in terms of indicators of the personality traits discussed above. It should be noted that the estimations of this econometric model is not trivial.

It is easy to see that there are many other variables that could be included in a model explaining the academic performance of the students. However, most of these additional variables are usually related to the personality traits, thus increasing the risk of multicolinearity. On the other hand, it is easy to see that there are practical difficulties in including all the potentially relevant variables in a model explaining the academic performance of the students. This introduce the problem of the bias of excluded variables.

Following the identification strategy presented in (Delaney, Harmon, and Ryan 2013) we related the academic performance according to the following model:

$$Y_i = \beta_0 + \beta_1 \mathbf{X}_{1i} + \beta_2 \mathbf{X}_{2i} + \beta_3 \mathbf{X}_{3i} + \beta_4 \mathbf{X}_{4i} + \epsilon_i, i \in \{1, \cdots, N\}, \qquad (1)$$

where Y_i stands for an index of the academic performance of the ith student. For example, it could be the variable G_i, the final grade at the end of the course. Several other metrics related to partial evaluations of the students can be used. These indexes of academic performance will be discussed later on. The scale of the grades was transformed to an achievement scale, from 0 to 100 percent, in order to facilitate the interpretation of the coefficients. The vector $\mathbf{X}_1$ represents the personality traits, which were standardized using z-scores. The results of the PSU (University Selection Test)[1] test is contained in $\mathbf{X}_2$, also standardized using z-scores. Vector $\mathbf{X}_3$ includes family characteristics of the students and $\mathbf{X}_4$ includes the characteristics of the students.

We estimated the model in equation (1) using Ordinary Least Squares (OLS), including a robust estimation of the variance of the estimator. This is a rather early course with many students and it was divided in smaller groups with different teachers that lectured at different times during the day. The students had a limited possibility of choose among these groups. Thus, we included a number of dummy variables in order to correct for the heterogeneity introduced by the structure of the course.

[1]This is a general test, taken once each year, by the students that finished their secondary school. It is a requisite for admission to most and best universities

3 Our Data

The data used in our study are related to a sample of 622 undergraduates at the School of Economics and Business of the University of Chile, following three different professional programs; namely, 19 students from the Accountant Auditor program, 73 students from Engineering in Information Systems and Management Control, 525 from the Business Administration and Economics *(Ingeniería Comercial)*, and 5 students from Special Admission[2] (Ingreso Especial). Eventually, the sample was reduced to 545 persons when we eliminated people that abandoned the course, people that took this course for second time, and those that refused to answer the voluntary survey on the Big Five personality traits. Formally, these students belong to two different cohorts: one that started their university studies in 2012 and the other in 2013. However, because of a change in the programs all these students met each other at a course called *Statistics I*. We collected data on these students from different sources. These sources and these data are discussed in this section.

Institutional records and survey

We collected data on the grades obtained by the students and their past academic performance, as well as their demographic characteristics from the records of the University of Chile and Chile's Ministry of Education. This must be contrasted with many other studies that collected these data on a self-reporting basis. Examples of such studies are (Delaney, Harmon, and Ryan 2013), (Adrian Furnham, Tomas Chamorro-Premuzic, and McDougall 2003), and (Zeidner and Shani-Zinovich 2011). Thus, by using these institutional records we reduced considerably a possible self-reporting bias.

Additionally the students were submitted to a voluntary survey aimed at identifying the main personality traits. No incentives were offered to the students completing the survey. This survey is, in fact, a Spanish language version of the questionnaire ***Ten Item Personality Inventory*** (TIPI) presented in (Gosling, Rentfrow, and Swann 2003) and aimed at capturing the personality traits. Our Spanish version is included in Appendix A. This survey, in its shorter version includes ten questions aimed at measuring five personality traits: ***Extroversion***, ***Agreeableness***, ***Conscientiousness***,

[2]Foreign students, or students selected by their sport performance, or with an especially deficient socioeconomic situation.

Neurotism, and ***Openness***. The survey was taken during two consecutive terms; namely, Fall term 2013 and Spring term 2013. That is, the survey collected data from two cohorts of students. However, due to changes in the organization of the courses, these two cohorts shared the same course on Statistics at the basic cycle for all the programs.

The results of our TIPI survey are summarized at Table 1 and Figure 1. Here we can see that the distribution of the personality traits of our students are consistent with those presented in (Delaney, Harmon, and Ryan 2013). As these authors we found that the students tend to see themselves with higher level of Conscientiousness and extroversion. This is reflected in the skewness of the corresponding distributions.

Table 1: The personality traits. Basic Statistics.

Personality Traits	Mean	Std. Dev.	Skewness	Min.	Max.
Conscientiousness	0.00	0.98	-0.40	-3.31	1.68
Extroversion	0.03	1.00	-0,32	-2.87	1.82
Openness	0.01	0.99	-0,32	-3.10	2.00
Agreeableness	0.00	0.99	-0,18	-3.26	2.47
Neurotism	0.00	1.02	-0,10	-2.95	2.24

Source: Own elaboration with 545 observations.

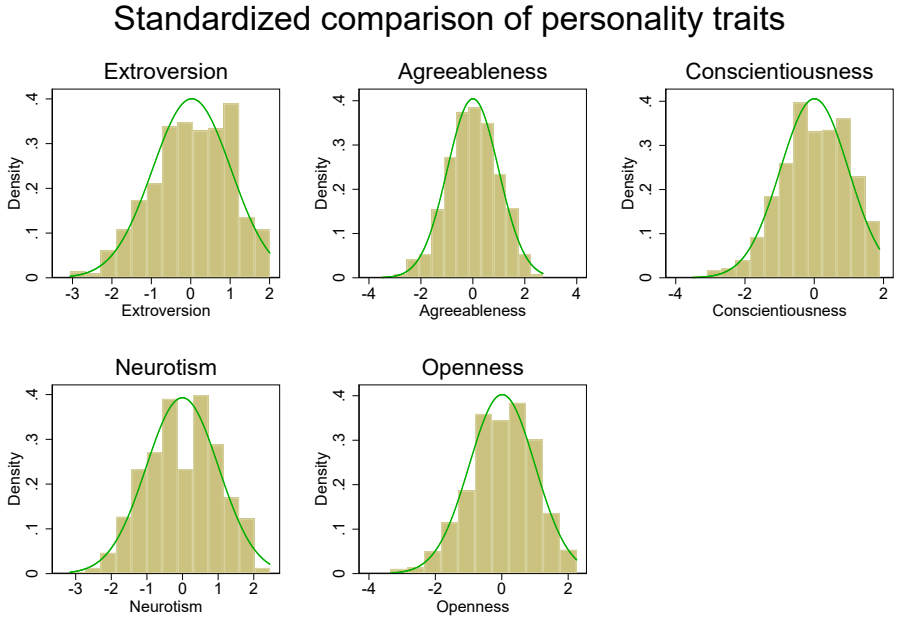
Academic Performance (DA)

We measured the academic performance of the students using the grades obtained at the different partial evaluations during the course. These can be ordered in four categories as described below. All these evaluations are graded with a scale from 1 (minimum) to 7 (maximum).

- ***Mid Term Exams(ME)***: These are four one-hour individual tests with open answers. The contents progress through the whole term and they are not cumulative. These test keep the same format along the term and even during several years. Thus, these are standardized tests. The students can access, on-line, a base of old tests, including the right answers.

- ***Homework (HW)***: These are two assignments to be carried on as home work over a two-week period. These assignments include a com-

Figure 1: Personality Traits



Source: Prepared by the authors

putational task and some purely mathematical and statistical tasks. These assignments are standardized along the time, but the students cannot access a base with the right answers. The students can carry on these home works in self-selected groups including, at most, three participants. In the formula below we consider the average of the results of these two homeworks.

- ***Multiple Choice (MC)***: These are two multiple-choice tests with a durations of forty minutes to be answered individually. There are fifteen question and six alternative answers are offered. These tests were first used during the first term 2013, and again the following term. No database with old tests and their answers is available. In the formula below we consider the average of the results of these two multiple choice tests.

- ***Final Exam (FE)***: This is a test with the same format and duration than the partial tests **ME**. It covers the contents of the final part of the course and have a somewhat higher weight in the final grade of the course.

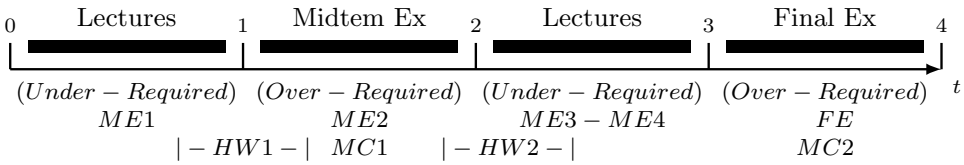
- ***Final Grade (G)***: This is the final grade of the course. Once again we use our standard scale from 1 to 7, eliminating the ME with the lowest grade and using the equation (2). In order to pass the course the students must have a final grade equal or greater to 3.95.

$$G = 0.4\left[\frac{1}{3}\left(\sum_{i=1}^{4} ME_i - \min\{ME_i\}_{i=1}^{4}\right)\right] + 0.1\overline{HW} + 0.3\overline{MC} + 0.2FE. \quad (2)$$

The evaluations are distributed during different period during the term, together with other academic activities of the course. These activities are ***Midterm Exams***, ***Final Exam***, and ***Lectures***. The distribution of activities and tests can be seen in Figure 2. The midterm exams and final exams periods concentrate all the partial and final evaluations in all the courses followed by the students. These are more or less the same because they are following the same program. Both periods have a duration of about one and a half week. The lectures are suspended during these periods, but the students should face many evaluations. Thus the time available for study become scarce. Thus, these periods will be called ***Over-Required-Periods***.

In contrast, during the other two periods the dominant activity are lectures, with fewer evaluations and more time available for study. Thus, we will call these periods as ***Under-Required-Periods***.

Figure 2: Schedule of Evaluations over the Term



The average result of each test is shown in Table 2 with the corresponding distributions in Figure 3. We can see that the lowest grades correspond to midterm exams and highest to home works.

Table 2: Academic Performance by Type of Test

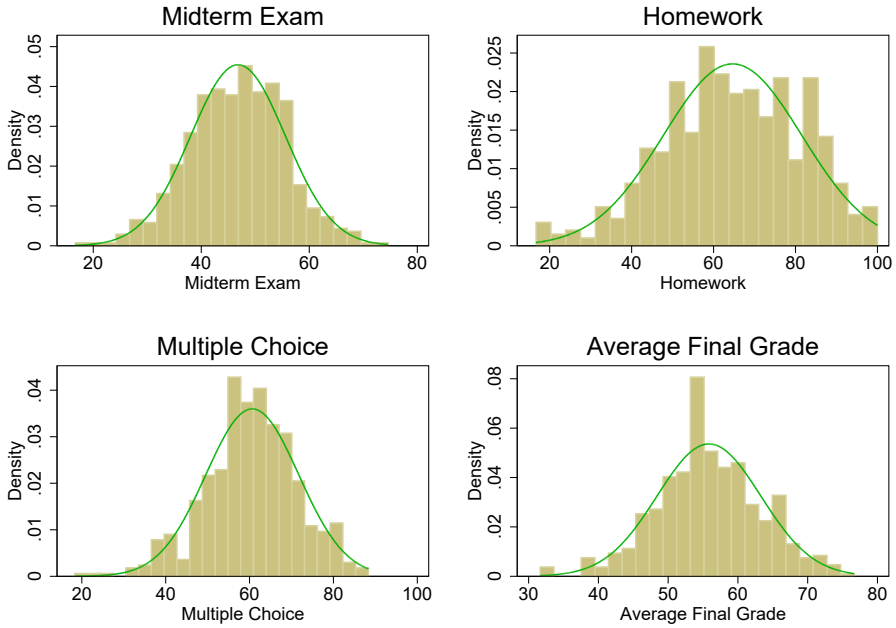
Variable	Mean[a]	(Std. Dev.)	Min.	Max.
Evaluaciones				
Midterm (ME) 1	3.77	(0.83)	1.5	6.2
Midterm (ME) 2	3.61	(0.91)	1.4	6.6
Midterm (ME) 3	4.35	(0.92)	1.6	6.9
Midterm (ME) 4	3.51	(1.08)	1.0	6.5
Homework (HW) 1	4.61	(1.14)	1.0	7.0
Homework (HW) 2	5.14	(1.26)	1.0	7.0
Multiple Choice (MC) 1	4.45	(0.88)	1.9	6.3
Multiple Choice (MC) 2	4.83	(0.89)	1.9	7.0
G	4.35	(0.45)	2.9	5.6
N		545		

[a] Grades fom 1 to 7.

These results are also shown graphically in Figure 3. We can see that the final grade (G) shows a sharp mode, quite close to the mean. We can also see that Homework and Multiple Choice tests show indications or multimodality. In the case of Homework this is clearly associated to high degree of variability of these results.

The course on Statistics, target for this study, enrolled many students. These are divided into smaller groups, with about thirty students each, called ***sections***. During the Fall Term 2013 we had eight sections and nine during

Figure 3: Average Grades Distributions



the Spring Term 2013. Each section has a teacher and the lectures take place between 8:00 and 18:00. The assignment of the students to the different sections includes voluntary elements, the demand of other courses, and some academic characteristics.

Socioeconomic and Demographic Variables

An important characteristic of our study is that most of our data is taken from institutional records. This is especially true for the socioeconomic and demographic characteristics of the students. We expect that these will considerably reduce the self-reporting bias found in many studies. A similar approach, using data taken from institutional records, can be found in (Duff et al. 2004). The following Table 3 shows the basic statistics of these variables.

Table 3: Socioeconomic and Demographic Variables

Variable	Mean	(Std. Dev.)	Min.	Max.
Age	19.16	1.22	18.0	30.0
Gender (Male =1)	0.61	0.49	0.0	1.0
PSU	716.23	27.36	632.8	826.4
Bus. Adm. (yes =1)	0.85	0.36	0.0	1.0
Term (spring =1)	0.54	0.50	0.0	1.0
University parents (both = 1)	0.36	0.48	0.0	1.0
Upper Income (yes = 1)	0.49	0.50	0.0	1.0
Municipal School (yes = 1)	0.16	0.37	0.0	1.0
Private School (yes = 1)	0.61	0.49	0.0	1.0
Subventioned School (yes = 1)	0.23	0.42	0.0	1.0
Men-Only School (yes = 1)	0.14	0.35	0.0	1.0
Women-Only School (yes =1)	0.12	0.32	0.0	1.0
Mixed School (yes =1)	0.74	0.44	0.0	1.0
N		545		

Table 3 shows the basic statistics of the variables of our sample. We can see that the average age of our students was 19 years with a rather small variance. PSU stands for University Selection Test, a standardized test taken by most of the students after graduating from the secondary school and used as a main indicator for the admittance to most universities. Business Administrator indicates if the students follows he main professional program. The variable Upper Income is an indicator of the income of the household,

and equals one when the students belongs to a household within the highest income bracket, as detailed in Appendix B. There are three types of secondary schools in Chile. Schools that are entirely funded from private sources, mainly the pupils themselves, municipal schools funded by public sources and cost free for the pupils, and municipal school with mixed funding, basically private funding completed with public subventions. In Chile most secondary schools have a mixed gender enrollment but still there are a few boys-only and girls-only schools.

We can also see that about 36 percent of the students have both parents with a university degree. The corresponding national indicator tell us that less than 10 percent of the relevant population has some university educations, while only 7.2 percent[3] earned some university degree. Most students come from private school and only 16 percent from municipal schools. Most students, 61 percent, are male.

[3]Encuesta de Protección Social 2015: Informe Final VI Ronda EPS, Subsecretaría de Previsión Social

4 Results

This section presents OLS estimations of different versions of the model introduced in equation (1). In all the estimations we present robust standard errors of the estimator. In each case we estimated two nested models. One of them consider only the five personality traits discussed above, and the second one include a number of control variables. In both estimations we included a dummy variable for each "section"(not reported here) that captures the possible heterogeneity introduced by the division of the students in several groups.

The Basic Estimations

The basic estimations are presented in Table 4. In this case, the explained variable is $\boldsymbol{G}$, our main indicator of academic performance. The estimated model fits poorly to the data; we got quite low value for the adjusted R^2 indicator. However, the F-test suggests that both models are significant at a level better than 1 percent. It should also be noted that we estimated a quite large and highly significant constant. We estimated only a few coefficients corresponding to the personality traits, Conscientiousness and Extroversion, with a significance level better than 1 percent, and only one (Conscientiousness) with a significance better than 10 percent in the model without controls. On other hand, we estimated most of the coefficients of the controls with significance levels worse than 10 percent. The exceptions are the PSU (University Selection Test), estimated at a significance level better than 1 percent; belonging to a private school, estimated at a level of significance better than 5 percent; and belonging to a subventionized school, estimated at a level of significance better than 10 percent. All the estimates of these coefficients are rather large. In the case of the PSU, the effect is large and positive. That is, the PSU is a good predictor of the academic performance, especially in early courses. It is surprising that the effects of belonging to a private or to a subventionized school are large and negative. It should be noted that we expect that the relationship between the PSU and non-municipal schools would be positive, implying positive coefficients for this model. A possible explanation is a process of convergence between students from private and municipal schools.

Alternatively, we estimated both models using $\boldsymbol{HW}$, the standardized average of the grades of the homeworks, as the explained variable and indi-

Table 4: Academic Performance (G), OLS Robust Estimation.

Variables	**Coef.**[a]	t–**index**	**Coef.**	t–**index**
Conscientiousness	0.82***	2.99	0.50*	1.72
Extroversion	-0.91***	-2.87	-1.14***	-3.28
Openness	-0.01	-0.03	-0.10	-0.30
Agreeableness	0.09	0.30	-0.09	-0.27
Neurotism	-0.22	-0.78	-0.23	-0.74
PSU	2.98***	8.39		
Gender (male =1)	0.19	0.31		
Age	-0.39	-1.15		
University Parents (both=1)	1.18	0.21		
Private School (yes=1)	-2.53**	-2.11		
Subventioned School (yes=1)	-1.80*	-1.70		
Upper Income (yes=1)	0.11	0.15		
Bus. Administrator (yes=1)	0.39	0.37		
Term Spring (yes=1)	-0.26	-0.14		
Mixed School (yes=1)	0.39	0.48		
Constant	63.45***	9.57	55.88***	176.87
Observations	545		545	
Adjusted R-squared	0.19		0.02	
F test	5.66		3.54	
Prob > F	0.00		0.00	

[a] *** p<0.01, ** p<0.05, * p<0.1

cator of academic performance. Table 5 summarizes these estimations. The comments about the fit of the model are also valid here. In this case, we were not able to estimate the coefficients of the personality traits with an acceptable level of significance. The exception is Conscientiousness, estimated at a level of significance better that 5 percent, and only better than 10 percent in the case of the model without controls. We estimated the coefficient of Extroversion with a level of significance better than 10 percent in the same model. Once again we estimated a large coefficient for the PSU and at a level of significance better than 1 percent, strengthening the idea that the PSU is a good predictor of the, at least, early academic performance. We estimated a strong negative coefficient for Gender, with a significance level better than 5 percent, suggesting that men have a worse performance in homeworks than female students. A similar estimation for Age suggests that younger students have a better performance. We also got a rather strong suggestion that belonging to the highest income racket has a negative effect on the performance of homeworks. There is a quite strong effect suggesting that students have a better performance at homeworks at the Fall Term than at the Spring Term.

Table 6 summarizes our results of our estimation using the average grade of the multiple choice tests ($\boldsymbol{MC}$) as the academic performance indicator. Once again the model has a poor fit to the data. We could not estimate the coefficients with an acceptable level of significance. The exception is the coefficient of Extroversion, which we estimated at a significance level better than 1 percent. It is worth to note that the multiple choice tests were introduced during the Fall term, 2013. Thus, no answer data basee was available to the students. This means that the students with a higher level of Conscientiousness could not train properly for these tests. This could explai why we were unable to estmate the coefficient at a better level of significance. We got results for the PSU and Private School that follow the pattern established by the two previous estimations. In the case of multiple choice tests, male students get better results. We also got a positive effect, estimated at a level of significance better than 10 percent, for those students that come from a mixed gender schools

Notice that our results for Conscientiousness and Extroversion are similar to other results in the literature, such as (Goff and P. L. Ackerman 1992), (Wolfe and Johnson 1995), (Bauer and Liang 2003), and (Adrian Furnham, Tomas Chamorro-Premuzic, and McDougall 2003). Thus, our evidence seem to support the conclusions in (Almlund et al. 2011) suggesting that the personality traits are useful as strategic orientations in order to face different

Table 5: Homework Performance (HW), OLS Robust Estimation.

Variables	**Coef.**[a]	***t*–index**	**Coef.**	***t*–index**
Conscientiousness	1.27**	2.24	1.33*	1.84
Extroversion	-0.40	-0.73	-1.31*	-1.70
Openness	-0.00	-0.01	0.49	0.61
Agreeableness	-0.02	-0.03	0.12	0.16
Neurotism	-0.47	-0.82	-0.28	-0.35
PSU	1.54***	2.64		
Gender (male =1)	-2.67**	-2.45		
Age	-1.86**	-2.58		
University Parents (both =1)	0.41	0.30		
Private School (yes =1)	-1.79	-0.91		
Subventioned School (yes =1)	0.22	0.12		
Upper Income (yes =1)	-3.28**	-2.32		
Bus. Administrator (yes=1)	-1.72	-1.00		
Term (Spring =1)	-15.04***	-4.39		
Mixed School (yes =1)	-1.60	-1.31		
Constant	112.86***	(7.88)	64.67***	89.51
Observations	545		545	
Adjusted R-squared	0.19		0.02	
F test	5.66		3.54	
Prob > F	0.00		0.00	

[a] *** p<0.01, ** p<0.05, * p<0.1

Table 6: Multiple Choice Tests (MC), OLS Robust Estimation.

Variables	**Coef.**[a]	t–**index**	**Coef.**	t–**index**
Conscientiousness	0.63	1.43	0.07	0.16
Extroversion	-1.40***	-3.03	-1.57***	-3.14
Openness	-0.23	-0.50	-0.43	-0.91
Agreeableness	0.62	1.32	0.29	0.57
Neurotism	-0.55	-1.28	-0.54	-1.16
PSU	4.20***	8.21		
Gender (male =1)	3.91***	4.16		
Age	-0.34	-0.97		
University Parents (both =1)	1.19	1.16		
Private School (yes =1)	-3.57**	-2.10		
Subventioned School (yes =1)	-2.40	-1.52		
Upper Income (yes =1)	1.02	0.89		
Bus. Administrator (yes=1)	0.47	0.33		
Term (Spring =1)	0.61	0.22		
Mixed School (yes =1)	1.79*	1.66		
Constant	63.86***	8.67	60.69***	128.83
Observations	545		545	
Adjusted R-squared	0.20		0.02	
F test	5.99		3.05	
Prob > F	0.00		0.01	

[a] *** p<0.01, ** p<0.05, * p<0.1

situations. Following (N. J. Entwistle and D. Entwistle 1970) and (Sánchez, Rejano, and Rodríguez 2001), more extroverted students have a more active social life, thus reducing the time devoted to studying and, in consequence, the academic performance. This is consistent with our results Multiple-Choice tests, where we estimated negative effects with at least a 10 percent level of significance.

In the case of the control variables, notice that the endowment of previous knowledge, as measured by the variable PSU, seems to have a strong positive effect, at rather high levels of significance. That is, the PSU is a good predictor of the academic performance in a course on Statistics, at least at an early stadium. In the case of the gender variable we found a negative effect (better performance of female students) in the case of the Homework (HW). These coefficients were estimated at a level of significance better than 5 percent. However we found a positive effect (male students have a better performance) in the case of Multiple-Choice tests, but with a level of significance better than 1 percent.

We did also estimate these models for the case when the tests were taken during periods when the students are under a higher pressure of lectures and tests (Over-required) an periods where the students are under a lighter pressure of lectures and tests. These estimations are summarized in Tables 11 and 12 in Appendix B Statistical Appendix. These results clearly support the hypothesis that the type of tests and evaluations is an important factor explaining the academic performance. This is a central result because it has clear implications for the design of teaching and control strategies and policies.

The Gender Gap

Quite often the gender issue emerges when discussing the academic performance. In our study we found that female students get a better academic performance than male students in the case of tests during the Over-Required periods, and in the case of homeworks. This is consistent with results reported in (Fryer and Levitt 2010). We observed the opposite result, with a better performance for males than for females, in the case of multiple choice. A possible explanation is that these tests required more mathematical abilities, where male students would have an advantage following results reported in (Li 1999) and (Marks 2008). Table 13 summarizes tha gender differences for the five performance indicators estimated before. We can see that only

the gender differences for the OVER, HW, and MC variables are significant at a level better than 1 percent.

In order to further explore the gender gap we will focus in these three estimations, test under Over-Required period (OVER), homework (HW) and Multiple-Choice test (MC).

Oaxaca-Blinder decomposition

In order to discuss the gender gap, we will use the Oaxaca–Blinder approach. Possible bibliographic references on the subject are (Elder, Goddeeris, and Haider 2009) and (Oaxaca and Ransom 1994). Suppose that we have three regressions, considering the same independent variables. One of these regressions include all the individuals in the sample, and it will be indexed with T. For the second regression we will consider only the male individuals and it will be indexed with M. For the third and last regression we will consider only the female individuals, indexed with F. That is, we have the regressions:

$$\mathbf{y}_T = \beta'_T X_T + \epsilon_T, \quad \mathbf{y}_M = \beta'_M X_T + \epsilon_M \quad \mathbf{y}_F = \beta'_F X_F + \epsilon_F \tag{3}$$

We estimated models in equation (3) using Ordinary Least Squares. Then, taking means of the estimated models and remembering that for an OLS estimation the mean of the residuals equals zero, we can deduce equation (4).

$$\bar{\mathbf{y}}_M - \bar{\mathbf{y}}_F = \underbrace{\hat{\beta}'_T \left(\bar{\mathbf{x}}_M - \bar{\mathbf{x}}_F\right)}_{A} + \underbrace{\left(\hat{\beta}_M - \hat{\beta}_T\right)' \bar{\mathbf{x}}_M}_{B} + \underbrace{\left(\hat{\beta}_T - \hat{\beta}_F\right)' \bar{\mathbf{x}}_F}_{C}. \tag{4}$$

Note that what we have done in equation (4) is decomposing the sample mean difference in variable y between male and female individuals. This difference was decomposed in three parts: A, B, and C. Part A evaluates the effect of the difference of characteristics between male and female individuals. That is this the part of the difference in the average academic performance that can be explained by elements outside or before the students started at the University. Part B evaluates the advantage of being male, originated in unknown or unobserved reasons. If, in fact, there is a disadvantage for being male this part will have a negative sign. Part C is similar, but evaluates de disadvantage of being female. A negative sign implies an advantage for female students. Parts B and C are, then, related to processes taking place within the university. For example, the type of tests used for evaluate the

students. or because some pedagogical approaches are better suited for on gender that the other.

In Table 13 in Appendix B, Statistical Appendix, we present the sample means of all variables considered in this study, by gender. Notice that out of five different performance indexes considered in our regressions only in three cases these differences resulted significant at a level better than one percent. These are OVER, tests during over-required periods, HW, home work assignments, and MC, multiple choice tests.

Table 7: Chow Test for Selected Variables

			Degrees of Freedom	
Variables	**F-index**	**p-val.**	**Numerator**	**Denominator**
OVER	0.8401	0.3673	15	513
HW	1.1176	0.3369	15	513
MC	1.9747	0.0153	15	513

It is worth to note that, according to the Chow tests, only in the case of MC, multiple choice tests, we could reject the hypothesis of equal coefficients for both genders. The results of the Chow test are shown in Table 7.

The results of our estimations for Equation (4) are shown in Table 8. In this table we show our results for three different academic performance indexes. We show the scores for each part resulting of computing Equation (4). In the following line we have the same results expressed as percentages of the mean difference between male and female differences for each academic performance index.

Table 8: Oaxaca-Blinder Decomposition

Models	**A**	**B**	**C**	**Total**
		OVER		
Score	-0.3737	-0.6788	-1.0491	-2.1016
%	17.78	32.30	49.92	100.00
		HW		
Score	-1.9247	-1.0182	-1.5633	-4.50612
%	42.71	22.60	34.69	100.00
		MC		
Score	0.2355	1.4703	2.2365	3.9423
%	5.97	37.30	56.73	100.00

Examining the results shown in Table 8, we can see that in the case of tests taken under over-required periods we can see that the difference in performance is explained only to a rather small extent by external factors. Female students seem to have a strong advantage, explaining almost half the difference in performance (49.9 percent). That is, female students seem to be better managing the stress associated to the over-required periods. In the case of homework assignments, external factors seeem to explain to a large extent (42.7 percent) the difference in performance. That is, female students seem to have characteristics that are better suited for these type of tests than male students. Finally, in the case of multiple choice tests, external factors explain the difference in performance only to a quite small extent.Most of the difference (56.7 percent) is explained by a possible disadvantage of female students. It should be noted that these are mostly mathematical tests. Among these characteristics differentiating the behavior of male and female students we can, of course, included the Big Five personality traits discussed above. Thus, our results could be in line with those reported by (Li 1999) and (Marks 2008).

A warning should be issued about the Oaxaca-Blinder decomposition. This decomposition is quite attractive and has an immediate and important interpretation. However, we cannot forget that this a purely mathematic decomposition and that it is not unique.

5 Conclusions

The empirical data collected for this study support the main results presented in the literature. There is a somewhat weak effect of some personality traits, Conscientiousness and Extroversion, on the academic performance of the undergraduate students. Moreover, this results persist when we consider different types of tests and evaluations. On the other hand, we were unable to estimate effects on the academic performance of the other three personality traits included in the Big Five model, at a level of significance better than 10 percent.

But personality traits are not the only factors that can explain the academic performance of the students. Thus, we included in our regressions a number of control variables. We were able to estimate significant effects only for a few of these variables. It is worth to note that we found a quite strong and significant positive effect of the PSU (University Selection Test) variable. That is, the PSU score is a quite good predictor of academic performance, at least during the first courses in quantitative methods. In the case of the final grade of the course we found a negative effect for the private school that seems to be counterintuitive. In the case of some type of of tests or evaluations we found a gender effect.

An important result of this paper is that our estimations give support to the hypothesis that the academic performance also depends on the type and distribution of the different tests and evaluations. It should be noted that our rather weak results for the multiple choice tests (MC) could be explained by te fact that they were used for the first time during the sampled period. It is possible that many of the students had no previous experience with this type of test. The implications are clear and immediate, suggesting that the academic performance can be improved by redistributing tests and evaluations during the term, remedial activities as training the students in some types of tests, and modifying the number of tests.

Not surprisingly we found significant gender differences in the performance in the homework assignments, the multiple choice and tests during the over required periods. Only in the case of home work assignments this difference in performance seems to originate in the previous background of the students. This result suggests that a better selection of types of tests and evaluations could decrease this gender difference in the academic performance.

A Spanish version of TIPI

PREGUNTA: (TEST TIPI) Usted debe calificar en qué medida se aplican a usted estos rasgos de personalidad, aun cuando algunas características se apliquen en mayor medida que otra. Por favor use la misma escala de 1 a 7 para indicar su acuerdo o descuerdo.

RASGOS DE PERSONALIDAD	Completamente en desacuerdo		Ni de acuerdo ni en desacuerdo			Completamente de acuerdo	
1. Extrovertido, entusiasta	1	2	3	4	5	6	7
2. Crítico, peleador	1	2	3	4	5	6	7
3. Confiable, disciplinado	1	2	3	4	5	6	7
4. Ansioso, fácil de molestar	1	2	3	4	5	6	7
5. Abierto a nuevas experiencias, complejo	1	2	3	4	5	6	7
6. Reservado, callado	1	2	3	4	5	6	7
7. Compasivo, afectuoso	1	2	3	4	5	6	7
8. Desorganizado, descuidado	1	2	3	4	5	6	7
9.Calmado, emocionalmente estable	1	2	3	4	5	6	7
10. Convencional, poco creativo	1	2	3	4	5	6	7

B Satistical Appendix

The Education of the Parents

We collected data about the education of the parents; namely if a parent has a university degree. The results of these data is shown beloww in Table 9

Table 9: Parents with a University Degree

Parents	**N**	**%**	**Acc.**
None	230	42.2	42.2
Just one	120	22.0	64.2
Both university parents	195	35.8	100.0
Total	545	100.0	.

The Income of the Household

We also collected data on the household income. These data was not collected as continuous variable, but by brackets. Table 10 summarizes these data. As we discovered that almost exactly a half of the students came from households in the highest income bracket (equivalent to USD 33,000 or more) we created a new dummy variabel equat to one if the student came from one of these household and equal to zero otherwise.

Table 10: Household Income by Brackets

Income bracket[a]	**N**	**%**	**Acc.**
0–144,000	13	2.39	2.39
144,001–288,000	47	8.62	11.01
288,001–432,000	42	7.71	18.72
432,001–576,000	29	5.32	24.04
576,001–720,000	27	4.95	28.99
675,001–864,000	22	4.04	33.03
864,001–1,080,000	26	4.77	37.80
1,080,001–1,152,000	20	3.67	41.47
1,152,001–1,296,000	17	3.12	44.59
1,296,001–1,440,000	16	2.94	47.52
1,440,001–1,584,000	15	2.75	50.28
1,584,001 and more	271	49.72	100.00
TOTAL	545	100.00	

[a] In Chilean pesos from 2012.

Estimations

Table 11: Under-required (UNDER), OLS Robust Estimation

Variables	**Coef.**[a]	***t*–index**	**Coef.**	***t*–index**
Conscientiousness	0.55	1.30	0.31	0.74
Extroversion	-0.61	-1.40	-0.82*	-1.87
Openness	-0.11	-0.25	-0.10	-0.24
Agreebleness	0.16	0.39	0.12	0.27
Neurotism	-0.03	-0.08	-0.01	-0.01
PSU (Std)	2.90***	5.54		
Gender (Male =1)	-0.96	-1.16		
Age	0.34	0.88		
University Parents (Both =1)	0.22	0.21		
Privte School (yes =1)	-2.04	-1.24		
Subvencionate School (yes =1)	-1.58	-1.07		
Upper Income (yes =1)	0.11	0.10		
Bus. Administrator (yes=1)	0.80	0.54		
Term (Spring =1)	2.33	0.86		
Mixed School (yes =1)	0.09	0.09		
Constant	58.37***	5.26	46.60***	114.11
Observations	545		545	
Adjusted R-squared	0.07		-0.00	
F test	3.01		1.13	
Prob > F	0.00		0.35	

[a] *** p<0.01, ** p<0.05, * p<0.1

Table 12: Over-required (OVER), OLS Robust Estimation

Variables	**Coef.**[a]	***t*–index**	**Coef.**	***t*–index**
Conscientiousness	1.32***	2.66	1.02**	2.06
Extroversion	-1.03*	-1.93	-1.17**	-2.25
Openness	0.60	1.14	0.36	0.73
Agreebleness	-0.83	-1.63	-1.02**	-1.98
Neurotism	0.04	0.08	-0.04	-0.08
PSU (Std)	2.49***	4.22		
Gender (Male =1)	-1.85*	-1.85		
Age	-0.54	-1.16		
University Parents (Both =1)	2.26*	1.87		
Privte School (yes =1)	-2.11	-1.13		
Subvencionate School (yes =1)	-1.99	-1.23		
Upper Income (yes =1)	-0.40	-0.30		
Bus. Administrator (yes=1)	-0.20	-0.11		
Term (Spring =1)	0.33	0.11		
Mixed School (yes =1)	0.61	0.48		
Constant	58.37***	6.10	46.60***	94.05
Observations	545		545	
Adjusted R-squared	0.08		0.02	
F test	2.84		2.51	
Prob > F	0.00		0.03	

[a] *** p<0.01, ** p<0.05, * p<0.1

Oaxaca-Blinder

Table 13: Mean Differences of Variables by Gender

	Female		Male			
Variables	**Mean**	**s.d.**	**Mean**	**s.d.**	**Difference**[a]	**t-index**
G	55.86	7.32	55.84	7.53	0.02	0.03
UNDER	48.47	9.26	47.56	10.20	0.91	1.06
OVER	47.84	11.21	45.74	11.87	2.11***	2.07
HW	67.37	16.76	62.87	16.80	4.51***	3.06
MC	58.27	11.41	62.20	10.60	-3.93***	-4.10
Conscientiousness	0.12	0.94	-0.07	1.00	0.20***	2.30
Extroversion	0.05	0.99	0.01	1.00	0.03	0.37
Openness	0.02	0.99	0.01	0.99	0.01	0.10
Agreebleness	0.04	1.02	-0.02	0.96	0.05	0.61
Neurotism	-0.07	1.03	0.04	1.00	-0.11	-1.27
PSU (Std)	-0.04	1.01	0.03	0.99	-0.06	-0.74
Age	19.18	1.41	19.14	1.08	0.04	0.39
University Parents (both = 1)	0.40	0.49	0.33	0.47	0.08*	1.84
Private School (yes = 1)	0.60	0.49	0.62	0.49	-0.03	-0.68
Subventioned School (yes = 1)	0.20	0.40	0.24	0.43	-0.03	-0.95
Upper Income (yes = 1)	0.48	0.50	0.51	0.50	-0.03	-0.68
Bus. Administrator (yes=1)	0.83	0.38	0.86	0.35	-0.03	-1.04
Term (Spring = 1)	0.50	0.50	0.56	0.50	-0.07	-1.51
Mixed School (yes =1)	0.71	0.46	0.76	0.43	-0.06	-1.48
Observations	215		330			

[a] *** p<0.01, ** p<0.05, * p<0.1

References

Almlund, Mathilda et al. (2011). "Personality psychology and economics". In: *Handbook of the Economics of Education*. Vol. **4**. Elsevier. Chap. 1, pp. 1–181. ISBN: 9780444534446.

Anderson, Eileen S and Timothy Z Keith (1997). "A longitudinal test of a model of academic success for at–risk high school students". In: *The Journal of Educational Research* **90**.5, pp. 259–268.

Bauer, Karen W and Qingfeng Liang (2003). "The effect of personality and precollege characteristics on first-year activities and academic performance". In: *Journal of College Student Development* **44**.3, pp. 277–290.

Borghans, L. et al. (2008). "The economics and psychology of personality traits". In: *Journal of human Resources* **29**.6, pp. 972–1049.

Busato, Vittorio V et al. (1998). "The relation between learning styles, the Big Five personality traits and achievement motivation in higher education". In: *Personality and individual differences* **26**.1, pp. 129–140.

— (2000). "Intellectual ability, learning style, personality, achievement motivation and academic success of psychology students in higher education". In: *Personality and Individual differences* **29**.6, pp. 1057–1068.

Chamorro-Premuzic, T. and A. Furnham (2003). "Personality traits and academic examination performance". In: *European journal of Personality* **17**.3, pp. 237–250.

De Raad, Boele and Henri C Schouwenburg (1996). "Personality in learning and education: A review". In: *European Journal of personality* **10**.5, pp. 303–336.

Delaney, L., C. Harmon, and M. Ryan (2013). "The role of noncognitive traits in undergraduate study behaviours". In: *Economics of Education Review* **32**, pp. 181–195.

Duckworth, Angela L and Martin EP Seligman (2005). "Self-discipline outdoes IQ in predicting academic performance of adolescents". In: *Psychological science* **16**.12, pp. 939–944.

Duff, Angus et al. (2004). "The relationship between personality, approach to learning and academic performance". In: *Personality and individual differences* **36**.8, pp. 1907–1920.

Elder, Todd E., John H. Goddeeris, and Steven J. Haider (2009). *Unexplained gaps and Oaxaca-Blinder decompositions*. IZA discussion papers, No. 4159. Institute for the Study of Labor (IZA), Bonn.

Entwistle, Noel J and Dorothy Entwistle (1970). "The relationships between personality, study methods and academic performance". In: *British Journal of Educational Psychology* **40**.2, pp. 132–143.

Eysenck, HJ and D Cookson (1969). "Personality in primary school children". In: *British Journal of Educational Psychology* **39**.2, pp. 109–122.

Fryer, Roland G and Steven D Levitt (2010). "An empirical analysis of the gender gap in mathematics". In: *American Economic Journal: Applied Economics* **2**.2, pp. 210–240.

Furnham, Adrian (1995). "The relationship of personality and intelligence to cognitive learning style and achievement". In: *International handbook of personality and intelligence*. Springer, pp. 397–413.

Furnham, Adrian and Tomas Chamorro-Premuzic (2004). "Personality and intelligence as predictors of statistics examination grades". In: *Personality and individual differences* **37**.5, pp. 943–955.

Furnham, Adrian, Tomas Chamorro-Premuzic, and Fiona McDougall (2003). "Personality, cognitive ability, and beliefs about intelligence as predictors of academic performance". In: *Learning and Individual Differences* **14**.1, pp. 47–64.

Goff, M. and P. L. Ackerman (1992). "Personality-intelligence relations: Assessment of typical intellectual engagement". In: *Journal of Educational Psychology* **84**.4, pp. 537–552.

Gosling, Samuel D, Peter J Rentfrow, and William B Swann (2003). "A very brief measure of the Big-Five personality domains". In: *Journal of Research in personality* **37**.6, pp. 504–528.

Hair, Peter and Sarah E Hampson (2006). "The role of impulsivity in predicting maladaptive behaviour among female students". In: *Personality and Individual Differences* **40**.5, pp. 943–952.

Jin, Leili, David Watkins, and Mantak Yuen (2009). "Personality, career decision self-efficacy and commitment to the career choices process among Chinese graduate students". In: *Journal of Vocational Behavior* **74**.1, pp. 47–52.

Komarraju, M. et al. (2011). "The Big Five personality traits, learning styles, and academic achievement". In: *Personality and individual differences* **51**.4, pp. 472–477.

Li, Qing (1999). "Teachers' beliefs and gender differences in mathematics: A review". In: *Educational Research* **41**.1, pp. 63–76.

Marks, Gary N (2008). "Accounting for the gender gaps in student performance in reading and mathematics: evidence from 31 countries". In: *Oxford Review of Education* **34**.1, pp. 89–109.

Moutafi, Joanna, Adrian Furnham, and Laurence Paltiel (2004). "Why is conscientiousness negatively correlated with intelligence?" In: *Personality and Individual Differences* **37**.5, pp. 1013–1022.

Noftle, E. E. and R. W. Robins (2011). "Personality predictors of academic outcomes: big five correlates of GPA and SAT scores". In: *Journal of personality and social psychology* **93**.1, pp. 116–130.

Oaxaca, R. L. and M. R. Ransom (1994). "On Discrimination and the Decomposition of Wage Differentials". In: *Journal of Econometrics* **61**.1, pp. 5–21.

Rolfhus, Eric L and Phillip L Ackerman (1999). "Assessing individual differences in knowledge: Knowledge, intelligence, and related traits." In: *Journal of educational psychology* **91**.3, pp. 511–526.

Rothstein, Mitchell G et al. (1994). "Personality and cognitive ability predictors of performance in graduate business school." In: *Journal of Educational Psychology* **86**.4, pp. 516–530.

Sánchez, Manuel Marín, Eduardo Infante Rejano, and Yolanda Troyano Rodríguez (2001). "Personality and academic productivity in the university student". In: *Social Behavior and Personality: an international journal* **29**.3, pp. 299–305.

Smith, Gene M (1970). "Personality correlates of academic performance in three dissimilar populations." In: *Nursing Research* **19**.3, p. 285.

Wolfe, Raymond N and Scott D Johnson (1995). "Personality as a predictor of college performance". In: *Educational and psychological measurement* **55**.2, pp. 177–185.

Zeidner, Moshe and Inbal Shani-Zinovich (2011). "Do academically gifted and nongifted students differ on the Big-Five and adaptive status? Some recent data and conclusions". In: *Personality and Individual Differences* **51**.5, pp. 566–570.