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CORRELATION BETWEEN INTELLIGENCE AND DIMENSIONS OF PERSONALITY AND SCHOOL SUCCESS

Krunoslav Matešić, ml.

Naklada Slap
Center for Education and Research

Predrag Zarevski

Department of Psychology, Faculty of Philosophy
University of Zagreb

Summary *– The correlation between intelligence and personality and academic success was examined on a sample of 3rd year high school students from various high schools. The NEO-FFI was used to measure five personality dimensions (Neuroticism, Extroversion, Openness to Experience, Agreeableness and Conscientiousness) and the D-48 intelligence test with a highly saturated »g« factor. Academic success was defined by grades for mathematics and Croatian as well as the final, half-term overall grade. Intelligence showed a statistically significant but relatively low correlation with the three most relevant indicators of academic success. A possible explanation is that nominally identical grades received by students from various classes are not obtained by students of equal intelligence. Conscientiousness was the strongest individual predictor of all three academic success criteria. The result is not surprising in view of the fact that conscientiousness is connected with work ethics, the need to succeed and personal organization. The structure of predictor variables for general success and Croatian language criteria is practically identical. Conscientiousness is followed by intelligence and introversion in the prediction of these criteria. Mathematics has a different relationship structure with intelligence measures and personality. The prediction ratio of intelligence has increased and is just below conscientiousness. A significant predictor of mathemat-*

ical success is lower Agreeableness, while Extroversion does not play a significant role. A possible explanation is persons with lower agreeableness scores are prone to critical thinking which contributes to accurate analyses in science and mathematics. The obtained findings support data on personality measures playing a more significant role than intelligence in later educational phases, while intelligence is a stronger predictor of academic success in primary school.

Key words: *D-48, NEO-FFI, school achievement*

INTRODUCTION

School success has always been an important factor in the life of an individual. It directly determines possibilities in the choice of profession, which in the end strongly influences an individual's life. A very clear relationship between intelligence and the completed degree of education was determined, but also the criteria of success such as income and hierarchical level within the status which is established by the completed degree of education.

The prediction of that success has been a challenge for psychologists from the beginning of the 20th century, and was also the reason for developing what is known today as intelligence tests. The first widespread application of the intelligence test was the one by Afred Binet and Theodore Simon in 1905. It was created on the demand of the French Minister for public education in order to identify children with learning difficulties (Hothersall, 2002, p. 431). Since then, intelligence tests have developed primarily for the needs of predicting school success or failure. They are strong predictors when referring to persons of below average intelligence in relation to persons with above average intellectual potential (Zarevski, 2000). The second important set of factors in predicting school and academic success are personality characteristics. It is important to mention that the higher the level of education, the more significant the factors of personality become.

The discussion about intelligence in the context of this research is directed to the understanding that it is determined by the ***g*** factor in the way it was defined by Charles Spearman. He established that the link between success in intelligence tests and school subjects can be explained by the »two-factor theory«. The first factor is »general intelligence« or ***g***. Spearman claimed that the ***g*** factor is in the set for all intellectual tasks. He named the second factor ***s*** or »specific intelligence« – it describes any ability which is unique for carrying out a task, and he emphasizes that those factors are mutually independent (Spearman, 1904., 1923., 1927.; according to Gardner, Kornhaber, Wake, 1999).

Intelligence tests measure various cognitive abilities, and their correlations lay in the range from 0,2 to 0,8 (Colom, R., Robello, I., Palacios, A., Juan-Espinosa, M., & Kyllonen, P.C., 2004.). This empirical fact points out that different intelligence tests measure something common, i.e. ***g***. Tests more saturated with ***g*** involve complex cognitive operations (induction, deduction, abstraction). Low saturated tests involve less complexity (e.g. sensory discrimination, simple time of reaction, mechanical memory, etc.) Jensen (1998) says that ***g*** isn't a measure for specific

knowledge, skills or strategies of problem solving. It reflects individual differences in the processing of information, that is, the capacity and effectiveness of mental processes by which knowledge and skills are acquired and used.

Spearman's concept provides a practical approach in the measure of intelligence and points to the possibility of direct measure of such intelligence through a homogenous test which is highly saturated with the general factor. Tests which are believed to best measure intelligence, i.e., tests with the greatest saturation of the ***g*** factor are those which tested *eduction* of relations and correlations. The term *correlation eduction (Cro. edukcija korelata)* refers to finding logical abstractions based on two or more stimuli, while the correlates are characteristics which are found within the stimuli themselves and are experienced as the same, similar or in another relationship. Such tasks are like the following (elements A, D and K are shown to the examinee):

A	D
K	?

The task is to find the relationship between A and D, and then to apply that relationship onto K in order to reach the element which has the same relationship to K as is the relationship A – D. Among the first tests used in the mentioned way of measuring intelligence are »Raven's Progressive Matrices« from 1938 (Raven, Raven and Court, 1999). The test was highly saturated with the ***g*** factor (r = 0,79), but in addition, it contained some specific, insufficiently identified factors, that is, one perceptive visual group factor. In 1943, Anstey developed the D-48 test, based on the same principle as »Raven's progressive matrices« which was supposed to be a conceptually parallel form of the »Progressive Matrices« (Handbook for Test D-48, 1997). This test was solely composed of domino images, as a highly homogenous stimulus material. A factor analysis of the D-48 Test showed that the saturation of the general factor of r = 0,86 was higher than the one in the »Progressive matrices«. Furthermore, the examinees who were familiar with the game of domino did not have an advantage over the ones who encountered it in the test for the first time. In that respect, the test is highly independent of culture. In relation to Raven's progressive matrices which offer solutions to tasks, in test D-48, random guessing is reduced to the minimal level (1/49), considering that the examinee must decide on the answer independently.

The D-48 Test and school success

The correlation coefficients between general intelligence and school grades in primary school average about 0,50 (Jensen, 1980; Neisser et al., 1996). This correlation is reduced in secondary schools and even more at the university level (Jensen, 1980). The only explanation for these changes is the fact that there is a reduction of variability caused by a selection of students. The best students in primary school usually enroll into grammar schools and for entering the university other forms of (auto) selection take place. Also, with the increase of the education-

al level there is an increase in the role of motivational and personality variables in the narrower sense of the word.

Although the D-48 Test has often been used for the purpose of professional orientation and in selecting candidates for work, the majority of the studies were related to the analysis of its relationship to school success. The following research are mentioned in the Handbook for the application of the D-48 Test. Drevillon (1953., Handbook for the application of the D-48 Test, 1997.) applied the test to 357 male students and199 female students between 14 and 15 years of age in the first grade of one vocational school. The grades obtained after 4 moths of schooling served as the criteria. The correlations obtained were:

- Language and literature 0,34
- Natural Sciences subjects 0,42
- Technology 0,28

Maillard (Handbook for the application of Test D-48, 1997.) measured the prognostic validity of the D-48 Test. He applied it on students in their final year of primary school and took the grades from the first or second grade in secondary school as the criteria. The correlation coefficient calculated based on the indicators was $r = 0,54$.

In a recent research conducted in USA, Domino and Morales (2001) state that correlation coefficients for the D-48 Test and school success at colleges and higher education institutions was somewhere in the range of 0,41 for men, to 0,50 for women. They claim that these correlations are rather low due to the homogeneity of the sample. They believe that the correlation coefficients would have been higher had the sample been more diverse in terms of colleges.

In testing at five primary schools in the Republic of Croatia using the D-48 test, 254 male students and 246 female students of seventh and eight grade the relationship between the test results and the average school achievement was $r = 0,43$ (Matešić, 2004).

The Five-factor Personality Model

According to the number of publications, this is the dominating personality model of today. The reasons for that are good theoretical and empirical foundations. The idea of five big personality dimensions has existed for a long time, since they were mentioned in factor analyses of terminology used for describing personalities such as the Allport-Odbertova list of traits and questionable measures of personalities (Ozer and Reise, 1994; McCrea and Costa, 1997, 1999).

The five factors of personality were found in several dozens of research which used various samples of participants (Digman and Inoyue, 1986). This was done in each decade of the second half of the century, which points to the conclusion that the five-factor structure is stable over time. It is also replicated in different languages, i.e., different cultures and through various types of operational in-

struments. It is also significant that it is well operational in personality questionnaires.

It was established that people can evaluate well within the system of 5 basic dimensions of personality which as core traits organize thousands of narrower personality characteristics. The basic dimensions are mostly in normal distribution. That means that the majority of people lie somewhere in the middle of a particular personality dimension, and the more extreme the alienation is from the average, the smaller the percentage of people at the poles.

The first and foremost dimension in the model is *Openness to Experience* – how open we are intellectually for new awareness and experience, how liberal and original we are. It covers elements such as imagination, independence in judgment, focusing attention to personal feelings, preference of diversity, intellectual inquiry. Open people are interested in the external but also their inner world, so their experiences are enriched with various happenings. They are prone to accepting new ideas and unconventional values, and positive and negative emotions are felt more intensively than closed persons (Costa and McCrae, 2005). Many authors relate this dimension with intellect, while Costa and McCrae state that it is related to some aspects of intelligence, such as, divergent thinking, but excluding any equivalence to intelligence (McCrae, 1987, according to Costa and McCrae, 2005). People with high intelligence are not necessarily open to experience, and some very open people have a rather low intelligence level. People with low results on the Openness are prone to conventional behavior, usually businesslike and practical and politically conservative.

The second dimension is *Neuroticism* or inadaptability – calmness, self-assurance, invulnerability, excitement; does even a small surprising stimulus arouse us and does it take a long time for the pulse, breathing and level of cortisol to get back to normal, or do we ignore such stimuli. Obviously, emotionally instable persons react strongly in a situation of potential stress and have difficulty facing it. *Neuroticism* (N) is the most widespread dimension which confronts emotional stability or adaptability or inadaptability (Costa and McCrae, 2005). The general predisposition for experiencing negative emotional conditions such as fear, fury, anger, guilt and disgust, makes the core of the N-dimension. Emotional disorder in people with a high score on the N-scale interfere with adapting, and in addition to sensibility to psychical difficulties, N also measures aptitude to irrational ideas, lowered ability of impulse control and less successful coping with stress. It should be mentioned that although persons with diagnosed neurosis (in the traditional sense) achieve high results on this scale, the high result on the N scale is possible even without the existence of any kind of psychiatric disorder (Costa and McCrae, 2005). Persons with low scores on the scale of Neuroticism are emotionally stable, calm, relaxed, balanced and are capable of handling stressful situation without getting upset. The description of the N scale coincides highly with the similar dimension from Eysenck's personality model (Eysenck and Eysenck,

1994a; 1994b) and the same applies for *Extroversion* (E). This dimension points to socialization, assertiveness and talkativeness, but also characteristics of temperament such as seeking excitement and positive emotionality. In their relationship with other people extroverts are amicable and warm, they talk fast and usually become group leaders. On the other hand, introverted persons are reticent, independent and balanced.

The fourth personality dimension is often called *Conscientiousness* – being careful towards others, how reliable we are, and how demanding we are of ourselves in terms of conscientiousness in private and professional lives. It is related to high reliability and neatness. *Conscientiousness* (S) is a characteristic of persons who are determined, prudent, exact, reliable and successful on the academic field and who efficiently do their social and civil duties. Contrary to that, those who achieve low results on that scale most likely won't be good at school and at work. *Conscientiousness* can be defined as a non-pathological form of obsessive-compulsive personality which is characterized by the need for work and tidiness (Matešić, 2004). *Conscientiousness* is one of the aspects of what was once referred to as character (Costa i McCrae, 2005). Persons with a high score on the S scale are scrupulous. Persons with a low score are not necessarily without moral values, but apply them less readily, are more relaxed in the attempt to achieve their goals.

The fifth broad personality dimension is *Agreeableness* – being benign, unselfish, non-irritable, it refers to how pleasurably we talk to other people and what our affinity for cooperation is like. *Agreeableness* (U) is primarily a dimension which refers to interpersonal affinity and to interpersonal communication, similarly to *Extroversion*. However, the difference is that Extroversion is defined through sociability and the need for more social contacts, while Agreeableness seeks a higher quality of interpersonal relations. A pleasurable person is actually altruistic, easily experiences others' emotions, readily helps other people and believes that people will do the same in return. In addition to empathy, they are characterized by modesty, thoughtfulness and sincerity. Persons with a low score on the *Agreeableness* scale are disagreeable, egocentric, they reject cooperation, they are skeptics, and paranoid towards others. Costa and McCrae have observed that high agreeableness is related to addictive personality disorders, and low agreeableness with narcissistic, antisocial and paranoid personality disorders.

School success and personality dimensions

Although the relationship between personality characteristics and school success has been intensively researched, the results are not as unambiguous as with intelligence. Issues that arise are the use of various instruments for measuring personality, often small and non-representative samples, the use of different criteria and the time span between measurements of the predictor and the criteria (Farsides and Woodfield, 2003). School success is best predicted by the dimension of *Conscientiousness* and *Emotional stability* (e.g. Chamorro-Premuzic and

Furnham, 2004; Larsen and Buss, 2005). The reason for that can be that even though less likely that emotionally more stable and conscientious people will postpone learning and exams. In research conducted by Laidra, Pullman, Allik (2007) on 3618 students, there was a positive link between *Openness to Experience, Agreeableness* and *Conscientiousness* and school success, and there was a negative link towards Neuroticism. The most significant predictor from the personality dimensions which were covered by the NEO FFI personality and school success questionnaire is *Conscientiousness*.

RESEARCH AIM

While the relationship between intelligence and school success has been a long research problem, there are not that many in the area of characteristic determinants of academic achievement. The aim of this research was to establish the correlation between personality traits and the theory of the Great five and success on the D 48 test of intelligence on school success. As a matter of fact, those instruments are widely present in our professional practice, and it seemed valuable to test the correlation with one such significant criterion as is school success prior to making the most important professional decision by the student at the end of secondary school – the decision of continuing education.

METHODOLOGY

Sample

The number of participants in this research was 220, of which there were 78 (35.5%) young men and 142 (64.5%) young women of the average age M = 17,2 years (SD = 0,41). They are students in the third year of high school in Jastrebarsko (1 class in the trade school, 1 class in business school, and 1 class in the grammar school) and Samobor (3 classes from grammar school, 2 classes from business school) and the grammar school Lucijan Vranjanin in Zagreb (1 class). The sample was selected based on the cooperation of school principals and psychologists in these schools and not some other systematic factor. In addition to that we made sure that both grammar school students and vocational school students are represented in the sample.

Instruments and measures

1. School success

The marks chosen were from the subjects: Croatian language, Math and the average grade from all subjects at the end of the first semester. The main criteria for selection of subjects was defined by the fact that the participants are students in various schools and that the only subjects that they all had in common were Math and Croatian language. In addition to that, those subjects present a kind of

approximation of the fluid and crystallized intelligence (Cattell, 1971.; Horn and Cattell., 1966.; Horn, 1982). The reason why grades were taken at the end of the first semester, the half year, was because the grade range is higher than the one at the end of the school year.

2. Test D-48

Test D-48 is an intelligence test with a highly saturated ***g*** factor. It consists of 4 examples and 44 tasks which are sorted by difficulty within the series. Both parts of the domino must be answered in order for the answer to be counted as correct. The answers are not weighted, each correct answer carries one point. The application of that test is limited to 25 minutes. The test is standardized in Croatia on 937 participants, where not one difference gender difference was found (Herceg, 1998). Reliability determined through the odd – even procedure is r = 0,89, and the test-retest procedure in the two-month time span between applications is r = 0,69 (Handbook for the test D-48, 1997.).

3. NEO-FFI

The NEO-FFI Instrument (Handbook for NEO-PI-R) measures five character traits: *Neuroticism, Extroversion, Openness to Experience, Agreeableness and Conscientiousness* according to the Great five theory. Each personality trait is measured with a 12 variable Likert type scale in the range of 0 (do not agree at all) to 4 (I agree completely). A total of 60 variables and 3 added variables for checking validity. The time for solving the tasks is not limited. Marušić, Bratko and Eterović (1996) wrote the first translation and validation of the questionnaire, and the form used today was translated by Mirjana Krizmanić, while Bratko and Marušić reviewed and validated the Croatian translation on samples of high school students and adults and confirmed its five factor structure (Costa and McCrae, 2005).

Procedure

All measurements were conducted during homeroom teaching. The first test applied was Test D-48 (work time was 25 minutes), followed by NEO-FFI, for which the average work time was 15 minutes. All measurements were completed within one school hour. The participants were not anonymous; however the psychologists' professional confidentiality secured their anonymity. The research was conducted in June 2006.

RESULTS AND DISCUSSION

The data analysis is exempt of the results of 6 participants who had less than three standard deviations on the D-48 Test.

Table 1 shows the arithmetic means, standard deviations and Cronbach alpha type of reliability for personality scales obtained on the Croatian population and

our sample. The alpha coefficients range from medium values for three variables Extraversion, *Openness to Experience and Agreeableness,* to high for *Neuroticism and Conscientiousness*. In comparison with other research (e.g. Laidra, Pullman, Allik 2007), the calculated reliability is within the acceptable range, that is, there are no significant differences between this and other research using this instrument. Also, comparing reliability of personality traits of our sample with Croatian standards, we can see that they are very similar.

Table 1. Arithmetic means, standard deviations, t-test values, alpha coefficients for particular scales NEO FFI questionnaire obtained in our sample (*N*=214) and on the normative sample (*N*=350) (according to Costa and McCrae, 2005)

	M		SD		t	α	
	Sample	**Norms**	**Sample**	**Norms**		**Sample**	**Norms**
Neuroticism	22,29	21,3	8,32	8,1	1,4	0,82	0,84
Extraversion	29,91	29,3	5,8	5,9	1,2	0,69	0,72
Openness to Experience	23,99	25,8	5,76	5,5	2,6**	0,57	0,58
Agreeableness	26,7	28,0	5,8	5,4	1,9*	0,64	0,66
Conscientiousness	29,08	28,9	7,75	6,3	0,3	0,85	0,80

** p< 0,01
* p< 0,05

The results on particular NEO-FFI scales are similar to data contained in the Croatian Handbook (Costa and McCrae, 2005). There are no statistically significant differences between our results on the scales for *Neuroticism, Extraversion,* and *Conscientiousness* in comparison with the results in the standards mentioned. A statistically significant difference was obtained with the trait *Openness to Experience* and *Agreeableness*. By comparing the arithmetic means for those variables we can see that the difference is 1.8 points for openness and 1.3 for agreeableness. The difference is not even a quarter of one standard deviation in both cases. In other words the difference obtained is questionable considering that we are talking about less than two points on the scales which have a maximum of 60 points. The similarities obtained in reliability and arithmetic means in our sample with the normative points directly to the fact that a systematic factor was not included in the selection of participants and that the participants approached the research in a serious manner.

The arithmetic means of the results on the D-48 test which was obtained in this measurement is M = 28,0, with SD=6,17. The distribution was tested using the Kolmogorov-Smirnov test which showed that it is not statistically different from the normal (Z=1,34 p>0,05). Reliability measured by the Cronbach alpha test is 0,69. The value which was obtained during the standardization of this instrument on the sample of 695 participants (secondary education) between 18 and 20 years of age was *M*=26,12, SD=7,83. The difference of 1.8 points in favor of

high school students in our research is significant at the risk level of 5% but is not such that we would refer to as a highly positive sample selection.

Table 2 shows the correlations between particular variables. As expected, the D-48 teat has a statistically significant relationship with all three measures of school success.

Table 2. Correlations of predictors and criteria variables in research

	D-48	**Neuroticism**	**Extraversion**	**Openness**	**Agreeableness**	**Conscientiousness**	**Croatian**	**Math**	**Grade point average**
D-48	1,00	-0,09	0,00	0,09	0,05	-0,06	0,16*	0,23**	0,14*
Neuroticism		1,00	-0,31**	-0,02	-0,19	-0,17	0,07	0,05	-0,01
Extraversion			1,00	0,03	0,19**	0,31**	-0,04	0,02	-0,02
Openness				1,00	0,10	0,02	0,05	0,01	0,05
Agreeableness					1,00	0,28**	0,15*	-0,06	0,12
Conscientiousness						1,00	0,26**	0,22**	0,30**
Croatian							1,00	0,44**	0,73**
Math								1,00	0,60**
Grade point average									1,00

* p** p<0,05
** p<0,01

The obtained correlation coefficients between D-38 and measures of school achievements are somewhat lower in comparison with other research. Kagitcibasi (1972) finding on a relatively small sample N=54 students in the 7th level of one high school in Turkey, the correlation coefficient between the D-48 test and math grades r=0,36, and for Turkish r=0,38, with the general teachers' evaluation r=0,50.

Of the Five Great model a statistically significant link with school success was obtained for two personality dimensions:

a) Agreeableness – for this dimension there was a statistically significant correlation coefficient in the case of marks from the Croatian language (r=0,14, p<0,05).

b) Conscientiousness – only self-evaluation in the part of Conscientiousness in NEO FFI questionnaire are statistically significant (p<0,01) linked to all three indicators of school success. Conscientiousness is linked with the average grade r=0,29, with grades from the Croatian language r=0,25 and Math r=0,22. This is in

accordance with the data in literature to date (see e.g. Bratko, Chamoro-Premuzic, Saks, 2006).

In the continuation of the data analysis we have conducted 3 gradient regressive analyses. The aim was to research predictability of intelligence and personality dimensions for school success from the Croatian language, Math and the grade point average. Considering that predictor variables are in mutually significant correlations, using a gradient regressive analysis we wanted to establish which predictors have a significant independent role in success in a particular measure of school success. Table 3 shows comparatively the results of the regressive analysis for all three measures of school success.

Table 3. Results of the progressive regressive analysis for the criteria for the grade in Croatian language, Math, and Grade point average

Criteria	Prediktor (beta)	p od beta	Multiple correlation coefficient	Corrected coefficient of multiple determination
Croatian lang.	D-48 (0,21) Ext. (-0,16) Consc. (0,33)	0,001 0,02 0,001	0,36	0,11
Math	D-48 (0,26) Agree. (-0,15) Consc. (0,29)	0,001 0,02 0,001	0,36	0,12
Grade average	D-48 (0,19) Ext. (-0,13) Consc. (0,35)	0,001 0,06 0,001	0,36	0,12

(NB: *Agree., Consc., and Extr.* are abbreviations for the personality dimensions agreeableness, conscientiousness and extraversion)

The most significant finding is that for all three measures of school success, the personality dimension Conscientiousness has the greatest individual predictive influence. This result is not surprising considering that Conscientiousness is linked with work ethic, the need for success and organization. The structure of predictor variables for criteria of overall success and Croatian language is practically identical. This is logical since overall success is highly related to knowledge and the Croatian language use. For predicting those criteria behind Conscientiousness, intelligence comes next followed by introversion. The finding is in accord with the observation that extraverted students are better off in primary school, while that trend changes later on (Zarevski, 2000).

The Math criterion has a different relationship structure with measures of intelligence and personality. The portion of predictive strength of intelligence has grown significantly and is only slightly lower that the one for *Conscientiousness*. An interesting finding is that for success in math the predictor of agreeableness is important while the dimension of extraversion has no significant role. A possi-

ble explanation could be that less agreeable people are prone to critical thinking which contributes to accurate analysis in science and in math.

CONCLUSION

The measure using the D-48 test has shown a statistically significant, but rather low link between intelligence and the most relevant measures of school success: Croatian language grades, Math grades and grade point average. A possible explanation is that nominally the same grades from different schools are not obtained by students of the same intelligence. The sample represented grammar schools and vocational schools.

The link of three measures of personality and school success proved significant for predicting school success. The Conscientiousness dimension correlates the most with all three measures of school success. For overall success and success in the Croatian language introversion is most significant. This set of findings is in accordance with the majority researches which show that measures of personality are linked with conscientiousness and perseverance in later years of education take over a more significant role in relation to intelligence which at the primary school level is a stronger predictor than school success. For success in math, lower agreeableness is a good predictor, most likely through the predisposition for critical thinking.

Considering that we are talking about a correlation research, the link between variables were observed in a way that the status of criteria was given to school success. Of course there is the other side of the coin – it refers to the effects of schooling on the development of intelligence in the sense of theory of intelligence investment (Cattell, 1971.; Horn and Cattell., 1966.; Horn, 1982).

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