

## Predicting students' academic performance in Aviation College from their admission test results

Aavo Luuk  
Institute of Psychology  
University of Tartu  
[aavo.luuk@ut.ee](mailto:aavo.luuk@ut.ee)

Kersti Luuk  
Psychiatric Clinic  
University of Tartu  
[kersti.luuk@kliinikum.ee](mailto:kersti.luuk@kliinikum.ee)

### ***Abstract***

Academic performance of 134 students from Tartu Aviation College (Tartu, Estonia) was monitored during their first four study semesters. Moderate statistically significant correlations were found between several performance criteria and admission test results. Statistically significant sex differences in several variables measured had higher values in female students. Two regression models were developed. In the first model sex, ability scores and secondary school grades predicted 39,6 % of variance in mean college grades; in another model sex, abilities and Conscientiousness predicted 24 % of variance in academic performance.

### ***Introduction***

Psychological journals are full of papers about predictors of academic performance of university psychology students. This is in contrast with other specialties, especially technical ones. To bridge the gap in aviation education, the present study was undertaken in Tartu Aviation College (Tartu, Estonia) to assess the strengths and weaknesses of admission tests in predicting academic success of aviation specialties students.

The College is a four-year higher education institution, preparing a wide range of aviation specialists – aircraft and helicopter pilots, air traffic controllers, specialists in aircraft maintenance, communication and navigation systems management, maintenance of aerodrome equipment and systems, aviation company management and aeronautical information services.

Candidates to the college must have secondary education, passed state approved examinations in foreign language and in mathematics or physics, lacking of criminal record and should pass the college entrance medical examinations, psychological testing and interview. The candidates are ranked on the basis of mentioned state examination results and psychological (cognitive) ability testing, competing in parallel up to three study specializations. Among these, the specializations of the pilots and air traffic controllers are typically the most competitive ones.

In different years, the admission criteria have varied slightly, mainly in the proportion of impact of state examination results, psychological ability tests and interview into the final entrance grade. As the variability of the ability tests results is the greatest, it is clear that these tests have had the greatest impact every year, despite minor changes introduced in proportions between the admission criteria.

One of the primary purposes of the admission tests is to select in those candidates who will be successful in their later professional career after the college. The secondary purpose, supporting the previous one, is to get into the college the candidates, who are able and motivated to study successfully enough to pass all the study requirements. In that sense the selection procedure at admission is selecting *in* the best available candidates.

Psychological selection at the admission to the college is carried out using both cognitive ability and personality measures. While cognitive abilities (and/or intelligence) are traditional selection criteria, using personality measures is gaining more and more popularity in the field of selection. Well-established relationships exist between cognitive abilities and academic performance, but the relationships between school grades and personality traits are less clear. The authors of the present study consider personality testing especially important part of the admission selection to educational institution, as personality traits may play major role in the post educational professional career of former students.

Results from previous studies have revealed an average correlation between intelligence (cognitive ability) and academic performance about  $r = 0.5$  (Schmitt *et al*, 2007; Trapmann *et al*, 2007; Laidra *et al*, 2006), having tendency towards lowering with age. Generally, the association between cognitive abilities and academic success depends on kinds of abilities and criteria chosen. For example Driscell *et al* (1994) have found the correlations of  $r = 0.53$  between the mathematics knowledge and academic performance *versus*  $r = 0.45$  between mechanical comprehension and the same criteria. It is very important to keep in mind that predictor and criterion associations depend on the type of the educational institution and professional or educational groups studied.

Relationships between personality traits and academic performance criteria are usually weaker than those between cognitive abilities and academic performance, but general agreement exists about usefulness of personality and motivational factors in predicting academic performance additionally to intelligence. Driscell *et al* (1996) found that personality traits Openness and Conscientiousness were relatively independent from cognitive capability in predicting army-training results. Recently Chamorro-Premusic & Furnham (2008) have concluded that Openness and Conscientiousness together with measurable approaches to learning mediated the effects between ability and academic performance in the predominantly female college students' sample. Gender seems to be one of the moderating factors influencing the relationships between personality traits and academic performance. Nguyen *et al* (2005) have reported that both emotional stability and openness predicted academic performance positively and significantly in male but not in female students.

## **Method**

*The sample* The students from the admissions of the years 2001 – 2004 served as the sample. College examination data from the first four study semesters was available for 149 students. The initial sample was corrected on the basis of the following considerations: in the final sample are only those students, who at admission were able to fill in the forms and pass the tests in Estonian language. This

requirement restricted the sample to 134 students, of them 31 females and 103 males. Further restriction of the sample came from the fact that seven students did not have their secondary school records in the archive files. Therefore, full data (secondary school results, admission tests data, and college examination grades) was available for 28 female and 99 male students. In some analyses the sample of 134 (31 + 103) and in other analyses the smaller sample of 127 (28 + 99) has been used.

*Secondary school grades* Several groupings of school subjects were made (humanitarian subjects, real sciences, mandatory and elective subjects etc) and their mean grades calculated, but main analysis in the present paper is carried out using overall general mean of secondary school grades.

*Testing at admission* Psychological testing at admission included cognitive ability and personality testing. Personality was assessed by using the Estonian version of initial NEO PI questionnaire (Pulver et al, 1995), which gave us Big Five (Neuroticism, N; Extroversion, E; Openness to Experience, O; Agreeableness, A; Conscientiousness, C) personality factors, but the facets for N, E and O only. The questionnaire had also an additional Social Desirability (SD) scale. Cognitive ability tests included Raven's matrices, tests of technical reasoning, vocabulary, categorical reasoning; number, letter and graphic strings, long-term memory, spatial orientation, multiple mental operations and mental calculus, of which 14 numerical test results were derived. These results were transformed into stanines; summed and divided by a constant (the constant used at admission could have been slightly different depending on the maximal stanine sum at the given year). To have the common basis for analyses, the stanines and their sums were recalculated for the present study sample.

*College examination results* At the Study Department of the College the records of all students have been kept since the opening of the college. Only those students from the admission years of 2001 -2004 were included into sample, which had finished their second year of studies and were not in dropping out position. This means that the most unsuccessful students, who had dropped out during their first four semesters or did not fulfil the requirements to continue after four semesters, were excluded from the study and so we are dealing with the success, and not with the failure conditions of students. It has to be mentioned here that this precondition additionally restricts the possible variability in sample data. The college has a six-point grade system with A being the maximum and F being the „failed” grade. For the present study purposes, these grades were transformed onto numeric scale with 5 as maximum and 0 as „failed” grade (and 1 being the weakest „pass” grade). For taking into account the extent of the effort made by students on different study subjects, their mean weighed grades were calculated, where the weight of the grade was dependent on the amount of study credits on given subject (typically varying between 1 – 4).

## **Results**

The summary ability score at admission correlated moderately with the students general mean secondary school grades ( $r = 0.309$ ,  $p < 0.001$ ) and slightly better with mean weighed college grades ( $r = 0.401$ ,  $p < 0.001$ ).

Of personality measures only the Conscientiousness (C) correlated statistically significantly with mean weighed college grades ( $r = 0.197$ ,  $p = 0.022$ ).

The sex of students was also moderately correlated with both school ( $r = -0.493$ ,  $p = 0.000$ ) and college grades ( $r = -0.299$ ,  $p = 0,000$ ), but not with mean ability score.

$t$ -test showed statistically significant differences between female and male students in school grades, college grades and in Extroversion (E) and Openness (O) dimensions of personality, with females having higher scores in all these variables.

Based on correlation study, the following variables were selected into multiple regression analysis to predict college weighed mean grades: sex, mean secondary school grade, mean cognitive ability tests score, and Conscientiousness.

One hierarchical model for predicting college grades was built on sex, secondary school grades and ability scores. Starting with the gender statistically significant ( $\beta = -0.29$ , adjusted  $R^2 = .078$ ), adding the secondary school grade improved the model significantly ( $\beta = 0.56$ , adjusted  $R^2 = .313$ ), but turned the sex nonsignificant. Adding ability tests improved predictive value of the model to 39,6 % ( $\beta = 0.31$ ), keeping both school grades and abilities significant.

Another hierarchical model to predict college grades included sex, abilities and Conscientiousness. The final model predicted 24 % of the variance of college grades with all three predictors remaining significant. Ability score added significantly to the variance in grades ( $\beta = 0.38$ , adjusted  $R^2 = .22$ ), when sex was controlled. In addition, Conscientiousness became a significant predictor ( $\beta = 0.18$ ) of the two first year academic performance over and above sex and the mean tested ability score at admission.

## **Discussion**

The analysis proved the value of ability testing in predicting college performance. In our sample, the secondary school grades served as good predictors for academic performance. Secondary school grades proved to be an important selection criterion, although mixed results have been reported about the kind of relationship in the literature.

Of personality measures the Conscientiousness only predicted college performance, which is in accordance with research results in personality- performance relationships of other authors in the diverse field of academic training (Chamorro-Premuzic, & Furnham, 2008; Kaufman *et al*, 2007; Trapmann *et al*, 2007).

Sex differences found in the study are sample specific and can be interpreted in different ways. One of them could be the following: To be successful in aviation community, females must excel males in their studies. Partial support for this hypothesis comes from the previous study of the authors on professional success of air traffic controllers (Luuk *et al*, 2007). However, as our female sample is limited in size, it is premature to build any sophisticated interpretations on this topic.

In conclusion, it can be said that the quality of future aviation personnel studying at the college depends mostly on their secondary school and college studies and cognitive abilities, while personality measures are of arbitrary significance during their first two years of studies.

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